▶ RESEARCHER PROFILES

Korea Brain Research Institute

Contents

Message from the President

The 21st century is commonly called the "era of the brain". The Korea Brain Research Institute (KBRI) was established to play a central role of brain research of the nation in December 2011. Since then, all of us in KBRI have been endeavoring to recruit excellent scientists and to set up the infrastructure for top notch research. We aim to understand the basis of how the brain works by deepening current research and nurturing young scientists at the KBRI. Also, we hold up our end of the responsibility in pursuit of human well-being and innovative growth of our community.

In these days, the innovative scientific discovery is often determined by the collaborative work of multidisciplinary research groups. To that end, we are trying to establish a "Hub-spoke" research model that encourages collaborations among academia, research institute, hospital and industry. I believe that it will promote a virtuous cycle in translational (bed-to-benchside) or reverse-translational (bench-to-bedside) research based on clinical data-driven study.

I will pledge to do my best to turn KBRI into a global-leading research institute in brain science. In order to integrate diverse backgrounds, KBRI is open to working with any of you as a collaboration partner to uncover the complexity of the brain, develop the ways for curing brain disease, and use of brain function. Let's work together to understand the mind better.

President
Pann-Ghill Suh, DVM & PhD

KBRI Organization

Establishment Basis

“Brain Research Promotion Act”

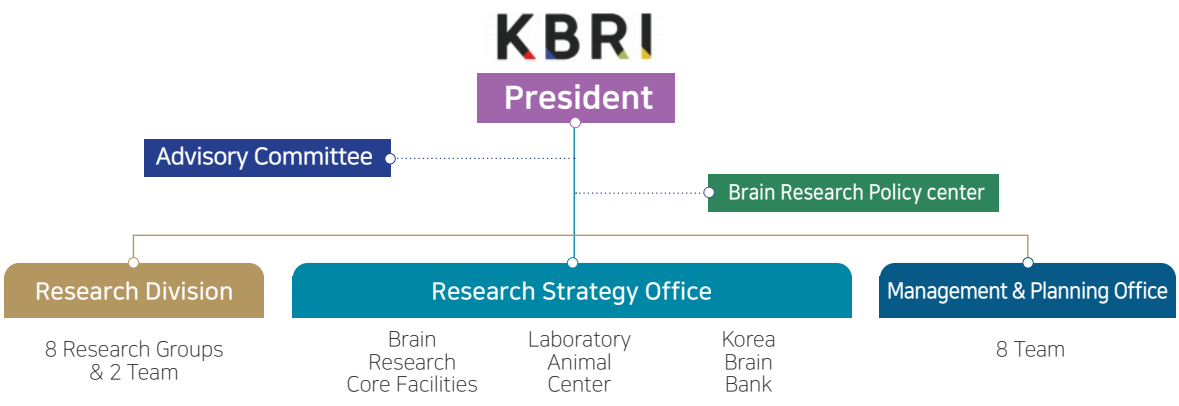
(Article 17) Establishment of Research Institute

A government-funded research institute may be established **for conducting, utilizing, and supporting brain research, as well as for maintaining and developing a close cooperative system among academia, research institutes, and industries.**

History

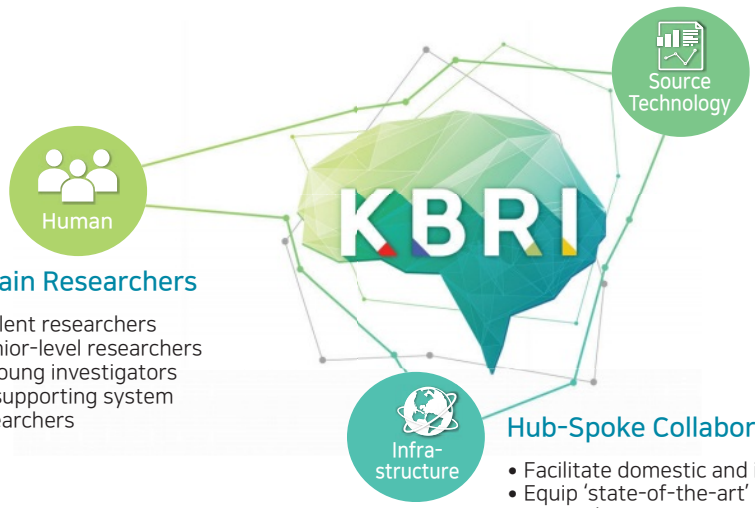
2018	December	Inauguration of the 3rd president (Pann-Ghill Suh, DVM & PhD)
2016	March	KBRI 5-year Plan for long-term development
	April	Korea Brain Bank Network in cooperation with PNUH, SNUH, CNUH, KNUMC
	May	Brain Science Development Strategy was declared by MSIT (Ministry of Science and ICT)
2015	July	Inauguration of the 2nd president (Kyung-Jin Kim, PhD)
		Hosted 10th IBRO World Congress of Neuroscience
2014	December	Completion of KBRI main building
2012	July	Inauguration of the 1st president (Yoo-hun Suh, MD & PhD)
2011	December	Establishment of KBRI
1988	July	Enactment of the Brain Research Promotion Act (Article 17, Establishment of Research Institute)

Organization



KBRI Strategy

Establishing Global Brain Research Institute (HIT strategy)



Cutting-edge Neuro-technology

- Develop new technologies and accumulate data to treat brain diseases
- Promote the practical use of advanced technology in brain research
- Discover future leading technologies using advanced equipment and facilities

Leading Brain Researchers

- Foster excellent researchers
  - Recruit senior-level researchers
  - Cultivate young investigators
- Establish a supporting system for new researchers

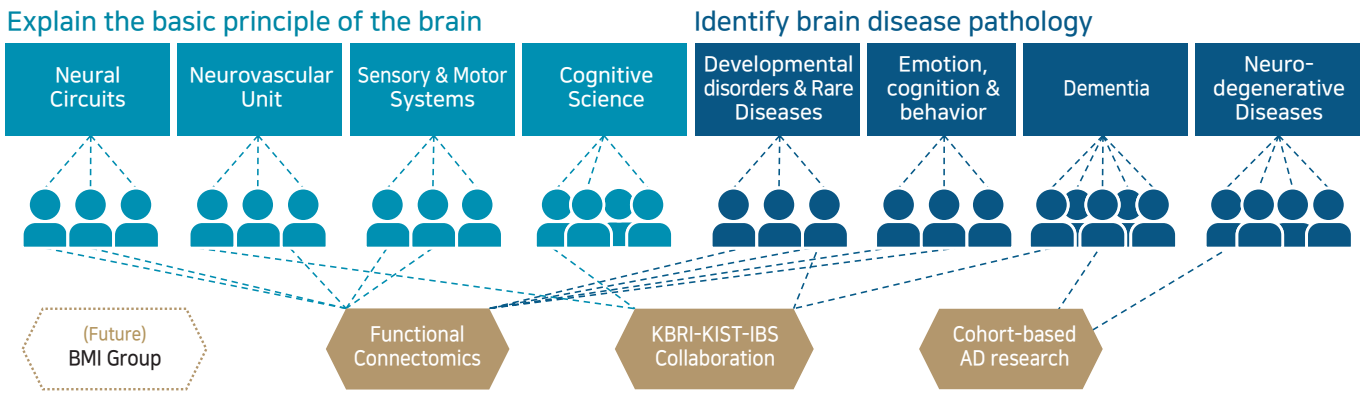
Hub-Spoke Collaboration Model

- Facilitate domestic and international collaborative partnership
- Equip 'state-of-the-art' research facilities to creat novel research environments
- Build research bridges among academia, institute, clinics, and industries

Promoting self-motivated and mission-oriented Research

Collaborative research projects among researchers with diverse backgrounds will be prioritized and supported

Research Groups



KBRI Strategy

Commnunication & Sharing Workshop

Establishing

a **global research network** for world-class institute of neuroscience

Aim

Establishing the virtuous cycle in research base

Who are involved

KBRI researchers
+ domestic and international investigators
(including engineers & clinical scientists)

Events

Each research group will host ~3 events per year

- ✓ **Identify emerging research topics**
- ✓ **Strengthen research capability**
- ✓ **Establish collaborative networks**
- ✓ **Facilitate practical applications of basic research outcomes**

Output

Implementing

Global Research Projects

Promoting the Virtuous Cycle in Translational Research

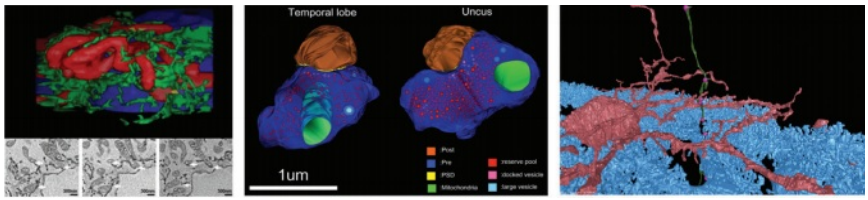
Strengthening the virtuous cycle in TR
Basic research based on clinical demand (Bed-to-Bench)
Practical applications of basic research outcomes
Alleviating the uncertainties of clinical applications


RESEARCH
GROUP

NEURAL CIRCUITS GROUP

NEURAL CIRCUITS GROUP

Overview

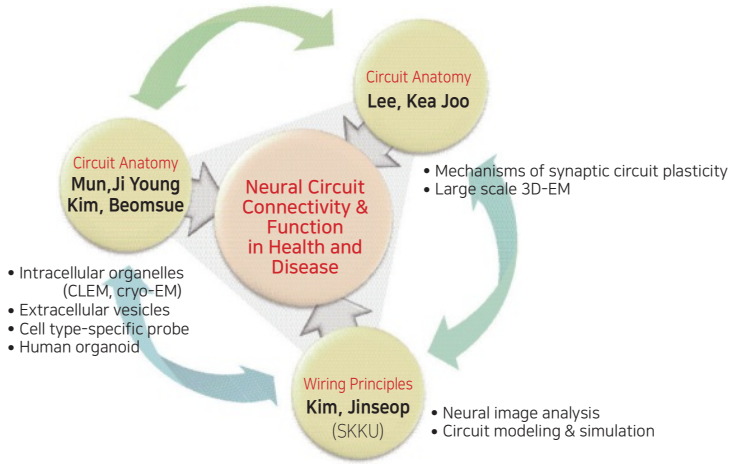


- Our research goal is to understand local connectivity, synaptic plasticity and their functional implications in neural systems in health and disease.
- We study neuroanatomy at the ultrastructure to microcircuit levels, including circuit components such as intracellular organelles, cells, and synapses. Electron microscopy provides the ultra-high resolution and dense staining necessary for these investigations.
- We employ correlative LM & EM, cryo-EM, and 3D EM technologies for imaging and various computational technologies for analysis, including artificial intelligence and image processing algorithms.

Research Objectives

- Understand the fundamental principles of brain functions through the study of information processing in neural microcircuits
- Investigate the causes of brain disorders due to dysfunction of neural circuits and develop neuromodulation methods to treat them
- Research the cause of neural circuit impairments via the study of the regulatory factors for intracellular organelle interactions that drive synapse formation
- Study the structural changes of neural circuits from healthy and diseased brains and their molecular mechanisms
- Discover the connection specificity and model the functional mechanism in simple neural microcircuits

Organization



Major Tasks

- Elucidate molecular mechanisms of activity-dependent synaptic remodeling under physiological and pathological conditions
- Anatomical studies of the connectome using 3D electron microscopy and computational models of neural microcircuits
- Characterize networks between cellular organelles and the function of extracellular vesicles in neuronal cells

Kea Joo Lee, PhD

Group Leader
Principal Investigator

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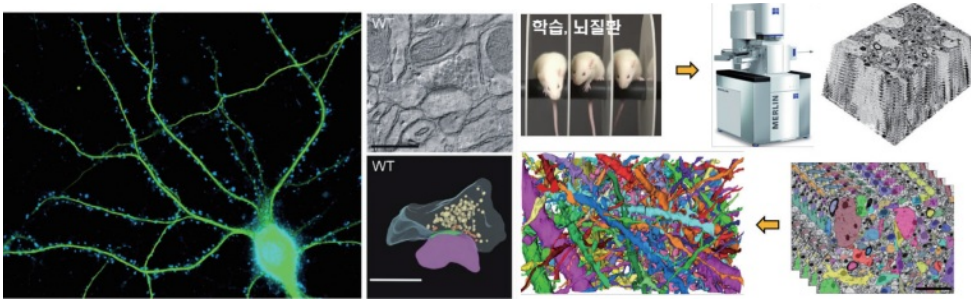
Structural and molecular mechanisms of synaptic circuit plasticity

The ultimate goal of my research is to understand structural and molecular mechanisms underlying experience-dependent synapse remodeling in physiological and pathological conditions. To investigate these issues, I have studied how learning and brain disorders modify the pattern of synaptic connectivity and reorganize molecular composition of synaptic circuits in the brain.
I have used systematic neurobiological approaches including live confocal and three-dimensional electron microscopy, molecular cell biology, biochemistry, and behavioral tests with rodent models. In long-term perspective, I hope to provide key insights into neuronal circuit plasticity as well as therapeutic regimens for synaptic impairments involved in brain disorders such as Alzheimer's disease and autism.



Curriculum Vitae

2019~present : Group Leader, KBRI
2015~present : Adjunct Professor, Brain Science, DGIST
2015~2019 : Department Head, KBRI
2013~present : Principal Investigator, KBRI
2006~2013 : Postdoctoral Fellow, Georgetown Univ., USA
2006~2006 : Postdoctoral Fellow, Korea Univ.

Academic Credential

2006 : Ph.D., Neurobiology, Korea Univ.
2002 : M.S., Neurobiology, Korea Univ.
2000 : B.E., Kinesiology, Korea Univ.

Awards/Honors/Memberships

2020~present: Chairman, KBRI Personnel Committee
2020~2021 : Academic Director, Korean Society of Microscopy
2019~2019 : Financial Director, The Korean Brain Society
2018~Present : Editor, Microscopy, Japanese Society of Microscopy
2018~Present : ReviewEditor, Frontiers in Molecular Neuroscience
2018~2018 : Academic Director, The Korean Brain Society
2018~2018 : Financial Director, Korean Society of Microscopy
2017~2017 : Planning Committee Member, KSBNS
2016~2016 : Secretary of General Affairs, Korean Society of Microscopy
2014~present : HVEM advisory committee member, KBSI
2014~2017 : Chairman, KBRI Institutional Review Board

Research keyword

synapse, connectomics, electron microscopy, molecular signaling, learning and memory, brain diseases

Key techniques

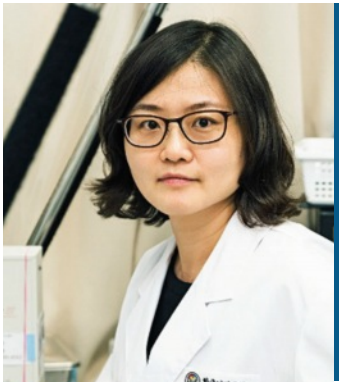
3D reconstruction of neural circuits using volume electron microscopy, Live confocal imaging, Neuron culture, Molecular cell biology, Biochemistry, Behavioral analysis

Research Interests/Topics

- Molecular signaling mechanisms of synapse remodeling in physiological and pathological conditions.
- Large-scale reconstruction and mapping of synaptic network in the cerebral cortex.
- Evaluation of novel compounds based on behavioral and neural circuit analysis in AD mouse models.

Research Publications (selected)

- Jang et al., RAPGEF2 mediates oligomeric Aβ-induced synaptic loss and cognitive dysfunction in the 3xTg-AD mouse model of Alzheimer's disease. *Neuropathol Appl Neurobiol, 2021.* correspondence.
- **Lee** et al., Haploinsufficiency of Cyfip2 causes Lithium-responsive prefrontal dysfunction. *Ann Neurol, 88(3):526-543, 2020.* correspondence.
- Kim et al., Microtubule-associated protein 2 mediates induction of long-term potentiation in hippocampal neurons. *Faseb J, 34(5): 6965-6983, 2020.* correspondence.
- **Lee** et al, Motor skill training induces coordinated strengthening and weakening between neighboring synapses. *J Neurosci, 33(23):9794-9799, 2013.*
- **Lee** et al, Mossy fiber-CA3 synapses mediate homeostatic plasticity in mature hippocampal neurons. *Neuron, 77(1):99-114, 2013.*
- **Lee** et al, Requirement for Plk2 in orchestrated ras and rap signaling, homeostatic structural plasticity, and memory. *Neuron, 69(5):957-973, 2011.*



Ji Young Mun, PhD

Principal Investigator

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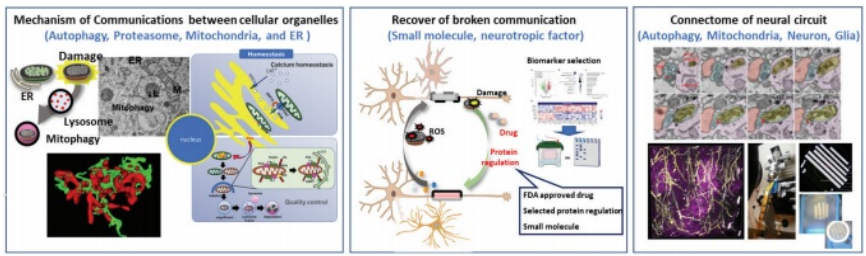
Inter-organelle communication in neural circuits

The goal of our research is to understand the network of inter-organelles in neuron and glia, and to identify the mechanisms of their homeostasis. Membrane-bound cellular organelles are distinct compartments for specialized functions, but the organelles have extensive communication and network. Because the network is highly dynamic depending cellular conditions, the visualization of the network has been tried by super resolution fluorescence microscopy. However, their resolution has still limitation for detail membranes in organelles. Therefore, high-resolution analyses of the network at electron microscopy level are crucial to understand the cellular functions and dysfunction in disease. Our current research aims at investigating changes of the networks in disorder related to neurodevelopment and neurodegeneration; specially, the communication between mitochondria and other organelles such as lysosome, peroxisome, lipid droplet.

Aim	Functional and structural relationship between cellular organelles in neuron and glia
Tool	Single particle analysis, Cryo-EM, Correlative microscopy, 3DEM, Brain organoid
TARGET	

Curriculum Vitae

2020~Present : Principal Researcher, KBRI
2018~2019: Senior Researcher, KBRI
2014~2017: Assistant professor, Eulji University
2009~2014: Postdoctoral Fellow,
Medical school, University of Massachusettes

Academic Credential

2009 : Ph.D, School of Life sciences and Biotechnology, Korea Univ.
(Thesis: 3D analysis on functional structure of cellular organelles)
2002: M.S, School of life Sciences and biotechnology, Korea University
(Thesis: Effects of cypermethrin on the dopaminergic neurons in the progressive hemiparkinsonian rats)

Awards/Honors/Memberships

2020~Present: Committee Member, Korean Society for Neural and Brain Science
2017~Present: Member, Society for neuroscience
2017~Present: Associate editor (Applied microscopy), Springer
2009~Present: Member, Biophysical Society
2000~Present: Member, Korean Society of Microscopy (2015~ Committee Member)
2000~Present: Member, Korean Society of Molecular and Cellular Biology

Research keyword

Network between Cellular organelles, Mitochondria, Autophagy, Neural circuit

Key techniques

Cryo-TEM, 3DEM, Correlative light and electron microscopy, human iPSC culture, Brain organoid

Research Interests/Topics

- Network between cellular organelles in neuron and glia
- Connectome between neuron and glia
- Mechanisms of drugs related to neurodevelopment and neuroimmune disease

Research Publications (selected)

- Choi H, Kim IS, **Mun JY**. Propionic acid induces dendritic spine loss by MAPK/ERK signaling and dysregulation of autophagic flux. *Mol Brain, 13(1):86, 2020.*
- Jung M, Choi H, Kim J, **Mun JY**. Correlative Light and Transmission Electron Microscopy Showed Details of Mitophagy by Mitochondria Quality Control in Propionic Acid Treated SH-SY5Y Cell. *Materials, 13(19):4336, 2020.*
- Kwak C, Shin S, Park JS, Jung M, Nhung TTM, Kang MG, Lee C, Kwon TH, Park SK, **Mun JY***, Kim JS*, Rhee HW*. Contact-ID, a new tool for profiling organelle contact site, reveals regulatory proteins of mitochondrial-associated membrane formation. *Proc Natl Acad Sci U S A.,117(22):12109, 2020.* (*equally contributed)
- Kim HR, Kwon MS, Lee S, Mun Y, Lee KS, Kim CH, Na BR, Kim BNR, Piragyte I, Lee HS, Jun Y, Jin MS, Hyun YM, Jung HS, **Mun JY***, Jun CD*. TAGLN2 polymerizes G-actin in a low ionic state but blocks Arp2/3-nucleated actin branching in physiological conditions. *Sci Rep., 8(1):5503, 2018.* (*equally contributed)
- Previs MJ*, **Mun JY***, Michalek AJ, Previs SB, Gulick J, Robbins J, Warshaw DM, Craig R. Phosphorylation and calcium antagonistically tune myosin-binding protein C's structure and function. *Proc Natl Acad Sci U S A., 113(12):3239, 2016.* (*equally contributed)
- **Mun JY**, Previs MJ, Yu HY, Gulick J, Tobacman LS, Beck Previs S, Robbins J, Warshaw DM, Craig R. Myosin-binding protein C displaces tropomyosin to activate cardiac thin filaments and governs their speed by an independent mechanism. *Proc Natl Acad Sci U S A., 11;111(6):2170-5, 2014.*

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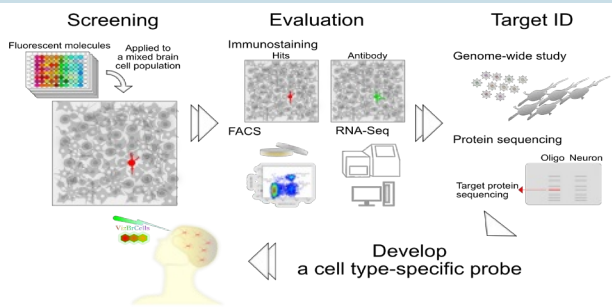
Visualizing brain cells

The brain is a mysterious organ. Current knowledge has led us to think about glia as well as neurons for understanding the brain. However, tracking/visualizing specific brain cells in a live state often requires labor-intensive, time-consuming work to produce transgenic lines or viral particles. I developed a chemical fluorescent probe for microglia and neural stem cells to simplify the approach, which quickly labels the live target cells by applying the compounds under heterogeneous cell populations. The ongoing research aims to develop novel fluorescent chemical probes targeting other brain cells including oligodendrocytes, astrocytes, and unknown brain cell populations that can eventually be applied to the human brain. Through a subtle target identification of the developing probe, those chemical structures can be applied in neuroscience studies and further in biomedical applications.

Aim	Development of visualizing tools for Brain Cells
Tool	Fluorescent molecules screening, Animal/human brain cells, Biochemical methods , Bioimaging
TARGET	

Curriculum Vitae

2020~ : Principal Investigator, KBRI
2014~2019 : Research Fellow / SBIC, A-STAR, Singapore
2013~2014 : Research Fellow / Dept. Chemistry, NUS, Singapore
2010~2013 : Postdoctoral Fellow / School of Medicine, Ajou University
2003~2004 : Visiting Scholar / Dept. Pediatrics, UTHSC, USA

Academic Credential

2009 : Ph.D. Neural Science & Technology, Ajou Univ.
2003 : M.S. Life Science, Hanyang Univ.
2001 : B.S. Biology, Hanyang Univ.

Awards/Honors/Memberships

2020~Present, Fellow, KSIB
2020~Present, Member, KSM
2008~Present, Member, KSMCB
2007~Present, Member, KSBNS

Research keyword

Brin cells, Fluorescent small molecules, Neural circuit, Neurodegeneration

Key techniques

Optical live imaging, Brain cells/stem cells/tissue culture, Human organoid, Molecular & chemical biology

Research Interests/Topics

- Development of visualizing probes for a type of brain cell
- Identification of functional subtypes of glia
- Brain organoid: Provide a platform for studying neural circuits and for treating neurological disorders

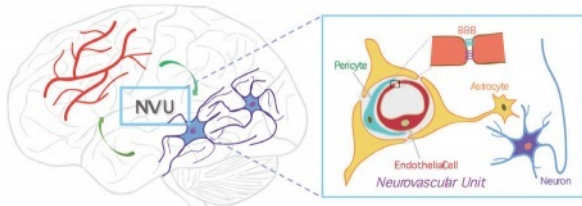
Research Publications (selected)

- **Kim B***, Fukuda M*, Lee JY, Su D, Sanu S, Silvin A, Khoo ATT, Kwon T, Liu X, Chi W, Liu X, Choi S, Wan SDY, Park SJ, Kim JS, Ginhoux F, Je HS, Chang YT. Visualizing microglia with a fluorescence turn-on Ugt1a7c substrate. *Angew Chem Int Ed Engl. 58(24):7972-76, 2019.* (Frontispiece)
- Park SJ*, **Kim B***, Choi S*, Balasubramaniam S, Lee SC, Lee JY, Kim HS, Kim JY, Kim JJ, Lee YA, Kang NY, Kim JS, Chang YT. Imaging inflammation using an activated macrophage probe with Slc18b1 as the activation-selective gating target. *Nat. Commun. 10(1):1111, 2019.* (*, equal contribution)
- **Kim B**, Feng S, Yun, SW, Leong C, Satapathy R, Wan SYD, Chang YT. A Fluorescent Probe for Neural Stem/Progenitor Cells with High Differentiation Capability into Neurons. *ChemBioChem. 17(22): 2118-2122, 2016.* (Front Cover)
- **Kim B**, Yang MS, Choi D, Kim JH, Kim HY, Seol W, Choi S, Jou I, Kim EY, Joe EH. Impaired inflammatory responses in murine Lrrk2-knockdown brain microglia. *PLoS ONE 7(4):e34693, 2012.*
- **Kim B**, Jeong HK, Kim JH, Lee SY, Jou I, Joe EH. Uridine 5′-diphosphate induces chemokine expression in microglia and astrocytes through activation of the P2Y6 receptor. *J. Immunol. 186(6);3701-3709, 2011.*

NEUROVASCULAR UNIT GROUP

NEUROVASCULAR UNIT GROUP

Overview



The functional integrity of the brain is tightly regulated by a neurovascular unit (NVU) comprising cells such as endothelial cells, pericytes, astrocytes, and neurons in the brain. In addition, the blood-brain barrier (BBB), a specialized structure of the brain vasculature, controls the selective passage of substances that are crucial for proper brain function.
Recent studies suggest that the disruption of NVU function via vascular defects and abnormal inter-cellular communications is linked to the development of neurological disorders. However, the exact molecular mechanisms underlying the NVU-mediated regulation of brain function remain elusive. The Neurovascular Group seeks to decipher the molecular and cellular mechanisms underlying neuron-glia-vasculature interactions to understand (1) how the NVU regulates cognitive function, (2) how NVU function is impaired in neurodegenerative diseases, and (3) how to deliver therapeutic material to the brain through the BBB.

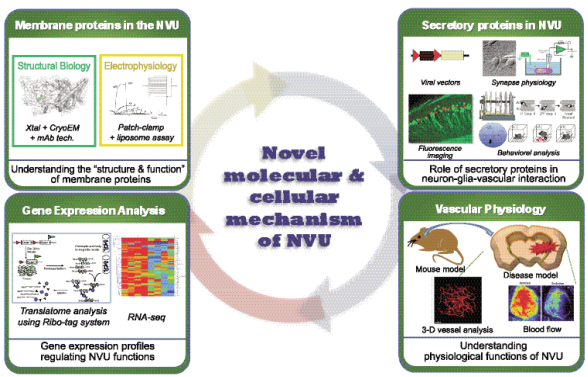
Research Objectives

Our **research goals** include:

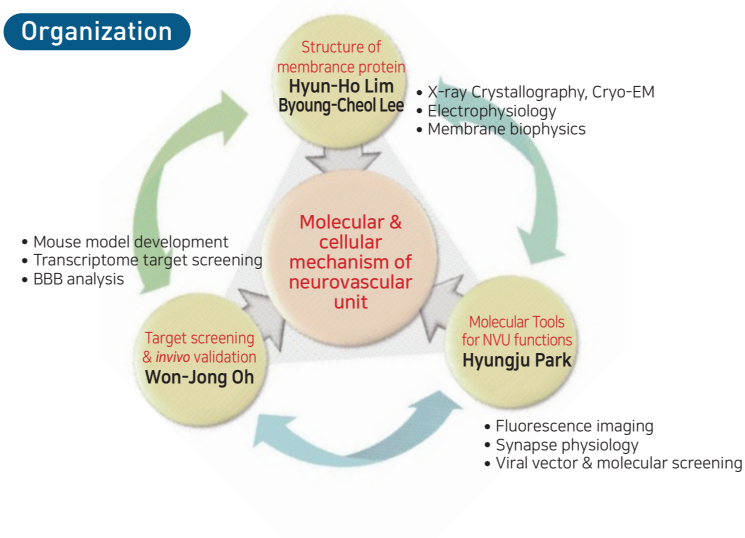
- Understanding the molecular and cellular mechanisms involved in neuron-glia-vasculature interactions in the NVU
- Uncovering the physiological/pathophysiological functions of the NVU and the underlying mechanisms

Research strategies to achieve these goals include:

- Investigating the atomic structure and molecular mechanism of the membrane proteins in the neurovascular unit
- Developing the novel techniques for analyzing secretory and membrane proteins in the neurovascular unit
- Screening and molecular analysis of novel regulatory target in the neurovascular unit and blood-brain barrier

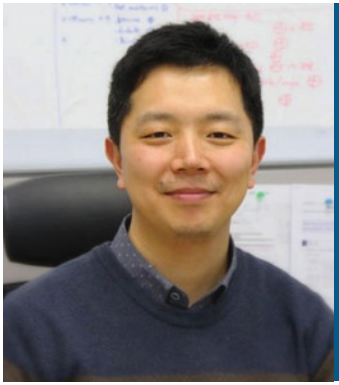


Organization



Major Tasks

- Investigate the atomic structure and molecular mechanisms of membrane proteins in the neurovascular unit
- Develop techniques for the selective labeling of secretory and membrane proteins in the neurovascular unit
- Screening and molecular analysis of novel regulatory targets in the neurovascular unit and blood-brain barrier



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Principal Investigator

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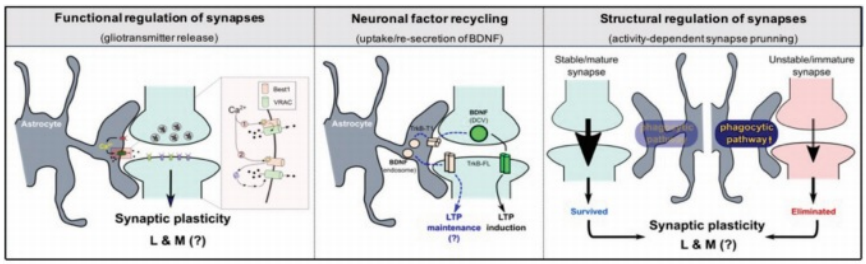
Molecular mechanisms of learning and memory

Proper regulation of neural circuit formation/elimination & plasticity is essential for normal cognitive functions such as learning and memory. To understand how learning and memory is regulated in the mammalian brain, we are focusing on the role of glia cells, astrocytes, in regulating "neural synapses" in functional and structural levels.

- By searching for **molecules mediating neuron-glia interaction and exploring their physiological roles in modulating learning & memory**, our study will suggest new mechanisms based on neuron- glia "intercellular communication" that is crucial for maintaining normal learning and memory processes.
- Moreover, we next aim to discover **how abnormal cognitive functions are disrupted in the diseased brain** by comparing intercellular communications in the normal brain or brain with neurodegenerative diseases.

Aim	Discovering molecular mediators of neuron-glia interaction regulating cognitive functions
Tool	Molecular biology, electrophysiology, animal behavior tests
TARGET	

Curriculum Vitae

2015~Present : Principle Investigator / Principal Research Scientist
Group leader of NVU (Neurovascular unit) research group, KBRI
Adjunct Professor, Department of Brain & Cognitive Sciences, DGIST
2013~2015 : Associate Specialist,
Univ. of California at Berkeley, USA
2009~2013 : Postdoctoral Fellow, Univ. of California at
Berkeley, USA (Advisor: Dr. Mu-ming Poo)
2007~2009 : Postdoctoral Fellow, Center for Neural
Science, KIST, Korea (Advisor: Dr. C Justin Lee)

Academic Credential

2007 : Ph.D., Biological Sciences, Seoul Nat'l University
(Advisor: Dr. Bong-Kiun Kaang)
2000 : B.S., Biological Sciences, Seoul Nat'l University

Awards/Honors/Memberships

2016 : Travel award, the 39th Annual meeting of the Japanese Neuroscience Society
2007~2009 : STAR-Postdoc. Fellowship, (KIST, South Korea)
2000~2005 : Brain Korea 21 Research Fellowship, (Korea Ministry of Education
& Human Resources Development)
2012 : President, Korean Life Scientists in the bay area (KOLIS)
2004~Present : Member, Society for Neuroscience

Research keyword

Learning and memory, Long-term synaptic plasticity, Neuron-astrocyte interaction.

Key techniques

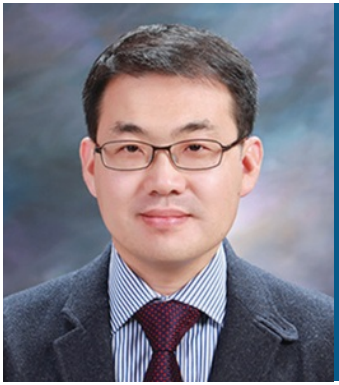
Electrophysiology (patch clamp, extracellular recording), Fluorescence imaging (wide-field imaging, confocal / multi-photon imaging), General molecular biology tools (related with gene cloning & verification), Animal behavior tests (fear conditioning, morris water maze, serial order task).

Research Interests/Topics

- Studying how astrocyte-mediated synapse pruning regulates long-term synaptic plasticity and hippocampal / striatal learning and memory.
- Identification of novel molecules mediating neuron-glia interaction and studying their roles in long-term synaptic plasticity.

Research Publications (selected)

- Lee JH, Kim JY, Noh S, Lee H, Lee SY, Mun JY, **Park H**, Chung WS. Astrocytes phagocytose adult hippocampal synapses for circuit homeostasis. *Nature, 590: 612-617, 2021.* (co-corresponding author)
- **Park H** and Kaang BK. Balanced actions of protein synthesis and degradation in memory formation. Learning and *Memory, 26: 299-306, 2019.*
- Jhang J, Lee H, Kang MS, **Park H**, Han J-H, Anterior cingulate cortex and its input to the basolateral amygdala control innate fear response. *Nature Communications, 9:2744, 2018.* (co-corresponding author)
- **Park H**, Popescu A, Poo MM, Essential role of presynaptic NMDA receptors in activity-dependent BDNF secretion and corticostriatal LTP. *Neuron, 84: 1009-1022, 2014.*
- **Park H**, Poo MM. Neurotrophin regulation of neural circuit development and function. *Nature Reviews Neuroscience, 14: 7-23, 2013.*



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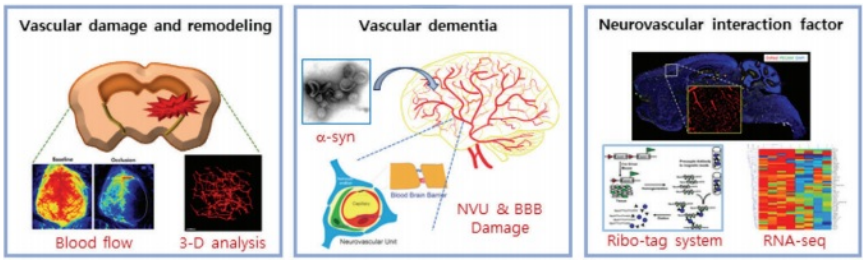
http://sites.google.com/site/neurovascularbiologylab/home

Molecular mechanism of neurovascular unit and blood-brain barrier

Evolution has crafted vertebrates with two exquisitely elaborate systems each specialized to perform their unique and vital functions: the nervous and vascular systems. These two systems are wired intimately to perform many physiological processes such as energy metabolism and hemodynamic control. However, in contrast to our advanced understanding of neural circuit assembly, how the architecture of the neurovascular system is wired and subsequently establishes the proper functional unit in the mammalian brain is still poorly understood. In addition, it has been widely highlighted that the impairments of the neurovascular structure and functions are crucial etiological factors leading the neuropathological conditions such as Alzheimer's disease, Parkinson's disease, and vascular dementia. Using a combination of advanced mouse genetic, histological, molecular and cellular approaches, we are currently investigating basic principles of brain neurovascular development and disease pathogenesis and will facilitate the development of a therapeutic strategy for curing neurological disorders.

Aim	Understanding neurovascular unit for mation and functional maintenance
Tool	*In vivo* mouse model + Molecular histology + Brain vasculature physiology

TARGET



Curriculum Vitae

2014~Present : Principal Investigator, KBRI
2007~2014 : Research Fellow, Harvard Medical School, USA
1996~1999 : Researcher, Samsung Biomedical Research Institute, Korea

Academic Credential

2006 : Ph.D., Molecular Medicine, Medical College of Georgia, USA
1995 : M.S., Molecular Biology, Chung-Ang Univ., Korea
1993 : B.S., Biology, Chung-Ang Univ.

Awards/Honors/Memberships

2002~Present : Member, Society for Neuroscience
2015~Present : Member (Academic committee), Korean Society for Vascular Biology and Medicine
2014~Present : Member, The Korean Society for Brain and Neural Sciences
2010~2011 : Alice and Joseph Brooks Fund Postdoctoral Fellowship, USA
2008~2010 : Lefler Fellowship, USA
2006 : Ph.D. with Distinction, Medical College of Georgia, USA

Research keyword

Brain Vasculature, Neurovascular Unit, Blood-Brain Barrier, Vascular Dementia.

Key techniques

Genetics- and surgery-based model mouse development, Molecular Histology, Blood flow and permeability analysis.

Research Interests/Topics

- Mechanism about establishment and maintenance of the neurovascular unit, and screening of novel neurovascular interaction factors.
- Basic mechanism of neuronal disorders by vascular impairment and therapeutic strategy.

Research Publications (selected)

- Choi MG, Kim MJ, Kim DG, Yu R, Jang YN, **Oh WJ**. Sequestration of synaptic proteins by alpha-synuclein aggregates leading to neurotoxicity is inhibited by small peptide. *Plos One, 13(4):e0195339, 2018.*
- **Oh WJ**, Gu C. Establishment of neurovascular congruency in the mouse whisker system by an independent patterning mechanism. *Neuron, 80: 458-469, 2013.*
- Ding JB*, **Oh WJ***, Sabatini BL, Gu C. Semaphorin3E-Plexin-D1 signaling controls pathway-specific synapse formation in the striatum. *Nature Neuroscience, 15:215-223, 2012.* (*equal contribution)
- Kim JH*, **Oh WJ***, Gaiano N, Yoshida Y, Gu C. Semaphorin3E-Plexin-D1 signaling regulates VEGF function in developmental angiogenesis via a feedback mechanism. *Genes and Development, 25:1399-1411, 2011.* (*equal contribution)

Patents (selected)

- Choi MG and **Oh WJ**. A method for suppressing alpha-Synuclein aggregates-mediated cellular toxicity. (10-1896182, patent registered)

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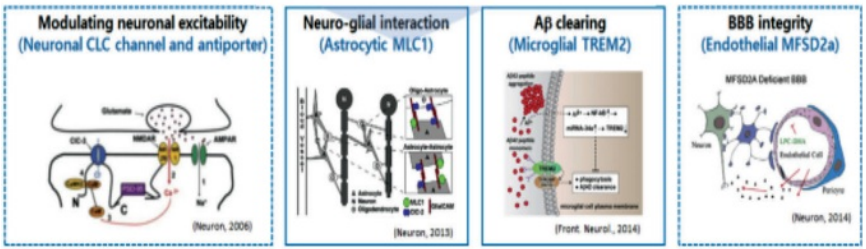
Molecular physiology & biophysics of the membrane proteins in the nervous system

The cells are enclosed by the selective barrier, phospholipid bilayer, called the membrane. The membrane proteins of the cells are critical to respond to external stimulations, relay signals from outside to inside or vice versa, transport molecules in and out of the cell, catalyze enzymatic activities, and generate cellular electricity. About 30% of genes are predicted to encode transmembrane proteins and more than 50% of current drugs are targeting membrane proteins. We are currently studying various membrane proteins including ion channels, transporters, and receptors. Especially, a membrane receptor critical for the microglial function, a new astrocytic membrane protein for glia-neuron interaction, and Cl- transporting proteins including VRAC, CLC, and BEST1 are focused to understand their functional and structural characteristics and physiological roles in the nervous system. In the long term, we hope to develop a way of modulating membrane proteins based on their molecular mechanisms and 3D-architectures. To tackle the questions on membrane proteins, we are conducting multidisciplinary approaches including electrophysiology, x-ray crystallography, membrane biochemistry, and cell biology.

Aim	Elucidating structure-function relationship of membrance proteins in the nervous system
Tool	Electrophysiology + Membrance biochemistry + X-ray crystallography
TARGET	

Curriculum Vitae

2013.9 – Present : Principal Investigator, KBRI
2016.1– 2019.4 : Scientific Director, Research Division, KBRI
2013.11 – 2015.1 : Scientific Director, Research Division, KBRI
2007.04 – 2013.08 : Postdoctoral Associate, HHMI / Brandeis University, U.S.A.
2005.02 – 2007.03 : Postdoctoral Fellow, Center for Distributed Sensor Network, GIST.

Academic Credential

2005 : Ph.D., Life Science, GIST
1999 : M.S., Life Science, GIST
1995 : B.S., Agricultural Biology, Seoul Nat'l University

Awards/Honors/Memberships

2020.12 – 22.11 : Chair, Planning and Strategy Committee, Korean Society for Brain and Neuroscience
2020.1 : Chair, 2020 Annual Conference Steering Committee, Federation of Korean Societies for Biomolecular Sciences
2018.1 – 19.12 : Secretary, Korean Biophysical Society
2016 – 17 : Committee Member, Nat'l Brain Science Working Committee (Ministry of Sci. & Tech., KOREA)
2015 : International Collaboration Committee, Korean Society for Brain and Neuroscience
2012 : Treasurer, New England Bioscience Society (NEBS), Boston, USA
1998 – Present : Member, Biophysical Society
1998 – Present : Member, Society for Neuroscience

Research keyword

Membrane protein, Ion transport, X-ray crystallography, Electrophysiology.

Key techniques

Membrane protein biochemistry and crystallography, Liposome-based ion transport assay, Planar lipid bilayer and patch-clamp recordings, and monoclonal antibody generation.

Research Interests/Topics

- Structural and functional studies on the membrane proteins involved in the neuro-glia-vascular interactions.
- Structure-function relationship of chloride transporting membrane proteins.

Research Publications (selected)

- Lee HJ, Jeong H, Hyun J, Ryu B, Park K, **Lim HH**, Yoo J, and Woo JS. Cryo-EM structure of human Cx31.3/GJC3 connexin hemichannel. *Science Advances 6: eaba4996, 2020.*
- Hwang J, Vu HM, Kim MS and Lim HH. Plasma membrane localization of MLC1 regulates cellular morphology and motility. *Molecular Brain 12: 116 doi:10.1186/s13041-019-0540-6, 2019.*
- Park K, Lee BC, and **Lim HH**. Mutation of external glutamate residue reveals a new intermediate transport state and anion binding site in a CLC Cl^-/H^+ antiporter. *Proc. Natl. Acad. Sci. USA. 116: 17345-17354, 2019.*
- **Lim HH**, Stockbridge RB, and Miller C. Fluoride-dependent interruption of the transport cycle of a CLC Cl^-/H^+ antiporter. *Nature Chem. Biol. 9(11):721-725, 2013.*
- **Lim HH**, Shane T and Miller C. Intracellular proton access ina C^{l-}/H^+ antiporter. *PLoS Biology, 10(12): e1001441, 2012.*

PATENT

- **Lim HH**, Kim HJ, Choi HS, Lee JH. Monoclonal antibody with specificity for human TREM2 protein, hybridoma cell line producing the same and use thereof. (Korea Patent #10-2156165)

KyeongJin Kang, PhD

Principal Investigator

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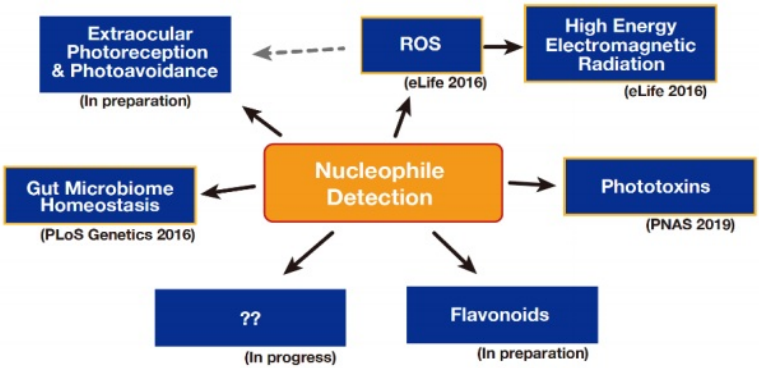
Understanding chemical information processing

Organisms continuously utilize chemical cues not only from the environment but also for internal/external communications. Precise monitoring and proper behavioral and physiological responses to the chemical information are critical for their survival, requiring complex signal processing from sensory detection to circuitry-dependent computation. To help understand this pivotal function, we exploit Drosophila sensory systems which offer advanced neurogenetic tools and well-defined physiology and anatomy. The ongoing research topics concern 1) chemical nociception, a chemo-sensory function to detect tissue-damaging chemical reactivity, and 2) atypical inter-neuronal communication in modulation of gustation interaction.

Aim	Understanding chemical information acquisition and processing at the organism level
Tool	Drosophila molecular genetics, in vivo/vitro electrophysiology, Ca2+ imaging, behavioral assays
TARGET	

Curriculum Vitae

2020~Present : Principal Investigator, KBRI
2016~2020 : Associate professor, Sungkyunkwan Univ. ROK
2012~2016 : Assistant professor, Sungkyunkwan Univ. ROK
2006~2012 : Postdoctoral Fellow, Brandeis Univ., MA, USA

Awards/Honors/Memberships

2016: Research excellence award, Sungkyunkwan Univ.
2012~Present, Member, Korean Society for Molecular and Cellular Biology
2012~Present, Member, Korean Society for Brain and Neural Sciences

Academic Credential

2006 : Ph.D. Medical Sciences, University of Calgary
1999 : M.S. Life Sciences and Biotechnology, Korea Univ.
1997 : B.S. Genetic Engineering, Korea Univ.

Research keyword

Chemical nociception, gustation, behavior, ephaptic coupling, nucleophile

Key techniques

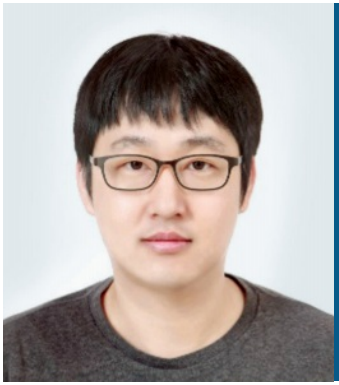
Behavioral assays, electrophysiology, Ca2+ imaging, biochemistry, molecular genetics/biology

Research Interests/Topics

Nucleophile nociception and natural insights from its implications
Gustatory interaction between primary tastes via atypical interneuronal communication

Research Publications (selected)

- Du, E.J., Ahn, T.J., Sung, H., Jo, H., Kim, H.-W., Kim, S.-T., and **Kang, K.** Analysis of phototoxin taste closely correlates nucleophilicity to type 1 phototoxicity. Proc. *Natl. Acad. Sci. 116(24):12013-12018 . 2019.*
- Du, E.J., Ahn, T.J., Wen, X., Seo, D.-W., Na, D.L., Kwon, J.Y., Choi, M., Kim, H.-W., Cho, H., and **Kang, K.** Nucleophile sensitivity of Drosophila TRPA1 underlies light-induced feeding deterrence. *eLife 5, e18425. 2016.*
- Du, E.J., Ahn, T.J., Kwon, I., Lee, J.H., Park, J.-H., Park, S.H. et al. ··· **Kang, K**. TrpA1 Regulates Defecation of Food-Borne Pathogens under the Control of the Duox Pathway. *PLoS Genet. 12, e1005773. 2016.*
- **Kang, K**. Exceptionally high thermal sensitivity of rattlesnake TRPA1 correlates with peak current amplitude. Biochim. Biophys. *Acta 1858, 318–325. 2016.*
- Du, E.J., Ahn, T.J., Choi, M.S., Kwon, I., Kim, H.-W., Kwon, J.Y., and **Kang, K**. The Mosquito Repellent Citronellal Directly Potentiates Drosophila TRPA1, Facilitating Feeding Suppression. *Mol. Cells 38, 911–917. 2015.*
- **Kang, K.*,** Panzano, V.*, Chang, E.C., Ni, L., Dainis, A.M., Jenkins, A.M. Regna, K., Muskavitch, M.A.T. and Garrity P.A. Modulation of TRPA1 thermal sensitivity enables sensory discrimination in Drosophila. *Nature, 481, 76-80. 2012.*



Byoung-Cheol Lee, PhD

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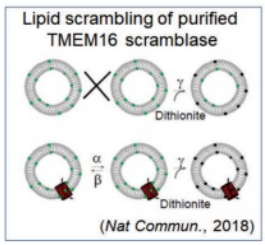
Molecular physiology of lipid scrambling in the brain

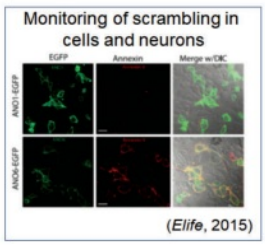
Lipid Scrambling & Ion Transport in Brain

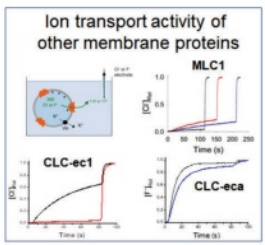
Ions and lipids can move through cellular membranes dynamically. While ion transport mediated by channels or pumps is well studied, the molecular mechanism, cellular functions, and physiological roles of lipid transport are still poorly understood. Recently, independent groups suggested that TMEM16 protein family includes both ion channels and lipid scramblases. These findings raise new questions to tackle the lipid transport phenomenon. Phospholipids undergo dynamic redistribution when the lipid scramblases are activated. The collapse of asymmetric lipid distribution can change the local/global lipid composition spatiotemporally and alter the various signaling cascades. By using a combination of biochemical experiment, electrophysiology and imaging techniques, I will facilitate the understanding of TMEM16 proteins at the molecular level, which helps to reveal their physiological functions and provide insights to develop new therapeutics to prevent and treat neurological disorders.

Aim	Investigation of stucture-function relationship of membrane proteins in brain
Tool	Membrane protein biochemisty + Liposome-based functional assays + Cellular imaging + Electrophysiology

TARGET







Curriculum Vitae

2018~Present : Principal Investigator, KBRI
2014~2018 : Postdoctoral Associate,
Weill Cornell Medical College, USA
2013~2014 : Postdoctoral Fellow, Gwangju Institute of
Science and Technology (GIST), Korea

Academic Credential

2013 : Ph.D., Life Science, GIST
2007 : M.S., Life Science, GIST
2005 : B.S., Bioinformatics, Soongsil University

Awards/Honors/Memberships

2019~2022 : Grant from Young Researcher Foundation of Korea(NRF)
grant funded by the Korea government(MSIT)
(grant 2019R1C1C1002699)
2014 : Fellowship from Basic Science Research Program through the
National Research Foundation of Korea (N.R.F.) funded by the
Ministry of Education, Science and Technology
(grant 2013R1A6A3A03064407)
2007~Present : Member, Biophysical Society

Research keyword

Membrane protein, Ion transport, Lipid scrambling, Electrophysiology.

Key techniques

Membrane protein biochemistry, Liposome-based ion transport assay (w/ion-specific electrode or ion-specific fluophore), Lipid scrambling assay and patch-clamp recording.

Research Interests/Topics

- Structural and functional studies on the brain-specific TMEM16 scramblases.
- Structure-function relationship of chloride transporting membrane proteins.

Research Publications (selected)

- Falzone ME, Rheinberger J, **Lee BC**, Peyear T, Sasset L, Raczkowski AM, Eng ET, Di Lorenzo A, Andersen OS, Nimigean CM, Accardi A. Structural basis of Ca^{2+}-dependent activation and lipid transport by a TMEM16 scramblase. *Elife, 8:e43229, 2019.*
- **Lee BC**, Kelashvili G, Falzone M, Menon AK, Weinstein H, Accardi A. Gating mechanism of the extracellular entry to the lipid pathway in a TMEM16 scramblase. *Nat Commun., 9:3251, 2018.*
- Malvezzi M, Andra KK, Pandey K, **Lee BC**, Falzone M, Brown A, Iqbal R, Menon AK, Accardi A. Out of the groove transport of lipids by TMEM16 and GPCR scramblases. *Proc Natl Acad Sci., 115:E7033-E7042, 2018.*
- Falzone M, Malvezzi M, **Lee BC**, Accardi A. TMEM16 scramblases and channels: known structures, unknown mechanisms. *J Gen Physiol., 150:933-947, 2018.*
- **Lee BC**, Menon AK, Accardi A. The nhTMEM16 Scramblase Is Also a Nonselective Ion Channel. *Biophys J., 111:1919-1924, 2016.*

Patents

- Screening Methods of a Ion Channel Modulator Using a Mutated BKCa Channel. 1015996860000 (2016.02.24)

Sehyun Chae, PhD

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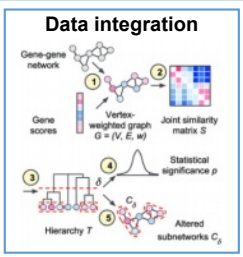
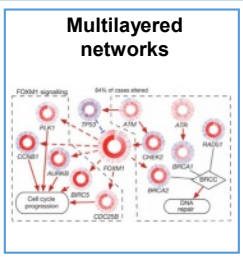
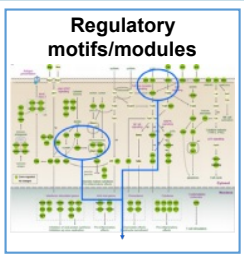
Systems biology approaches to understand multilayered spatiotemporal networks in neurodegenerative diseases

We are developing various systems approaches that decode multilayered spatiotemporal network models underlying the pathogenesis of neurodegenerative diseases by integrative analysis of multi-omics data.
The approaches involve generation of comprehensive global data using high-throughput genomic and proteomic technologies and development of various bioinformatics tools for following systems analysis: 1) identification of molecular signatures whose expression levels or activities are changed between control and treatment conditions; 2) integration of different types of molecular signatures to identify key cellular processes under the conditions of interest; 3) reconstruction of biological network models describing the key cellular processes using the molecular signatures; 4) identification of important regulators and regulatory motifs/modules that define the key cellular processes by analyzing the networks; and 5) generation of hypotheses for regulatory mechanisms underlying the key cellular processes.

Aim	Decoding of multilayered spatiotemporal networks underlying the pathogenesis of neurodegenerative diseases
Tool	Systems biology, bioinformatics, multi-omics
TARGET	







Curriculum Vitae

2018~Present : Principal Investigator, KBRI
2014~2018 : Postdoctoral Fellow, Department of New Biology, DGIST and Center for Plant Aging Research, Institute for Basic Science

Academic Credential

2009~2014 : Ph.D., School of Interdisciplinary Bioscience and Bioengineering, POSTECH
2009 : B.S., Department of Life Science, Chung-ang University

Memberships

2014~Present : Member, Korean Society for Mass Spectrometry

Research keyword

Systems biology, bioinformatics, and multi-omics

Key techniques

Genomics (next generation sequencing), proteomics (LC-MS/MS), integration of multi-omics data, multilayered networks, and network motifs/modules

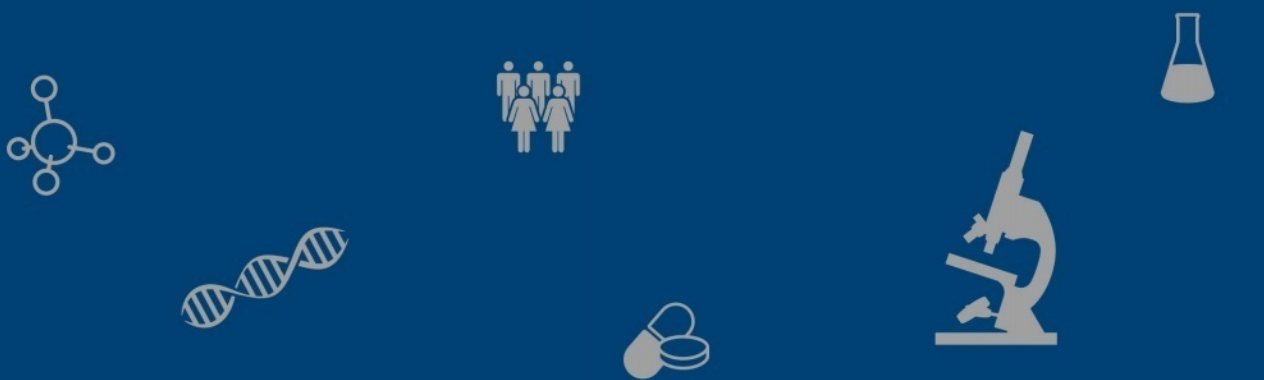
Research Interests/Topics

- Decoding of multilayered spatiotemporal networks underlying the pathogenesis of neurodegenerative diseases through integrative multi-omics analyses.
- Identification of key regulators and regulatory motifs/modules from the multilayered networks.
- Identification of spatially coded network motifs/modules by integrating organellar proteomic data.

Research Publications (selected)

- Jo W, Min BS, Yang HY, Park NH, Kang KK, Lee S, **Chae S†**, Ma ES†, Son WC†. Sappanone A Prevents Left Ventricular Dysfunction in a Rat Myocardial Ischemia Reperfusion Injury Model. *Int J Mol Sci., 21:6935, 2020.* († corresponding authors)
- Lee BR*, **Chae S***, Moon J, Kim MJ, Lee H, Ko HW, Cho BC, Shim HS, Hwang D, Kim HR, Ha SJ. Combination of PD-L1 and PVR determines sensitivity to PD-1 blockade. *JCI Insight, 2020 5:128633, 2020.* (*co-first authors)
- **Chae S***, Kim S*, Koo YD*, Lee JW, Kim H, Ahn BY, Ha Y, Kim Y, Jang MG, Koo K, Choi SH, Lim S, Park YJ, Jang HC, Hwang D, Lee S, Park KS. A mitochondrial proteome profile indicative of type 2 diabetes mellitus in skeletal muscles. *Exp Mol Med. 50:129, 2018.*
- Lee S*, Lee J*, **Chae S***, Moon Y*, Lee HY, Park B, Yang EG, Hwang D, Park H. Multi-dimensional histone methylations for coordinated regulation of gene expression under hypoxia. *Nucleic Acids Res, 45:11643-57, 2017.*
- **Chae S***, Ahn BY*, Byun K*, Cho YM, Yu MH, Lee B, Hwang D, Park KS. A systems approach for decoding mitochondrial retrograde signaling pathways. *Science signaling, 6(264):p.rs4, 2013.*

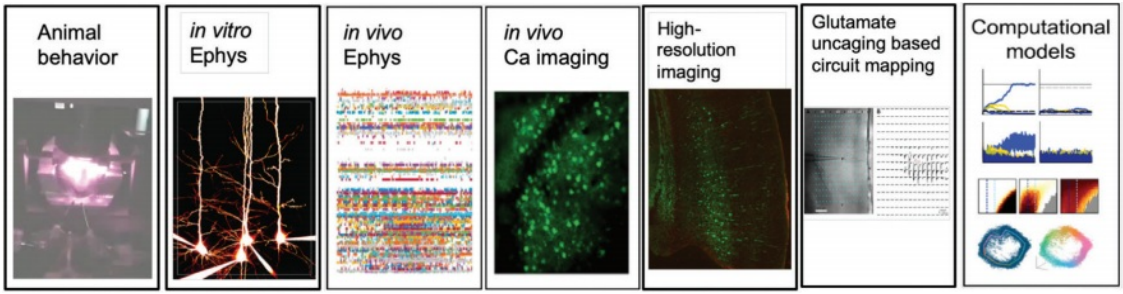
SENSORY & MOTOR SYSTEMS NEUROSCIENCE GROUP



SENSORY & MOTOR SYSTEMS NEUROSCIENCE GROUP

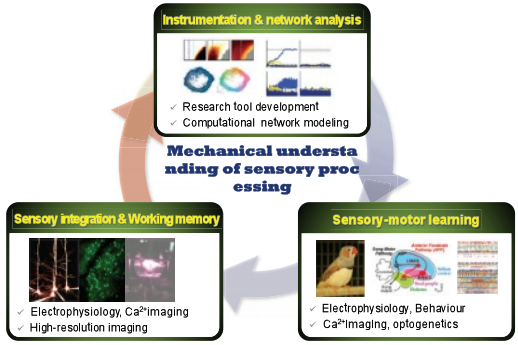
Overview

- The ultimate goal of the research in our group is to understand the circuits and **patterns of neural activity** that give rise to **mental processes** and behavior.
- To achieve success in translational research, we must understand how the normal brian works and what goes wrong in brains with diseases.
- With the aid of recently developed research tools, many efforts have been made to understand the function of the brain at the systems level.
- Two key steps toward realizing this goal are:
  - observing **patterns of neuronal activity** during circuit function, and
  - identifying the neurons and **physiological properties of the synaptic connections** within circuits



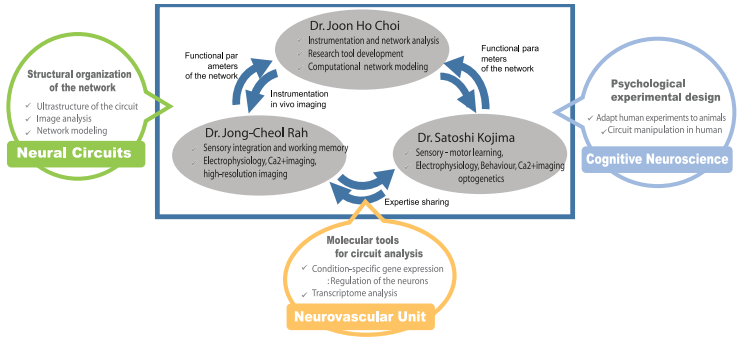
Research Objectives

- Mechanical understanding of sensory processing
- Circuit-level understanding of neural disorders
- Circuit-level understanding of sensory motor learning
- Understanding age-dependent decline of sensory-motor learning



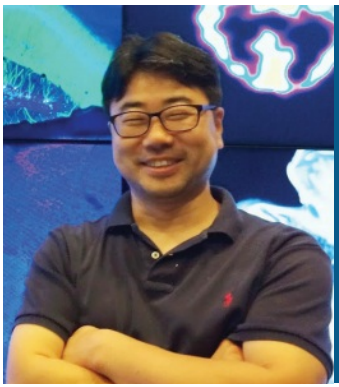
Understand the circuits and patterns of neural activity that give rise to mental processes and behavior

Organization



Major Tasks

- Sensory integration & working memory
- Sensorimotor learning
- Instrumentation & neural network modeling



Jong-Cheol Rah, PhD

Group Leader
Principal Investigator

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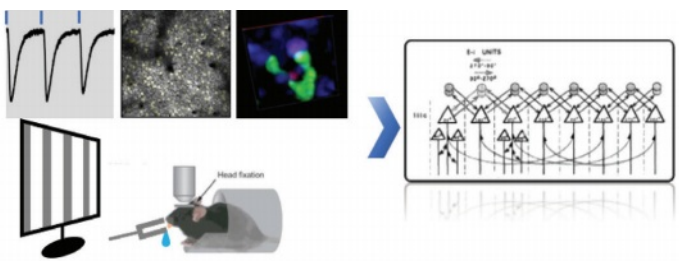
Neurophysiology of sensory processing

Effective brain function depends upon accurate information transfer from one region of the brain to another through synaptic connections and misconnections frequently lead to the development of neurological disorders. The posterior parietal cortex (PPC) is a multimodal sensory association area that associates various sensory modalities and has high level sensory processing function. Furthermore, a series of electrophysiological studies have shown that the firing rates of the neurons in the PPC, ramp up during the process of decision formation and the slope of the firing rate increase is proportional to the goodness of the evidence. These studies suggest the role of PPC as an evidence accumulator of the brain. However, till now, there is no microcircuit level understanding how sensory information formulates such activity and how the activity is terminated. In our research group, we aim to solve these problems using Ca^{2+} imaging, electrophysiology and high-resolution anatomical tools.

Aim	Circuit mechanisms of perceptual decision making
Tool	Electrophysiology + Functional imaging + High-resolution imaging

TARGET

Functional and strutural circuit analysis of sensory perception and decision making



Curriculum Vitae

2014~Present : Principal Investigator, KBRI
2012~2014 : Research Specialist, HMI / Janelia Research Campus
2005~2012 : Vising Fellow/Research Fellow National Inst. Neurol Disorders and Stroke, National Inst Health

Academic Credential

2004 : Ph.D., Neurophysiology, Max-Planck Institut fur biophysikalische Chemie
2002 : M.Sc., Pharmacology, Seoul Nat'l Univ. Coll Med
1999 : B.Sc., Life Science/Chemistry, Sogang Univ

Professional Affiliations and Services

Planning Committee (2021-2022), Korean Society for Brain and Neural Sciences
Planning Director (2018-2020), Korean Society of Microscopy
Member, Society for Neuroscience
Member, Biophysical Society
Member, Korean Society for Brain and Neural Science
Associate Editor, Experimental Neurobiology
Associate Editor, Frontiers in Drug, Chemistry and Clinical Research
Topic Editor, Biology

Research keyword

Decision making, Short-term memory, Neural circuit mechanism.

Key techniques

Electrophysiology, Calcium imaging, Array tomography.

Research Interests/Topics

- Understanding circuit mechanism of decision making.
- Dendritic integration in multimodal sensory integration.

Research Publications (selected)

- Heo S, Ha J, Son SJ, Choi IS, Lee H, Oh S, Jekal J, Kang MH, Lee GJ, Jung HH, Yea J, Lee T, Lee Y, Choi JW, Xu S, Choi JH, Jeong JW, Song YM, **Rah JC***, Keum H*, and Jang KI*, Instant, Multi-scale dry transfer printing by atomic diffusion control at heterogeneous interfaces, *Science Advances, 2021. (accepted)* *Corresponding authors
- Kim NR, Bahn SK, Choi JH, Kim JS and **Rah JC**, Synapses from the high-order thalamic nucleus and motor cortex are co-clustered in the distal dendrites of the mouse somatosensory cortex, *bioRxiv; doi: https://doi.org/10.1101/2020.11.08.363200*
- Oh SW, Son SJ, Morris JA, Choi JH, Lee C, and **Rah JC**, Comprehensive analysis of long-range connectivity from and to the posterior parietal cortex of the mouse, *Cerebral Cortex. 1;31(1):356-378, 2021.*
- Lee JM, Choi JH, **Rah JC**, Frequency-dependent gating of feedforward inhibition in thalamofrontal synapses, *Molecular Brain, 6; 13: 68, 2020.*
- Kang S, Noh HJ, Bae SH, Kim YS, Lew H, Lim J, Kim SJ, Hong KS, **Rah JC***, Kim CH*, Clozapine generates obsessive compulsive disorder-like behavior in mice, *Molecular Brain, 13:84, 2020.**Corresponding authors
- Yang YS, Son SJ, Choi JH, **Rah JC**, Synaptic transmission and excitability during hypoxia with inflammation and reoxygenation in hippocampal CA1 neurons, *Neuropharmacology, 25;138:20-31. doi: 10.1016/j.neuropharm.2018.05.011, 2018.*

Patents (selected)

- Yang YS, **Rah JC**. Pharmaceutical composition for prevention and treatment of ischemic brain disease. (10-1936836, 2019.01.03)
- Kim GT, **Rah JC**, Kim JS, Bahn SK, Apparatus for photographing synapse image and operating method thereof. (10-2018-0038831, 2018.04.03)

Satoshi Kojima, PhD

Principal Investigator

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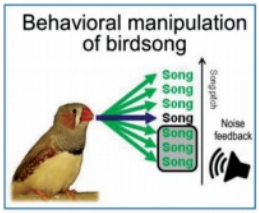
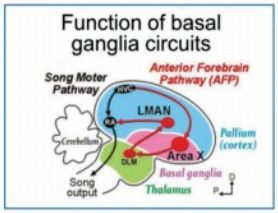
Behavioral and neural mechanisms of vocal learning

Humans are excellent vocal learners. Infants learn to produce complex vocal patterns of their native language from their parents. Research in our laboratory focuses on the question of how animals learn to produce their complex vocalizations from other individuals during a critical period of development, and more broadly, how experience during early life shapes the functioning of the nervous system and individuals' perception and behavior. To address these questions we mainly study passerine songbirds such as the zebra finch. Songbirds are one of the few animals that show vocal learning like humans, and thus they are great and unizue model systems for studying the neural substrates of vocal learning, as well as developmental learning of complex motor skills. Songbirds are also recognized as a powerful model system for studying the function of basal ganglia circuits in reinforcement (trial-and-error) learning, because they are thought to develop their vocal patterns in a trial-and-error process using a specialized basal ganglia-thalamo-cortical circuit.

Aim	Understanding neural substrates of vocal learning and its critical period
Tool	Electrophysiology + phamacology + Ca^{2+} imaging + behavioral manipulation
TARGET	  

Curriculum Vitae

2015~Present : Principal Investigator, KBRI
2003~2014 : Postdoctoral Fellow and Research Specialist, Univ of California, San Francisco, USA
2000~2003 : Postdoctoral Fellow, Sophia University, Japan

Academic Credential

2000 : Ph.D., Neurobiology, Hokkaido Univ, Japan
1997 : M.S., Neurobiology, Hokkaido Univ, Japan
1995 : B.S., Biology, Hokkaido Univ, Japan

Awards/Honors/Memberships

2014 : Cozzarelli Prize of the National Academy of Science, USA
2014 : Yong Investigator's Award of the Japanese Society for Comparative Physiology and Biochemistry
2015~Present : Councilor, Japanese Society for Comparative Physiology and Biochemistry
1998~Present : Member, Society for Neuroscience
1997~Present : Member, Japan Society for Neuroscience

Research keyword

Vocal learning, Imitation, songbird, Critical period, Reinforcement learning, Basal ganglia, Electrophysiology, Ca^{2+} imaging.

Key techniques

in-vivo electrophysiology and pharmacological manipulation in free-moving birds, Ca^{2+} imaging in free-moving birds, Behavioral manipulation and operant conditioning in birds.

Research Interests/Topics

- Understanding how songbirds regulate their vocal patterns using the basal ganglia-thalamo cortical circuit and the auditory feedback.
- Understanding how young songbirds develop their song by imitating their tutor, and how such learning ability declines with age.
- Investigating how the studies of songbirds will contribute to our understanding of the neural substrates underlying human speech learning and basal ganglia-related motor control and disorders, and how such understanding might be harnessed to ultimately benefit humans.

Research Publications (selected)

- **Kojima S**.*, Kao MH, Doupe AJ, Brainard MS. The avian basal ganglia are a source of rapid behavioral variation that enables vocal motor exploration. *J Neurosci, 38,9635-9647, 2018.* (*corresponding author)
- **Kojima S**, Kao MH, Doupe AJ. Task-related 'cortical' bursting depends critically on basal ganglia input and is linked to vocal plasticity. *Proc Natl Acad Sci USA, 110,4756-4761, 2013.*
- **Kojima S**, Doupe AJ. Social performance reveals unexpected vocal competency in young songbirds. *Proc Natl Acad Sci USA, 108,1687-1692, 2011.*
- **Kojima S**, Doupe AJ. Activity propagation in an avian basal ganglia-thalamocortical circuit essential for vocal learning. *J Neurosci., 29,4782-4793, 2009.*

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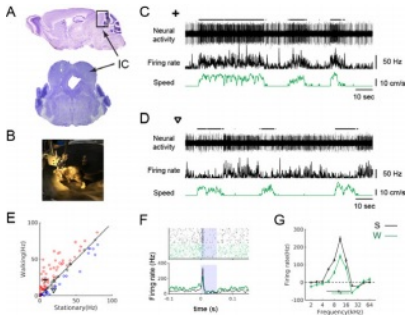
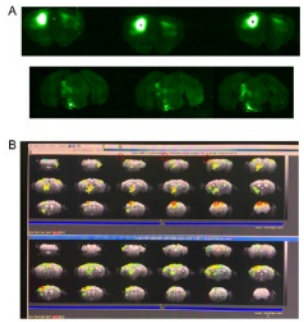
Neural circuits for auditory-motor integration

A main goal of my lab is to elucidate the neural mechanisms underlying integration of auditory and movement-related signals by central auditory neurons. During natural hearing, subjects are often engaged in diverse types of movement. However, how auditory neurons process and integrate the movement-related signals remain poorly understood. We are investigating how auditory neurons in the inferior colliculus, a critical midbrain integration center, process sound and motion together. To understand neural circuit mechanisms, we combine in vivo electrophysiology with optogenetics in behaving mice. We also use fMRI techniques for brain-wide circuit mapping.

Aim	To understand neural mechanisms for auditory-motor integration	
Tool	In vivo electrophysiology, optogenetics, operant behavior, fMRI	
TARGET	Auditory–motor integration	Optogenetic circuit mapping





Curriculum Vitae

2020~Present : Principal Investigator, KBRI
2015~2020 : Research Fellow / IBS, Center for Neuroscience Imaging Research
2011~2015 : Associate Specialist / Dept. Physiology, UCSF, USA
2005~2011 : Postdoctoral Fellow / Dept. Physiology, UCSF, USA

Academic Credential

2004 : Ph.D. Neurobiology, Univ. of Pittsburgh, USA
1999 : M.S. Chemistry, Seoul National Univ.
1994 : B.S. Chemistry, Seoul National Univ.

Awards/Honors/Memberships

2018~Present : Review editor, Frontiers in Neural Circuits
2011 : Takeda travel award, The Molecular and Cellular Cognition Society - Asia
2005 : Association of Korean Neuroscientists president's excellence in research award
2015~Present : Member, Korean Society for Brain and Neural Sciences
2005~Present : Member, Association for Research in Otolaryngology
2005~Present : Member, Society for Neuroscience

Research keyword

Auditory, Behavior, Inferior colliculus, Mice, Hearing loss

Key techniques

In vivo electrophysiology, Optogenetics, Operant behavior, fMRI

Research Interests/Topics

- Neural basis of auditory perception
- Auditory-motor integration
- Neural plasticity in hearing loss

Research Publications (selected)

- Yang Y, Lee J, and **Kim G,** Integration of locomotion and auditory signals in the mouse inferior colliculus. *eLife 9:e52228, 2020.*
- Clause A*, **Kim G*,** Sonntag M, Weisz C, Vetter D, Rubsamen R, and Kandler K, The precise temporal pattern of pre-hearing spontaneous activity is necessary for tonotopic map refinement. *Neuron 82:822-835, 2014.*
- **Kim G** and Doupe A, Organized representation of spectrotemporal features in songbird auditory forebrain. *Journal of Neuroscience 31:16977-90, 2011.*
- **Kim G** and Kandler K, Synaptic changes underlying the strengthening of GABA/glycinergic connections in the developing lateral superior olive. *Neuroscience 171:924-933, 2010.*
- **Kim G** and Kandler K, Elimination and strengthening of glycinergic/GABAergic connections during tonotopic map formation. *Nature Neuroscience 6:282-290, 2003.*

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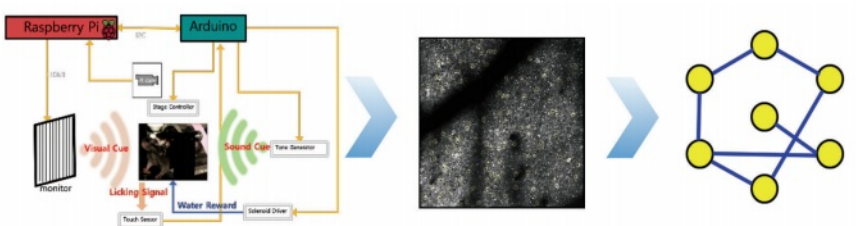
Information processing of neural network *in vivo*

Our knowledge of neural network behind sensory input processing and decision making has been experiencing a huge expansion. But it is still based on old doctrines from many decades ago. Recent developments of information theory, non-linear dynamics and network science have potentials to provide new insight of information processing in cortex. For instance, a brain has huge error/noise tolerance, redundant information processing area/pathway and efficient neural network that demands new understanding of it. To support this endeavor, it is mandatory to develop a new experimental apparatus which can control and monitor behaviors of many mice automatically in a dissimilar way. We are trying to apply newly developed controllers (Arduino, RaspberryPi, BeagleBone etc.) to automate experiments with complex protocol and combine them to *in vivo* imaging devices such as two-photon microscope and miniscope. Along with that, we are trying to apply more insightful but mathematically rigorous measures to data sets from those tools.

Aim	Understanding information processing in neural network
Tool	New behavioral device + 2P imaging + Network analysis
TARGET	

Curriculum Vitae

2016~Present : Principal Investigator, KBRI
2013~2016 : Postdoctoral Fellow, MPFI, USA
2012~2013 : Postdoctoral Fellow, Korea Univ., Korea

Academic Credential

2012 : Ph.D., Physics, Korea Univ.
2004 : M.S., Physics, Korea Univ.
2002 : B.S., Physics, Korea Univ.

Awards/Honors

2005 : Seoul Science Fellowship

Research keyword

In vivo imaging, Time-series analysis, Network analysis.

Key techniques

in vivo calcium imaging, Device & circuit design/fabrication, Time-series analysis.

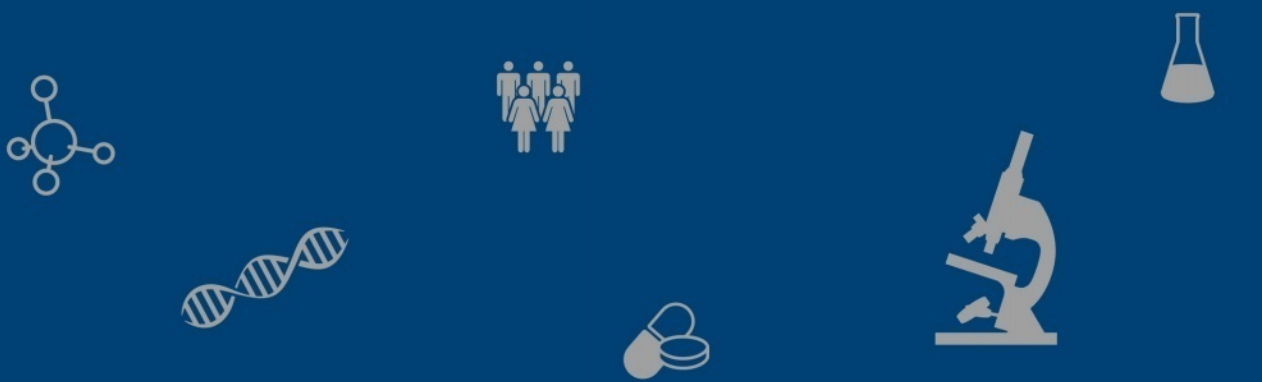
Research Interests/Topics

- Development of apparatus for multimodal stimuli driven behavior analysis in rodents.
- Application of advanced imaging techniques for brain research.
- Analysis of neuronal time-series data from *in-vivo* experiment.

Research Publications (selected)

- Yang YS, Son SJ, **Choi JH**, Rah JC. Synaptic transmission and excitability during hypoxia with inflammation and reoxygenation in hippocampal CA1 neurons. *Neuropharmacol., 138:20-31, 2018.*
- Kim T, Oh WC, **Choi JH**, Kwon HB. Emergence of functional subnetworks in layer 2/3 cortex induced by sequential spikes *In vivo*. *PNAS, 113(10), 2016.*
- Kim JH, Heo R, **Choi JH**, Lee KJ. Dynamic transitions among multiple oscillators of synchronized bursts in cultured neural networks. *J Stat Mech., 2014.*
- **Choi JH** Kim JH, Heo R, Lee KJ, Modulating the precision of recurrent bursts in cultured neural network. *PRL., 108(13), 2012.*

COGNITIVE SCIENCE GROUP

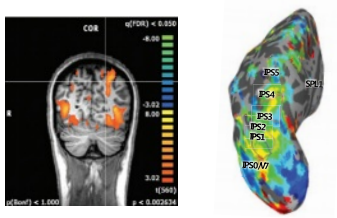


COGNITIVE SCIENCE GROUP

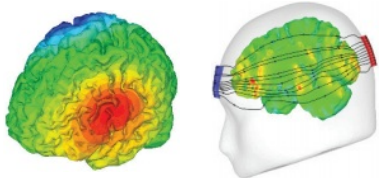
Overview

Cognitive science research group examines how the human brain extracts acquires abstract knowledge from past experiences using a multifaceted approach including psychophysics, neuroimaging (fMRI, EEG), and non-invasive brain stimulation (tCS). We also investigate electro/magnetoencephalography and modulation of neural activity using computer simulation based on numerical analysis

Macroscale functional brain imaging



Numerical analysis on neuroelectromagnetics



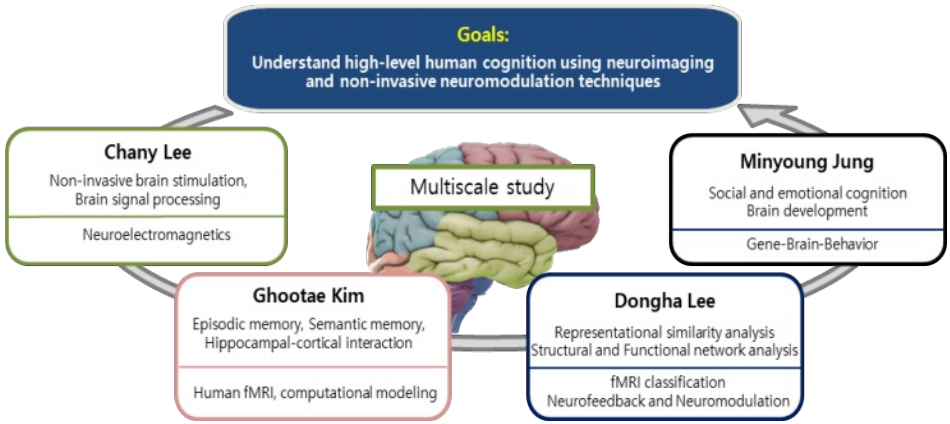
Research Objectives

- Understanding higher-level human cognitions
  - Neural mechanisms of human memory and learning
  - Developmental changes in higher-level cognitions
- Analyzing electromagnetic phenomena
- Decoding and Encoding of brain states
  - Object representation within-category exemplars
  - Emotional brain states classification
  - Brain decoding based remote control of robot
- Understanding the Gene-Brain-Behavior feature interactions in children
  - Mechanisms of social and emotional cognition
  - Receptor gene genotype effect of brain development
  - Neuroanatomical feature alterations during childhood

Major Tasks

- Research on human visual cognition and long-term memory
- Optimization of neuromodulation
- Neural Representation and Classification on human brain
- Establish the Gene-Brain-Behavior feature test system for developmental disorders

Organization



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Principal Investigator

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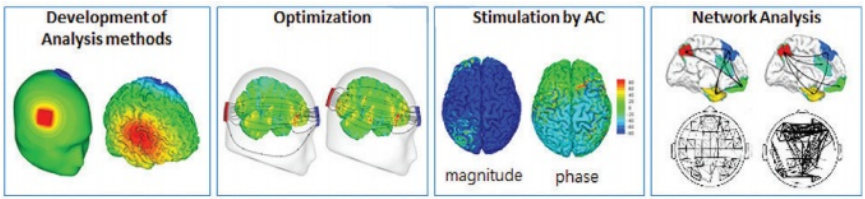
Numerical analysis on neuroelectromagnetics

NeuroEngineering laboratory researches electromagnetic phenomena and modulation of neuronal activities using the techniques of computer simulation based on numerical analysis so that people can understand functions and diseases of the human brain, ultimately. Electricity is an important tool for inter- and intra-regional communication of the brain. Neural activity involves the flow of ions which are charged particles, and the flow of charged particles is defined as electric current. According to electromagnetics, electric current accompanies electric and magnetic fields. Hence, we can guess where the activated regions are and how the regions correlate in the brain by measuring and analyzing electromagnetic fields. On the other hand, external electromagnetic fields influence the activity of the brain, because electric current can change membrane potential, which alters firing rate of the neural cell. To find out the characteristics of the measured biosignal, the position of the activated cortical area, and effective methods to modulate the target area, mathematical approaches are essential. In NeuroEngineering lab, algorithms and methods for solving neuroelectromagnetic problems are developed, and the software is implemented considering accuracy and efficiency of computation. Recently, research is focused on optimized electric stimulation for focal regions and deep regions using alternating current. In near future, optical stimulation using near infrared light will be considered as a new stimulation modality.

Aim	Modulating neuronal excitability by noninvasive stimulation
Tool	Computer-based simulation
TARGET	

Curriculum Vitae

2018~Present : Principal Investigator, KBRI
2014~2018 : Research Professor, Department of Biomedical Engineering, Hanyang University, Korea
2010~2013 : Research Professor, Neurology, Korea University Medical Center, Korea

Academic Credential

2010 : Ph.D., Department of Electrical and Computer Engineering, Seoul Nat'l University (MS/PhD Integrated program)
2003 : B.S., Department of Electrical Engineering, Seoul Nat'l University

Awards/Honors/Memberships

2018~present : Member of Korean Society of EEG and Neurophysiology

Research keyword

Electroencephalography (EEG), Magnetoencephalography (MEG), Transcranial electric stimulation (tES), Numerical analysis.

Key techniques

Signal processing of brain waves, Source localization, Inverse problem, Numerical analysis, Finite element method.

Research Interests/Topics

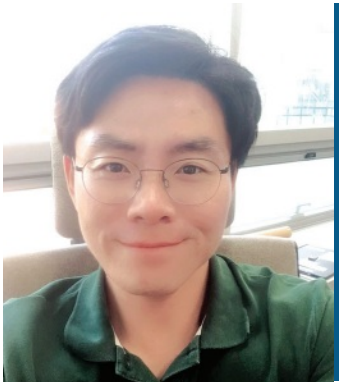
- Non-invasive neuromodulation by direct and alternating current and near infrared light.
- Brain network analysis and brain-machine interface based on EEG.

Research Publications (selected)

- Lee S, **Lee C**, Park J, Im C-H. Individually customized transcranial temporal interference stimulation for focussed modulation of deep brain structures: a simulation study with different head models, *Sci Rep, 10:11730, 2020.*
- Jang K-I, **Lee C**, Lee S, Huh S, Chae J-H. Comparison of frontal alpha asymmetry among schizophrenia patients, pajor depressive disorder patients, and healthy controls, *BMC Psychiatry, 20:586, 2020.*
- Park J, **Lee C**, Lee S, Im C-H. Comparison of magnetic field distributions generatored by various permanent magnets for transcranial static magnetic stimulation: A simulation study, *Comput Biol Med, 114: 103476, 2019.*
- **Lee C**, Im C-H. New Strategy for finite elements mesh generation for accurate solutions of electroencephalography forward problems, *Brain Topogr, 32(3):354-362, 2019.*

Patents (selected)

- Im C-H, Lee S, **Lee C**, Methods and Apparatus for Estimating Electrical Conductivity of Eye. (10-2017-0044039)



Ghootae Kim, PhD

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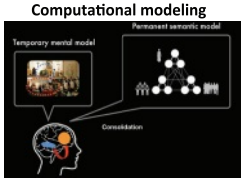
Neural mechanisms of learning and memory

Over the past several decades, the "stability-plasticity dilemma" has been a central issue in the field of learning and memory: That is, an organism must be able to learn about information shared across similar episodes while simultaneously retaining individual memories. Many theoretical accounts have embraced the complementary learning systems (CLS) model which holds that these two these types of learning depend on separate memory systems with different specializations. The hippocampus maintains specific memories by assigning distinct representations to similar experiences, and the neocortex is specialized for slowly developing representations of the schematic statistical structure of overlapping experiences. Despite substantial evidence supporting this CLS view, it is not fully understood how exactly structured knowledge is emerged through accumulated experiences. Specifically, the CLS model predicts that the neocortex requires a large number of overlapping experiences to represent generalities due to its inherent low learning rate. However, it does not provide sound explanations on how we often successfully learn general knowledge only based on several observations. Given the current computational challenges, I propose a novel theoretical account explaining how an organism acquires structured knowledge efficiently by taking into account interactions between the two memory systems.

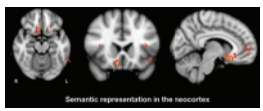
Aim	Understandingng neural mechanisms of learning and memory
Tool	Computational modeling + Behavioral experiment + fMRI + machine learning

TARGET

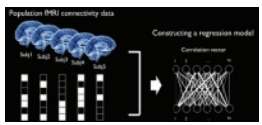
Computational modeling



fMRI data



Analyzing fMRI data using machine learning techniques



Curriculum Vitae

2018~Present : Principal Investigator, KBRI
2016~2018 : Postdoctoral Associate, Dept. of Psychology/ Univ. of Oregon, OR, USA

Academic Credential

2016 : Ph.D., Dept. of Psychology, Princeton Univ., NJ, USA
2010 : M.S., Dept. of Psychology, Yonsei Univ., Seoul, Korea
2008 : B.A., Dept. of Psychology, Yonsei Univ., Seoul, Korea

Awards/Honors/Memberships

2018~Present : Member, Korean Psychological Association
2011~Present : Member, Context and Episodic Memory Symposium
2011~Present : Member, Vision Science Society
2011~Present : Member, Society for Neuroscience

Research keyword

Episodic memory, Semantic memory, Hippocampus, fMRI, Computational modeling.

Key techniques

- Memory competition between overlapping episodic memories and neural differentiation.
- Comparing a current input with related memories facilitates semanticization of the overlapping experiences.

Research Publications (selected)

- **Kim G**, Lewis-Peacock JA, Norman KA, Turk-Browne NB. Pruning of memories by context-based prediction error. *Proc. Natl. Acad. Sci. USA, 111(24):8997-9002, 2014.*
- **Kim G**, Norman KA, Turk-Browne NB. Neural differentiation of incorrectly predicted memories. *J Neurosci. 37(8): 2022-2031, 2017.*
- **Kim G**, Norman KA, Turk-Browne NB. Neural overlap in item representations across episodes impairs context memory. *Cereb. Cortex. 29(6): 2682-2693, 2019.*
- **Kim G**, Yi DJ. Repetition antipriming: The effects of perceptual ambiguity on object recognition. *Korean J Cogsci. 21(4), 2010.*

Dongha Lee, PhD

Principal Investigator

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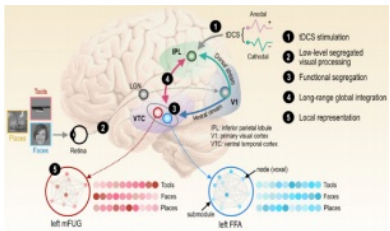
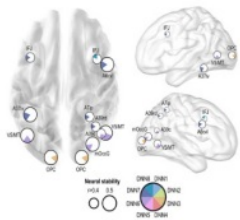
Brain decoding and encoding: From neuroimaging to cognition

Our brain is an exceptionally complex system and understanding the complexity of the brain is the goal of modern neuroscience. The goal of my research is to explore (1) how we can decode brain states, (2) how we can encode high-level brain functions, and finally (3) how we can modulate for neural plasticity. To do this, we use advanced neuroimaging approaches - multivariate pattern analysis and representational similarity analysis, structural and functional connectivity. For studying the brain decoding, we have done the following research: First, we suggested the method to optimize fMRI signals for real-time fMRI decoding of motor execution and motor imagery. Second, we applied this method to neurofeedback learning based on real-time fMRI decoding. we demonstrated that a brief experience of neurofeedback learning enhances trial-by-trial neural pattern consistency during motor imagery and that this experience would change functional connectivity in the motor imagery and default mode networks. Regarding these studies, we controlled a robot by thinking about motor movements (https://youtu.be/lh5Smoxdlwl). It would be helpful for motor imagery learning in clinical application. To better study the brain encoding, we have studied object representations using neural, behavioral, and computational methods.

Aim	Decoding and encoding of neural activity patterns
Tool	DTI, fMRI, Multivariate pattern analysis
TARGET	





Curriculum Vitae

2020~Present : Principal Investigator, KBRI
2020~2020 : Research Assistant Professor, Department of Nuclear Medicine, Yonsei University College of Medicine, Republic of Korea
2019~2020 : Senior Postdoctoral Researcher, Department of Nuclear Medicine, Yonsei University College of Medicine, Republic of Korea
2016~2019 : Research Fellow (PI), Faculty of Psychology and Education Sciences, University of Coimbra, Portugal
2014~2016 : Postdoctoral Researcher, Severance Biomedical Science Institute, Yonsei University College of Medicine, Republic of Korea

Academic Credential

2014 : Ph.D. Medical Science (Neuroimaging), Yonsei University College of Medicine, Republic of Korea
2007 : B.S. Biomedical Engineering, Yonsei University

Research keyword

Decoding, Encoding, Neurofeedback, Neuromodulation, Object representation

Key techniques

fMRI classification, Representational similarly analysis, Probabilistic tractography, Functional connectivity analysis, Structure-Function coupling

Research Interests/Topics

- Brain decoding using multivariate pattern analysis (MVPA)
- Comparison of neural and behavioral models using representational similarity analysis (RSA)
- Transfer learning using deep convolutional neural network
- Relationship between structural and functional networks (DTI & resting state fMRI)
- Neuromodulation using real-time fMRI based on decoded neurofeedback

Research Publications (selected)

- **Dongha Lee**, Jorge Almeida, Within-category representational stability through the lens of manipulable objects, *Cortex, 137, 282-291, 2021.*
- **Dongha Lee,** Bradford Z. Mahon, Jorge Almeida, Action at a distance on object-related ventral temporal representations, *Cortex, 117, 157-167, 2019. #coverpage*
- **Dongha Lee**, Changwon Jang, Hae-Jeong Park, Neurofeedback learning for mental practice rather than repetitive practice improves neural pattern consistency and functional network efficiency in the subsequent mental motor execution, *Neuroimage, 188, 680-693, 2019.*
- **Dongha Lee,** Chongwon Pae, Jong Doo Lee, Eun Sook Park, Sung-Rae Cho, Min-Hee Um, Seung-Koo Lee, Maeng-Keun Oh, Hae-Jeong Park, Analysis of structure–function network decoupling in the brain systems of spastic diplegic cerebral palsy, *Human Brain Mapping, 38(10), 5292-5306, 2017.*
- **Dongha Lee,** Changwon Jang, Hae-Jeong Park, Multivariate detrending of fMRI signal drifts for real-time multiclass pattern classification, *NeuroImage, 108, 203-213, 2015.*

Patents

- Pattern Classification Apparatus and Method for fMRI (Republic of Korea, KR101601041B1)
  https://patents.google.com/patent/KR20160016357A/en

Minyoung Jung, PhD

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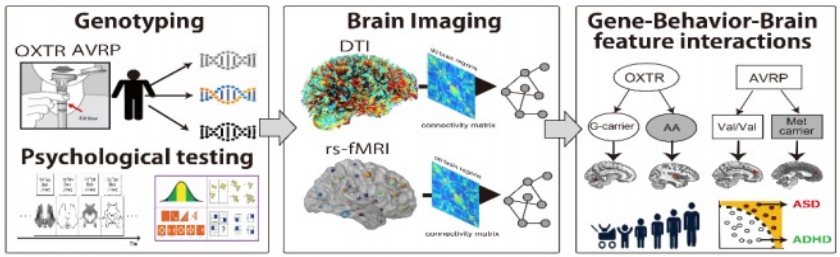
Emotion and Social cognitive development during childhood

The aim of my research is to investigate neural mechanisms of emotion and social cognition in children and young adult. Our lab used the multimodal brain imaging approach and genotyping to understand gene-behavior-brain feature interactions during childhood and adolescence. Specifically, our lab had 3 goals: 1) to classify gene polymorphism (OXTR, AVPR) features which effect brain development during childhood; 2) to determine whether there is an association between assessed neuroanatomical features and gene polymorphism; and 3) to examine the association between neuroanatomical feature alterations and emotion & social cognition in children with developmental disorder.

Aim	Understanding Emotion and Social cognition
Tool	Genotyping + Psychological testing + Brain imaging (sMRI, DTI, rs-fMRI)
TARGET	

Curriculum Vitae

2021~Present : Principal Investigator, KBRI
2019~2021 : Senior Assistant Professor / School of Medicine, University of Fukui, Japan
2017~2019 : Assistant Professor / School of Medicine, University of Fukui, Japan
2015~2017 : Postdoctoral Fellow / Department of Psychiatry, Harvard Medical School, USA
2014~2015 : Research Fellow / Japan Society for the Promotion of Science (JSPS), Japan

Academic Credential

2015 : Ph.D, Child Development, Osaka Univ. Japan
2013 : M.S, Disability Science, Tsukuba Univ. Japan
2009 : B.S, Rehabilitation Psychology, Daegu Univ. Korea

Awards/Honors/Memberships

2019~Present : Director, The Korean Society of Emotional and Behavioral Disorders
2019~Present : Director, Korean Association for Behavior Analysis
2015: International Meeting for Autism Research Travel Award
2014: Young Scientist Award of Japan Brain Science Society
2014: National Institute for Physiological Sciences Abstract Travel Award

Research keyword

Social cognition, Emotion, Child development, Autism spectrum disorder, ADHD, Sensory processing

Key techniques

Resting state fMRI, Diffusion tensor imaging, Structural MRI, Local gyrification indexing, Graph theory, Multivoxel pattern analysis, Behavior analysis.

Research Interests/Topics

- The understanding of the neural mechanisms for the relationship between the receptor gene genotype (OXTR, AVPR) and brain development in children.
- The neural mechanisms of social and emotion cognition in developmental disorder.

Research Publications (selected)

- **Jung M,** Takiguchi S, Hamamura S, Mizuno Y, Kosaka H, Tomoda A. Thalamic volume is related to increased anterior thalamic radiations in children with reactive attachment disorder. *Cerebral Cortex 30, 7, 4238-4245. 2020.*
- **Jung M,** Tu Y, Park J, Jorgenson K, Lang C, Song W, Kong J. Surface-based shared and distinct resting functional connectivity between attention deficit hyperactivity disorder and autism spectrum disorder. *The British Journal of Psychiatry. 214, 339-344, 2019.*
- **Jung M**, Mizuno Y, FujisawaTX, Takiguchi S, Kong J, Kosaka H, Tomoda A. The effects of COMT polymorphism on cortical thickness and surface area abnormalities in children with ADHD. *Cerebral Cortex. 29, 9, 3902-3911, 2019.*
- **Jung M,** Tu Y, Lang CA, Ortiz A, Park J, Jorgenson K, Kong XJ, Kong. Decreased structural connectivity and resting-state brain activity in the lateral occipital cortex is associated with social communication deficits in boys with autism spectrum disorder. *NeuroImage. 190, 205-212, 2019.*
- **Jung M**, Mody M, Fujioka T, Kimura Y, Okazawa H, Kosaka H. Sex Differences in White Matter Pathways Related to Language Ability. *Frontiers in Neuroscience. 13, 898. 2019.*

Patents

- Kosaka H, **Jung M,** Medical diagnosis system for resting state fMRI. (6566471 JP)

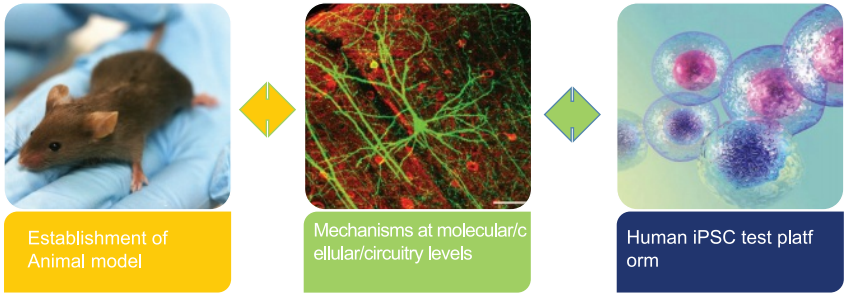
DEVELOPMENTAL DISORDERS & RARE DISEASES GROUP

DEVELOPMENTAL DISORDERS & RARE DISEASES GROUP

Overview

- Major Object : Research mechanisms of brain development and rare brain diseases based on molecule-cell-network-behavior research and develop technologies for early prevention and diagnosis
  - Explore mechanisms by utilizing databases
  - Model developmental disorders based on molecular/cellular/circuitry levels
  - Develop tools for circuit repair systems

- Research group of Developmental disorders and rare diseases



Development of therapeutic targets/agents for Neurodegenerative diseases

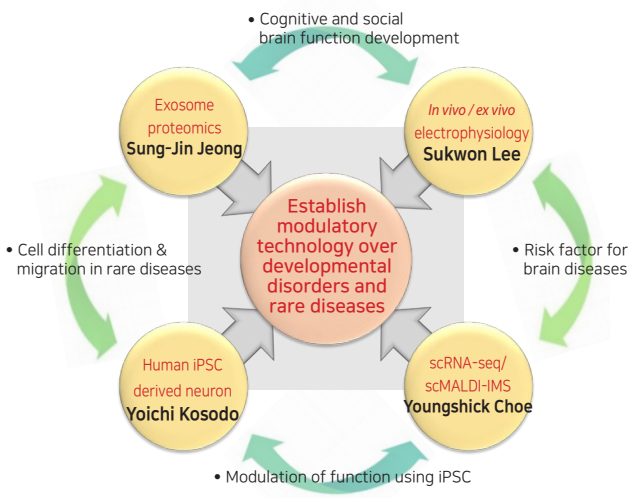
Research Objectives

- Molecular-level research on exosome proteins
- Cell-based research using human iPSC-derived neurons
- Network-level research using *in vivo* / *ex vivo* electrophysiology
- Single cell omics characterization of brain diseasea

Major Tasks

- Study the mechanisms of cortical development and malformations using exosome-omics techniques
- Establish a human iPSC test platform and cell transplantation
- Analyze and modulate neural activation at the circuitry level
- Analyzing single cell resolution multi-omics features to understand development of circuit dysfuntion

Organization



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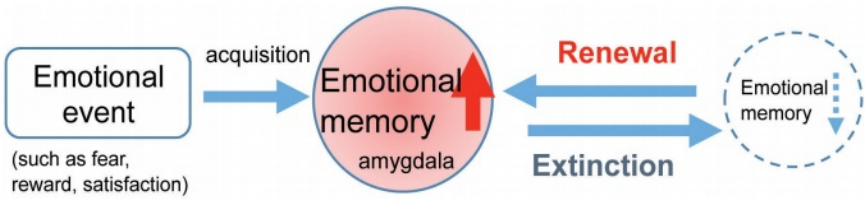
Neurophysiology of modulation memory

Emotional memory, a special category of memory involving the implicit learning and storage of information about the emotional significance of events, is modeled in rodent experiments using associational training. The neural system underlying emotional memory critically involves the amygdala and structures with which it is connected. This emotional memory can be modulated by additional training, such as extinction. After extinction training, emotional memory is diminished and, at some cases, erase permanently. However, at certain circumstance, weakened memory suddenly relapsed robustly. My research interest is focused on the neural mechanisms underlying these changes in emotional memory after acquisition, such as extinction and renewal.

Aim	Neural mechanisms underlying the changes in emotional memory
Tool	*Ex vivo* whole-cell patch clamp, *in vivo* single unit recording, miniscope, *in vivo* LFP analysis, virtual reality for mice, behavior analysis of mice with deep learning
TARGET	

Curriculum Vitae

2016~Present : Principal Investigator, KBRI
2014~2016 : Research Professor, Basic science
2009~2014 : Assistant Research Professor, Basic Science Institute, Seoul National University.
2004~2009 : Postdoctoral Fellow, School of Biological Sciences, Seoul National University

Academic Credential

2004 : Ph.D., School of Biological Sciences, Seoul National University.
1998 : M.S., School of Biological Sciences, Seoul National University.
1996 : B.S., Dept. of Molecular Biology, Seoul National University.

Awards/Honors/Memberships

2016~Present : Member, Society for Neuroscience
2014~Present : Member, The Korean Society for Brain and Neural Sciences
2014~Present : Board of directors, The Korean Society for Integrative Biology

Research keywords

Emotional memory, extinction, renewal, *ex vivo/in vivo* electrophysiology, metaplasticity.

Key techniques

Ex vivo whole-cell patch clamp, *In vivo* single unit recording, miniscope, *in vivo* LFP analysis, Virtual reality for mice, Behavior analysis of mice with deep learning.

Research Interests/Topics

- Neural mechanisms underlying weakening of emotional memory.
- Studies on the renewal of extinguished emotional memory.
- Neural circuit for the impulse control.

Research Publications (last 5 years)

- Joo B, Kool JW*, **Lee S***. Posterior parietal cortex mediates fear renewal in the novel context. *Molecular Brain, 13:16, 2020.* (IF: 4.668) (*,corresponding authors)
- Song S, Kim J, Park K, Lee J, Park S, **Lee S**, Kim J, Hong I, Song S, Choi S. GSK-3 beta activation is required for ZIP-induced disruption of learned fear. *Scientific reports, 10:18227, 2020.* (IF: 4.011)
- Kim D, Jang S, Kim J, Park I, Ku K, Choi M, **Lee S**, Heo WD, Son GH, Choe HK, Kim K. Kisspeptin neuron-specific and self-sustained calcium oscillation in the hypothalamic arcuate nucleus of neonatal mice: Regulatory factors of its synchronization. *Neuroendocrinology, 110:1010, 2020.* (IF: 6.804)
- **Lee S*,** Kim J*, Choi S Endogenous amyloid-beta mediates memory forgetting in the normal. *Biochem Bioph Res Co, 506:492, 2018.* (IF 2.28) (*, equal contribution)
- An B*, Kim J*,Park K*,**Lee S***,Song S*,Choi SAmount of fear extinction changes its underlying mechanisms. *eLife., 6:e25224, 2017.* (IF: 9.322) (*, equal contribution) (F1000 recommendation)
- Park S, Lee J, Park K, Kim J, Song, B, Hong I, Kim J, **Lee S***, Choi S*. Sound tuning of amygdala plasticity in auditory fear conditioning. *Scientific Reports, 6:31069, 2016.* (IF: 5.578) (*,corresponding authors)

Sung-Jin Jeong, PhD

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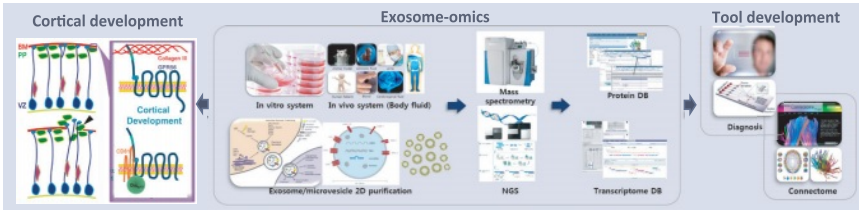
Molecular aging and development

Intellectual disability known as mental retardation and learning deficiency is common phenomenon of the developmental disorders which are present from early life affecting the entire life. Our study is focused on the pathoetiological mechanisms of the developmental disorders and the exploring the rare disorders utilizing the exosome-omics technology and database. Many similarities appear in the developmental disorders and the neurodegenerative disorders in the disease process. In long term study, we will intensively study the common mechanism of the developmental and neurodegenerative disorders in many difference levels of neuronal circuitry ranging from molecular to systemic and develop the cutting-edge technologies for diagnosis and therapies.

Aim	Study on the mechanisms of developmental disorders and establishment of diagnostic and therapeutic tools
Tool	2D Exosome purification and proteomics, 3D clearing and staining, in utero electroporation, behavior test
TARGET	

Research keywords

Developmental disorders, GPCR, exosome, secretome, nanobody, database.

Key techniques

2D Exosome purification and proteomics, 3D clearing and staining, in utero electroporation, behavior test, single-cell transcriptome.

Curriculum Vitae

2013~Present : Principal Investigator, KBRI
2009~2013 : Research Fellow, HMS/Boston Children's Hospital , USA
2002~2009 : Postdoctoral Fellow, HMS/MGH, USA
2000~2002 : Postdoctoral Fellow, Dept. of Pharmacology, College of Medicine, SNU, Korea

Academic Credential

2000 : Ph.D., Molecular Biology, SNU
1994 : M.S., Molecular Biology, SNU
1992 : B.S., Biology, Catholic Univ of Korea

Awards/Honors/Memberships

2020~ : Secretary General, International Brain Research Organization
2020~ : Committee Member, Dana Foundation
2020~ : Committee Member, Korea Society for Molecular and Cellular Biology
2020 : Award of Ministry of Science and ICT
2019~2020 : Committee Member, Korea Society for Neural and Brain Science
2018~2020 : Council Member, World Economic Forum, Neurotech Council
2017~ : Co-chair, Global Neuroethics Summit/IBI Neuroethics Working Group
2017~ : Secretary General, Federation of Asian-Oceanian Neuroscience Societies
2016~2019: Office Director of 2019 IBRO World Congress
2015~2018: Director, Korea Brain Research Policy Center
2015 : Award of Daegu City Mayor
1994 ~ : Member, Society for Neuroscience

Research Interests/Topics

- Pathoetiological study on the mechanisms of cortical development and malformation.
- Development of new tools for diagnosis and therapy utilizing extracellular vesicle incl exosome.

Research Publications (selected)

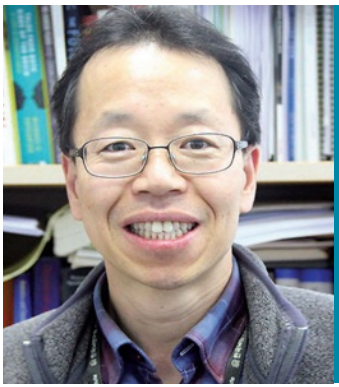
- Ha BG*, Heo JY*, Jang YJ, Park TS, Choi JY, Jang WY, and **Jeong SJ**. Depletion of mitochondrial components from extracellular vesicles secreted from astrocytes in a mouse model of Fragile X Syndrome. *International Journal of Molecular Sciences, 22,410, 2021.* (*These authors contributed equally to the work)
- **Jeong SJ**, Lee IY, Jun BO, Ryu YJ, Sohn JW, Kim SP, Woo CW, Koo JW, Cho IJ, Oh UT, Kim K, and Suh PG. Korea Brain Initiative: Emerging Issues and Institutionalization of Neuroethics. *Neuron 202:390-393. 2019.*
- Global Neuroethics Summit Delegates; Rommelfanger KR, **Jeong SJ,** Ema A, Fukushi T, Kasai K, Ramos KM, Salles A, Singh I. Neuroethics Questions to Guide Ethical Research in the International Brain Initiatives. *Neuron 100:19-36, 2018.*
- Giera S, Luo R, Ying Y, Ackerman SD, **Jeong SJ**, Stoveken HM, Folts CJ, Welsh CA, Tall GG, Stevens B, Monk KR, Piao X. Microglial transglutaminase-2 drives myelination and myelin repair via GPR56/ADGRG1 in oligodendrocyte precursor cells. *eLife, 33385, 2018.*
- Petersen SC, Luo R, Liebscher I, Giera S, **Jeong SJ,** Mogha A, Ghidinelli M, Feltri ML, Schoneberg T, Piao X, Monk KR. The adhesion GPCR GPR126 has distinct, domain-dependent functions in Schwann cell development mediated by interaction with laminin-211. *Neuron, 85(4):755-69, 2015.*
- **Jeong SJ**, Luo R, Singer K, Giera S, Krediberg J, Kyozumi D, Shimono C, Sekiguchi K, Piao X. GPR56 functions together with a3b1 integrin in regulating cerebral cortical development. *PLoS ONE, 8(7):E68781, 2013.*

Patents (selected)

- Kim NU, Choi JY, Jang YJ, Kang BS, and **Jeong SJ**. Web-based imaging processing system and method for 3D reconstruction of neural circuits in brain. 2020. (10-2075454-0000)
- Kim NU, Choi JY, Kang BS, and **Jeong SJ.** Web-based cell profiling system and method using brain imaging. 2020. (10-2098794-0000)

Ongoing Research Support

- **NRF (PI, 06/01/17-12/31/21)** Multimodal DB for understanding neural networks of PFC.
- **NRF (PI, 06/01/19-12/3123)** International and domestic networking of neuroethics research



Youngshik Choe, PhD

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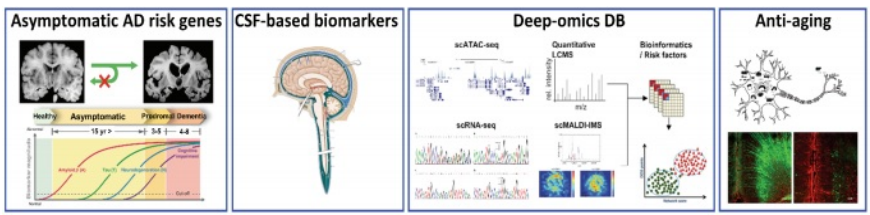
http://www.kbri.re.kr/new/pages_lab/sub/page.html?mc=2038

Single cell omics & brain disease

I have scientific experiences covering molecular biology, mass spectrometry, mouse genetics, stem cells and have a life-long question about how we store and retrieve data in the brain. Researches asking this question will lead us to a cure for brain diseases including Alzheimer's disease and circuitopathies such as depression and autism. To pursue this scientific endeavor, collaboration of open minded scientists and adoption of novel tools are critical. Working together with professionals in the field of mouse genetics, omics, informatics and neuroengineering, I believe it will be cleared how brain cells utilize electric current to decode memories written in molecular languages.

Aim	Characterization of risk factors for brain diseases including brain aging with deep-omics integration
Tool	scRNA-seq, scMALDI-IMS, EV proteomics, 3D IHC, human brain organoids

TARGET



Research keywords

Multi-omics, Exosome, 3D brain mapping, Molecular connectome, Single cell platform, Closed-loop neural probe, Organoid, Big data analysis

Curriculum Vitae

2013~Present : Principal Investigator, KBRI
2008~2013 : Specialist, Neuroscience, UCSF, USA
2003~2008 : Postdoctoral Fellow, Neuroscience, UCSF, USA

Academic Credential

2001 : Ph.D., Molecular Biology, SNU
1996 : M.S., Molecular Biology, SNU
1994 : B.S., Molecular Biology, SNU

Awards/Honors/Memberships

2019~Present : Committee, The Genetics Society of Korea
2014~Present : Member, Society for Neuroscience

Key techniques

Proteomics, Lipidomics, MALDI-imaging, Cohort precision omics, Exosome omics, CLARITY, 3D IHC, Single cell omics, Single cell RNA seq, Neural recording (probe, 2p), Big data informatics pipeline (R, Python), Behavioral analysis, Neural circuit analysis.

Research Interests/Topics

- Multi-omics analysis of brain organoids: scRNA-seq, lipidomics, proteomics.
- Extracellular vesicle biomarkers of Korean AD cohort.
- scRNA-seq biomarkers of brain aging.

Research Publications (selected)

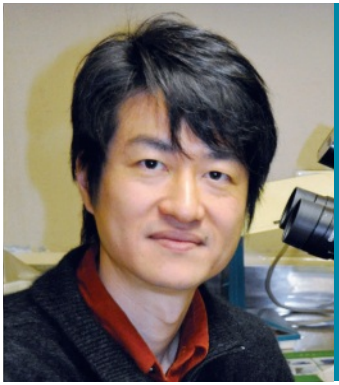
- **Choe Y**, Pleasure SJ. Meningeal Bmps regulate cortical layer formation. Brain Plasticity, 26:169-183, 2018.
- Mishra S, **Choe Y**, Pleasure SJ, Siegenthaler JA. Cerebrovascular defects in Foxc1 mutants correlate with aberrant WNT and VEGF-A pathways downstream of retinoic acid from the meninges. *Dev Biol, 420:148-165, 2016.*
- **Choe Y**, Pleasure SJ, Mira H. Control of Adult Neurogenesis by Short-Range Morphogenic-Signaling Molecules. *Cold Spring Harb Perspect Biol, doi:10.1101/cshperspect.a018887, 2015.*
- **Choe Y**, Huynh T, Pleasure SJ. Epithelial cells supply Sonic Hedgehog to the perinatal dentate gyrus via transport by platelets. *Elife, 10.7554/eLife.07834, 2015.*

Patents

- 10-2017-0086725, 10-2017-0118125, 10-2017-0135948, 10-2017-0168844, 10-2018-0004121, 10-2018-0054511, PCT/KR2018/012369.

Technology transfer

- 10-2017-0135948, 10-2018-0004121. (Logos Biosystems, DeepLabelTM)



Yoichi Kosodo, PhD

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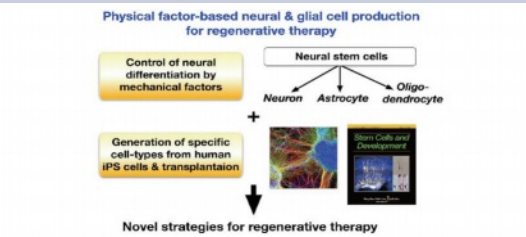
Neural Regeneration

Although mechanical properties have been shown to influence stem cell fate, little is known if mechanical properties of the stem cell niche change *in vivo* and whether and how this can influence behavior, growth and differentiation of stem cells.
We will seek mechanisms and logics how mechanical factors control differentiation towards specific neural and glial cells by systematic use of molecular biology, biochemistry, mouse genetics, biomaterials, bioinformatics, and advanced microscopy.
Furthermore, we will apply our knowledge to invent novel strategies to understand and recover from developmental brain disorders by producing specific neurons and astrocytes for transplantation and drug screening.

Aim	Physical factor-based neural-glial cell production for regenerative therapy
Tool	Atomic Force Microscopy (AFM), In utero electroporation, High-efficient transplantation of iPSC
TARGET	

Research keywords

Neurogenesis, human iPS cells, Neural and glial differentiation, Brain development disorders, Extracellular physical factors, CRISPR/Cas9 genome edition, Transplantation, Biomaterial

Curriculum Vitae

2015~Present : Principle Researcher, KBRI
2010~2015 : Associate Professor, Department of Anatomy, Kawasaki Medical School, Kurashiki, Japan
2005~2010 : Research Scientist, RIKEN Center for Developmental Biology, Kobe, Japan
2001~2005 : Postdoctoral Fellow, Max-Planck-Institute of Molecular Cell Biology and Genetics (MPI-CBG), Dresden, Germany

Academic Credential

2001 : Ph.D. in Life Sciences, Dept. of Biotechnology, University of Tokyo
1998 : M.Sc. in Life Sciences, Dept. of Biotechnology, University of Tokyo
1996 : B.Sc. in Engineering, Dept. of Chemistry and Biotechnology, University of Tokyo

Awards/Honors/Memberships

2000~2002 : Research Fellowship of the JSPS for PhD student
1998~1999 : Junior Research Associate at the RIKEN Institute

Key techniques

1) Measurement of tissue and cellular stiffness during organogenesis using Atomic Force Microscopy. (AFM) (Iwashita et al, 2014 Development)
2) In utero electroporation and tissue live imaging. (Kosodo et al, 2011 EMBO J)
3) High-efficient transplantation to the developing brain. (Nagashima et al, 2014 Stem Cells Dev)

Research Interests/Topics

- Understanding the mechanism of neural and glial differentiation during formation of brain cortex.
- Production of specific neural cells from human iPS cells to analyze and apply for brain development disorders.

Research Publications (selected)

- Iwashita M, Ohta H, Fujisawa T, Cho M, Ikeya M, Kidoaki S, **Kosodo Y**. Brain-stiffness-mimicking tilapia collagen gel promotes the induction of dorsal cortical neurons from human pluripotent stem cells. *Sci Rep., 9(1):3068, 2019.*
- Iwashita M, Kataoka N, Toida K, **Kosodo Y**. Systematic profiling of spatiotemporal tissue and cellular stiffness in the developing brain. *Development, 141:3793-98, 2014.*
- Nagashima F, Suzuki IK, Shitamukai A, Sakaguchi H, Iwashita M, Kobayashi T, Tone S, Toida K, Vanderhaegheon P and **Kosodo Y**, Novel and robust transplantation reveals the acquisition of polarized processes by cortical cells derived from mouse and human pluripotent stem cells. *Stem Cells Dev., 15;23(18) 2129-42, 2014.*
- **Kosodo Y**, Suetsugu T, Suda M, Mimori-Kiyosue Y, Toida K, Baba SA, Kimura A, Matsuzaki F. Regulation of interkinetic nuclear migration by cell cycle-coupled active and passive mechanisms in the developing brain. *EMBO J., 30:1690-1704, 2011.*
- **Kosodo Y**, Toida K, Dubreul V, Alexandre P, Schenk J, Kiyokage E, Attardo A, Mora-Bermudez F, Arii T, Clarke JD, Huttner WB. Cytokinesis of neuroepithelial cells can divide their basal process before anaphase. *EMBO J., 27:3151-63, 2008.*

External grants (Korean)

- NRF (2016~19) Investigation to Uncover How Mechanical Factors Control Brain Formation and Application for Neural Regeneration.
- NRF (2017~19) Elucidation of mechanical factor-driven neural and glial differentiation of the CNS and PNS derived from human induced pluripotent stem cells.

Patents (Korean)

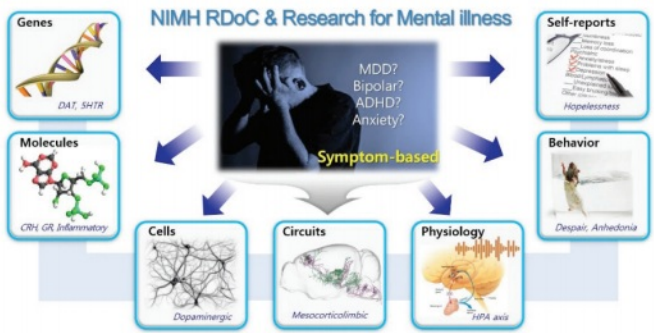
- **Kosodo Y**, Iwashita M. A method for inducing dorsal cortical neurons from pluripotent stem cells by using tilapia collagen gel. (10-2018-0099003, patent application)


EMOTION,
COGNITION
& BEHAVIOR
GROUP
RESEARCHERS

EMOTION, COGNITION & BEHAVIOR GROUP

Overview

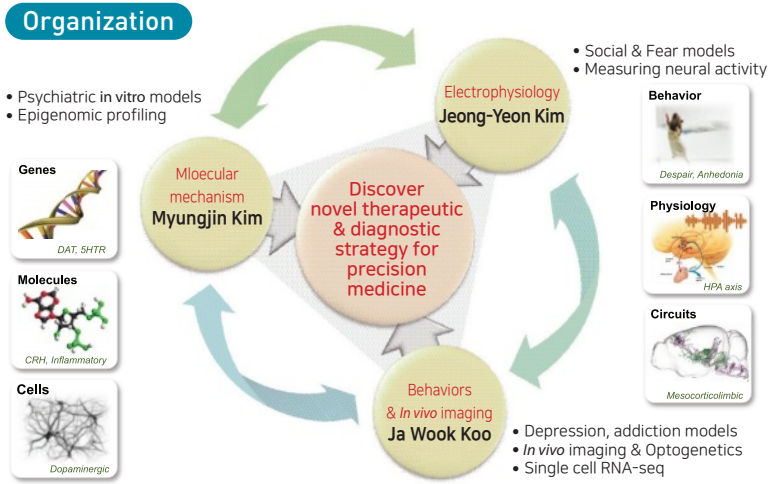
- Emotional-cognitive functional control by neuro-circuitry regulation
- Brain circuitry-based studies of transcriptomic and epigenetic mechanisms in psychiatric/cognitive disorders at the cell type and single-cell levels
- Multi-disciplinary approaches including optogenetics, electrophysiological, pharmacological and imaging techniques to explain **how emotional and cognitive behaviors are modulated in heath and disease**



Research Objectives

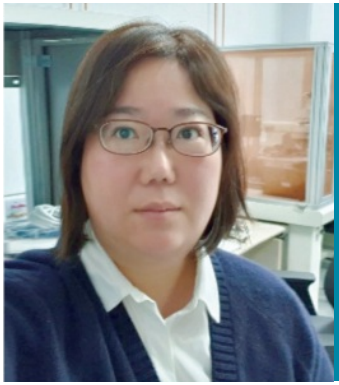
- Our research group aims to understand how our brain networks works for emotional and cognitive functions in health and disease.
- By developing cutting-edge technologies, our group elucidates the dynamics of brain circuitries that are related to psychiatric/cognitive disorders.
- Based on the functional neural network mapping in the animal models of mental illness, we investigate molecular dynamics at multiple levels of brain region, cell type, and single cell.
- Such comprehensive understanding of "behavior-circuitry-cellular-molecular" mechanisms underlying emotion-cognition may shed light on the development of novel therapeutic and diagnostic tools for psychiatric/cognitive disorders.

Organization



Major Tasks

- Emotional-cognitive disease animal models reflecting individual differences (depression and addiction)
- *In vitro* modeling of mental illness
- Rare mental disease animal models for sociality (sociality cognition, caution)



Jeongyeon Kim, PhD

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Principal Investigator

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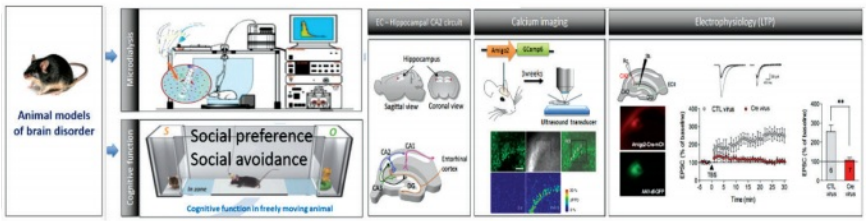
Social dysfunction in brain disorders

Dr. Kim and colleagues will employ a multi-disciplinary approach including optogenetics, *in vivo* and *ex vivo* electrophysiological, pharmacological and imaging techniques to find mechanistic explanations for how social information mediates behavior in heath and disease.

Aim	Social dysfunction in brain disorders
Tool	***In vivo, ex vivo*** **electrophysiology + social function + animal model**
TARGET	

Research keywords

Social-cognitive dysfunction, Brain disorder. (neurodegeneration, neuroinflammation)

Key techniques

- *In vivo, ex vivo* electrophysiology. (extracellular field recording, patch-clamp recording, *in vivo* unit recording)
- Behavioral analysis. (social cue–associated avoidance behavior, etc)
- Optogenetics, calcium imaging, *in vivo* microdialysis.

Curriculum Vitae

2017~Present : Principal Investigator, KBRI
2017~2017 : Research Fellow, IBS
2012~2016 : Postdoctoral Fellow, KIST
2011~2011 : Research prof. Ewha Univ.
2010~2011 : BK21 Postdoctoral Fellow, Seoul National Univ.
2019 ~ present : Group leader, Emotion, Cognition & Behavior research group, KBRI, Daegu, Republic of Korea

Academic Credential

2008 : Ph.D., Biological Sciences, Seoul Nat. Univ.
2002 : M.S., Interdisciplinary Graduate program in Genetic engineering, Seoul Nat. Univ.
2000 : B.S., Biology, Ewha Univ.

Awards/Honors/Memberships

2018 : Member, Korean Society for Brain and Neuroscience
2018 : Member, Society for Neuroscience
2007 : Best poster presentation The Korean Brain society
2005 : Travel award in Extinction Conference at Ponce, Puerto Rico
2021 : Editorial Committee, KSBNS

Research Interests/Topics

- Synaptic circuit in neurodegeneration.
- Hippocampal CA2 function in health and disease.
- Social dysfunction.

Research Publications (selected)

- Kim S, Jo Y, Kook G, Pasquinelli C, Kim H, Kim K, Hoe HS, Choe Y, Rhim H, Thielscher A, **Kim J***, Lee HJ*. Transcranial focused ultrasound stimulation with high spatial resolution. *Brain Stimul. 12;14(2):290-300, 2021.* (co-corresponding)
- Heo JY*, Nam MH*, Yoon HH*, **Kim J***, Hwang YJ, Won W, Woo DH, Lee JA, Park HJ, Jo S, Lee MJ, Kim S, Shim JE, Jang DP, Kim KI, Huh SH, Jeong JY, Kowall NW, Lee J, Im H, Park JH, Jang BK, Park KD, Lee HJ, Shin H, Cho IJ, Hwang EM, Kim Y, Kim HY, Oh SJ, Lee SE, Paek SH, Yoon JH, Jin BK, Kweon GR, Shim I, Hwang O, Ryu H, Jeon SR, Lee CJ. Aberrant Tonic Inhibition of Dopaminergic Neuronal Activity Causes Motor Symptoms in Animal Models of Parkinson's Disease., *Curr Biol. 20;30(2):276-291, 2020.* (co-first)
- Lee JY, Nam JH, Nam Y, Nam HY, Yoon G, Ko E, Kim SB, Bautista MR, Capule CC, Koyanagi T, Leriche G, Choi HG, Yang J, **Kim J***, Hoe HS#. The small molecule CA140 inhibits the neuroinflammatory response in wild-type mice and a mouse model of AD. *J Neuroinflammation, 15(1):286, 2018.* (co-corresponding)
- **Kim J** An B*, Kim J*, Park S, Park S, Hong I, Lee S, Park K, Choi S. mGluR2/3 in the Lateral Amygdala is Required for Fear Extinction: Cortical Input Synapses onto the Lateral Amygdala as a Target Site of the mGluR2/3 Action. *Neuropsychopharmacology, 40(13):2916-28, 2015.* (co-first)
- Lee S*, Song B*, **Kim J***, Park K, Hong I, An B, Song S, Lee J, Park S, Kim J, Park D, Lee CJ, Kim K, Shin KS, Tsien RW, Choi S. *Nat. Neurosci., 16(10):1436-44, 2013.* (co-first)
- Hong I*, **Kim J***, Kim J, Lee S, Ko HG, Nader K, Kaang BK, Tsien RW, Choi S. AMPA receptor exchange underlies transient memory destabilization on retrieval. Proc. *Natl. Acad. Sci. USA, 110:8218-23, 2013.* (co-first)

Ja Wook Koo, PhD

Principal Investigator

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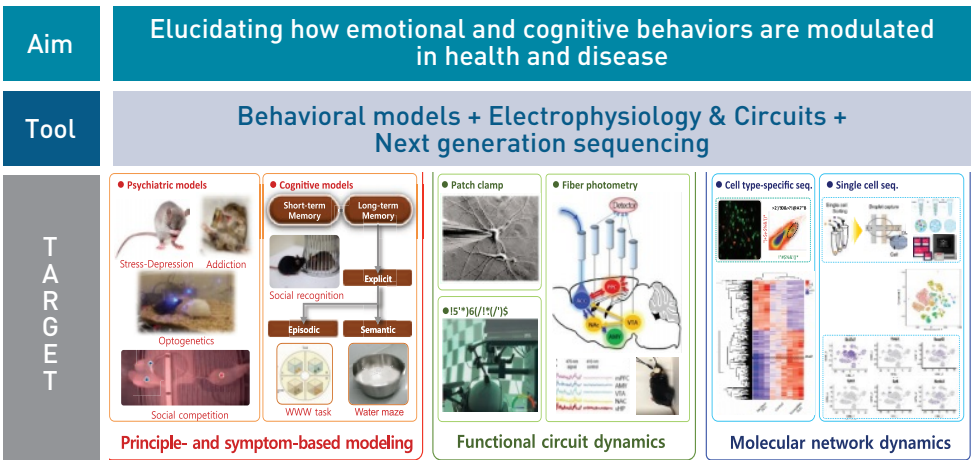
Neural circuitry & Molecular connectome in Psychiatric disorders

Our research aims to understand how our brain network, particularly motivation circuitry, works for emotional and cognitive functions. By developing cutting-edge technological resources and monitoring the functional mesoscale connectome, our lab elucidates dynamics of the brain circuitry that is related to psychiatric/cognitive disorders. Based on the mapping of functional neural circuitry in the animal models of psychiatric/cognitive disorders, we profiles transcriptome and epigenome at the levels of brain area, cell type, and single cell, which are followed by gene network analyses. The comprehensive understanding of "behavior-circuitry-molecular" mechanisms underlying emotion-cognition may shed light on the development of therapeutic tools for psychiatric/cognitive disorders.



Research keywords

Emotion, Cognition, Psychiatric disorders, Depression, Addiction, Reward circuitry, Optogenetics, Single cell/Cell-type specific transcriptome, Epigenetics, ***in vivo*** electrophysiology.

Curriculum Vitae

2015~Present : Principal Investigator, KBRI
2008~2015 : Postdoctoral Fellow, Fishberg Department of Neuroscience, Icahn School of Medicine at Mount Sinai, New York, USA

Academic Credential

2008 : Ph.D., Department of Psychology, (Behavioral Neuroscience) Yale University, USA
2002 : M.S., School of Biological Sciences, Seoul National University, Korea
2000 : B.S., School of Biological Sciences, Seoul National University, Korea

Awards/Honors/Memberships

2018 : Mol. & Cell. Biol. News Committee, KSMCB
2018 : Planning Committee Coordinator, KSBNS
2015~2016 : Academic Affairs Committee Coordinator, KSBNS
2011 : Young Investigators Travel Award, NIDA
2008~2015 : Member, Association for Psychological Science
2002~2015 : Member, Association of Korean Neuroscientists
2000~Present : Member, Society for Neuroscience

Key techniques

Animal models of psychiatric/cognitive disorders, Optogenetics, Fiber photometry, Virtual reality, *in vivo/ex vivo* recordings, FACS, Single cell/Cell-type seq, ChIP assay, Viral-mediated gene transfer.

Research Interests/Topics

- Emotional-cognitive functional control by neuro-circuitry regulation.
- Brain circuitry based studies at cell type and single cell levels on transcriptomic and epigenetic
- mechanisms in psychiatric/cognitive disorders.

Research Publications (selected)

- Lee J, Ribeiro E, Kim J, Ko B, Kronman HG, Jeong YH, Kim JK, Janak PH, Nestler EJ*, **Koo JW***, Kim J-H* (2020) Dopaminergic regulation of nucleus accumbens cholinergic interneurons demarcates susceptibility to cocaine addiction. *Biol Psychiatry 88:746-757, 2020.* (*contributed equally)
- Labonté B*, Jeong YH*, Engmann O, Parise E, Issler O, Nestler EJ, **Koo JW** (2019) Gadd45b mediates depressive-like role through DNA demethylation. *Sci Rep 9:4615, 2019.* (*contributed equally)
- **Koo JW**, Labonte B, Engmann O, Calipari ES, Lorsch Z, Juarez B, Friedman AK, Walsh JJ, Han MH, Nestler EJ. Essential Role of Mesolimbic Brain-Derived Neurotrophic Factor in Chronic Social Stress-Induced Depressive Behaviors. *Biol Psychiatry 80:469-478, 2016.*
- **Koo JW**, Mazei-Robison MS, LaPlant Q, Egervari G, Braunscheidel KM, Adank DN, Ferguson D, Feng J, Sun H, Scobie KN, Damez-Werno D, Riberio E, Pe a CJ, Walker D, Bagot RC, Cahill ME, Anderson SA, Labonte B, Hodes GE, Browne H, Chadwick B, Robison AJ, Vialou VF, Dias C, Lorsch Z, Mouzon E, Lobo MK, Dietz DM, Russo SJ, Neve RL, Hurd YL, Nestler EJ. Epigenetic basis of opiate suppression of Bdnf gene expression in the ventral tegmental area. *Nat Neurosci 18:415-422, 2015.*
- **Koo JW**, Mazei-Robison MS, Chaudhury D, Juarez B, LaPlant Q, Ferguson D, Feng J, Sun H, Scobie KN, Damez-Werno D, Crumiller M, Ohnishi YN, Ohnishi YH, Mouzon E, Hodes GE, Dietz DM, Lobo MK, Neve RL, Russo SJ, Han MH, Nestler EJ. BDNF is a Negative Modulator of Morphine Action. *Science 338:124-128, 2012.*

Patents (selected)

- **Koo JW**, Nestler EJ. A BDNF (Brain-derived neurotrophic factor) overexpressed animal model for depression disorder and a method of producing thereof. Korea Patent #10-1884650, filed Oct. 2, 2016 and issued July 18, 2018.
- Choi HK, Koh EH, Cho JH, Son JB, Koh EK, Park JH, Kim SY, Kang SY, Lee SY, Ryu HY, Kim ND, Kim SB, Lee SH, Kim DY, Lee SJ, Cho SC, Lee KS, Yoo K, Choi M, **Koo JW**, Hoe H. Pyrolo-pyridine derivatives, preparation method thereof, and pharmaceutical composition for use in preventing or treating protein kinase related disease as an active ingredient. Korea Patent #10-1896568, filed March 23, 2018 and issued Sept. 3, 2018.

Myungjin Kim, PhD

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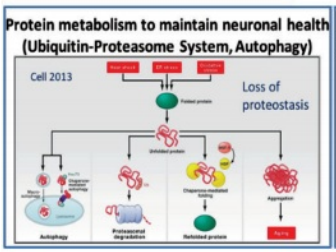
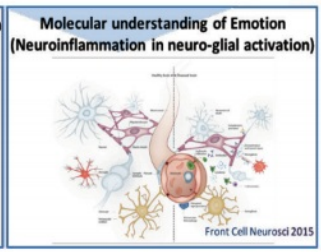
Molecular mechanisms of neuronal cell fate determination in neural development and brain disorders

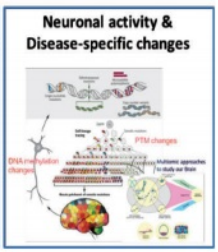
From genes to proteins, all are dynamically modified to respond to internal and external stress. Especially, when neurons are exposed to various stimuli, they need to quickly decide how to cope with such signals and maintain cellular homeostasis. The MKLNB (MK Lab of Neurobiochemistry) group at KBRI actively investigates to gain a better understanding of the molecular mechanisms underlying neuronal cell fate determination during cellular stress response, from normal neuronal development to senescence and neuronal death. We also focus on the whole and single-cell multiomics approaches for brain connectome project.

Aim	Elucidating the underlying molecular mechanisms for development and brain disorders by investigating the neuro-epigenome and epiproteome dynamics(NEED)
Tool	Biochemistry & Molecular Biology for Protein Modification / Degradation(UPS) & DNA Methylation analyses

TARGET







Curriculum Vitae

2017~Present : Principal Investigator, KBRI
2008~2017 : BK professor, Research Assistant Professor, Research Associate Professor, School of Biological Sciences, IMBG, RIBS, Seoul National University, Korea
2006~2007 : Postdoctoral Research Associate., USC/ Norris Cancer Center, USC Epigenome Center, University of Southern California, USA

Academic Credential

2006 : Ph.D., Biochemistry and Molecular Biology, University of Southern California, USA
1998 : M.S., Molecular Biology, Seoul National University
1995 : B.S., Biological Sciences, Ewha Womans University

Awards/Honors/Memberships

2019~2022 : Mid-career Research Grant, NRF, Ministry of Science, ICT
2018~Present : Member, Society for Neuroscience
2015~2018 : Basic Research Grant. NRF, Ministry of Education
2017~Present : Member, The Korean Society for Brain and Neural Sciences
2016 : IASSF Best Young Scientist group membership, KAST.
Qualified candidate for Young Academy, KAST.
2013~2016 : Basic Research Grant for Female Scientist. NRF, Ministry of Science, ICT and Future Planning
2009~2012 : Basic Research Grant for Female Scientist. NRF, MEST
2008~2009 : Prospective Female Scientist Grant. Korea Research Foundation, MST
2004 : The Best Poster Presentation Award. USC Annual Biochemistry Retreat
2003 : The Outstanding Oral Presentation Award. USC Graduate Student Seminar Series

Research keywords

Neuronal cell fate determination, Post-translational modifications, Cellular stress response, Epigenetics.

Key techniques

- Molecular approaches for epigenome and epiproteome dynamics : protein modification (ubiquitylation, SUMOylation, phosphorylation, acetylation, O-GlcNAcylation, etc.), Analyses for gene expression, DNA methylation, histone modification, chromatin accessibility.
- Monitoring neuronal health: neuronal senescence and apoptosis assays.

Research Interests/Topics

- Molecular biology of protein metabolism in neuronal health.
- Development of single cell-based multiomic analyses for neuro-glial activation during neuroinflammation.
- Molecular understanding of neuronal activity and disease-specific changes in development and brain disorders through NEED. (Neuro-Epigenome and Epiproteome Dynamics)

Research Publications (selected)

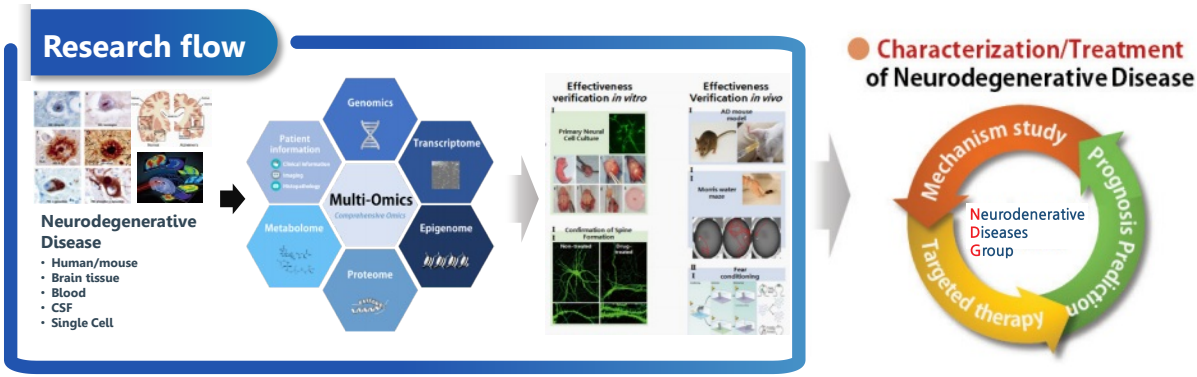
- Lee J, Ko YU, Chung Y, Yun N, **Kim M**, Kim K, Oh YJ. The acetylation of cyclin-dependent kinase 5 at lysine 33 regulates kinase activity and neurite length in hippocampal neurons. *Sci Rep., 8(1):13676, 2018.*
- Lee KA, Cho KC, Kim B, Jang IH, Nam K, Kwon YE, **Kim M**, Hyeon DY, Hwang D, Seol JH, Lee WJ. Inflammation-Modulated Metabolic Reprogramming Is Required for DUOX-Dependent Gut Immunity in Drosophila. *Cell Host Microbe., 23(3):338-352.e5, 2018.*
- **Kim M**, Kwon YE, Song JO, Bae SJ, Seol JH. CHFR negatively regulates SIRT1 activity upon oxidative stress. *Sci Rep., 6,37578, 2016.*
- Joo JH*, Oh H*, **Kim M**, An EJ, Kim RK, Lee SY, Kang DH, Kang SW, Park CK, Kim, Lee SJ, Lee D, Seol JH, Bae YS. NADPH Oxidase 1 Activity and ROS Generation Are Regulated by Grb2/Cbl-Mediated Proteasomal Degradation of NoxO1 in Colon Cancer Cells. *Cancer Res., 76(4):855-65, 2016.*
- Bae SJ*, **Kim M***, Kim SH, Kwon YE, Lee JH, Kim J, Chung CH, Lee WJ, Seol JH. NEDD4 controls intestinal stem cell homeostasis by regulating the Hippo signalling pathway. *Nat Commun., 6:6314, 2015.* (*co-first author)

NEURO-DEGENERATIVE DISEASES GROUP

NEURODEGENERATIVE DISEASES GROUP

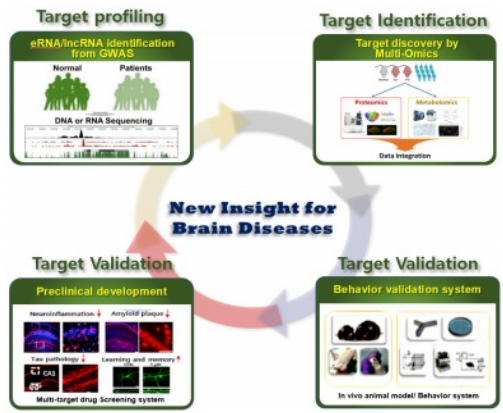
Overview

• Major Object : Development of therapeutic targets/agents for neurodegenerative diseases



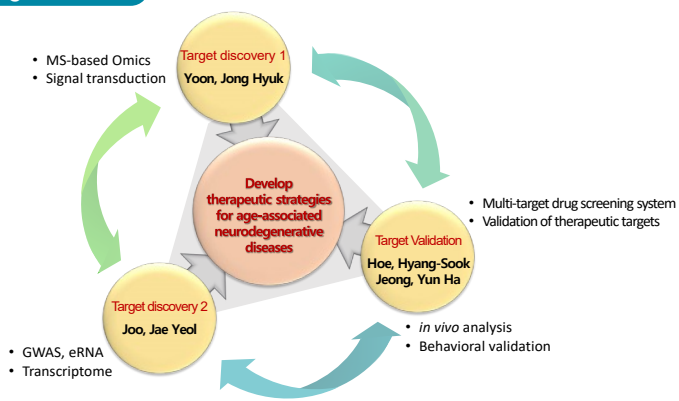
Research Objectives

- Discovery/Validation of diagnostic/therapeutic target for neurodegenerative disease
- Characterization of molecular targets/mechanisms using a multi-omics approach
- Establishment of gene to behavior validation system based on *in vivo* animal model



Development of therapeutic targets/agents for Neurodegenerative diseases

Organization



Major Tasks

- Identify molecular targets using a multi-Omics approach
- Establish a gene-to-behavior validation system based on *in vivo* animal models

Jong Hyuk Yoon, PhD

Group Leader

Principal Investigator

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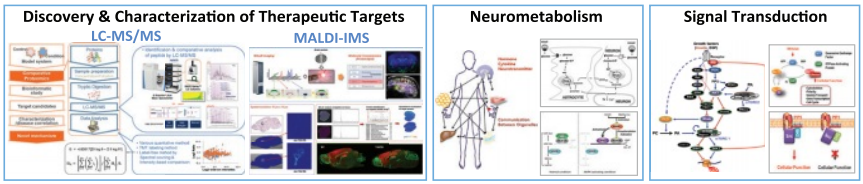
Mass spectrometry-based Omics and neurometabolism

I'm interested in study on biomarkers and therapeutic targets of neurological disorders using mass spectrometry-based Omics technology. This study aims at finding molecular targets of companion diagnostics for precision medicine. Metabolic organs, including brain, skeletal muscle and adipose, dynamically secrete various factors, communicate with each other and orchestrate functions to maintain body homeostasis. I'm also interested in metabolic features of neural cells under disorder state as well as crosstalk between brain and metabolic organs.

Aim	Elucidating molecular mechanisms in neurological disorders using mass spectrometry-based approach
Tool	Mass Spectrometry + Biochemistry + Molecular Biology + Cell Biology + Bioinformatics
TARGET	

Research keywords

Proteomics, Neurometabolism, Signal transduction, Multi-Omics, Stem cell therapy

Key techniques

Mass spectrometry, Biochemistry, Molecular biology, Cell biology, Bioinformatics, Stem cell biology

Curriculum Vitae

2019~present : Group Leader, Neurodegenerative Diseases Research Group, KBRI, South Korea
2016~present : Principal Investigator, KBRI, South Korea
2014~2016 : Senior Researcher, MOGAM Institute for Biomedical Research, South Korea

Academic Credential

2012 : Ph.D., Life Science, POSTECH
2007 : M.S., Life Science, GIST
2005 : B.S., Genetic Engineering, Kyungpook Nat'l University

Awards/Honors/Memberships

2018 : Young Scientist Award, The Korean Human Proteome Organization (KHUPO)
2016 : Year's Author Award, KHUPO
2021~present : Member, Editorial Board, Molecules and Cells
2020~present : Chief, Editorial Committee, The Korean Human Proteome Organization (KHUPO)
2019~present : Member, Organizing Committee, 10th Asia-Oceania Human Proteome Organization (AOHUPO) Congress
2019~present : Manager, General Affairs, Signal Transduction Association (STA)
2018~2020 : Member, Steering Committee, Korea Cancer ProteoGenomics Research Program, Ministry of Health and welfare
2018~present : Handling Editor, Molecules and Cells

Research Interests/Topics

- Discovery and characterization of biomarkers and therapeutic targets of neurological disorder using mass spectrometry-based Omics study
- Characterization of metabolic features of neural cells under disorder state
- Characterization of crosstalk between brain and metabolic organs
- Development of new fusion proteins for brain drug delivery
- Development of the engineered stem cell therapy for neurodegenerative diseases

Research Publications (selected)

- Song P., Jo HS., Kwon YW, Bae S, Kwon Y, Hur J, Lee D, Ryu SH **Yoon JH**. Emodin induces collagen type I synthesis in Hs27 human dermal fibroblasts. *Experimental and Therapeutic Medicine, May;21(5):420, 2021.* (Corresponding)
- Song P, Kwon Y, Joo JY, Kim DG, **Yoon JH**. Secretomics to Discover Regulators in Diseases. *Int J Mol Sci. Aug 9;20(16). pii: E3893. 2019.* (Corresponding)
- **Yoon JH***, Kim D*, Kim J, Lee H, Ghim J, Kang BJ, Song P, Suh PG, Ryu SH. and Lee TG. NOTUM is involved in the progression of colorectal cancer, *Cancer Genomics Proteomics. 15(6):485-497. 2018.* (Corresponding)
- Park S, Park J-H, Jung, H-J,··· Suh PG, Chae S, **Yoon JH**, Ryu SH and Hwang D. A secretome profile indicative of oleate-induced proliferation of hepatocellular carcinoma cells. *Exp Mol Med. 3;50(8):93. 2018.* (Corresponding)
- **Yoon JH**, Kim D, Jang JH, Ghim J, Park S, Song P, Kwon Y, Kim J, Hwang D, Bae YS, Suh PG, Berggren PO, and Ryu SH. Proteomic analysis of the palmitate-induced myotube secretome reveals involvement of the annexin A1-FPR2 pathway in insulin resistance. *Mol Cell Proteomics. Apr;14(4):882-92. 2015.*

Patents (registered)

- **Yoon JH**, Hwang D, Ryu SH, Park S, Park JH (2020) "Novel hepatocellular carcinoma diagnostic marker and use thereof" (KR10-2136643)
- **Yoon JH**, Choe Y, Jung HJ, Choi YR, Lee MS, Kim D, Jang JM (2020). "A method of isolation of protein and lipid using zwitterionic detergents and the use thereof" (KR10-2099567)
- **Yoon JH**, Choe Y, Jung HJ, Lee MS, Kim HJ, Jang JM, Kim D, Choi YR (2019). "A novel protein marker for diagnosing Alzheimer's disease and the use thereof" (KR10-2010655)
- **Yoon JH**, Lee TG, Kim J, Kim BJ (2018). "Novel peptide having ability to synthesize collagen and use thereof" (PCT/KR2013/000122)
- **Yoon JH**, Lee TG, Kim J (2017). "Novel bio-marker of neuroglioma and use thereof" (KR10-1727026)

Hyang-Sook Hoe, PhD

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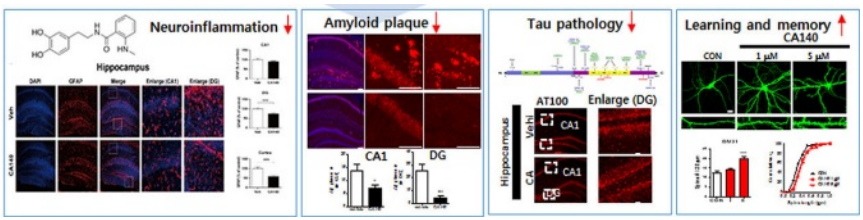
Development of therapeutic agents in Neurdegenerative disease

Our lab research is focused on the role of APP and its binding synaptic proteins in the neuronal and synaptic damage that occurs in neurodegenerative diseases of the central nervous system (CNS). Specifically, we will focus on examining A) the role of APP in synapse regulation in the normal brain and in the Alzheimer's disease (AD) and B) Novel treatments for AD including the effects of anti-neuroinflammatory drugs, Ab/Tau binding small molecules, synaptic and cognitive function enhancement, as well as its therapeutic effects on neurodegenerative disease. To achieve our goals, we will continuously examine the effectiveness of Ab/Tau targeting small molecules and 15 of these novel agents as effective novel therapeutic strategy for AD.

Aim	Develop therapeutic drug for Alzheimer's disease(AD)
Tool	Cell biology+Molecular biology+Multi-target drug screening +***in vivo*** validation system
TARGET	

Research Keywords Key techniques

Alzheimer's disease, Amyloid, Tau, Neuroinflammation, learning and memory.

Curriculum Vitae

2013~Present : Principal Investigator, KBRI
2010~2013 : Assistant Professor (Tenure track), Georgetown University, USA
2008~2009 : Assistant Professor (Research track), Georgetown University, USA
2006~2008 : Instructor, Georgetown University, USA
2003~2005 : Post-doc, Georgetown University, USA
2002~2003 : Post-doc, Osaka University, Japan

Academic Credential

2002 : Ph.D., Genetic engineering, Sungkyunkwan University
1997 : M.S., Genetics, Wonkwang Univeristy
1995 : B.S., Biology, Wonkwang University

Grant

2013~present : American Journal of Neurodegenerative Diseases (AJND), Editorial Board Member
2011 : M4M Young Investigator award, Georgetown University, USA
2002~2003 : Award from post-doctoral fellowship of Korea science & Engineering foundation (KOSEF)
2002~Present : Member, Society for Neuroscience

Key techniques

Virus-related work, Primary hippocampal cultures, Primary astrocyte/microglial ell culture, Behavior work (Y maze, NOR test), Golgi staining.

Research Interests/Topics

- Determine the effects of APP and AD related protein on cognitive function in the normal brain and AD pathology and its molecular mechanism of action.
- Development of novel therapeutic strategy for Alzheimer's disease.

Research Publications (selected)

- Lee HJ, Jeon SG, Kim J, Kang RJ, Kim SM, Han KM, Park H, Kim KT, Sung YM, Nam HY, Koh YH, Song M, Suk K, **Hoe HS** Ibrutinib modulates Ab/tau pathology, neuroinflammation, and cognitive function in mouse models of AD. *Aging cell. In press.2021.*
- Kim S, Jo Y, Kook G, Pasquinelli C, Kim H, Kim K, **Hoe HS**, Choe Y, Rhim H, Thielscher A, Kim J, Lee HJ. Transcranial focused ultrasound stimulation with high spatial resolution. *Brain Stimul. 14:290-300.2021.*
- Moon DW, Park YH, Lee SY, Lim H, Kwak S, Kim MS, Kim H, Kim EJ, Jung Y, **Hoe HS,** Kim S, Lim DK, Kim C, In SI Muliplex protein imaging with secondary ion mass spectrometry using metal oxide nanoparticle conjugated antibodies. *ACS Applied Materials & Interfaces. 12:18056-18064.2020.*
- Lee HJ, Choi TI, Kim YM, Lee S, Han B, Bak IS, Moon SA, Yu DY, Shin K, Kwon YK, Moon C, **Hoe HS** , Kim CH, Shim I Regulation of habenular G protein gamma 8 on learning and memory via modulation of the central acetylcholine system. *Molecular Psychiatry. doi:10.1038/s41380-020-00893-2.2020.*
- Lee HJ, Woo H, Lee HE, Jeon H, Ryu KY, Nam JH, Jeon SG, Park H, Lee JS, Han KM, Lee SM, Kim J, Kang RJ, Lee YH, Kim JI, **Hoe HS**. The novel DYRK1A inhibitor KVN93 regulates cognitive function, amyloid-beta pathology, and neuroinflammation *Free radical biology and medicine .5;160:575-595. Doi:10.1016/*j.freeradbiomed.*2020.*
- Jeon SG, Lee HJ, Park H, Han KM, **Hoe HS** . (2020) The VEGF inhibitor vatalanib regulates AD pathology in 5xFAD mice. *Mol Brain. 25;13(1):131. Doi:10.1186/s13041-020-00673-7.2020.*
- Kim JH, Afridi R, Han J, Jung HG, Kim SC, Hwang EM, Shim HS, Ryu H, Choe Y, **Hoe HS**, Suk K. Gamma subunit of complement component 8 is a neuroinflammation inhibitor. *Brain. DoI: 10.1093/BRAIN/ASAA425.2020.*

Yun Ha Jeong, PhD

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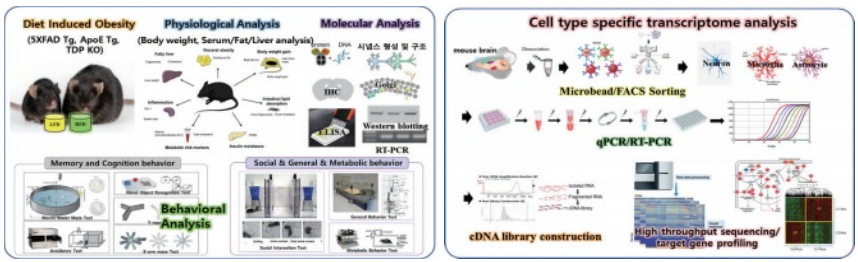
http: //sites.google.com/view/braindisease/home

Behavioral and molecular pathobiology of Neurological diseases

The increasing prevalence of overweight and obesity is a major public health concern in these days. Recently, growing evidence indicate that the obese population are more susceptible to some neurological conditions such as cognitive disorders, including Alzheimer's disease (AD) or mood disorders, including major depression disorder (MDD). These evidences indicate that changes in the organism that accompany overweight, and obesity can ultimately lead to CNS dysfunction. However, the pathophysiological mechanisms and molecular players underlying this connection are poorly known. In this study, I focus on the mechanistic correlation between obesity and neurological disorders (such as Alzheimer's disease or Depression). To address this correlation, I approach using multidisciplinary way from gene to behavior level. Using this systematic exploration of this relationship would help to elucidate causal mechanism and opportunities for prevention and treatment.

Aim	Study of mechanistic cross-talk between Neurodegenerative disease and Obesity
Tool	***In vivo*** mouse model + Behavioral analysis + Molecular biology, histology, physiology
TARGET	

Curriculum Vitae

2013~Present : Principal Investigator, KBRI
2008~2013 : Postdoctoral Fellow, Department of Pathology, Division of Neuropathology, The Johns Hopkins University School of Medicine, USA
2007~2008 : Postdoctoral Fellow, Department of Pharmacology, College of Medicine, Seoul National University, Korea

Academic Credential

2007 : Ph.D., Interdisciplinary Program in Neuroscience, Seoul National University
2004 : M.S., Interdisciplinary Program in Cognitive Science, Seoul National University
2002 : B.S., Department of Genetic Engineering, SungKyunKwan University

Grant

General Researcher Program
(Young Researchers), National Research Funding of Korea, Principal Investigator
- Title : "Elucidation of the role of TDP-43, an ALS/FTD linked protein, in eating disorder (anorexia nervosa, bulimia nervosa) and obesity"
  Total costs : 149,430,000 Inclusive dates : 7/1/2014-6/30/2017
- Title : "Study on molecular connectome difference of stress susceptible and stress resilient in various models of depressive mood disorders"
  Total costs : 500,000,000 Inclusive dates : 3/1/2019-2/29/2024

Research keywords

Neurodegenerative disorder, Stress, Obesity, Depression, Mental illness, Feeding behavior, Impulsive control disorder, Neurometabolic disorder, Eating disorder (anorexia nervosa, bulimia nervosa).

Key techniques

Behavioral modeling, Genetic modification (cre/lox), Transcriptomics, Epigenomics,
Viral gene transfer, Optogenetics, Chemogenetics, FACs, Cell-type specific seq., Single cell seq.

Research Interests/Topics

- Mechanistic cross-talk among Neurodegenerative disease, Mental illness and Obesity.
- Study of correlation between neurological disorders and environmental factors. (ex. stress, environmental endocrine disruptors, etc.)
- Molecular mechanisms of eating behaviors in impulse disorder.
- Study of neurological disorders using multiple approach of behavior analyses.
- Study of transcriptome and epigenome in neurodegenerative/neurometabolic disorders.

Research Publications (selected)

- Park H, Han K-M, Jeon H, Lee J-S, Lee H, Jeon SG, Park J-H, Kim YG, Lin Y, Lee Y-H, **Jeong YH*** and Hoe H-S*. The MAO Inhibitor Tranylcypromine Alters LPS and Aβ-Mediated Neuroinflammatory Responses in Wild-type Mice and a Mouse Model of AD. *Cells. 9(9), 1982; doi:10.3390/cells9091982. 2020.* *Co-Corresponding
- Lee JH, Ribeiro EA, Kim J, Ko B, Kronman H, **Jeong YH**, Kim JK, Janak PH, Nestler EJ, Koo JW, Kim JH. Dopaminergic Regulation of Nucleus Accumbens Cholinergic Interneurons Demarcates Susceptibility to Cocaine Addiction. *Bio.l Psychiatry. 88(10):746-757. 2020.*
- Donde A*, Sun M*, **Jeong YH***, Ling J, Lin S, Braunstein K, Wang S, Chen L and Wong PC. Upregulation of Atg7 attenuates motor neuron dysfunction associated with depletion of TDP-43. *Autophagy. July 7:1-11. 2019* *Co-First
- Labonté B*, **Jeong YH***, Parise E, Issler O, Fatma M, Engmann O, Cho K, Neve Rachael, Nestler EJ, Koo W. Gadd45b mediates depressive-like role through DNA demethylation. *Sci Rep. 9(1):461. 2019.* *Co-First
- **Jeong YH***, Ling J*, Lin S*, Donde A, Braunstein KE, Majounie E, Traynor BJ, LaClair K, Lloyd TE and Wong PC. Tdp-43 cryptic exons are highly variable between cell types. *Molecular Neurodegeneration. 12:13. 2017.* *Co-First

Jae-Yeol Joo, PhD

Principal Investigator

NEURODEGENERATIVE DISEASES GROUP
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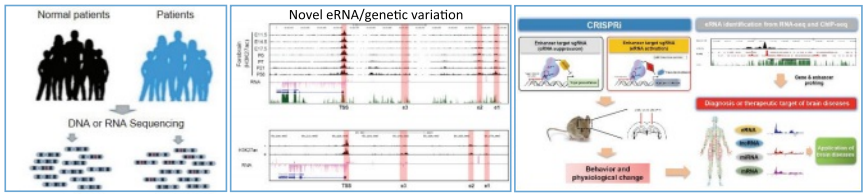
RNA Neurobiology: Potential targets of lncRNAs (eRNA) and their promise as novel therapeutics and biomarkers in human brain disorders with AI-deep learning-based approach

Enhancer RNAs (eRNAs) are a class of long noncoding RNAs (lncRNAs) that are transcribed from DNA sequences upstream or downstream of active enhancer regions. Activity-regulated transcriptional programs are essential for the maturation or development of synapses, and transcription of gene contributes many cognitive disorders, which include Fragile X syndrome, Down syndrome, autism spectrum disorders or other rare genetic disorders. One interesting my preliminary data indicated that endogenous eRNAs altered mouse behavior, and completely impaired the fear memory. Altogether, those evidence could imply that not only endogenous eRNAs directly regulates specific gene expression but also could be alter behavior *in vivo*. Therefore, high target gene specificity eRNAs may be useful therapeutic or diagnosis targets, and unique biomarkers of various diseases. Although biochemical research has contributed to important advancements in the diagnosis of brain disease pathogenesis, studies on single nucleotide variations (SNVs) in brain diseases are scarce due to the lack of informative genetic information. Therefore, identification of gene mutations in brain disease remains challenging and a comparative genomics approach is required. High-throughput screening based deep learning has been used to predict splicing from primary sequences. However, high-throughput screening based deep learning has not yet been extended to identify SNVs in specific target genes associated with various human brin diseases. Genome-wide association study (GWAS) derived deep learning would be an effective model system for predicting brain disease and its progression. GWAS with deep learning platform can be analyze query expression patterns and mutations of the human brain disease related gene. Our research may be a useful tool that provides the identification of certain molecules for diagnosis of various disease, and multimodal data fusion research will open new avenues for rare diseases in human.

Aim	Enhancer RNA therapy : Genome editing in eRNA research
Tool	RNA-seq, ChIP-seq, CRISPRi, Chromosome conformation capture (3C), UV-RNA immunoprecipitation (UV-RIP)
TARGET	

Curriculum Vitae

2016.12~Present : Principal Investigator, KBRI
2012.04~2016.10 : Postdoctoral Fellow, University of Texas Southwestern Medical Center, TX, USA
2006~2007.03 : Researcher, The University of Tokyo, Graduate School of Medicine, Tokyo, Japan

Academic Credential

2012 : Ph.D., The University of Tokyo Graduate School of Medicine, Tokyo, Japan
2005 : M.S., Hanyang University, College of Medicine, Seoul, Korea
2003 : B.S., Hanyang University, Life Science, Seoul, Korea

Awards/Honors/Memberships

2008~2012 : The University of Tokyo Fellowship, Special full Scholarship (Excellence scholarship student, President Award)
2011 : KSBNS-MCCS Asia Conference, Takeda MCCS Travel Award
2014 : Association of Korean Neuroscientist (AKN), Research Award (Post-doc)
2008~Present : Member, Society for Neuroscience

Research Keywords and Techniques

Deep learning, AI, Genetic variants, Genome-Wide Association Study, Enhancer RNA, lncRNA, Transcriptome, Gene expression.

Research Interests/Topics

- Elucidation of function and mechanism for brain disease from novel enhancer RNA (lncRNA) through transcriptome analysis and CRISPRi
- Prediction and therapy of human brain disease by deep learning-based approach (AI)

Research Publications (selected)

- Kim SH, Yang S, Lim KH, Ko E, Jang HJ, Kang MG, Suh PG, and **Joo JY,** Prediction of Alzheimer's disease specific phospholipase c gamma-1 SNV by deep-learning based approach for high-throughput screening. *Proc. Natl. Acad. Sci. U S A. Jan 19: 118(3) e2011250118, 2021.*
- Yang S, Lim KH, Kim SH, and **Joo JY,** Molecular landscape of long noncoding RNAs in brain disorders. *Molecular Psychiatry. Nov 10: 41380-020-00947-5, 2020.*
- Lim KH, Yang S, Kim SH, and **Joo JY,** Elevation of Ace2 as a SARS-CoV-2 entry receptor gene expression in Alzheimer's disease. *Journal of Infection (20)30453-9, 2020.*
- **Joo JY**, Schaukowitch K, Farbiak L, Kilaru G, and Kim TK. Stimulus-specific combinatorial functionality of neuronal c-fos enhancers. *Nature Neuroscience 19(1):75-83, 2016.*
- Schaukowitch K*, **Joo JY***, Liu X, Watts JK, Martinez C, and Kim TK. Enhancer RNA Facilitates NELF Release from Immediate Early Genes. *Molecular Cell 56(1):29-42, 2014.* * Co-first author

Patent

- Use of Ube2h for Diagnosis or Treatment of Alzheimer's Disease (No.10-2202120, Registration, 2021) (Main inventor)
- Use of SCARNA13 for Diagnosis or Treatment of Alzheimer's Disease (No.10-2020-0053906, Application, 2020) (Main inventor)
- Use of Eef1a1 for Diagnosis of Alzheimer's Disease (No.10-2020-0064437, Application, 2020) (Main inventor)
- Novel biomarker composition for diagnosis of Alzheimer's Disease based on multiplex PCR platform (No.10-2020-0105229, Application, 2020) (Main inventor)

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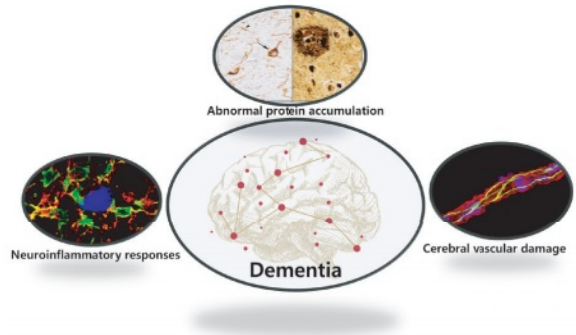
Overview

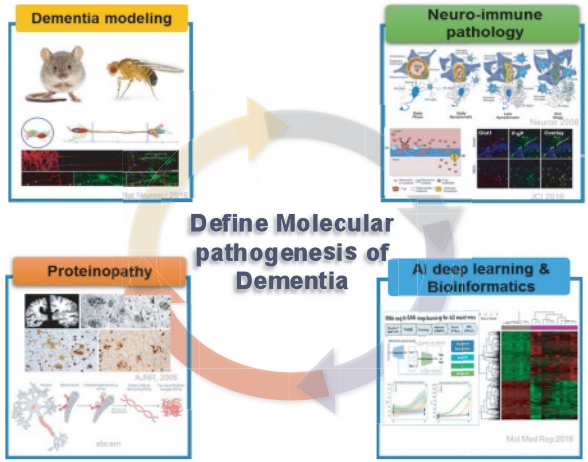
Dementia is a broad category of brain disorders with a gradual decline in memory and cognition, such as Alzheimer's disease, vascular dementia, Lewy body dementia, frontotemporal dementia, etc. Although prevalence of dementia worldwide is exponentially growing, there is currently no cure for dementia. To meet an urgent need for dementia cure, our group is focusing on developing novel therapeutic interventions through elucidating molecular mechanisms underlying dementia.



Research Objectives

Develop innovative strategies for diagnosis and treatment of dementia through elucidating molecular pathogenesis

- Dissect molecular mechanisms of proteinopathy and cerebrovascular pathology of dementia
- Develop AI-based DB analysis platform for multi-omics data
- Identify novel biomarkers and therapeutic targets
- Establish research models of dementia for preclinical study



Development of innovative strategies for diagnosis and treatment of dementia through elucidating molecular pathogenesis

Organization

Major Tasks

- Dissect molecular mechanisms of proteinopathy and cerebrovascular pathology of dementia
- Develop AI-based DB analysis platform for multiomics data
- Identify novel biomarkers and therapeutic targets
- Establish research models of dementia for preclinical study

Mookyung Cheon, PhD

Group Leader
Principal Investigator

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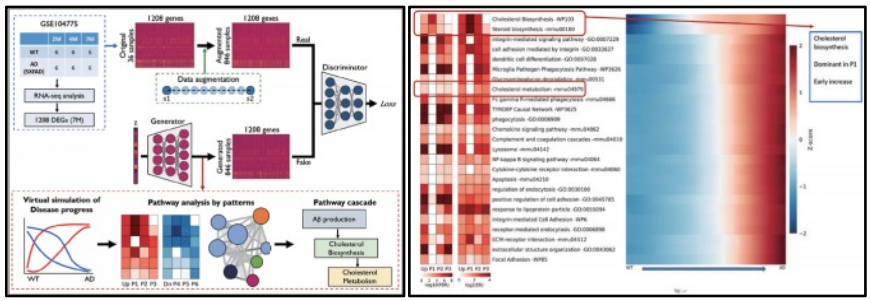
Bioinformatics, computational neuroscience and AI for dementia research

In the big data era, various and highly organized omics data have been accumulated rapidly and released to be open for data scientists who can perform meta analysis or AI-based applications. Recently our lab applied a deep learning technique called generative adversarial networks (GANs) to predict the molecular progress of Alzheimer's disease (AD) from RNA-seq data of 5xFAD mice. We suggest that GANs are a useful tool to study disease progression, leading to the identification of early pathological signatures. Based on generative models such as GANs and Style transfer, we are trying to develop algorithms to analyze human derived omics datawhich are highly heterogeneous for clarifying disease subtypes and molecular mechanisms for neurodegenerative diseases.

Aim	Convergence omics study for dementia research
Tool	Bioinformatics (RNA-seq) and AI deep learning (Generative models)
TARGET	

Curriculum Vitae

2016~Present : Principal Investigator, KBRI
2009~2016 : Research Professor, Creative Research Initiative Center for Proteome Biophysics, DGIST (2013~2016), Pusan Nat'l University (2009~2012),KOREA
2007~2009 : Postdoctoral Fellow, Chemical and Biomolecular Engineering, North Carolina State University, USA
2005~2007 : Postdoctoral Fellow, Chemistry, University of Cambridge, UK
2003~2005 : Postdoctoral Fellow, National Research Laboratory for Computational Proteomics and Biophysics, Pusan Nat'l University, Korea

Academic Credential

2001 : Ph.D., Physics, Pusan Nat'l Univ.
1996 : M.S., Physics, Pusan Nat'l Univ.
1994 : B.S., Physics, Pusan Nat'l Univ.

Awards/Honors/Memberships

2020~Present : Member, International Neuroinformatics Coordinating Facility (INCF)
2016~Present : Member, Korean Society for Brain and Neuroscience
2012~Present : Member, Biophysical Society

Research keywords

Morphological Neuron retrieval, RNA-seq for AD model mouse, Oligomerization of Aβ peptide, AI based omics analysis.

Key techniques

- AutoEncoder deep learning, Generative adversarial deep learning, RNA-seq, Molecular dynamics.
- Style transfer.

Research Interests/Topics

- Morphological neuron retrieval by feature extraction and deep learning.
- RNA-seq for AD model mice and simulation of gene expression by GAN deep learning.
- Molecular dynamics for oligomerization of Aβ peptide.
- Generative model based omics analysis for human derived materials

Research Publications (selected)

- Park J, Kim H, Kim J, **Cheon M**. A practical application of generative adversarial networks for RNA-seq analysis to predict the molecular progress of Alzheimers disease. *PLoS Comp Biol, 16:e1008099,2020.*
- **Cheon M**, Kang M, Chang I. Polymorphism of fibrillar structures depending on the size of assembled Aβ 17-42 peptides. *Scientific Reports, 6:38196, 2016.*
- **Cheon M**, Kim C, Chang I. Uncovering Multi Loci-Ordering by Algebraic Property of Laplacian Matrix and its Fiedler Vector. *Bioinformatics, 32: 801-807, 2016.*
- **Cheon M**, Hall KH, Chang I. Structural Conversion of Aβ17-42 Peptides from Disordered Oligomers to U-Shape Protofilaments via Multiple Kinetic Pathways. *PLoS Comp Biol., 11:e1004258, 2015.*
- **Cheon M**, Chang I, Hall CK. Spontaneous Formation of Twisted Aβ16-22 Fibrils in Large-Scale Molecular-Dynamics Simulations. *Biophysical Journal, 101:2493-2501, 2011.*
- **Cheon M**, Chang I, Mohanty S, Luheshi LM, Dobson CM, Vendruscolo M, Favrin G. Structural reorganisation and potential toxicity of oligomeric species formed during the assembly of amyloid fibrils. *PLoS Comp Biol., 3:1727, 2007.* (Commented by ALZFORUM)

Hyung-Jun Kim, PhD

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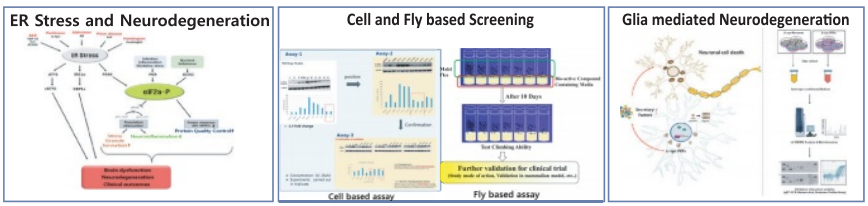
Elucidation of molecular pathogenesis for neurodegenerative diseases

Neurodegenerative diseases are devastating both to the individual suffering from disease, and the family members of patients. However, there are no effective therapies for major neurodegenerative diseases such as Amyotrophic Lateral Sclerosis (ALS), Alzheimer's disease (AD), and Parkinson's disease (PD). Therefore, we desperately need new insights and ideas for developing novel therapeutic strategies. Our lab uses Drosophila and mammalian cell culture system as a model for human neurodegenerative diseases. Drosophila has the most powerful *in vivo* genetic manipulation system among eukaryotic model organisms currently in use. Moreover, these systems are simple and fast, and have highly conserved fundamental pathways that allow powerful insight into complex human neurodegenerative diseases. Using these systems, we are trying to dissect common shared pathological mechanisms of neurodegenerative diseases including dysfunction of protein quality control system, Endoplasmic reticulum stress and neuroinflammation.

Aim	Elucidating shared pathological mechanisms of age-associated Dementia
Tool	Drosophila genetics + Mammalian Neuron-glia co-culture system
TARGET	ER Stress and Neurodegeneration Cell and Fly based Screening Glia mediated Neurodegeneration



Curriculum Vitae

2013~Present : Principal Investigator, KBRI
2008~2013 : Postdoctoral fellow, HHMI / UPENN., USA
2007~2008 : Postdoctoral Fellow, School of biological sciences, Seoul National Univ., Korea

Academic Credential

2007 : Ph.D., Biology, Seoul National Univ.
2000 : B.S., Microbiology, Seoul National Univ.

Awards/Honors/Memberships

2017~Present : Member, Scientific committee of Korean Society for Neurodegenerative disease
2013~Present : Member, Korean Society for Molecular and Cellular Biology
2013~Present : Member, Korean Society for Brain and Neuroscience
2015~ Present : Member, Korean Society for Biochemistry and Molecular Biology
2000 : Honored Graduation

Research keywords

Neurodegenerative diseases, Drosophila genetics, Neuron-glia interaction.

Key techniques

Drosophila genetics, Neuron-glia co-culture, Mitochondrial activity assay, Behavioral analysis in fly.

Research Interests/Topics

- Establishment of High-throughput validation system for candidate genes of neurodegenerative diseases.
- Precise molecular analysis of common pathogenic mechanisms of neurodegenerative diseases. (PQC, ER stress, Neuroinflammation)

Research Publications (selected)

- Elden AC*, **Kim HJ***, Hart MP*, Chen-Plotkin AS*, Johnson BS, Fang X, Armakola M, Geser F, Greene R, Lu MM, Padmanabhan A, Clay-Falcone D, McCluskey L, Elman L, Juhr D, Gruber PJ, Rub U, Auburger G, Trojanowski JQ, Lee VM, Van Deerlin VM, Bonini NM, Gitler AD. Ataxin-2 intermediate-length polyglutamine expansions are associated with increased risk for ALS. *Nature, 466(7310):1069-75, 2010.* (*These Authors equally contributed. Nature News and Views. F1000 must read.)
- **Kim HJ**, Raphael AR, LaDow ES, McGurk L, Weber RA, Trojanowski JQ, Lee VM, Finkbeiner S, Gitler AD, Bonini NM. Therapeutic modulation of eIF2α phosphorylation rescues TDP-43 toxicity in amyotrophic lateral sclerosis disease models. *Nature Genetics, 46(2):152-60, 2014.*
- Shinrye Lee*, Seyeon Kim*, Ha-Young Kang, Hye Ryeong Lim, Younghwi Kwon, Myungjin Jo, Yu-Mi Jeon, Sang Ryong Kim, Kiyoung Kim, Chang Man Ha, Seongsoo Lee#, **Hyung-Jun Kim**#, The overexpression of TDP-43 in astrocytes causes neurodegeneration via a PTP1B mediated inflammatory response. *Journal of Neuroinflammation, 17:299, 2020.* (Corresponding author)
- Shinrye Lee, Yu-Mi Jeon, Sun Joo Cha, Seyeon Kim, Younghwi Kwon, Myungjin Jo, You-Na Jang, Seongsoo Lee, Jaekwang Kim, Sang Ryong Kim , Kea Joo Lee , Sung Bae Lee , Kiyoung Kim & **Hyung-Jun Kim** (2019). PTK2/FAK regulates UPS impairment via SQSTM1/p62 phosphorylation in TARDBP/TDP-43 proteinopathies. *Autophagy, 1-17. doi:10.1080/15548627.2019.1686729* (Corresponding author)

Jaekwang Kim, PhD

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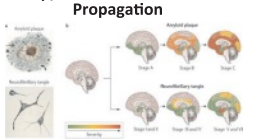
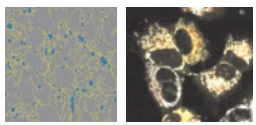
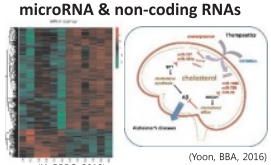
Neurobiology of Alzheimer's disease

Alzheimer's disease (AD) is the most common form of dementia in the elderly. Although details of AD pathogenesis still remain elusive, abnormal accumulation of amyloid-β (Aβ) and Tau in the brain is hypothesized to trigger pathogenic cascades that lead to AD. Abnormal accumulation of Aβ and Tau starts from specific brain regions and progressively propagates throughout the brain. Therefore, elucidating the molecular mechanisms of their accumulation and propagation is critical to understand AD pathogenesis. We are currently studying the molecular mechanisms for their accumulation and propagation utilizing cellular and mouse models.

Mounting evidence suggests that clearance of damaged mitochondria, termed mitophagy, is dysregulated, thereby leading to accumulation of damaged mitochondria and synaptic deficits in neurons. However, the underlying mechanisms for mitochondrial dysfunction and mitophagy deficits are largely unknown. We are currently studying the role of mitochondria and mitophagy in the pathogenesis of Alzheimer's disease as well as aging.

Accumulating evidence suggests that dysregulation of microRNAs is closely linked to the pathogeneses of various human diseases. However, the functional and therapeutic implication of microRNAs in AD remains largely unknown. Understanding the role of miRNAs in AD may provide new opportunities to develop novel therapeutic interventions for AD. We are currently seeking to probe the role of microRNAs in AD pathogenesis.

Aim	Elucidating the molecular pathogenesis of Alzheimer's disease and identifying targets for therapeutic intervention
Tool	Proteinopathy modeling + miRNA biology + mitochondria biochemistry + Mouse genetics
TARGET	Aβ/Tau accumulation & Propagation  (Masters, Nat Rev Dis Primers 2015) Synaptic deficits & Mitochondrial dysfunction  Neurite/synapse Mitophagy Assay microRNA & non-coding RNAs  (Li, BBRC, 2018) (Yoon, BBA, 2016)

Curriculum Vitae

2017~ : Principal Investigator, KBRI, Korea
2017 : Assistant Professor, Mayo Clinic, USA
2013~2017 : Senior Research Fellow/ Research Associate, Mayo Clinic, USA
2010~2013 : Postdoc/ Staff Scientist, Washington Univ., USA
2009~2010 : Postdoc, Univ. of Minnesota, USA
2008~2009 : Postdoc, Johns Hopkins Univ., USA
2007~2008 : Postdoc, Seoul National Univ., Korea

Academic Credential

2001~2007 : Ph.D., Biological Sciences, Seoul National, Univ., Korea
1996~2001 : B.S., Microbiology, Seoul National Univ., Korea

Awards/Honors/Memberships

2019~2020 : Member of the board of directors, Korean Society of Neurodegenerative disorder
2008~ : Member, Society for Neuroscience

Research keywords

Alzheimer's disease, Propagation, Synaptic deficits, Mitochondrial dysfunction, MicroRNA.

Key techniques

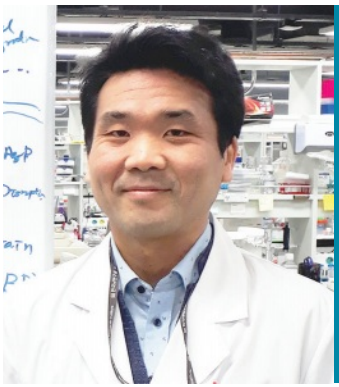
Modeling proteinopathies, Mouse genetics, Histology, Protein biochemistry, Primary neural cell-based assays, MicroRNA biology, Mitophagy assay, Somatic transgenesis.

Research Interests/Topics

- Dissect the molecular pathogenesis of Alzheimer's disease.
- Study the mechanisms of Aβ/Tau accumulation and propagation.
- Probe the role of miRNAs in the brain and Alzheimer's disease.
- Elucidate the molecular link between aging and Alzheimer's disease.
- Determine the role of mitophagy in the pathogenesis of Alzheimer's disease and aging.

Research Publications (selected)

- **Kim J***, Fiesel FC, Belmonte KC, Hudec R, Wang WX, Kim C, Nelson PT, Springer W, Kim J*. miR-27a and miR-27b regulate autophagic clearance of damaged mitochondria by targeting PTEN-induced putative kinase 1 (PINK1). *Mol ' Neurodegener, 11:55, 2016.* (*co-corresponding authors)
- **Kim J**, Yoon H, Chung DE, Brown JL, Belmonte KC, Kim J. miR-186 is decreased in aged brain and suppresses BACE1 expression. *J Neurochem., 137:436, 2016.* (Editorial highlight)
- Choi J*, Gao J*, **Kim J***, Hong C, Tontonoz P. The E3 ubiquitin ligase Idol controls brain LDL receptor expression, ApoE clearance, and Abeta amyloidosis. *Sci transl Med., 7:314ra184, 2015.* (*equally contributed)
- **Kim J**, Yoon H, Horie T, Burchett JM, Restivo JL, Rotllan N, Ramirez CM, Verghese PB, Ihara M, Hoe HS, Esau C, Fernandez-Hernando C, Holtzman DM, Cirrito JR, Ono K, Kim J. microRNA-33 Regulates ApoE Lipidation and Amyloid-beta Metabolism in the Brain. *J Neurosci., 35:14717, 2015.* (Featured Article)



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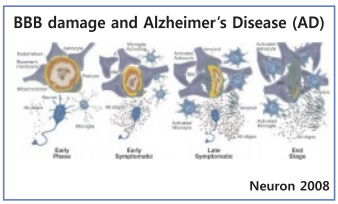
Elucidating the vascular pathophysilolgy in the development of neurodegenerative diseases

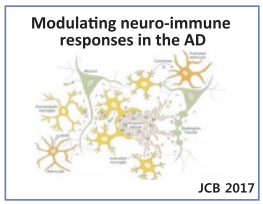
Research Description

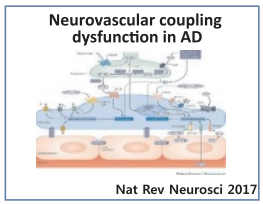
The brain is the center for the cognitive function and needs special means to protect itself from the peripheral insult and this entity of structural barrier of the vascular system is called blood brain barrier (BBB). It is unique in its structure delineating the vascular system of the CNS composed of the endothelial cells, pericyte, and astrocytes. Traditionally, BBB has been considered as a mere tight vascular integrity that has passive role just supporting the brain physiology. However, emerging studies show that it is not the case. Currently, we are studying the 1. Neurovascular coupling at the level of the BBB enhancing the molecular delivery to the brain and 2. Impact of BBB integrity in the progression of neurodegenerative diseases including Parkinson's Disease. In the future, we will enhance these topics toward CNS autoimmune diseases that will strengthen the understanding of the brain disease progression in a different view point. These studies will be done with our expertise on the BBB biology and collaboration with intra- and extramural experts from different fields.

Aim	Elucidating the role of blood brain barrier in neuroimmune responses in the Alzheimer's Diseases
Tool	***In vitro*** and ***in vivo*** BBB model+ Advanced Imaging + Mouse genetic model

TARGET







Curriculum Vitae

2016~Present : Principal Investigator, KBRI
2015~2016 : Postdoctoral Associate, Cornell University., USA
2008~2009 : Researcher, Korea Institute of Toxicology (KIT)

Academic Credential

2010~2015 : Ph.D., Cornell University, USA
2000~2008 : D.V.M., Konkuk University

Awards/Honors/Memberships

2010~2015 : International Kwanjung Educational Foundation Scholarship for Study Abroad
2016~Present : Member, Society for Neuroscience
2018~Present : Member, Korea Society of Biochemistry and Molecular Biology
2016~Present : Member, Korea Society of Vascular Biology

Research keywords

Blood brain barrier, Multi-Drug transporters, Drug delivery, Vascular dementia, CNS autoimmune disease, Brain endothelial cell metabolism.

Key techniques

3D vascular imaging, *In vitro* **BBB modeling, FACS, Immunohistochemistry.**

Research Interests/Topics

- Regulation of the permeability of the BBB by neurotransmitters and signaling molecules enhancing the drug delivery to the brain.
- Regulation of the CNS immune response by the disruption of the BBB.
- Impact of BBB function or integrity in the progression of the neurodegenerative diseases.

Research Publications (selected)

- Choi MG, Kim MJ, **Kim DG**, Yu R, Jang YN, Oh WJ. Sequestration of synaptic proteins by alpha-synuclein aggregates leading to neurotoxicity is inhibited by small peptide. *Plos One, 13, 2018.*
- Torres L*, Robinson SA*, **Kim DG***, Yan A, Cleland TA, Bynoe MS. Toxoplasma gondii alters NMDAR signaling and induces signs of Alzheimer's disease in wild-type, C57BL/6 mice. *J Neuroinflammation, 15:57, 2018.* (*Equal contribution)
- Kim DG and Bynoe MS. A2A adenosine receptor signaling regulates the trans-cellular permeability of the blood brain barrier. *J Clin Inv., 126:1717, 2016.*
- **Kim DG**, Krenz A, Toussaint LE, Maurer KJ, Robinson SA, Yan A, Bynoe. Non-alcoholic fatty liver disease induces Alzhimer's disease (AD) in wild type mice and accelerates AD in an AD model. *J Neuroinflamm, 13:1, 2016.*
- **Kim DG** and Bynoe MS. A2A Adenosine Receptor Regulates the Human Blood-Brain Barrier Permeability. *Mol Neurobiol., 52:664, 2014.*

RESEARCH STRATEGY OFFICE

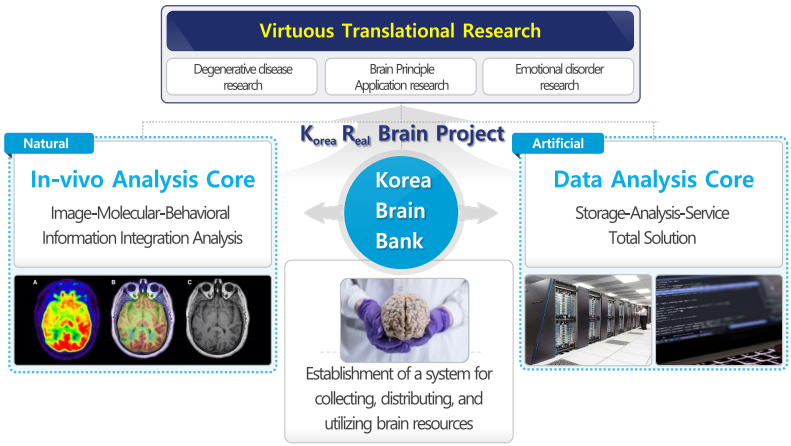
RESEARCH STRATEGY OFFICE

Overview

- Research Strategy Office is established to build global-leading research infrastructure.
- Promote the strategic infrastructure by strengthening the infra support system and establishing the new research buildings.

Objectives

- Plan and develop the strategies on research infrastructure, and revitalize the research infrastructure operations.
- Conduct new projects to support future research environmental changes.



Organization

Major Tasks

- Plan and develop strategies on research infrastructure
- Planning for Infrastructure of new construction project
- Support for virtuous translational research

Taekwan Lee, PhD

Principal Investigator

Research Strategy office
Korea Brain Research Institute (KBRI)

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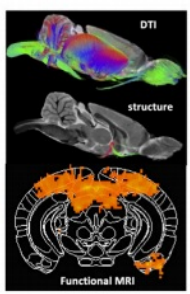
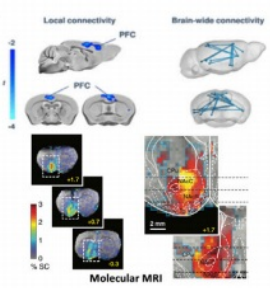
Functional molecular imaging of the whole brain

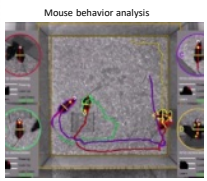
The mind is a product of the process in which the brain harmoniously controls the body to the external environment for survival. To understand our mind, it is essential to observe the activity of the whole brain, along with the monitoring neurons and various regions of the brain. The multimodal imaging technique, combination of micro to macro research techniques, is a powerful tool for brain study. For example, high-resolution optical imaging and electrophysiology can be combined with MRI and PET for awake animal imaging. I conduct research on learning, memory, cognition, emotion, and social behavior in mice and rats, and study the mechanisms of brain function through brain imaging. MRI provides high resolution structure images (T1, T2, DTI), whole brain activations and metabolite analysis (MRS). Molecular imaging has been performed using MRI contrast agents (dopamine, serotonin, zinc, amyloid beta probes) and PET.

Aim	Whole brain network involved in brain functions & behavior
Tool	Functional molecular MRI, Animal models, Behavioral analysis

TARGET







Curriculum Vitae

2020~Present : Principal Investigator, KBRI
2013~2020 : Principal Investigator, DGMIF
2009~2013 : Research Associate, Bio-engineering, MIT, USA
2007~2009 : Research Associate, Psychology,
Univ of Wisconsin-Milwaukee, USA

Academic Credential

2007 : PhD, Psychology, Yale Univ., USA
2000 : MA, Psychology, Korea Univ.
1998 : BE, Electrical Engineering, Korea Univ.

Awards/Honors/Memberships

2014 : Korean Minister of Health and Welfare Award for Advocates of health and medical technology promotion by
2000~Present : Member, Society for Neuroscience
2013~Present : Member, Korean Society for Magnetic Resonance in Medicine
2013~Present : Member, Korean Society for Brain and Neural Sciences
2017~Present : Member, International Society for Magnetic Resonance in Medicine

Research keywords

Molecular imaging, Neural circuit, Learning and memory, Emotion, Social behavior

Key techniques

In vivo brain imaging, functional MRI, Molecular imaging, Behavioral analysis

Research Interests/Topics

- Whole brain circuits involved in cognition, emotion, social behaviors
- Molecular imaging of brain chemical signals using MRI contrast agents
- Study of brain disorders in animal models using MRI

Research Publications (selected)

- Kim S, Kim HK, Baek AR, Sung B, Yang BW, Kim YH, Lee JJ, Yang J, Shin CH, Jung H, Kim M, Cho AE, **Lee T*,** Chang Y*. Rose bengal conjugated gadolinium complex as a new multimodal imaging agent targeting presynaptic vesicular glutamate transporters. *Journal of Industrial and Engineering Chemistry. 95, 83-91. 2021.*(*co-corresponding author)
- Baek AR, Kim HK, Yang J, Choi G, Kim M, Cho AE, Kim YH, Kim S, Sung B, Yang BW, Seo H, Lee GH, Ryeom HK, Jung HS, **Lee T*,** Chang Y*. High-performance hepatobiliary dysprosium contrast agent for ultra-high-field magnetic resonance imaging. *Journal of Industrial and Engineering Chemistry. 83, 297-307. 2020.* (*co-corresponding author)
- Choi G, Kim HK, Baek AR, Kim S, K MJ, Kim M, Cho AE, Lee GH, Jung HS, Yang J, **Lee T*,** Chang Y*. Multifunctional imaging of amyloid-beta peptides with a new gadolinium-based contrast agent in Alzheimer's disease. *Journal of Industrial and Engineering Chemistry. 83, 214-223. 2020.* (*co-corresponding author)
- Hai A, Cai LX, **Lee T**, Lelyveld VS, & Jasanoff A. Molecular fMRI of Serotonin Transport. *Neuron. 92, 754-765. 2016.*
- **Lee T**, Cai LX, Lelyveld VS, Hai A, & Jasanoff A. Molecular-Level Functional Magnetic Resonance Imaging of Dopaminergic Signaling. *Science, 344, 533-535. 2014.*
- **Lee T,** Zhang X, Dhar S, Faas H, Lippard SJ, & Jasanoff A. *In vivo* imaging with a cell-permeable porphyrin-based MRI contrast agent. *Chemistry & Biology, 17 (6), 665-673. 2010.*

Kipom Kim, PhD

Team Leader

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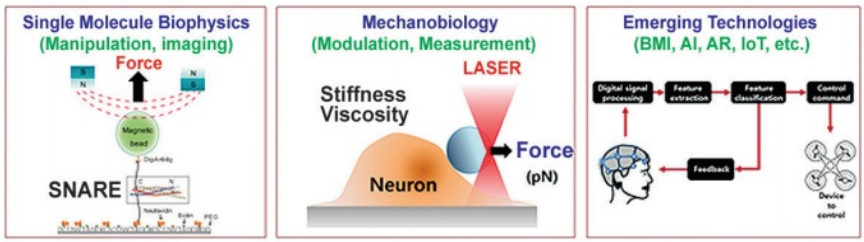
Neurophysics at the molecular and cellular levels

My passion for research starts from curiosities about the physical phenomena in biological systems. Major interests are molecular and cellular studies that apply the approaches and methods used in physics to solve problems in neuroscience. I am also interested in emerging technologies to lead Industry 4.0 such as brain-machine interface and brain-inspired intelligent.

BACKGROUND	SOFT MATTER PHYSICS + BIOLOGICAL PHYSICS + SCIENTIFIC INSTRUMENTATION
Aim	UNDERSTANDING BIOLOGICAL SYSTEMS AT MOLECULAR AND CELLULAR LEVEL WITH THE DEVELOPMENT AND USE OF PHYSICAL TECHNIQUES
Tool	CREATIVE BRIDGE SCIENTIST
TARGET	

Research keywords

Single molecule biophysics, Mechanobiology, Soft and living matter, Scientific instrumentation.

Curriculum Vitae

2016 ~ Present : Senior Researcher, KBRI
2014 ~ 2015 : Research Fellow,
IBS Center for Soft and Living Matter, UNIST
2009 ~ 2014 : Research Professor, Physics, KAIST
2006 ~ 2009 : Postdoctoral Associate,
Materials Department, UCSB, USA

Academic Credential

2001 : Ph.D. in Physics, Pusan Nat'l Univ.
1998 : M.S. Physics, Pusan Nat'l Univ.
1996 : B.S. Physics, Pusan Nat'l Univ.

Awards/Honors/Memberships

2011 ~ 2013 : PI, High Risk High Return Project, KAIST
2006 ~ 2007 : Korea Research Foundation Fellowship, KRF
2000 ~ Present : Member, Biophysical Society
1996 ~ Present : Member, Korean Physical Society

Key techniques

- Molecular and cellular NANO manipulation using magnetic and optical forces.
- Single molecule measurement using force and optical microscopy.
- Optical manipulation of liquid-liquid interfaces.
- Making scientific instruments (software and hardware).

Research Interests/Topics

- Development of optical methods to manipulate and measure the physical property of neuronal cells.
- Development of smart scientific instruments applying advanced technologies. (AI, VR/AR, IoT, BMI, adaptive optics, etc.)

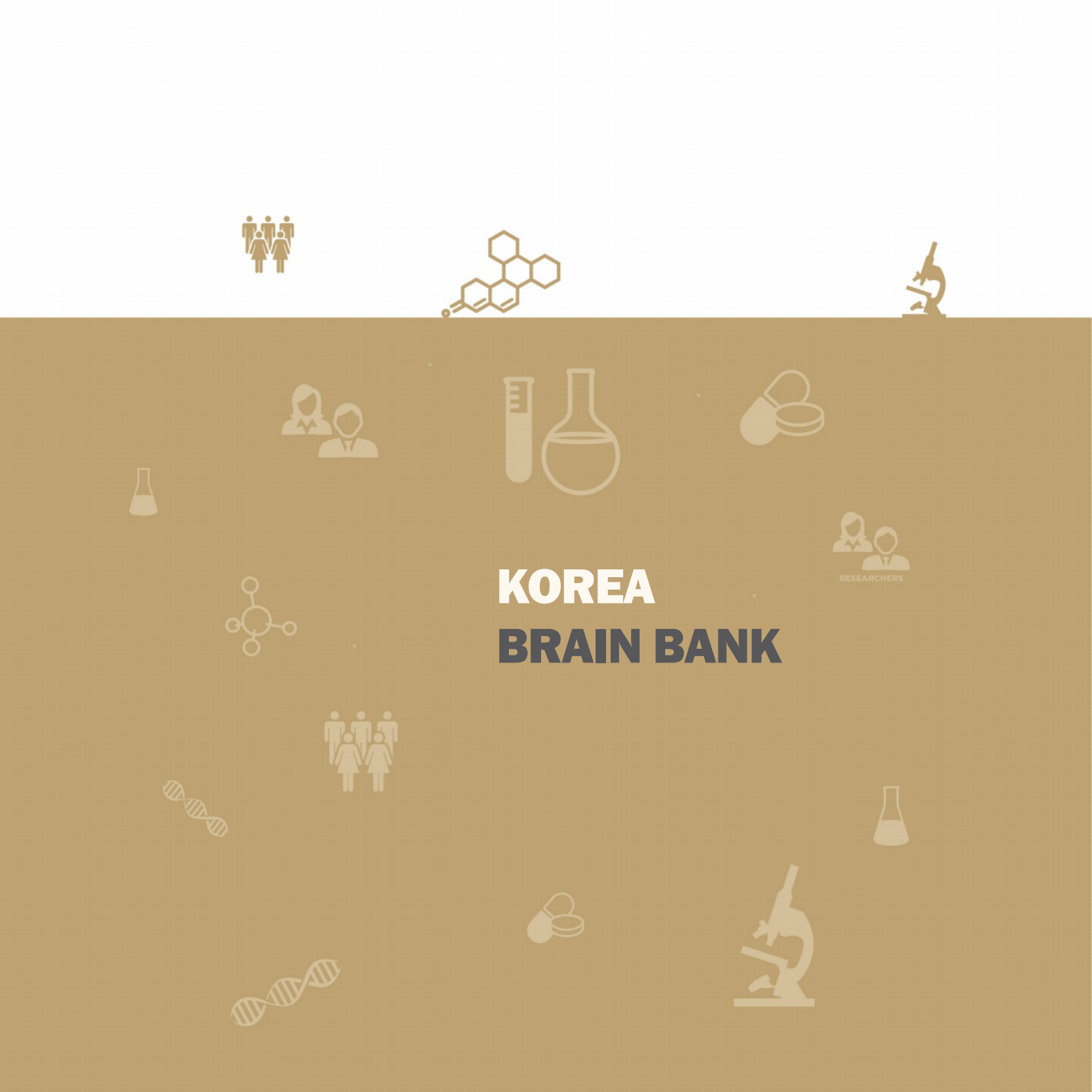
Research Publications (selected)

- Bae W, **Kim K**, Min D, Ryu JK, Hyeon C, Yoon TY. Programmed folding of DNA origami structures through single-molecule force control. *Nature Commnun., 5:5654, 2014.*(Corresponding author)
- Heo S, **Kim K**, Cho YH. Label-Free Biosensing over a Wide Concentration Range with Photonic Force Microscopy. *ChemPhysChem., 15:1573, 2014.* (Corresponding author)
- Lee HW, Ryu JY, Yoo J, Choi B, Kim K, Yoon TY. Real-time single-molecule Co-Immunoprecipitation of weak protein-protein interactions. *Nature Protoc., 8:2045, 2013.* (Corresponding author)
- Min D*, **Kim K***, Hyeon H, Cho YH, Shin YK, Yoon TY. Mechanical unzipping and rezipping of a single SNARE complex reveals hysteresis as a force-generating mechanism. *Nature Commun., 4:1705, 2013.* (Recommended by Faculty of 1000)
- Kang JH, **Kim K**, Ee SH, Lee YH, Yoon TY, Seo MK, Park HG. Low-power nano-optical vortex trapping via plasmonic diabolo nanoantennas. *Nature Commun., 2:582, 2011.*

Patents

- **Kim K**, Lee GY. Educational apparatus and method for experiencing brain machine interface technology. (10-2190458, KR Patent 2020)
- **Kim K**, Lee GY. Method and apparatus for manipulating micro object using laser beam controlled by brain signals. (10-2161654, KR Patent 2020)
- **Kim K**, Lee GY. Method and apparatus for controlling target object using brainwave (10-2136799, KR Patent 2020)
- Kang JH, **Kim K**, Ee SH, Lee YH, Yoon TY, Seo MK, and Park HG. Optical trapping device using plasmonic nano-antennas. (10-1301969, KR Patent 2013)

RESEARCHERS



KOREA
BRAIN BANK

KOREA BRAIN BANK

Vision & Goals

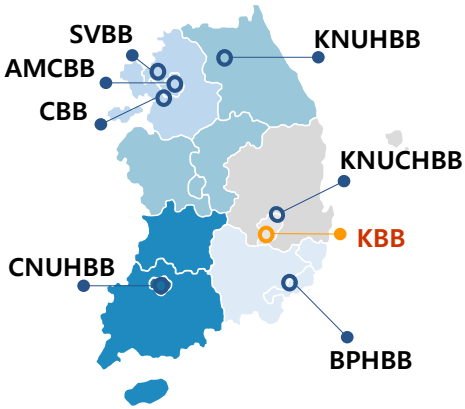
The Construction of a creative and smart research ecosystem for the global leading brain research

Brain Banking 1.0 (2014~2019)
- Infrastructure construction for the bank operation

Brain Banking 2.0 (2020~2022)
- Establishment of strategic collection-utilization system of human resources

Brain Banking 3.0 (2023~2028)
- Establishment of smart service and sharing system

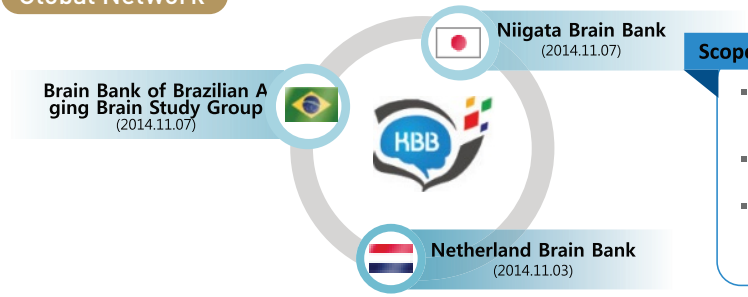
Korea Brain Bank Network



Korea Brain Bank
- Operation & management of KBBN project
- Development & supply of SOP
- Development & supply of BRAMS
- KBBN portal operation
- External cooperation and promotion

Local core Brain Bank
- Brain donation program
- Resource collection-supply management
- Report statistical data on resource input/output and project implementation performance

Global Network



Scope of cooperative activities
- Exchange of researchers for training, sample collection & handling, and histological technology standardization
- Joint academic activities and collaborative research
- Possible exchange of human brain tissues and specimens given all ethical and legal conditions are met

History

- January 2014 : Establishment of Korea Brain Bank
- December 2014 : BioBank authorized by KCDC
- February 2016 : Launching of Korea Brain Bank Network(KBBN)
- September 2017 : Designation of Biological Resource Center by MSIT

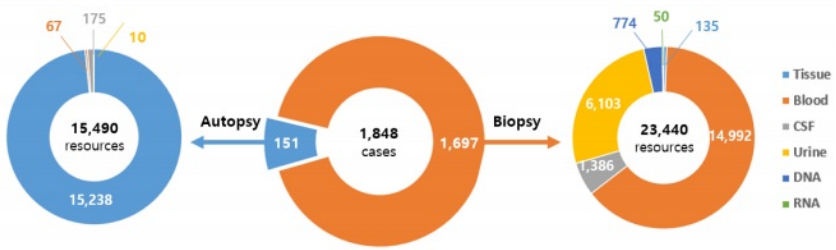
Major Project

- Korea Brain Bank Network (KBBN) project
  - Promotion activities for brain donation and establishment of brain resource collection-utilization system with local brain banks
  - KBBN portal(https://kbbn.kbri.re.kr) & Brain Resource Archive Management System(BRAMS) operation and update
- Neuropathology infrastructure construction project
  - Standardization of brain autopsy process
  - Construction of KBBN brain histology atlas
- Digital Brain Bank project
  - Open-platform construction based on metadata DB of clinical-imaging-genome information related to brain diseases
  - Ethical Legal Social Implication (ELSI) research

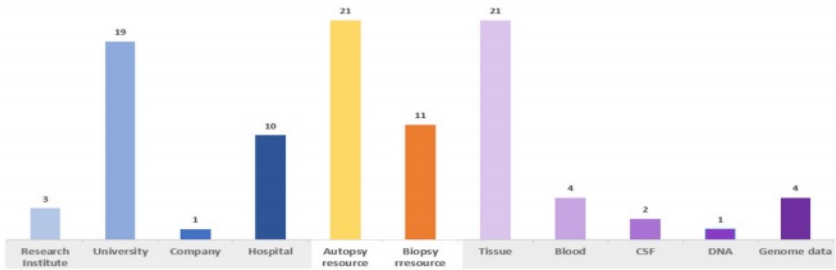
Major Tasks

- Establishment of supply and demand system of brain resource
- Brain resource supply of Integrated brain resource information network through KBBN portal operation
- Promotion for Brain donation and brain bank

Brain Resource Collection 2015~2020



Brain Resource Supply 2017~2021.04



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Director

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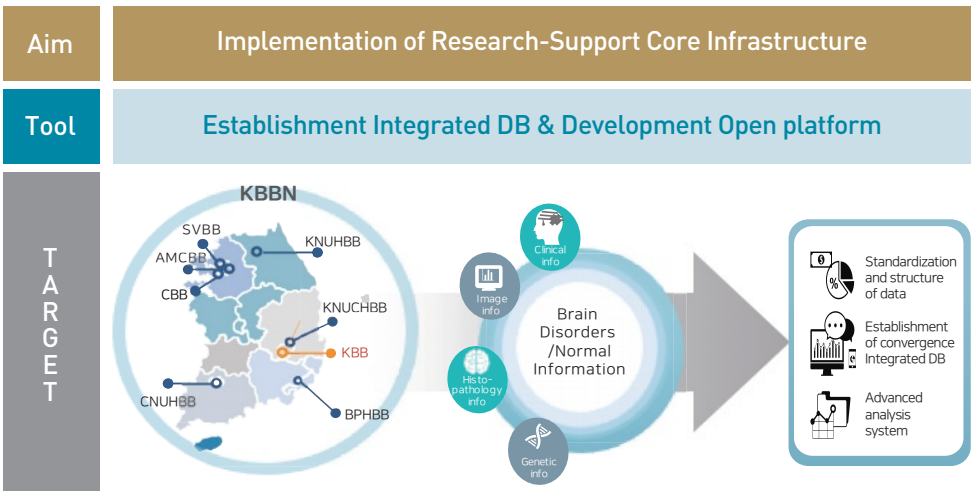
Korea Brain Bank

Korea Bain Bank(KBB) is the headquarter of Korea Brain Bank Network(KBBN). Seven hospitals across the nation have joined KBBN so far, and run brain bank programs to procure biological samples including human whole brain for brain research in alliance. KBB plans to expand KBBN, and has been working to build an effective infrastructure to support multi-disciplinary R&D projects such as KBBN information system, neuropathology database, and digital brain bank.



Curriculum Vitae

2021~Present : Director, Korea Brain Bank, KBRI
2019~Present : Senior Research Fellow, KBRI
2014~Present : Professor of Pathology, Yonsei University College of Medicine
2009~2014 : Associate Professor of Pathology, Yonsei University College of Medicine
2007~2009 : Research Fellow, MD Anderson Cancer Center Brain Tumor Research Center, USA

Academic Credential

2004 : Ph.D., Yonsei University
2001 : M.S., Yonsei University
1994 : M.D., Yonsei University

Awards/Honors/Memberships

1998 ~ : Korean Society for Pathologists
2010 ~ : The Society for Neuro-Oncology
2010 ~ : International Society of Cytopathology
2014 ~ : European Confederation of Neuropathological Societies, European Fellow of Neuropathology

Research keywords

Brain tumor, Neuropathology, Surgical Pathology

Research Interests/Topics

Brain tumor, glioma, molecular genetics, epilepsy,

Research Publications (selected)

- Seong Yi, Sunkyu Choi, Dong Ah Shin, Du Su Kim, Junjeong Choi, Yoon Ha, Keung Nyun Kim, Chang-Ok Suh, Jong Hee Chang, **Se Hoon Kim**, Do Heum Yoon. Impact of H3.3 K27M Mutation on Prognosis and Survival of Grade IV Spinal Cord Glioma on the Basis of New 2016 World Health Organization Classification of the Central Nervous System. *Neurosurgery, 84(5):1072-1081, 2019.*
- Sang Min Park, Jae Seok Lim, Suresh Ramakrishina, **Se Hoon Kim**, Woo Kyeong Kim, Junehawk Lee, Hoon-Chul Kang, Jeremy F Reiter, Dong Seok Kim, Hyongbum Henry Kim, Jeong Ho Lee. Brain Somatic Mutations in MTOR Disrupt Neuronal Ciliogenesis, Leading to Focal Cortical Dyslamination. *Neuron, 99(1):83-97.e7, 2018.*
- Jung Ho Im, Je Beom Hong, **Se Hoon Kim**, Junjeong Choi, Jong Hee Chang, Jaeho Cho & Chang-Ok Suh. Recurrence patterns after maximal surgical resection and postoperative radiotherapy in anaplastic gliomas according to the new 2016 WHO classification. *Scientific reports, 8:777, 2018.*
- Yoon Jin Cha, Junjeong Choi, **Se Hoon Kim**. Presence of apoptosis distinguishes primary central nervous system lymphoma from glioblastoma during intraoperative consultation, *Clinical Neuropathology, 37(3):105-111, 2018.*

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Establish operation system of brain bank

Time magazine included a biobank among 10 ideas to change the world in 2009. According to the biotechnology white paper (2013), brain research and biobank was described as having a high industrial impact. This is because biobank is related to disease treatment. Meanwhile, unlike other bioresource centers, Korea is legally required a permission to open a biobank. But there is no legal basis to operate the brain bank and to keep the brain tissue in the research institute. So the Korea Brain Bank can not keep brain resources donated from the dead.
Therefore we have to endeavor to revise the existing law and regulation and to prepare the legal status of Korea brain bank. If so, the Korea Brain Bank will be operate as an advanced public bank such as a backup bank, a QC bank, a DATA bank, a project-based bank, and a reference bank.

Aim	Hub bank implementation of scientific research for understanding brain disorders
Tool	Standard operation system based on KS J ISO 20387

TARGET

Curriculum Vitae

2015~present : Principal Investigator, KBRI
2008~2014 : Department Manager, Korea National Research Resources Center, Korea
2001~2008 : Principle Investigator, KCDC-NIH, Korea
2000~2001 : Postdoctoral Fellow, Seoul National University, Korea
1999~2000 : Postdoctoral Fellow, RIKEN, Japan

Academic Credential

1999 : Ph.D., Microbiology, Korea University
1994 : M.S., Microbiology, Korea University
1991 : B.S., Food Science and Nutrition, Soonchunhyang University

Research keywords

Korea brain bank, biobank, regulation.

Research Planning Publications

- National disease biomarker bank project. (2005~2008)
  Pathogenic microorganisms bank project. (2005~2008)
  Local Human-derived specimens bank projec.t (2007~2008)
  Comprehensive management plan for healthcare and biological resources. (2007~2008)
  Research resource bank project. (2008~2014)
  National brain bank project. (2015~present)

Best practice guidelines Publications for Biobank operation

- KNRRC best practice guidelines. (15 volumes, 2011~2013)
- Standards of Private Sectors approved by KSA.

Database development for Bioresources information management

- Infection disease biomarker database. (2006~2007)
- Human-derived specimens/ Pathogenic microorganisms management system. (2007~2008)
- KBBN brain resources archive management system. (2016~present)

Heon Seok, PhD

Senior Researcher

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Brain Research Policy Center

Brain Research Policy Center has been faithfully performing as a think tank for the national brain research policy. We are planning to develop the national brain science by establishing medium and long-term brain research policy and research strategy at the national level. We are analyzing brain research information and trends, planning new research projects, and building a brain research cooperation network.
Since I joined the Korea Brain Research Institute, I am responsible for coordinating national brain research policy support and suggesting research strategy establishment through the brain research data/trends analysis. As part of that, I am in charge of publishing the annual National Brain Research Promotion Plan which released by the Ministry of Science and ICT of Korea.
Another part of my job is to show brain science to the general public and to help researchers create good neuroscience. To this end, I managed to the establishment of the "Brain Library" homepage, and weekly publishing the "Brain News" for the general public and the "Brain View" for the Neuroscientist.

Aim	Planning & Establishing the National long-term brain research policy and strategy
Tool	Analyzing brain research information & trends, Planning new research projects, Building a brain research cooperation network, Public

TARGET

National Brain Research Plan

Brain Research Project Planning
- Discover new research projects
- Research Trend Analysis

Public Engagement

Public Announcement of New Brain Research, Provide Resource information
- Brain Library
- Publish Brain News, View

International Relations

Domestic and International Cooperative Research Networking
- International Workshop, Symposium, MOU

Curriculum Vitae

2018. 4~present : Principal Investigator, KBRI, Korea
2011. 3~2018. 2 : Assistant Professor, Dept. of Biomedical Science, Jungwon University, Korea
2010. 3~2011. 2 : Postdoctoral Fellow, School of Life Sciences, UNIST, Korea
2007. 9~2009. 8 : Postdoctoral Fellow, School of Clinical Science, University of Bristol, Korea

Academic Credential

2006 : Ph.D., Dept. of Biomedical Science, University of Sheffield, UK
2006 : B.S., Dept. of Life Science, Daejin University, Korea

Awards/Honors/Memberships

2016 : Head of Department, Jungwon University. Korea
2013 : Evaluation committee, National Research Foundation, Korea
2012 : Director, Biomedical research center, Jungwon University, Korea

Research keywords

Strategic planning, Research policy, Neuroscience trend analysis, Public Engagement, Cooperative international research network, Synaptic plasticity, Brain Disease.

Key techniques

Neuroscience research information and trends analysis, Discover the new research agenda and develop new project.

Research Publications (selected)

- Jo J, **Seok H***, Kim MJ, Son GH, Park Y, Henley JM, Weiss JL, Sheng M, Collingridge GL, Cho K. Metabotropic glutamate receptor-mediated LTD involves two interacting Ca^{2+} sensors, NCS-1 and PICK1. *Neuron, 60(6),1095-1111, 2008.* *equally contributed author
- Kimura T, Whitcomb DJ, Jo J, Regan P, Piers T, **Seok H**, Brown C, Hashikawa T, Murayama M, Seok H, Sotiropoulos I, Kim E, Collingridge GL, Takashima A, Cho K. Microtubule-associated protein tau is essential for long-term depression in the hippocampus. *Philos Trans R Soc Lond B Biol Sci., 2,369(1633), 2013.*
- Jo J, Ball SM, **Seok H**, Oh SB, Massey PV, Molnar E, Bashir ZI, Cho K. Experience-dependent modification of mechanisms of long-term depression. *Nat Neurosci., 9(2), 170-2, 2006.*
- Chang JS, **Seok H**, Kwon TK, Min DS, Ahn BH, Lee YH, Suh JW, Kim JW, Iwashita S, Omori A, Ichinose S, Numata O, Seo JK, Oh YS, Suh PG. Interaction of elongation factor-1alpha and pleckstrin homology domain of phospholipase C-gamma 1 with activating its activity. *J Biol Chem., 277(22):19697-702, 2002.*

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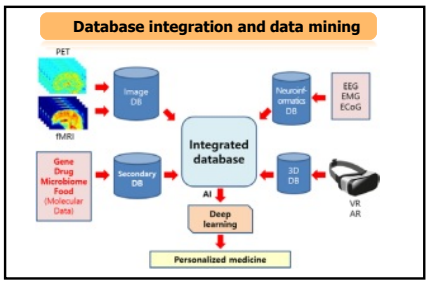
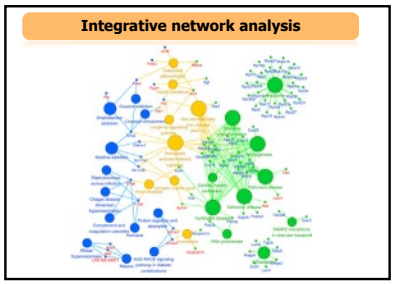
Mining neuroscience big data for precision medicine

Although massive amounts of neuroscience big data are being accumulated in public repositories every day, meaningful interpretation of these data remains a major challenge. It is important to harmonize data collected at different resources through the use of appropriate data models. Developing automated ontology mapping tools and structuring data and knowledge in a computable format are important pillars of biomedical computing. Research on data models and representation frameworks has permitted the combination of data from several sources for analytics that support a variety of applications, including decision support systems. To mining neuroscience big data, I build a comprehensive database for neuroinformatics and bioinformatics from heterogeneous data sources. Using the integrated data resource, my research is focused on data-driven biomarker discovery and in silico drug repurposing for precision medicine.

Aim	Big data-driven discovery of biomarkers for precision medicine
Tool	Bioinformatic analysis and machine learning
TARGET	 

Curriculum Vitae

2020~Present : Principal Investigator, KBRI
2016~2020 : Senior Researcher, Research Institute of Pharmaceutical Science, Seoul National University, Korea
2012~2015 : Researcher, Bioinformatics team, BML Clinic, Korea
2005~2007 : Researcher, Korean Bioinformation Center (KOBIC), Korea Research Institute of Bioscience and Biotechnology, Korea

Academic Credential

2006 : Ph.D., Bioinformatics, Pusan National University
2001 : M.S., Molecular Biology, Pusan National University
1999 : B.S., Molecular Biology, Pusan National University

Awards/Honors/Memberships

2019~Present : Member, Korean Society for Vascular Biology and Medicine
2017~2018 : Grant, Foundation for Medical Innovation, Korea
2016~Present : Member, Korea Genome Organization

Research keywords

Bioinformatics, Meta-analysis, Systems biology, Big data integration, Precision medicine

Key techniques

Network analysis, Multivariate data analysis, Data mining, Pattern recognition, Machine learning.

Research Interests/Topics

- Optimizing and validating biomarkers and drug candidates in silico using big data resources.
- Integrative analysis of neuroscience big data for precision medicine.

Research Publications (selected)

- Jeong GY, Park MK, Choi HJ, An HW, Park YU, Choi HJ, Park J, Kim HY, **Son T,** Lee H, Min KW, Oh YH, Lee JY, Kong G. NSD3-Induced Methylation of H3K36 Activates NOTCH Signaling to Drive Breast Tumor Initiation and Metastatic Progression. *Cancer Res., 81(1):77-90, 2021.*
- Jang WJ*, **Son T***, Song SH, Ryu IS, Lee S, Jeong CH. Transcriptional Profiling of Whisker Follicles and of the Striatum in Methamphetamine Self-Administered Rats. *Int J Mol Sci., 21(22):8856, 2020.* (co-first author)
- Lee CS, Cho HJ, Lee JW, Lee J, Kwon YW, **Son T**, Park H, Kim J, Kim HS. Identification of Latrophilin-2 as a Novel Cell-Surface Marker for the Cardiomyogenic Lineage and Its Functional Significance in Heart Development. *Circulation, 139(25):2910-2912, 2019.*
- Choi HJ, Joo HS, Won HY, Min KW, Kim HY, **Son T**, Oh YH, Lee JY, Kong G. Role of RBP2-Induced ER and IGF1R-ErbB Signaling in Tamoxifen Resistance in Breast Cancer. *J Natl Cancer Inst., 110(4), 2018.*
- Yang JO, Hwang S, Oh J, Bhak J, **Sohn TK**. An integrated database-pipeline system for studying single nucleotide polymorphisms and diseases. *BMC Bioinformatics, 9(Suppl 12):S19, 2008.*
- **Sohn TK**, Moon EJ, Lee SK, Cho HG, Kim KW. AngioDB: database of angiogenesis and angiogenesis-related molecules. *Nucleic Acids Res., 30(1):369-71, 2002.*

BRAIN RESEARCH CORE FACILITIES

BRAIN RESEARCH CORE FACILITIES

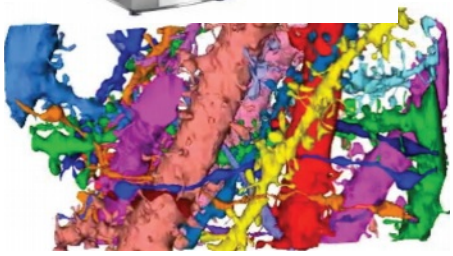
Overview

- Brain research has recently become a global hot topic in science and technology, along with artificial intelligence issues. Major countries have made massive investments in funding for brain research.
- As part of this global trend, KBRI organized the Brain Research Core Facilities which are responsible for building and supportingcutting-edge
- Brain research techniques and equipment in order to concentrate on national brain research capabilities and contribute to the development of innovative brain function technology.

Research Objectives

Strengthen the national brain research capacity through common use of advanced equipment infrastructure.

- Operate more than 120 advanced imaging, analysis, and animal behavior equipment.
- Collaborate with domestic and international researchers using advanced brain research equipment.
- Contribute significantly to the development of national brain science by working toward world-class research results in various brain research fields.

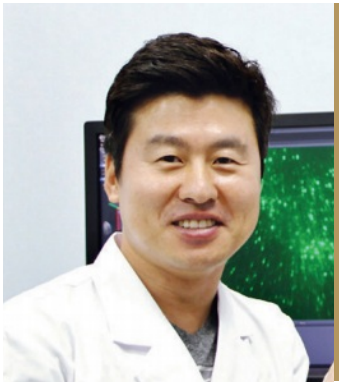


Organization

- Team Leader : Chang Man Ha (Ph.D)
- Professional operators : Kipom Kim (Ph.D), Sang-Hoon Lee (Ph.D), Young-Jae Ryu,
- Ga-Young Lee, Hye-Ryeong Lim
- Administrative staff : So-Young Park

Major Tasks

- Brain research equipment facility
- Overall research equipment management
- Research equipment education and seminars for equipment technology



Chang Man Ha, PhD

Director

BRAIN RESEARCH CORE FACILITIES
Korea Brain Research Institute (KBRI)

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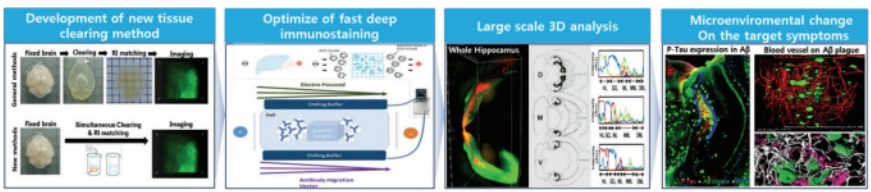
http://www.kbri.re.kr

Neurodisease and neuroimaging

In the brain tissue studies, deep imaging is very important because various cell types and blood vessels are spatiotemporally changes with developmental stage and neural disease. Recently, many optical clearing techniques were developed to improving depth penetration of tissue and resolution. However, most researcher have difficult use these technique because clear methods is complicates and have many limitations such as light scattering, tissue distortions, fluorescent bleaching and image aberrations. We are currently studying for the tissue clearing methods to user friendly and optimizing the deep tissue immunostaining method using electrophoresis and magnetic force. Now we can take the image of whole hippocampus of mouse brain (5mm) and immunostaining to 2 mm of brain slice for one day using the our innovative methods. We are further studying for three dimensionally microenvironment change such as capillary, neuron and various glia cells population on the neurodegenerative disease symptoms to applicate these technique. We can explain how brain damage occurs to microenvironment change sequentially by Tau or Aβ plagues.

Aim	Approach for the multi-dimensional micro-enviroment change using tissue clearing and fast deep immunostaining in neurodegenerative symptom

TARGET



Curriculum Vitae

2012~Present : Principal Investigator, KBRI
2011~2012 : Research Professor, Seoul National University College of Medicine
2010~2011 : Research Professor, UNIST
2007~2009 : Contract Professor, GIST
2005~2007 : Postdoctoral Associate, Dept. Cell Bio.& Neurosci. UC Riverside, USA

Academic Credential

2004 : Ph.D., Biology (Molecular Neuro Science), Univ. of Ulsan
1999 : B.S., Life Science, Univ. of Ulsan

Awards/Honors/Memberships

2015~Present : Frontier in Cellular Neuroscience, Reviewer board
2018~Present : Frontier in Molecular Neuroscience, Reviewer board
2018 : Member, Planning Committee, Korean Society for Brain and Neuroscience
1998~Present : Member, Korean Society for Molecular and Cellular Biology
1999~Present : Member, Society for Neuroscience
Fund for the basic researcher supporting from National research foundation of Korea (2010-2015).
Fund for the basic researcher supporting from National research foundation of Korea (2016-2018).

Research keywords

Deep tissue clearing methods & fast immunostaining, large scale 3D analysis, Super-resolution, Vesicle dynamics, live cell assay.

Key techniques

Vesicle endo-, Exocytosis kinetics & live imaging assay, Super-resolution imaging, Development of Tissue clearing methods, Large and deep tissue 3D analysis, Developmental behavior analysis.

Research Interests/Topics

- Development of 3D structural neuron network in large brain tissue using tissue clearing technique & fast-tissue immunostaining methods.
- Approach of multi-dimensional micro-environment change in neuronal disorder symptoms.

Research Publications (selected)

- Kim HR, Kim DH, An JY, Kang D, Park JW, Lee BJ, **Ha CM**. NELL2 function in axon development of hippocampal neurons. *Mol. Cells 43(6): 581-589. 2020.*
- Lim HR, Vo MT, Kim DJ, Lee UH, Yoon JH, Kim HJ, Kim J, Kim SR, Lee JY, Yang CH, Kim HY, Choi JS, Kim K, Yang E, Kim H, Lee SS, Lee BJ, Kim K, Park JW and **Ha CM**. DRG2 deficient mice exhibit impaired motor behaviors with reduced striatal dopamine release. *IJMS 21(60) 210100060. 2019.*
- Lee D, An SWA, Jung Y, Yamaoka Y, Ryu Y, Goh GY, Beigi A, Yang JS, Jung GY, Ma DK, **Ha CM**, Taubert S, Lee Y, Lee SJV. MDT-15/MED15 permits longevity at low temperature via enhancing lipidostasis and proteostasis. *Plos Biology 17(8): e3000415. 2019.*
- Son HG, Seo K, Seo M, Park S, Kim E, Ryu Y, **Ha CM** Hsu AL, Roh TY, Jang SK, Lee SJV. Prefoldin 6 mediates longevity response from heat shock factor 1 to FOXO in C.elegans. *Genes & Development, 32:1-14, 2018.*

Patents (selected)

- **Ha CM**. Apparatus for holding sample of microscope. (10-2018-0149886, patent)
- **Ha CM**. Pipette tip for preventing loss of sample. (10-2019-0002267, patent application)
- **Ha CM**. JW Park, HR Rim. The usage of DRG2 protein for dopamine release regulation (10-2020-0109266, patent application)
- **Ha CM**. HR Rim, YJ Ryu. A new aqueous refractive index matching and tissue clearing solution for biological imaging (10-2020-0141354, patent application)

RESEARCHERS








LABORATORY ANIMAL CENTER







LABORATORY ANIMAL CENTER

Overview

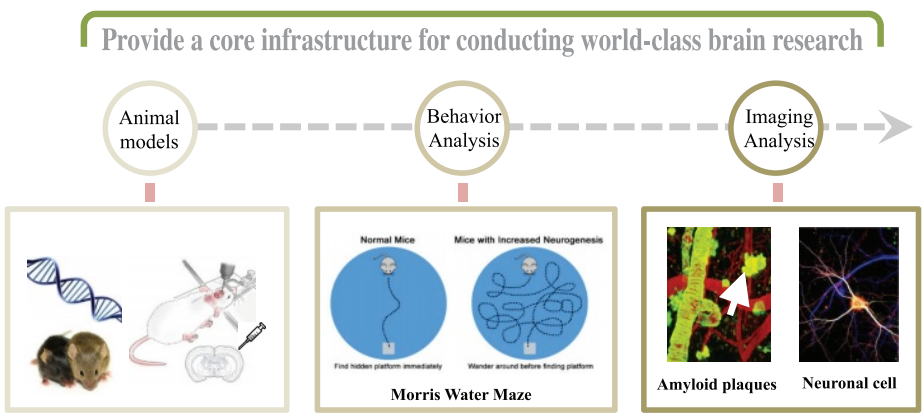
- KBRI Laboratory Animal Center accommodates more than 30,000 rodents
- Animal facility area of approximately 3,760m2 (Two floors and four zones)
- Breeding and strain management of various transgenic animal resources
- Conducting convergent brain research using animal behavior and image analysis

Floor	Dimensions		Area status		
	Total	Animal area	Area name	Animal room	Other areas※)
2	1,880 ㎡	1,090 ㎡	Imaging analysis	4	4
			Behavior analysis	4	11
3	1,880 ㎡	1,090 ㎡	SPF-A	4	4
			SPF-B	11	2

※) Other room : Behavior / Imaging analysis room, Surgery room, quarantine room, etc.

Objectives

- KBRI Laboratory Animal Center is a core infrastructure for conducting world-class brain research
- Provide infrastructure for behavior/action-image linked analysis using various transgenic animal resources



Major Tasks

- Stable management of animal experiment infrastructure
- Secure major brain disease-specific animal resources

• Animal Behavior & Imaging Analysis System

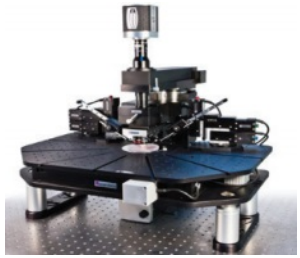
Learning & Memory	Morris water maze, Fear-conditioning & Startle, Y(T)-Maze, Novel objective recognition, Avoidance system
Motor/General activity & Metabolism	Motorater, LABORAS, Indirect calorimetry
Anxiety/Depression & Social behavior	Social interaction, Open-field, Elevated plus maze
Addiction & Reward	Self administration system, Conditioned place preference
***In-vivo* Imaging**	Multi-photon laser microscope, *in-vivo* confocal microscope, in-vivo recording & analysis system

<Fear-Conditioning & Startle>

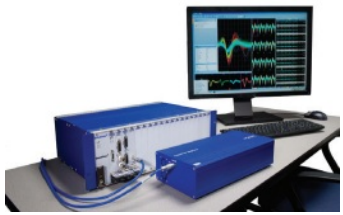
<Motorater>

<LABORAS>

<Self-administration>



<Multi-photon Laser Microscope>



<*in-vivo* Recording System>

<Behavior analysis room>

<Surgery room>

<Imaging analysis room>

Young Pyo Choi,
DVM, PhD

Director

Laboratory Animal Center
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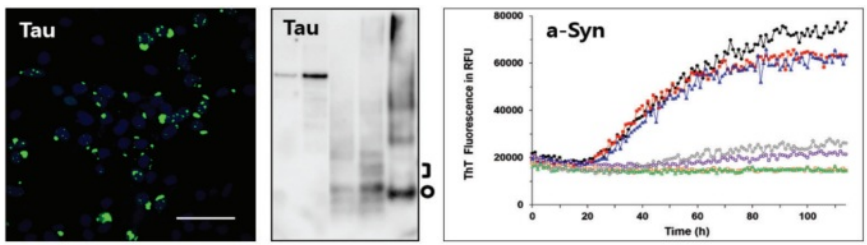
Prion-like proteinopathies in brains and animal models for neurological disorders

Neurodegenerative diseases like Alzheimer's disease (AD) or Parkinson's disease (PD) are pathologically characterized by the accumulation of misfolded protein aggregates in brains, which include amyloid-ß (Aß) and tau in AD and alpha-synuclein in PD. Recent studies have shown that these protein aggregates can spread in brains via their transcellular propagation. This inter-neuronal propagation of misfolded protein aggregates is often referred to as prion-like phenomenon due to the mechanistic similarity to the behaviors of misfolded prion aggregates (i.e. PrPSc) in prion diseases. More recent studies investigating human patients have suggested a possibility that the seeded propagation of Aß aggregates may occur between individuals through iatrogenic routes. My research interests focus on the prion-like seeded propagation of misfolded protein aggregates and on its application into the diagnostics and the discovery of new drug candidates.

Aim	Elucidation and application of molecular mechanisms underlying prion-like propagation of misfolded protein aggregates
Tool	***In vitro*** conversion systems for misfolded protein aggregates

TARGET



Curriculum Vitae

2020~Present : Principal Researcher, KBRI
2013-2020 : Senior Researcher, KBRI
2010~2013 : Postdoctoral Fellow, RML/NIAID, NIH, USA
2000~2007 : Veterinary Official, Ministry of Agriculture and Fishery

Academic Credential

2010 : Ph.D., Human prions, University of Edinburgh
2006 : M.S., Animal prions, Konkuk University
2000 : D.V.M., Konkuk University

Awards/Honors/Memberships

2007~2010 : Korean Research Fellowship for doctoral studies

Research keywords

Prion, misfolded protein aggregates, neurodegenerative diseases, animal models

Key techniques

In vitro generation and amplification of misfolded protein aggregates

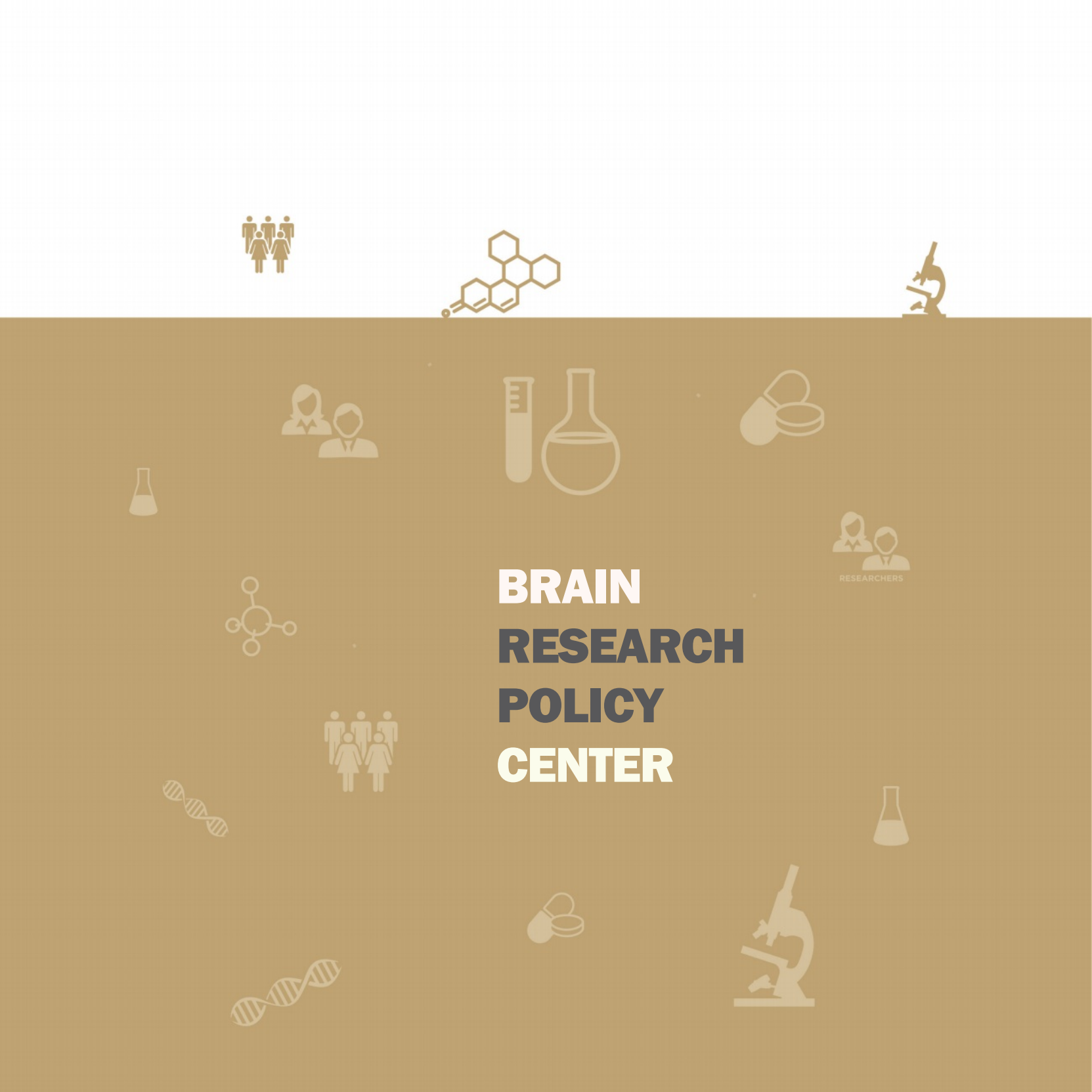
Research Interests/Topics

- Prions to proteinopathies in neurodegenerative diseases
- Animal models for neurological disorders

Research Publications (selected)

- JY Han, C Shin, **YP Choi**. Preclinical Detection of Alpha-Synuclein Seeding Activity in the Colon of a Transgenic Mouse Model of Synucleinopathy by RT-QuIC. *Viruses. 2021; 13(5):759.*
- JY Han, HS Jang, AJE Green and **YP Choi**. RT-QuIC-based detection of alpha-synuclein seeding activity in brains of dementia with Lewy Body patients and of a transgenic mouse model of synucleinopathy. *Prion 14(1):88- 94.2020.*
- WH Nam and **YP Choi**. *In vitro* generation of tau aggregates conformationally distinct from parent tau seeds of Alzheimer's brain. *Prion 13:1-12 .2019.*
- **YP Choi**, MW Head, JW Ironside and SA Priola. Uptake and degradations of protease-sensitive and protease-resistant forms of abnormal human prion protein by human astrocytes. *The American Journal of Pathology 184(12), 3299-3307.2014.*
- **YP Choi** and SA Priola. A specific population of abnormal prion protein aggregates is preferentially taken up by cells and disaggregated in a strain dependent manner. *Journal of Virology 87(21), 11552-11561.2013.*
- **YP Choi**, A Gr ner, JW Ironside and MW Head. Correlation of Polydispersed Prion Protein and Characteristic Pathology in the Thalamus in Variant Creutzfeldt-Jakob Disease: Implication of Small Oligomeric Species. *Brain Pathology 21, 298-307.2011.*

RESEARCHERS



BRAIN RESEARCH POLICY CENTER

BRAIN RESEARCH POLICY CENTER

Overview

- The Brain Research Policy Center(BRPC) functions as a Think-Tank to establish strategies and policies for innovative national brain research.
- The BRPC assists to build strategic planning of mid- to long-term national brain science for advancement of the research. The center also plans the R&D strategies for KBRI.
- Domestic and international information on brain research and policies are thoroughly investigated and analyzed in the BRPC, working as a national hub for neuroscience.
- The BRPC runs a portal site (Brain Library, www.library.kbri.re.kr) to provide access to resources related to brain science and expand the public understanding of the brain. It also distributes 'Brain News' weekly.
- Worldwide collaborative and transdisciplinary brain research networks are organized by the BRPC.

Think-tank for the national brain research in Korea

Establishment of National Brain Research Policies and Strategies	Hub for Information on Brain Science	Building Cooperation Network
✓ Establishment of the national policies and strategies	✓ Analysis of domestic and international information	✓ Organization of worldwide transdisciplinary collaborative networks
✓ Development of national mid- to long-term plans	✓ Management of Brain Library website	✓ Fostering Industry-Academia-Research-Medicine collaboration
✓ Responsible for R&D strategies of KBRI	✓ Distribution of weekly "Brain News"	

Objectives

- **Brain Researches Plans**
  - Establishment of strategies and policies for innovative national brain research
  - Building strategic planning of mid- to long-term national brain science
  - Plan R&D strategies for KBRI
  - Publication of 'Brain Insight'

- **Brain Research Information Hub**
  - Domestic and international Research Trend Analysis
  - Operation of website (Brain Library, www.library.kbri.re.kr)
  - Distribution of 'Brain News'

- **Support for Collaborative Networks**
  - Worldwide collaborative and transdisciplinary brain research networks
  - Fostering Industry-Academia-Research-Medicine collaboration

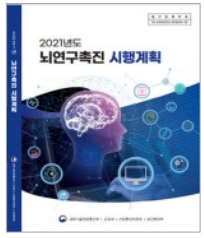
Major Tasks

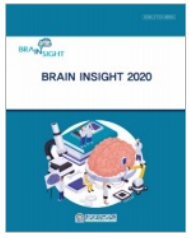
- Establish national brain research policies and strategies
- Function as a national brain information hub
- Organize collaboration networks

National Brain Research Plan

Brain Research Project Planning

- Novel Research Project
- Strategic Plan of National Neuroscience

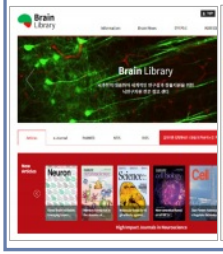




Public Engagement

Brain Information Hub

- Brain Library
- Brain News



Worldwide Relations

Domestic and international networks

- Collaborative Research
- MOU

Sun Ja Cho, PhD

Senior Researcher

Brain Research Policy Center
Korea Brain Research Institute (KBRI)

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Brain Research Policy Center

Brain Research Policy Center(BRPC) is responsible for coordinating national brain research policy support, research strategy establishment, brain research trends analysis, as well as convergent brain R&D project planning. We are analyzing brain research information and trends, planning new research projects, and building a brain research cooperation network.
Since I joined the KBRI, I am responsible for coordinating national brain research policy support and suggesting research strategy establishment through the global brain research trends analysis.
As part of that, I participated in the establishment of Neuroscience investment strategy project with the Ministry of Science and ICT of Korea. Another part of my work is to help researchers build domestic and international cooperation networks.

Aim	Planning and establishment of National Brain Research Policies and Strategies
Tool	Research planning, Policy and strategic planning, analyzing research information and trends, preemptively discover the agenda and new project, forecasting future promising technology, policy analysis
TARGET	

- Analyzing research trend and performance
- Planning mid-and long-term R&D strategies
- Planning and exploring new projects

- Planning the national R&D policies
- Exploring the national research agenda and strategic planning

- Domestic and International cooperative research networks(MOU planning)

Curriculum Vitae

2020~Present : Senior Researcher, KBRI
2018~2020 : Researcher, DGMIF
2015~2018 : Postdoctoral Fellow /
Biotech Policy Research Center, KRIBB, KOREA

Academic Credential

2015 : Ph.D., Chemical Engineering, POSTECH
2003 : M.S., Microbiology, Chungnam National University
2001 : B.S., Microbiology, Chungnam National University

Research keywords

Strategic planning, research policy, trend analysis, statistics, portfolio, cooperative network

Key techniques

Research planning, policy and strategic planning, analyzing research information and trends, preemptively discover the agenda and new projects, forecasting promising technology.

Research Interests/Topics

• Policy and strategic planning, analyzing research trends and exploring new projects etc.

Research Planning Publications(selected)

• Neuroscience investment strategy project (2020-2021)
• Neuroscience development strategy (2021)
• High-tech medical complex joint research and development project (2018~2020)
• Ministry of Science and ICT, Bio economy Innovation Strategy 2025 (2017)
• National strategies related to stem cells, natural products and microbiome(2015~2018)

RESEARCHERS

ADJUNCT RESEARCHER

Iksoo Chang, PhD

Invited Investigator
(DGIST, Professor)

Dept. of Brain and Cognitive Sciences
Daegu Gyeongbuk Institute of Science and Technology (DGIST)

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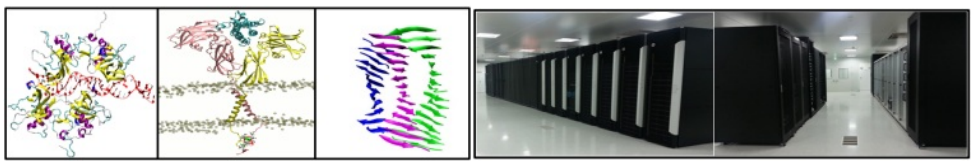
Fax : +82-53-785-1829
E-mail : iksoochang@dgist.ac.kr

From Atom to protein structure & function
From complex network to behavior

Theoretical and Computational Proteome Biophysics.
Theoretical and Computational Statistical Physics.
Theoretical and Computational Neurosciences.
Supercomputing Simulation of Biomolecules.
Supercomputing Bigdata Network Analysis.

Research Field

- Protein thermodynamics and folding kinetics
- Protein structure and function
- Protein-protein, protein-DNA interaction
- Environmental pH effect on protein function
- Receptor proteins and signal communication across cell membrane
- Protein aggregation and amyloid fibril formation
- Proteins for neuro-degenerative disease
- Supercomputing simulation of proteins and DNA
- Supercomputing neuroscience
- Network analysis of complex bigdata & brain network
- Classical and quantum neuronal circuits
- Quantum biology, biophysics



Curriculum Vitae

2015-Present : Distinguished Professor, DGIST, Korea
2013-2014 : Professor, DGIST, Korea
2017-Present : Director, DGIST Core Protein Resource Center
2014-Present : Director, DGIST Supercomputing and Bigdata Center
2008-2017 : Director, Creative Research Initiatives Center for Proteome Biophysics
2002-2007 : Director, National Research Laboratory for Computational Proteomics and Biophysics
1991-2012: Assistant/Associate/Full Professor, Department of Physics, Pusan National University, Korea
1990-1991: Postdoc, Tel Aviv University, Israel

Academic Credential

1990 : Ph.D in Theoretical/Computational Statistical Physics, University of Rochester, USA
1987 : MS in Theoretical Physics, University of Rochester, USA
1985 : MS in Theoretical Physics, Pusan National University, Korea
1981 : BS in Physics, Pusan National University, Korea

Awards/Honors/Memberships

2008 : The 7th Science and Technology Award, Pusan, Korea
1981 : First Scholastic Achievement, Pusan National University, Korea
2010~2014 : Review Board Member Division of Convergent Science National Research Foundation Korea
2010~2012 : National Board Member National Steering Committee for Basic Science Ministry of Education, Science and Technology Korea
2011 : Board Member for Reviewing National Research Foundation Ministry of Education, Science and Technology Korea
2013~ 2015 : President Korean Biophysical Society

Research keyword

Computational Biophysics, Protein Structure and Function, Molecular Dynamic Simulation, Computational Neuroscience. Brain and Neuronal Network Analysis, Complex Biology, Supercomputing.

Research Publications (selected)

- **Chang I**, Cieplak M, Dima RI, Maritan A, Banavar JR. Protein Threading by Learning. *Proc Natl Acad Sci USA, 4;98(25):14350-5, 2001.*
- Yu W, Chung K, Cheon M, Heo M, Han KH, Ham S, **Chang I.** Cooperative folding kinetics of BBL protein and peripheral subunit-binding domain homologues. *Proc Natl Acad Sci USA, 19;105(7):2397-402, 2008.*
- Kim C, Cheon M, Kang M, **Chang I.** A simple and exact Laplacian clustering of complex networking phenomena: application to gene expression profiles. *Proc Natl Acad Sci USA, 18;105(11):4083-7, 2018.*

PATENT

- Patent number: 10-0573799, 10-0573796, 10-0573792, 10-0573788, 10-0573786
- Patent number: 10-0573848

Cheil Moon, PhD

Invited Investigator
(DGIST, Professor)

Dept. of Brain & Cognitive Science
Daegu Gyeongbuk Institute of Science and Technology (DGIST)
Director, Convergence Research Advanced Centre for Olfaction

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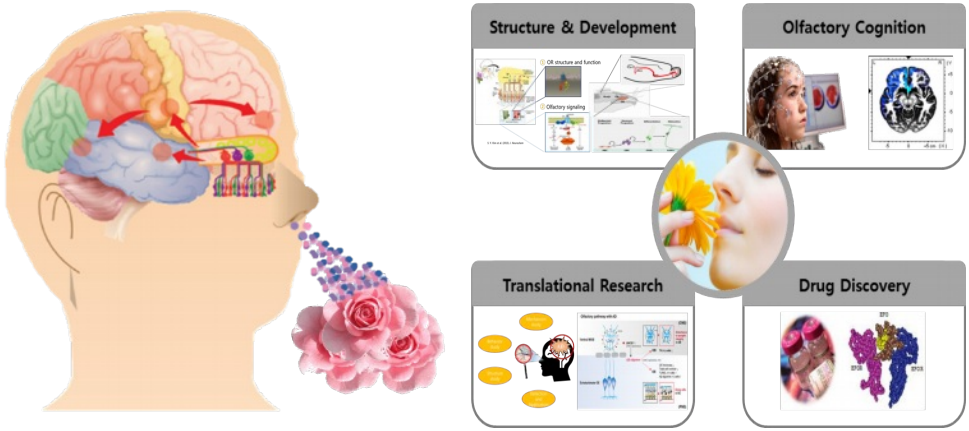
Laboratory of Chemical Senses

My laboratory is studying the chemical senses of the brain. The chemical senses have been spotlighted since Drs. Axel and Buck were awarded the Noble Prize in 2004 due to their pioneer works identifying odorant receptors and olfactory processes. Our laboratory is trying to understand the olfactory processes in the peripheral and central nervous systems using molecular, cellular, morphological and functional approaches. Moreover, we are performing translational researches for the biomedical and bioengineering applications such as anti-neurodegenerative drug discovery or fragrance engineering for improving the quality of human life.



Curriculum Vitae

2009~Present : Professor, Dept. of Brain & Cognitive Science, DGIST
2005~2009 : Assistant Professor, Dept. of Oral Anatomy & Neurobiology , School of Dentistry, Kyungpook National University
1994~2005 : Instructor/Research Associate, Dept. of Neuroscience, School of Medicine, Johns Hopkins University, USA

Academic Credential

1990-94 : Ph.D., Neurobiology, Imperial College London, London, UK
1989-90 : M.S., Biotechnology, Imperial College London, London, UK
1984-89 : B.S., Biochemistry, Yonsei University, Seoul, Korea

Awards/Honors/Memberships

2014~2016 : Member of Advisory Board, President Advisory Board for Sci. and Tech., Korea
1995~Present : Member, Society for Neuroscience
2005~Present : Member, Korean Society for Brain and Neural Science
2015 : Presidential Recognition, Korean Government

Research keyword

Synapse, Neural circuit, Learning and memory, Electron microscopy, Molecular signaling.

Key techniques

Primary culture of olfactory sensory neurons, in vivo fragrance-evoke EEG recording, Neuron culture, Molecular cell biology, Biochemistry, Behavioral analysis.

Research Interests/Topics

- Structure and Functions of the Olfactory Systems
- Development Study in the Olfactory system
- Neurodegenerative Diseases & the Olfactory System
- Fragrance-related Cognition Process in the Olfactory System

Research Publications (selected)

- Park SK, Kim JH, Yang ES, Ahn DK, **Moon C**, Bae YC. Ultrastructure and synaptic connectivity of main and accessory olfactory bulb efferent projections terminating in the rat anterior piriform cortex and medial amygdala. *Brain Structure and Function., 219(5):1603-1613, 2014.*
- Kim JY, Cho B, **Moon C**. Timely inhibitory circuit formation controlled by Abl1 regulates innate olfactory behaviors in mouse. *Cell reports 30 (1): 187-201, 2020.*
- Son G, Yoo S, Kang S, Rasheed A, Jung D, Park H, Cho B, Steinbusch HWM, Chang K, Suh Y, **Moon C**. Region-specific amyloid-β accumulation in the olfactory system influences olfactory sensory neuronal dysfunction in 5xFAD mice. *Alzheimer's Research & Therapy, 13(1):1-20, 2021.*
- Kim K, Bae J, Jin Y, **Moon C**. Odor habituation can modulate very early olfactory event-related potential. *Scientific Reports, 10(1): 18117, 2020.*

PATENT

- (P-2019-0127-US-60) USE OF ERYTHROPOIETIN-DERIVED PEPTIDE THROUGH EFFECT ON CELL DAMAGE PREVENTION THEREOF.
- (P-2015-0272-US-60) ENDOSCOPE SYSTEM FOR DIAGNOSIS SUPPORT AND METHOD FOR CONTROLLING SAME.

Eun-Kyoung Kim, PhD

Invited Investigator
(DGIST, Professor)

Dept. of Brain-Cognitive Sciences
Daegu Gyeongbuk Institute of Science and Technology (DGIST)

Office : E4-314
Lab : Neurometabolism/
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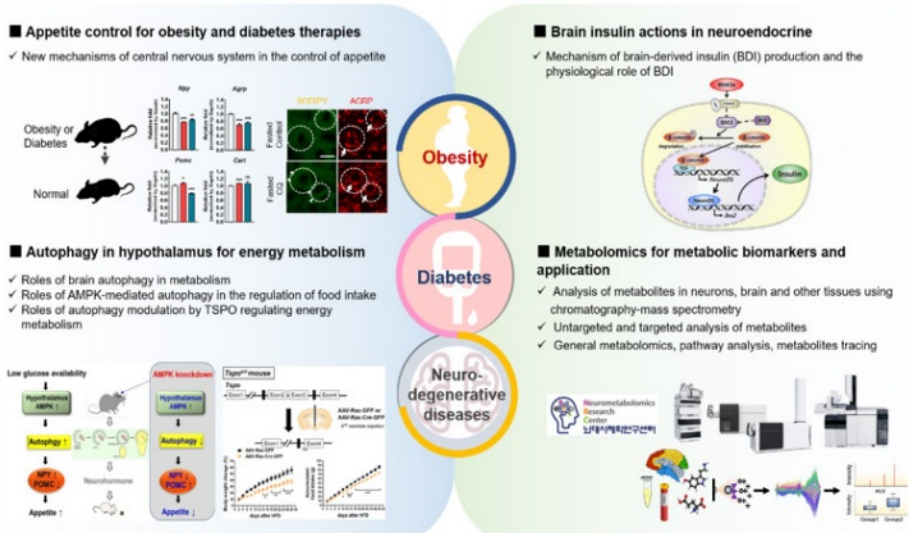
Fax : +82-53-785-6109
E-mail : ekkim@dgist.ac.kr

Brain Metabolism and Metabolic Diseases

- Roles of hormones and energy sensors in the regulation of food intake and energy homeostasis
- Metabolic communication between brain and body for energy balance
- Target screening for potential drugs for appetite control
- Analysis of metabolic pathway network using metabolomics for development of diagnostic markers and treatment



Research keyword

Metabolic diseases, Food intake, Energy Balance, Autophagy, Metabolomics

Curriculum Vitae

2016~Present : Professor, Dept. of Brain & Cognitive Sciences, DGIST, Korea
2013~Present : Director of Neurometabolomics Research Center, DGIST, Korea
2010~2016 : Assistant Professor, Dept. of Brain & Cognitive Sciences, DGIST, Korea
2006~2010 : Assistant Professor, Dept. of Food Science and Human Nutrition, Michigan State University, USA
2006~2006 : Research Associate, Dept. of Neuroscience, Johns Hopkins University, USA
2000~2006 : Postdoctoral fellow, Dept. of Neuroscience, Johns Hopkins University, USA
1999~2000 : Postdoctoral fellow, National Creative Research Center, Sungkyunkwan University, Korea

Academic Credential

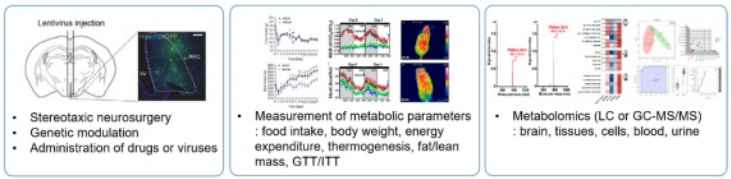
1999: Ph.D., Microbiology, Seoul National University
1993: M.S., Microbiology, Seoul National University
1991: B.S., Microbiology, Seoul National University

Awards/Honors/Memberships

2017 : Excellence in Research, Ministry of Science and ICT
2017 : The Best Academic Award, DGIST
1998 : Young Research Scientist Promotion Scholarship Award
2013~Presnt : Korea Society for Biochemistry and Molecular Biology member
2011~Present : The Korea Society for Brain and Neural Science member
2010~Present : International Autophagy Conference member
2002~Present : Society for Neuroscience member

Key techniques

Biochemistry, Cell biology, in vivo studies (Metabolic diseases models, Mouse genetics), Comprehensive Metabolomics (Untargeted, Targeted analysis)



Research Interests/Topics

- Appetite control for obesity and diabetes therapies
- The role of autophagy in obesity and diabetes
- Insulin actions on obesity, diabetes and neurodegenerative diseases
- Metabolomics using metabolite analysis

Research Publications (selected)

- Lee J, Kim K, Cho JH, Bae JY, O'Leary TP, Bae YC and **Kim EK**. Insulin synthesized in the paraventricular nucleus of the hypothalamus regulates pituitary growth hormone production. *JCI insight 5(16):e135412, 2020.*
- Kim S, Kim N, Park S, Jeon Y, Lee J, Yoo SJ, LeeJW, Moon C, Yu SW and **Kim EK**. Tanycytic TSPo inhibition Induces lipophagy to regulate lipid metabolism and improve energy balance. *Autophagy 16(7): 1200-1220, 2020.*
- Jung S, Choe S, Woo H, Jeong H, An HK, Moon H, Ryu HY, Yeo BK, Lee YW, Choi H, Mun JY, Sun W, Choe HK, **Kim EK**, Yu SW. Autophagic death of neural stem cells mediates chronic stress-induced decline of adult hippocampal neurogenesis and cognitive deficits. *Autophagy, DOI: 10.1080/15548627.2019.1630222, 2019.*
- Lee JW, Nam H, Kim LE, Jeon Y, Min H, Ha S, Lee Y, Kim SY, Lee SJ, **Kim EK**, Yu SW. TLR4 (toll-like receptor 4) activation suppresses autophagy through inhibition of FOX03 and impairs phagocytic capacity of microglia *Autophagy, 15(5), 2018.*
- Oh TS, Cho H, Cho JH, Yu SW, **Kim EK**. Hypothalamic AMPK-induced autophagy increases food intake by regulating NPY and POMC expression. *Autophagy, 12(11), 2016.*
- Oh TS, Jeon Y, Kim S, **Kim EK**. Hypothalamic AMPK as a regulator of food intake and energy balance. *CNS & Neurological Disorders-Drug targets 15(8), 2016.*

Seong-Woon Yu, PhD

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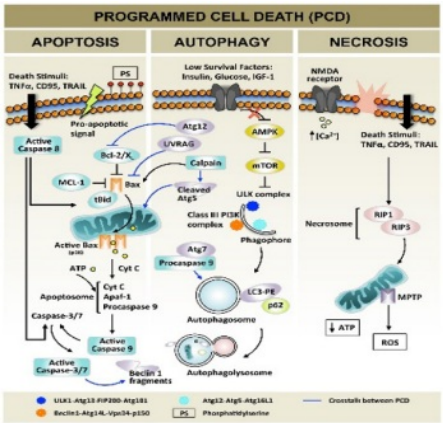
Laboratory of Neuronal Cell Death

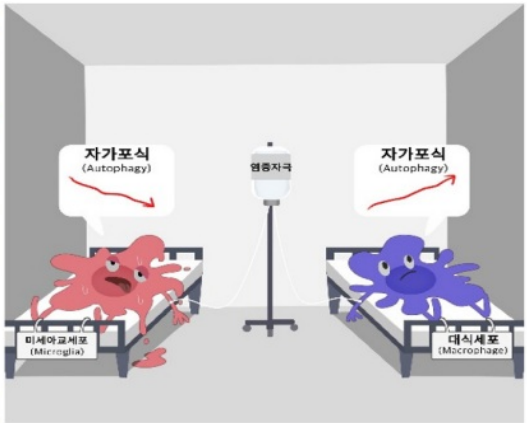
"Programmed" cell death (PCD) represents a specialized cellular function for cell suicide. Neurodegenerative diseases are characterized by gradual and progressive death of specific subsets of neurons in the central nervous system. The molecular mechanisms underlying this selective neuronal cell death remain largely unknown.

Our recent findings demonstrate that adult hippocampal neural stem cells undergo autophagic cell death following psychological stress. Recently there has been debate around autophagic cell death. Our study is at the center of this worldwide debate, providing the bona fide case of autophagic cell death in mammalian cells. Furthermore, our study will provide novel sight into the pathogenic mechanisms of pshchiatric disorders and dementia.

Another aspect of our research efforts is focused on investigating the signaling mechanisms underlying neuroinflammation and microglia activation in the degenerating brain.

Understanding the delicate interaction between neural stem cells and immune cells will be a critical prerequisite for development of novel therapeutic strategies for brain repair.





Curriculum Vitae

2016~Present : Professor, DGIST
2010~2016 : Associate professor, DGIST
2006~2010 : Assistant professor, Michigan State University, USA
2000~2006 : Post-doc, Johns Hopkins University School of Medicine, USA
1999~2000 : Post-doc, Seoul National University

Academic Credential

1993~1999 : Ph.D., Microbiology, Seoul National University
1991~1993 : M.S., Microbiology, Seoul National University
1987~1991 : B.S., Microbiology, Seoul National University

Awards/Honors/Memberships

- 2019 The Korean Society for Neuroglia Best Research Award
- 2008: Raymond B. Bauer Award by Michigan Parkinson Foundation, USA
- 2004: Association of Korean Neuroscientists, President's Oustanding Research Award , USA
- 2004: Cayman Chemicals Travel Award, USA
- Medicine in Drug Discovery (Elsevier), Editorial board member
- Animal Cells and Systems, Editorial board member
- Frontiers in Cellular Neuroscience, Editorial board member
- Molecular Brain, Editorial board member
- Molecules and Cells, Editorial board member

Research keyword

Programmed Cell Death, Autophagy, Apoptosis, Adult Hippocampal Neural Stem Cell, Adult Neurogenesis, Stress, Neuroinflammation, Microglia, Alzheimer's Diseases

Key techniques

Primary hippocampal neural stem cell culture, neuronal stem cell death mechanism and neurogenic mechanism using stress models, neuronal disease mechanism analysis through behavioral experiments, and neuroinflammatory response molecular mechanism analyses in primary astrocytes/microglial cells

Research Interests/Topics

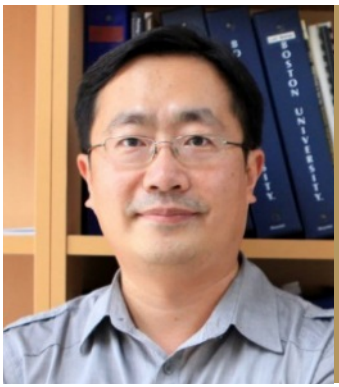
- A Study on the Treatment Method of Degenerative Brain Disease through the Mechanism of Neuronal Stem Cell Death and Neurogenesis by Stress-induced Autophagic Cell Death
- A Study on the Treatment Method of Degenerative Brain Disease through the Mechanism of Neuroinflammation in Microglial Cells

Research Publications (selected)

- An HK, Chung KM, Park HH, Hong JH, Gim JE, Choi HS, Mun JY, **Yu SW**. CASP9 (caspase 9) is essential for autophagosome maturation through regulation of mitochondrial homesostasis. *Autophagy 16:1598-1617, 2020.*
- Jung SH, Choe SW, Woo HW, Jeong HJ, An HK, Ryu HY, Yeo BK, Lee YW, Choi HS, Mun JY, Sun W, Choe HK, Kim EK, **Yu SW.** Autophagic death of neural stem cells mediates chronic stress— induced decline of adult hippocampal neurogenesis and cognitive deficits. *Autophagy 24:1-19, 2019.*
- Jeon SW, Kim S, Ha SH, Lee S, Kim E, Kim SY, Park SH, Jeon JH, Kim SW, Moon C, Nelson BJ, Kim Jy*, **Yu SW***, H Choi*. Magnetically actuated microrobots as a platform for stem cell transplantation. *Science Robotics, 4:eeav4317, 2019.*
- Lee JW, Nam HR, Kim Leah EJ, Jeon YJ, Min HJ, Ha SW, Lee YH, Kim SY, Lee SJ, Kim EK, **Yu SW**. TLR4(toll-like receptor 4) activation suppresses autophagy through inhibition of Fox03 and impairs phagocytic capacity of microglia. *Autophagy 15:753-770, 2019.*
- Park HH, Chung KM, An HK, Gim JE, Hong JH, Woo HW, Cho BK, Moon CI, **Yu SW**. Parkin promotes mitophagic cell death in adult hippocampal neural stem cells following insulin withdrawal. *Frontiers in MolecularNeuroscience, 12:46,2019.*

PATENT

- Pharmaceutical compos1t1ons for the prevention and treatment of the neurodegenerative disorders. (No. 10-1600666), 201 6, Republic of Korea



Kyuhyung Kim, PhD

Invited Investigator
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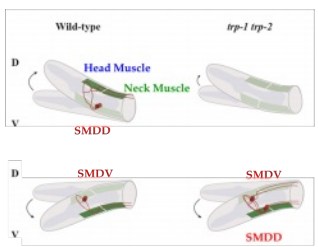
Lab of Neurobehavior and Neural Circuits

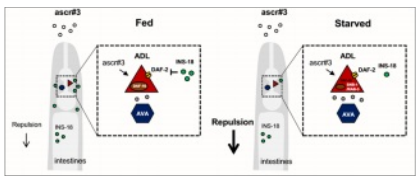
The overall goal of our research is to investigate the circuits and molecules that integrate environmental cues with internal signals to drive specific developmental and behavioral outcomes.
Our research focuses on identifying the neuronal and molecular mechanisms that underlie proprioception mediated locomotive behavior and pheromone-mediated behavioral plasticity using the C. elegans model system.
These studies will allow us to better understand the mechanisms and neuronal circuits by which complex species-specific environmental cues and internal metabolic status are integrated to drive highly precise developmental and behavioral responses.

Aim	Unveiling the circuit mechanisma underlying the behaviors and their plasticity
Tool	Molecular & Cellular Biology, Neurogenetics, Behavior Monitoring, Neuromodulation

Circuit mechanisms underlying
proprioception-mediated locomotive behavior



Circuit mechanisms underlying
pheromone-mediated behavioral plasticity



Curriculum Vitae

2016~Present : Associate Professor, Department of Brain & Cognitive Sciences, DGIST, Korea
2011~2015 : Assistant Professor, Department of Brain & Cognitive Sciences, DGIST, Korea
2010~2011 : Research Specialist, Brandeis University, USA
2003~2010: Postdoctoral Fellow, Brandeis University, USA
2002~2003: Research Associate, Boston University, USA

Academic Credential

2002: Ph.D., Biology, Boston University, USA
1990: B.S., Biochemistry, Yonsei University, Korea

Awards/Honors/Memberships

2018~Present: Editorial Board Member, Current Opinion in Neurobiology
2018~Present: Editorial Board Member, BMB Reports
2018: Outstanding Research Award, DGIST, Korea
2012: TJ Park Young Faculty Fellowship
2012: DGISTian of The Year, DGIST, Korea

Research keyword

Behavioral Plasticity, Proprioception, Neuronal Specification

Key techniques

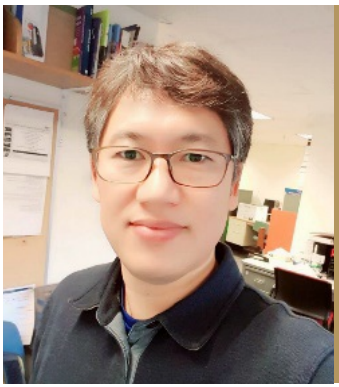
1) Molecular and cellular biological and neurogenetics techniques
2) Custom designed behavior monitoring and analysis programs
3) Neuromodulation and microfluidics

Research Interests/Topics

- Structural and functional connectomics related to behavioral plasticity
- Developmental mechanisms of individuals and neuronal systems

Research Publications (selected)

- Ryu L.,Cheon Y., Huh YH., Pyo S., Chinta S., Choi H., Butcher R., **Kim K**. Feeding state regulates pheromone-mediated avoidance behavior via the insulin signaling pathway in Caenorhabditis elegans. *EMBO J., 37(15). pii: e98402, 2018.*
- Yeon J*.,Kim J*., Kim D., Kim H., Kim J., Du E., Kang K., Lim H., Moon D., **Kim K**. A sensory-motor neuron type mediates proprioceptive coordination of steering in C. elegansvia two TRPC channels. *PLoS Biol., 16(6):e2004929, 2018.*
- Hong M*., Ryu L*., Ow M., Kim J., Je R., Chinta S., Huh Y., Lee K., Butcher R., Choi H., Sengupta P., Hall S., **Kim K**. Early pheromone experience modifies a synaptic activity to influence adult pheromone-responses of C.elegans. *Curr. Biol., 27(20):3168-3177, 2017.*
- Kim J.*, Yeon J.*, Choi S., Huh Y., Zhi F., Park S., Kim M., Ryoo Z., Kang K., Kweon H., Jeon W., Li C.#, and **Kim K**. #. The Evolutionarily Conserved LIM Homeodomain Protein LIM-4/LHX6 Specifies the Terminal Identity of a Cholinergic and Peptidergic C. elegans Sensory/Inter/Motor Neuron-Type. *PLoS Genet., 11(8):e1005480, 2015.*
- Jang H.*, **Kim K**.*#, Neal S., Macosko E., Kim D., Butcher R., Zeiger D., Bargmann C. #, and Sengupta P. #. Neuromodulatory state and sex specify alternative behaviors through antagonistic synaptic pathways in C. elegans. *Neuron, 75(4):585-592, 2012. (*equal contribution, #co-corresponding)*



Byung-Chang Suh, PhD

Invited Investigator
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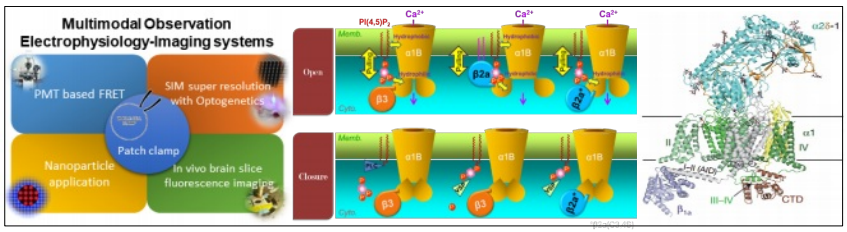
Brain Signal and Synaptic Transmission

My research goal is to determine the molecular mechanism and biophysical properties of ion channel modulation by receptor-mediated lipid dynamics and then to examine the functional significance in neuronal diseases, such as epilepsy, pain, psychiatric disorders, channelopathies and etc. I focus on voltage-gated Ca^{2+} (Cav) channels, KCNQ2/3 M-type K^+ channels, acid-sensing ion channels (ASICs), and TMEM16 Ca^{2+}-activated Cl- channels. I hypothesize that membrane phospholipid PIP_2 acts as the generalized diffusible messenger that slowly modulate those ion channels. Our group use several novel exogenous phosphatase systems that modify the phosphoinositides directly in living cells, in combination with electrophysiology, confocal & FRET imaging, and structural simulation.

Aim	Determine the molecular mechanism and biophysical properties of ion channel modulation by receptor-mediated lipid dynamics
Tool	Electrophysiology + Lipidomics Tool + Physiology & Channelopathies
TARGET	

Curriculum Vitae

2019.09~Present : Professor, DGIST, Korea
2015.09~2019.08 : Associate Professor, DGIST, Korea
2011.02~2015.08 : Assistant Professor, DGIST, Korea
2004.07~2011.01 : Assistant Professor (Research track), University of Washington, USA
2001.06~2004.06 : Senior Fellow, University of Washington, USA
1998~2001 : Post-doc, POSTECH, Korea

Academic Credential

1997 : Ph.D., Life Science, POSTECH
1994 : M.S., Life Science, POSTECH
1991 : B.S., Agricultural Biology, SNU

Awards/Honors/Memberships

2021.02 : Editorial Board Member of the journal LIFE
2018.02 : Editorial Board Member of THE JOURNAL OF GENERAL PHYSIOLOGY
2017.02. : Citation for Distinguished Service Award from the Journal of General Physiology
2016.09.05. : DGIST Achievement Award
1994.03 : The Young Scientist Award from the Korean Research Foundation
2009~Present : Member, Biophysical Society

Research keyword

Voltage-Gated Ca^{2+} (CaV) Channels, KCNQ K^{+} Channels and Epilepsy, Pain Signaling in Nociceptors

Research Publications (selected)

- Ko W, Jung SR, Kim KW, Yeon JH, Park CG, Nam JH, Hille B, and Suh BC. Allosteric modulation of alternatively spliced Ca^{2+}-activated Cl^{-} channels TMEM16A by PI(4,5)P_2 and CaMKII. *Proc. Natl. Acad. Sci. USA 117, 30787-30798, 2020.*
- Yeon JH, Park CG, Hille B*, and Suh BC*. Translocatable voltage-gated Ca^{2+} channel β subunits in α1-β complexes reveal competitive replacement yet no spontaneous dissociation. *Proc. Natl. Acad. Sci. USA 115, E9934-E9943, 2018. *co-correspondence.*
- Park CC, Park Y, and Suh BC. The HOOK region of voltage-gated Ca^{2+} channel β subunits senses and transmits PIP_2 signals to the gate. *J. Gen. Physiol. 149, 261-276. 2017.*
- Keum D, Kruse M, Kim DI, Hille B*, and Suh BC*. Phosphoinositide 5- and 3-phosphatase activities of a voltage-sensing phosphatase in living cells show identical voltage dependence. *Proc. Natl. Acad. Sci. USA 113, E3686-E3695, 2016.* *co-correspondence.
- Kim DI, Kweon HJ, Park Y, Jang DJ, and Suh BC. Ca^{2+} controls gating of voltage-gated calcium channels by releasing the β2e subunit from the plasma membrane. *Science Signaling 9, ra67, 2016.*

PATENT

- Patent Number: 10-1646597
  Application Number: 10-2015-0078549
  Registration Date: 2016.08.02.
  Title of Invention: PTEN Fusion Protein and Use Thereof
- Patent Number: 10-1845438
  Application Number: 10-2016-0122453
  Registration Date: 2018.03.29
  Title of Invention: Structural Lighting Microscope

Yong-Seok Oh, PhD

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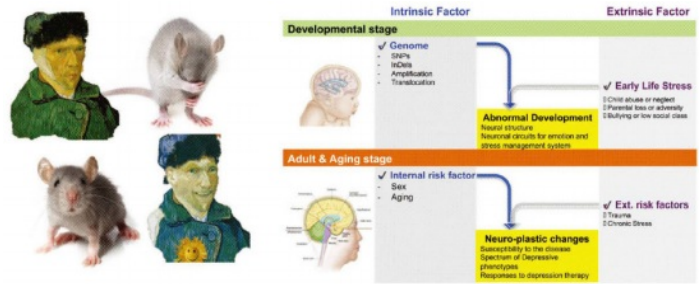
Neurobiology of Psychiatric Disorders

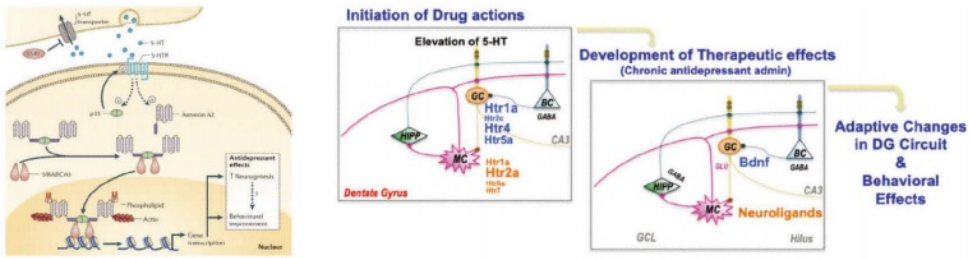
Goal of Our Approach

Identification of the molecular, cellular, and circuit-level changes that underlie the onset, persistence, and treatment of psychiatric disorders using animal models.



Research Interests and Topics

- Molecular Etiology of Neuropsychiatric Disorders
  - Major depressive disorder (MDD), post-traumatic stress disorder (PTSD)
  - Neuroadaptive changes to psychological stress or antidepressants
  - Serotonin and dopaminergic modulation of neural circuit and behaviors



Curriculum Vitae

2014~Present : Assistant & Associate Professor, DGIST, Korea
2015-Present : Director, Research-Infra Center, DGIST, Korea
2017-Present : Joint Researcher, KBRI, Korea
2014~2019 : Adjunct Faculty, , The Rockefeller University, US
2007~2014 : Postdoctoral fellow & Research Associate, The Rockefeller University, US

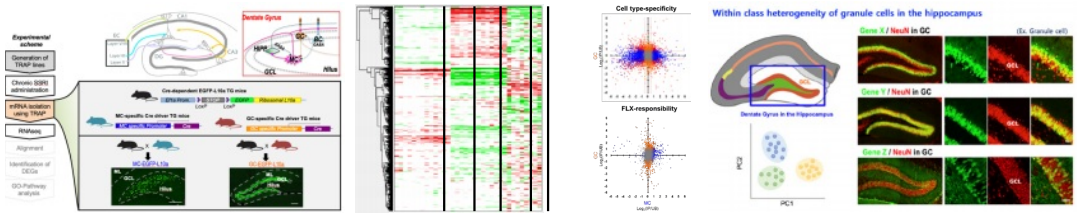
Academic Credential

2004: Ph.D., Life Science, POSTECH
1997: M.S., Life Science, POSTECH
1995: B.S., Animal Sci. & Tech, Seoul National University, Korea

Awards/Honors/Memberships

2014~2016 : Awardee, The NARSAD* Young Investigator Award and Grant from Brain & Behavior Research Foundation.
2013 : Awardee, The Travel Grant Award from the Korean Society for Molecular and Cellular Biology (KSMCB)
2007 : Recipient, Post-doctoral fellowship of Korea National Research Foundation (KRF)
2019-Present : Member of Editorial Board, Laboratory Animal Research (LAR)
2007~Presen t: Member, Society for Neuroscience

- Genomic Anatomy of Neuronal Circuit
  - Innate or induced heterogeneity of neuronal subtypes and single cells
  - Transcriptional and translational response to stress and therapeutic drugs



Research Publications (selected)

- **Oh SJ*,** Cheng J*, Jang JH, Arace J, Jeong MS, Shin CH, Park JR, Jin JH, Greengard P, Oh YS. Hippocampalmossy cell involvement in neurogenic and behavioral responses to chronic antidepressant treatment. *Molecular Psychiatry, e-pub, 2019.* (*contributed equally)
- Shuto T, Kuroiwa M, Naoki Sotogaku N, Kawahara Y, **Oh YS**., Jang JH, Shin CH, Ohnishi YN, Hanada Y, Miyakawa T, Kim Y, Greengard P, Nishi A Obligatory roles of dopamine D1 receptors in the dentate gyrus in antidepressant action of a selective serotonin reuptake inhibitor, fluoxetine. *MolecularPsychiatry, e-pub, 2018.*
- Leem EJ, Kim HJ, Choi M, Kim S, **Oh YS**., Lee KJ, Choe YS, Um JY, Shin WH, Jeong JY, Jin BK, Kim DW, McLean C, Fisher PB, Kholodilov N, Ahn KS, Lee JM, Jung UJ, Lee SG*, Kim SR*. Upregulation of neuronal astrocyte elevated gene-1 protects nigral dopaminergic neurons in vivo. *CellDeathDisease, 9:449, 2018.*
- Park JR, Jang JH, Kim MH, **Oh SJ**, Shin CH, Jeong MS, Heo K, Park JB, Kim SR, Oh YS.. LPA induced — migration of ovarian cancer cells requires activations via LPA1 and LPA2. *Cellular Signalling, 44:138-147, 2018.*

Hyosang Lee, PhD

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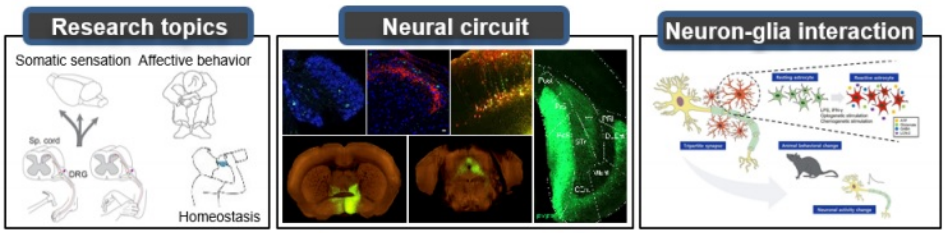
Neuronal circuits underlying somatosensory and affective behaviors

The ultimate goal of our research is to understand the neurobiology of motivational and emotional behaviors. We are particularly interested in studying the neuronal circuit mechanisms underlying somatic sensation (including pain and itch) as well as affective and homeostatic behaviors with the following questions:

1) Where in the brain are these behaviors mediated?
2) What is the relationship between neuronal circuits mediating similar or opponent behaviors (e.g., pain vs. itch)?
3) How are those neuronal circuits modulated by non-neuronal cells, such as astrocytes?

Research keyword

Neuronal circuit, behavior, glia, somatic sensation, pain, itch, depression, mouse genetics



Curriculum Vitae

2015~Present : Assistant Professor, DGIST
2013~2015 : Research Assistant Professor, Caltech, USA
2007~2012 : Postdoc, Caltech/HHMI, USA

Awards/Honors/Memberships

2011 : NIH Pathway to Independence Award, USA
2009 : Keystone Symposia Scholarship, USA
2009 : Postdoctoral fellowship from the Christopher and Dana Reeve Foundation

Academic Credential

2006 : Ph.D., Biological Chemistry, Johns Hopkins School of Medicine
1997 : M.S., Life Science, POSTECH
1995 : B.S., Biochemistry, Kyungpook National University

Key techniques

We adapt a combinatorial approach consisting of the gain- and loss-of-function manipulations such as optogenetics and chemogenetics, brain slice recording and fiber photometry, and circuit tracing tools as well as mouse genetics, behavioral assays and animal models.

Research Publications (selected)

- Lee JS, Kweon HJ, **Lee H***, Suh BC*. Rapid resensitization of ASIC2a is conferred by three amino acid residues in the N terminus. *General Physiology, 151:944-953, 2019.* (*contributed equally)
- Park I, Lee K, Bishayee K, Jeon HJ, **Lee H***, Lee U.* Machine-Learning Based Automatic and Real-time Detection of Mouse Scratching Behaviors. *Experimental Neurobiology, 28:54-56, 2019.* (*contributed equally)
- **Lee H**, Kim D-W, Remedios R, Anthony TE, Chang A, Madisen L, Zeng H, Anderson DJ Scalable control of mounting and attack by Esr1 + neurons in the ventromedial hypothalamus. *Nature, 509:627-632, 2014.*
- Lin D, Boyle MP, Dollar P, **Lee H**, Lein ES, Perona P, Anderson DJ. Functional identification of an aggression locus in the mouse hypothalamus. *Nature, 470:221-226, 2011*
- Cavanaugh DJ*, **Lee H***, Lo L*, Shields SD*, Zylka MJ, Basbaum AI, Anderson DJ. Distinct subsets of unmyelinated primary sensory fibers mediate behavioral responses to noxious thermal and mechanical stimuli. *PNAS, 106:9075-9080, 2(XJ<).* (*contributed equally)

Han Kyoung Choe, PhD

Invited Investigator
(DGIST, Professor)

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Daegu Gyeongbuk Institute of Science and Technology (DGIST)

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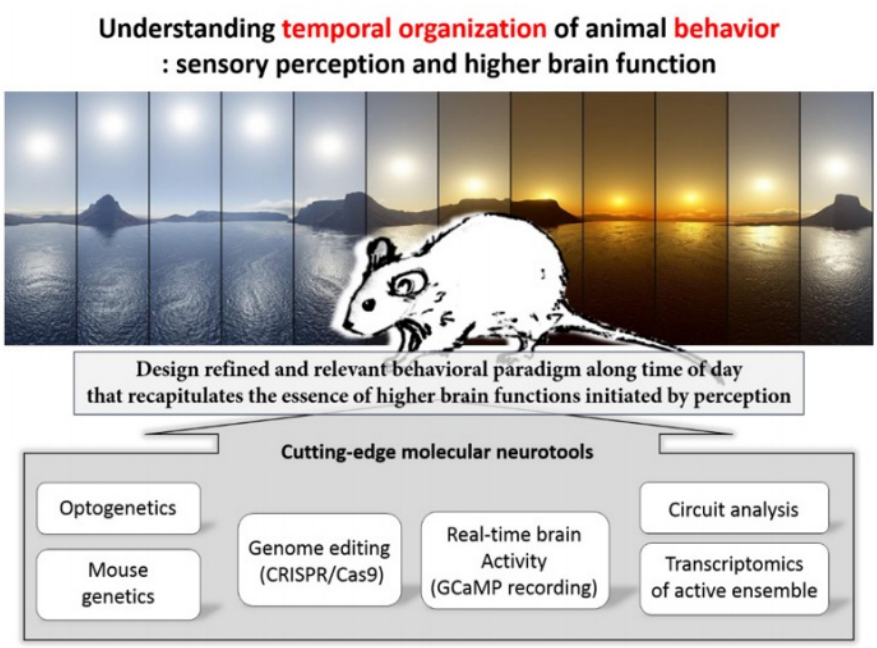
Understanding and Utilizing the Circadian Control of Cognitive Functions



Curriculum Vitae

2016~Present : Assistant Professor, DGIST
2013~2016 : Postdoctoral fellow, McGovern Institute for Brain Research, MIT
2013: Postdoctoral fellow, Department of Biological Sciences, SNU

Academic Credential

2013: Ph.D., Biology, SNU
2005: B.S., Biology, SNU

Awards/Honors/Memberships

2014~2016: Long-Term Fellowships from Human Frontier Science Program

Research keyword

Neural circuit, Circadian rhythm, Cognitive functions, Genome editing, AAV-mediated gene delivery

Key techniques

Mice behavior test, Circadian analysis of cognitive functions, Neural circuit tracing, Opto/chemogenetics, Calcium activity measurement, Packaging AAV, In vivo CRISPR/Cas9

Research Interests/Topics

- Understanding and utilizing circadian pattern of cognitive functions
- Neural circuit and molecular mechanisms of social cognition
- Brain-machine interface

Research Publications (selected)

- Lee S, Kim JA, Kim HD, Chung S, Kim K, **Choe HK**. Real-time temporal dynamics of bicistronic expression mediated by IRES and 2A cleaving sequence. *Mol Cells, 42(3): 245, 2019.*
- Park S, Guo Y, Jia X, **Choe HK**, Grena B, Kang J, Park J, Lu C, Canales A, Chen R, Yim YS, Choi GB, Fink Y, Anikeeva P. One-step optogenetics with multifunctional flexible polymer fibers. *Nat Neurosci, 20(4):612-61, 2017.*
- **Choe HK,** Reed MD*, Benavidez N, Montgomery D, Soares N, Yim YS, Choi GB. Oxytocin Mediates Entrainment of Sensory Stimuli to Social Cues of Opposing Valence. *Neuron, 87(1):152, 2015.*

Ho-Won Lee,
MD, PhD

Invited Investigator
(KNU, Professor)

Dept. of Neurology, School of Medicine/
Brain Science & Engineering Institute,
Kyungpook National University(KNU)
Dept. of Neurology, Kyungpook National University Chilgok Hospital

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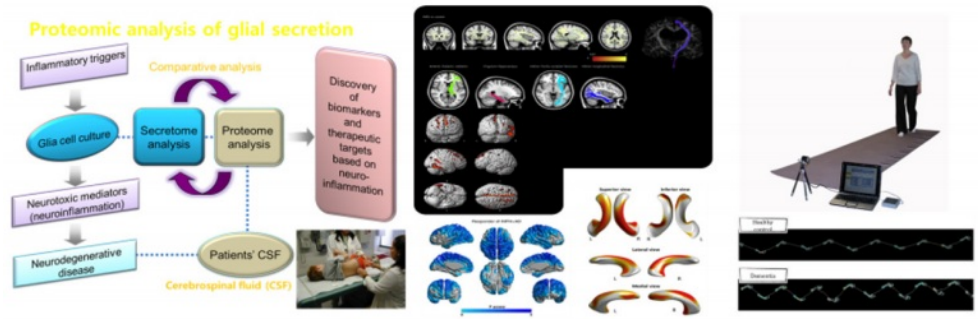
Translational Research Lab for Neurodegenerative diseases

Age-related neurodegenerative disorders like Alzheimer's disease, Parkinson's disease, late-onset cerebellar ataxia and idiopathic normal-pressure hydrocephalus take an overwhelming toll on individuals and society. The primary goal of our research has been the establishment of a scientific basis for the rational early diagnosis and treatment of age-related neurodegenerative disorders. Accordingly, our interests range from the mechanisms of pathophysiology of age-related neurodegenerative disorders and surrogate bio/imaging marker for early diagnosis and progression of age-related neurodegenerative disorders. Over 15 years, I have established a network of collaborative Lab which has focused on Bio-fluid such as CSF and blood, MRI and EEG. We have several patents for bio/imaging marker and Information technology in the field of neurodegenerative diseases.
Our mission includes delivering the most exceptional clinical care to our patients, leading transformative cutting-edge research, and training the leaders of tomorrow in both neurology and neuroscience.



Curriculum Vitae

2006~Present : Professor
2013 Fellow : Center for Movement Disorders &Neurorestoration, University of Florida
2003 Fellow : Dept. of Neurology and Alzheimer Disease Center, Baylor College of Medicine
2002 Residency : Dept. of neurology, Kyungpook National University Hospital

Academic Credential

2008 : Ph.D., Department of Neuroscience, Kyungpook National University School of Medicine
1996 : MD, Kyungpook National University School of Medicine

Memberships

Korean Neurological Association
Korean Dementia Association, executive member
Korean Movement Disorders Society, executive member
Korean Sleep Research Society, executive member
Korean Epilepsy Society

Research keyword

Alzheimer's disease, Parkinson's disease, late-onset cerebellar ataxia, idiopathic normal-pressure hydrocephalus, Neuroinflammation, bio/imaging marker, gait, Information technology

Key techniques

Biochemistry & Molecular Biology, MRI, EEG, gait analyzing system, Information technology

Major Questions that we focus on

- What is the surrogate bio/imaging marker for early diagnosis and progression of neurodegenerative diseases?
- How can we delay the progression of neurodegenerative diseases?
- Can Mesenchymal Stem Cell be disease-modifying therapy for neurodegenerative diseases ?
- How can we use Information technology to support the patients with neurodegenerative diseases ?
- How can Gait analysis with wearables predicts neurodegenerative diseases?

Research Publications (selected)

- Kang K, Yoon U, Hong J, Jeong SY, Ko PW, Lee SW, **Lee HW**. Amyloid Deposits and Idiopathic Normal-Pressure Hydrocephalus: An 18F-Florbetaben Study. *EurNeural., 79(3-4):192-199, 2018.*
- Ahn D, Chung H, **Lee HW**, Kang K, Ko PW, Kim NS, Park T. Smart Gait-Aid Glasses for Parkinson's Disease Patients. *IEEE Trans Biomed Eng., 64(10):2394-2402, 2017.*
- Kang K, Choi W, Yoon U, Lee JM, **Lee HW**. Diffusion tensor imaging of idiopathic normal-pressure hydrocephalus and the cerebrospinal fluid tap test. *J NeuralSci., 364:90-6, 2016.*
- Kim SA, Lee YM, **Lee HW**, Jacobs DR Jr, Lee DH. Can Inconsistent Association between Hypertension and Cognition in Elders be Explained by Levels of Organochlorine Pesticides? *PLoS One, 10(12):e0144205, 2015.*

Kyung-In Jang, PhD

Invited Investigator
(DGIST, Professor)

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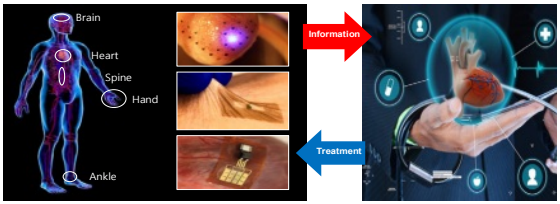
Bio-integrated Electronics

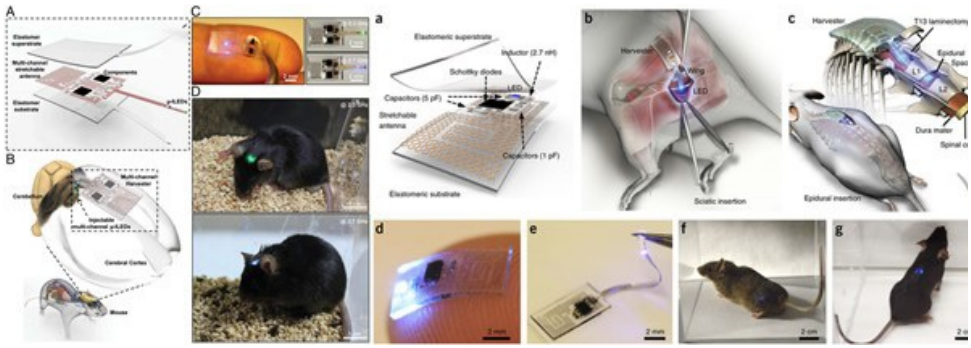
Goal of Our Approach

Development of bio-integrated electronics which can monitor bio-signals, stimulate biological tissues and control eccential functionalities of biological system via soft, wireless method.



Research Interests and Topics

- Fully Implantable neuro tools
  - Soft wireless electronic implant for optogenetics
  - Real-time monitoring of neuro-signals and stimulation of neuronal tissues



- Multi-functional electronic membrane design for biological organs
  - Thin and stretchable electronic membrane which can detect thermal, mechanical, electrical, chemical, optical sensing of living biological organs

Curriculum Vitae

2016~Present : Assistant & Associate Professor, DGIST, Korea
2011~2016 : Postdoctoral Researcher, University of Illinois at Urbana-Champaign

Academic Credential

2011: Ph.D., Mechanical Engineering, Yonsei University
2005: B.S., Mechanical Engineering, Chung-Ang University, Korea

Awards/Honors/Memberships

2018 : Young Researcher Award, Korean Society of Precision Engineering
2017 : Outstanding Researcher Award, Daegu Gyeongbuk Institute of Science and Technology
2011 : Post-Doctoral Fellowship funded by the Korean Government (MEST), 2011
2011 : Outstanding Dissertation Award, Yonsei University, 2011
2009 : The Korea Student Aid Foundation (KOSAF) grant funded by the Korean Government (MEST)
2017~Present : Member, Society for Precision Engineering

Research Publications (selected)

- **Jang KI**, Li K, Chung HU, Xu S, Jang HN, Yang Y, Kwak JW, Yang C, Wang A, Liu Z, Lee JY, Kim BH, Kim JH, Lee J, Yu Y, Kim BJ, Jang H, Yu KJ, Kim J, Lee JW, JEong JW, Song YM, Huang Y, Zhang Y, Rogers JA. Self-assembled three dimensional designs for soft electronics. *Nature Communications, 8, 15894, 2017.*
- Lee YK*, **Jang KI**, Ma Y, Koh A, Chen H, Jung HN, Kim Y, Kwak JW, Wang L, Xue Y, Yang Y, Tian W, Jiang Yu, Zhang Y, Feng X, Huang Y, Rogers JA. Chemical sensing systems that utilize soft electronics on thin elastomeric substrates with open cellular designs. *Advanced Functional Materials, 27,1605476, 2017.*
- Park SI, Shin G, McCall JG, Al-Hasani R, Norris AJ, Xia L, Brenner Ds, Noh KN, Bang SY, Bhatti DL, **Jang KI**, Kang SK, Mickle AD, Gereau IV RW, Brunchas MR, Rogers JA. Stretchable multichannel antennas in soft wireless optoelectronic implants for optogenetics. *Proceedings ofthe National Academy ofSciences,113, E8169-E8177, 2016.*
- **Jang KI**, Jung HN, Lee JW, Xu S, Liu YH, Ma Y, Jeong JW, Song YM, Kim J, Kim BH, Banks A, Kwak JW, Yang Y, Wei Z, Feng X, Huang Y, Ghaffari R and Rogers JA. Ferromagnetic, folded electrode composite as a soft interface to the skin for long-term electrophysiological recording. *Advanced Functional Materials, 26, 7281-7290, 2016.*
- **Jang KI**, Chung HU, Xu S, Lee CH, Luan H, Jeong J, Cheng H, Kim GT, HAn SY, Lee JW, Kim J, Cho M, Miao F, Yang Y, Jang HN, Flavin M, Liu H, Kong GW, Yu KJ, Rhee SI, Chung J, Kim B, Kwak JW, Yun MH, Kim JY, Song YM, Paik U, Zhang Y, Huang Y, Rogers JA. Soft Network Composite Materials with Deterministic, Bio-Inspired Designs. *Nature Communications, 6, 6566, 2015.*

Jin-Sung Park, MD

Invited Investigator
(KNUCH, Professor)

Neuromuscular Disease And Motor Neuron Diseases
Kyungpook National University,
Kyungpook National University Chilgok Hospital
Department Of Neurology

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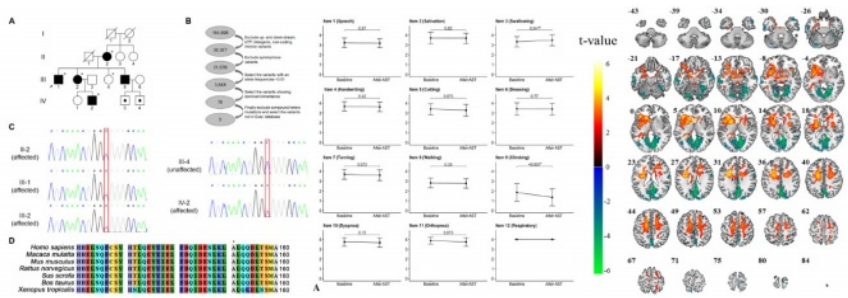
Clinico-genetic relationship and treatment of rare neuromuscular disease and motor neuron disease

The goal of my research is to understand and correlate the clinical and genetic relationship in rare neuromuscular and motor neuron disease. The final goal is to establish the most appropriate target and apply them to pre-clinical and clinical trials in rare neurological diseases.

Aim	In-depth research of the patho-mechanism based on genetic backgrounds in neurological rare disease
Tool	Next generation sequencing, pathology, neuro-imaging and electrophysiology
TARGET	

Curriculum Vitae

2017~Present : Assistant Professor in Kyungpook National University, Kyungpook National University Chilgok hospital
2014~2017 : Clinical Professor at Kyungpook National University Hsopital
2013 : Completed fellowship in Pusan National University Yangsan Hospital
2011 : Obtained Master`s degree in Neurology at Kyungpook National University School of Medicine
2007-2012 : Completed Internship and Residency in Department of Neurology of Kyungpook National University Hospital
2007 : Graduated Kyungpook National University School of Medicine

Awards/Honors/Memberships

2020 ~ Present : Editorial Board of Korean Journal of Korean Neurological Association
2019 ~ Present : Insurance director of Korean society of Neuromuscular Disorders
2019 ~ Present : Anticorruption & Civil rights director of Korean Clinical Neurophysiology Association
2018-2020 : Academic Committee of Korean Clinical Neurophysiology Association
2016 : Senate member of Korean Clinical Neurophysiology Association
2012 : Member of the Korean Neurological Association
2020 : Best Presentation Award at Korean society of Neuromuscular Disorder
2010, 2017, 2019 : Best Presentation Award at Annual Korean Neurological Association

Research keyword

Neuromuscular disease, motor neuron disease, genetic neurological disease, neuro-imaging, gene therapy, clinical trials

Key techniques

Clinical trial assessment, next generation sequencing, neuro-imaging, neurophysiology

Research Interests/Topics

- Clinical and genetic relationship in genetic rare neuromuscular disease
- Gene based therapy application in amyotrophic lateral sclerosis and other genetic motor neuron disease

Research Publications (selected)

- Kang MG, Gwak DW, Cho HJ, min YS, **Park JS**. Effect of leuprorelin in bulbar function of spinal and bulbar muscular atrophy patients: observational study for 1 year. *J Neurol 2021;doi: 10.1007/s00415-021-10503-y*
- Oh SI, Oh J, Park D, Son K, **Park JS**. Reliability and Validity of the Korean Version of the Spinal and Bulbar Muscular Atrophy Functional Rating Scale. *J Clin Neurol. 2020;16:586-591.*
- Park JM, Lee B, kim JH, Park SY, Yu J, Kim UK, **Park JS**. An autosomal dominant ERLIN2 mutation leads to a pure HSP phenotype distinct from the autosomal recessive ERLIN2 mutations (SPG18). *Sci Rep 2020;10:3295*
- Park JM, Kim SY, Park D, **Park JS**. Effect of edaravone therapy in Korean amyotrophic lateral sclerosis (ALS) patients. *Neurol Sci 2020;41:119-123.*
- **Park JS**, Song H, Jang KE, Cha H, Lee SH, Hwang SK, Park D, Lee HJ, Kim JY, Chang Y. Diffusion tensor imaging and voxel-based morphometry reveal corticospinal tract involvement in the motor dysfunction of adult-onset myotonic dystrophy type 1. *Sci Rep 2018;8:15592.*
- **Park JS**, Seo J, Song HJ, Lee SH, Jang KE, Lee HJ et al. Altered power spectral density in the resting-state sensorimotor network in patients with myotonic dystrophy type 1. *Sci Rep 2018;8:987.*
- **Park JS**, Park D. The terminal latency of the phrenic nerve correlates with respiratory symptoms in amyotrophic lateral sclerosis. *Clin Neurophysiol 2017;128:1625-1628.*

Sung Bae Lee, PhD

Invited Investigator
(DGIST, Professor)

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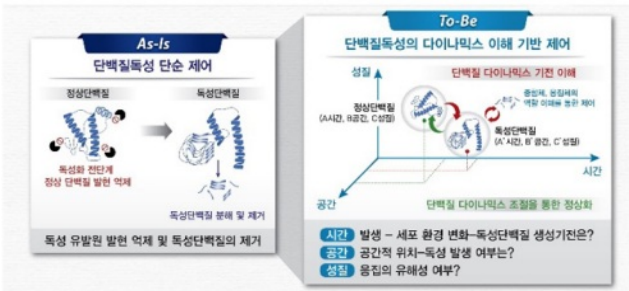
Lab of Neurodegenerative diseases and Aging

The primary goal of our research is to reveal the cellular and molecular basis of neurodegenerative diseases and neuronal aging. For this, we use disease model systems such as fruit flies (Drosophila Melanogaster) and mammalian cell culture.
In a collaboration basis, these neuronal changes are further analyzed by systems biology.
Notably, many neurodegenerative diseases are often associated with obvious and specific neuronal abnormalities during early stage of the diseases that precede massive neuronal cell death.
But, our understanding on the molecular details and the clinical implications of these neuronal abnormalities is very limited since most of related researches focus primarily on the neuronal cell death observed in the late stage of the diseases that may not account for the early symptoms.
So, our ongoing approach based on this unique research angle will provide invaluable clues to understanding these diseases and also will contribute to the future development of new and effective treatments..

Aim	Unveiling Cellular and Molecular Basis of Neurodegenerative diseases and Neuronal Aging
Tool	Molecular & Cellular Biology, Neurogenetics, Imaging, Behavior Monitoring
TARGET	

Curriculum Vitae

2012~Present : Professor, DGIST
2021~Present : Dept. Chair, DGIST
2018-2019 : Associate Vice President for External and International Affairs, DGIST
2012 : Associate Specialist, UCSF/HHMI
2007~2012 : Postdoctoral Fellow, UCSF/HHMI
2005~2007 : Postdoctoral Fellow, KAIST

Academic Credential

2005 : Ph.D., Biological Sciences, KAIST
2001 : M.S., Microbiology, Seoul Nat'l University
1999 : B.S., Biological Sciences, Seoul Nat'l University

Awards/Honors/Memberships

2015~Present: Committee Member, KSBMB
2017-2018 : Naver 생화학백과사전 집필위원
2018 : Committee Member, KSBNS
2018-2019 : Academic Secretary, Korean Society for Drosophila
2018-2019 : Committee Member, KOGO
2017 : ISAMMA 2017, Invited Speaker
2017 : KSBNS, Invited Speaker
2016-2017: Committee Member, KSMCB
2016 : UKC2016, Invited Speaker
2016 : 경암바이오유스캠프 Invited Speaker
2015 : 식품의약품안전처 신종유해물질팀 자문위원

Research keyword

Neurodegenerative diseases, Neuronal aging, Neuronal maintenance, Local organelles, Dendrites, Protein toxicity

Key techniques

Conventional imaging, Advanced imaging, Genetics, Genomics, Biochemistry & Molecular Biology

Research Interests/Topics

- What is the "cellular basis" of neurodegenerative diseases?
- How can we ameliorate the toxicity of aggregated proteins associated with neurodegenerative diseases?
- What's the relationship between neural cellular aging and late-onset neurodegenerative diseases?
- What's the physiological consequence of altered cellular ion & mRNA homeostasis?

Research Publications (selected)

- Park et al.Cytosolic calcium regulates cytoplasmic accumulation of TDP-43 through Calpain-A and Importin a3. *eLife.2020.*
- Han et al. NF-κB disinhibition contributes to dendrite defects in fly models of neurodegenerative diseases. *JCB.2020.*
- Kwon et al. Coiled-coil structure-dependent interactions between polyQ proteins and Foxo lead to dendrite pathology and behavioral defects. *PNAS.2018.*
- Chung et al. Mechanisms of protein toxicity in neurodegenerative diseases. *CMLS.2018.*
- Chung et al. Golgi outpost synthesis impaired by toxic polyglutamine proteins contributes to dendritic pathology in neurons. *Cell Reports.2017.*

Jinsoo Seo, PhD

Invited Investigator
(DGIST, Professor)

Dept. of Brain and Cognitive Sciences
Daegu Gyeongbuk Institute of Science and Technology (DGIST)

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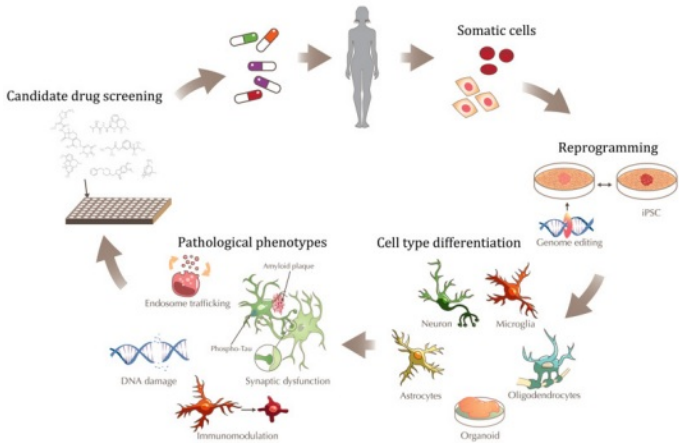
Fax : +82-53-785-6109
E-mail : jsseo@dgist.ac.kr

Mechanisms of Cellular Dysfunction and Cognitive Decline in Alzheimer's disease

Our group aim to reveal the mechanisms of cellular dysfunction in Alzheimer's disease by investigating the effects of disease-associated genetic and environ-mental risk factors using human-induced pluripotent stem cells (hiPSCs) and the CRISPR/Cas9 genome editing tool.



We are also searching key factors differentiating cognitively impaired aged brains from the high-functioning. Furthermore, we investigate how they initiate or accelerate age-associated cellular dysfunction and cognitive decline.

Curriculum Vitae

2017~Present : Assistant Professor, DGIST
2015~2017 : Research Scientist, MIT, USA
2014~2015 : Postdoctoral Associate, MIT, USA
2011~2013 : HHMI Postdoctoral Fellow, MIT, USA

Academic Credential

2011: Ph.D., School of Dentistry, Seoul National University
2008: M.S., School of Dentistry, Seoul National University
2006: B.S., Life Science, Yonsei University

Awards/Honors/Memberships

2018. Chung-am Science Fellowship, POSCO TJ Park Foundation
2018 APSN Young Investigation Colloquia Award
2018 Japan Neuroscience Society Travel Award
2017 Infinite K Award, MIT, School of Science
2014 Postdoctoral Fellowship Award, Korea Research Foundation
2008 Seoul Science Fellowship
2006 Academic Excellence and Achievement Scholarship, Yonsei University

Research keyword

Alzheimer's disease, human iPSC, CRISRP/Cas9 genome editing, genetic disease risk factors

Key techniques

hiPSC culture, Human neurons and glia generation, Human cerebral organoids generation, CRISPR/Cas-9 genome editing, Electrophysiology.

Research Interests/Topics

- Mechanisms of cellular dysfunctions and cognitive decline in neurodegenerative disease
- Studying the role of genetic risk factors for neurodegenerative diseases
- To explore the effects of environmental factors on neurodegenerative diseases

Research Publications (selected)

- Lee SI, Jeong W, Lim H, Cho S, Lee H, Jang Y, Cho J, Bae S, Lin YT, Tsai LH, Moon DW, **Seo J**. ApoE4-carrying human astrocytes oversupply cholesterol to promote neuronal lipid rafts expansion and Aβ generation. *Stem Cell Reports doi.org/10.1016/j.stemcr.2021.07.017*
- Lin YT*, **Seo J***, Gao F, Feldman HM, Wen HL, Penney J, Cam HP, Gjoneska E, Raja WK, Cheng J, Rueda R, Kritskiy 0, Abdurrob F, Peng Z, Milo B, Yu CJ, Elmsaouri S, Dey D, Ko T, Yankner BA, Tsai LH. APOE4 causes widespread molecular and cellular alterations associated with Alzheimer disease phenotypes in human iPSC-derived brain cell types. *Neuron, 98(6);1141-1154, 2018.*
- **Seo J*,** Kritskiy O*, Watson LA, Barker SJ, Dey D, Raja WK, Lin YT, Ko T, Cho S, Penney J, Silva MC, Sheridan SD, Lucente D, Gusella JF, Dickerson BC, Haggarty SJ, Tsai LH. Inhibition of p25/Cdk5 Attenuates Tauopathy in Mouse and iPSC Models of Frontotemporal Dementia. *J Neurosci., 37(41):9917-9924, 2017.*

Jun Soo Kwon,
MD, PhD

Invited Investigator
(SNU, Professor)

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Seoul National University

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E-mail : kwonjs@snu.ac.kr

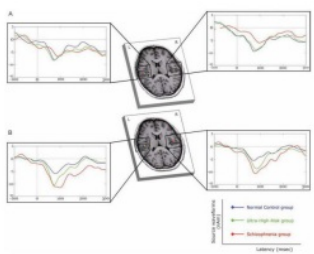
Clinical Cognitive Neuroscience Center (http://neuroimage.net)

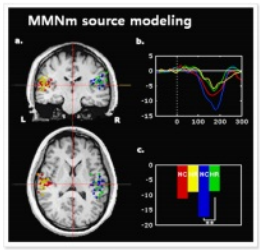
Goal of Our Approach

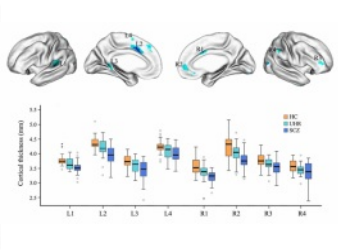
Our aim is to study fundamental mechanisms of cognitive functions in normal subject and the pathological conditions such as Schizophrenia and Obsessive-Compulsive Disorder (OCD). We also investigate the biomarkers for conversion to psychosis in the high risk subjects for psychosis and develop effective treatments for brain disorders. By comprehensive understanding of brain function with multi-modal imaging such as MRI, fMRI, DTI, PET and MEG, we want to contribute to maintaining the mental health of the public and enhancing human beings with the healthier life.

Research Interests and Topics

- Schizophrenia and High risk for psychosis
  - The mechanisms of schizophrenia onset
  - Early diagnostic methods by researching high-risk groups in their prodromal phase.







- Obsessive-Compulsive Disorder
  - Reward mechanism, functional brain abnormalities, and treatment mechanisms
  - Computer based cognitive rehabilitation.

Curriculum Vitae

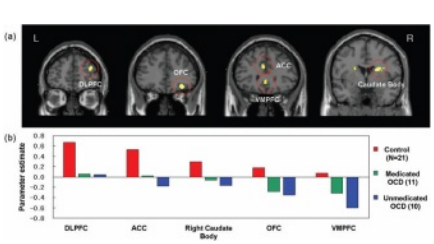
1994~Present : Professor of Psychiatry, Seoul National University, Korea
2011-Present : Director, Clinical Cognitive Neuroscience Center, Seoul National University Hospital
2016-Present : member, The Korean Academy of Science and Technology
2019-Present : Adjunct Scholar, KBRI, Korea

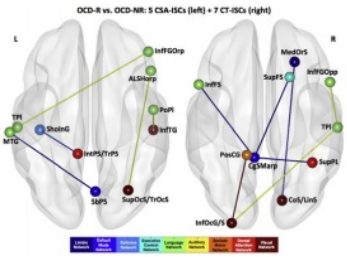
Academic Credential

1996-1998 : Psychiatry, Harvard Medical School, Visiting Assistant Professor
1994 : Ph.D., Psychiatry, Seoul National University, Korea
1988 : M.S., Pharmacology, Seoul National University, Korea
1984 : M.D., Seoul National University Medical School, Korea

Awards/Honors/Memberships

2018-2019: President, Korean Neuropsychiatric Association (KNPA)
2008-Present: Councilor, CINP
2010~2016: Chair, Dept. Psychiatry, Seoul National University Hospital
2013: Asan Medical Award, ASAN Foundation
2009: Bunch Medical Award, Korean Medical Association





Research Publications (selected)

- Cho KIK, Kwak YB, Hwang WJ, Lee J, Kim M, Lee TY, **Kwon JS**. Microstructural changes in higher-order nuclei of the thalamus in patients with first-episode psychosis. *Biol. Psychiatry., 1;85(1):70 , 78, 2019.*
- Jung WH, Lee TY, Yoon YB, Choi CH, **Kwon JS**. Beyond domain-specific expertise: neural signatures of face and spatial working memory in Baduk (Go Game) experts. *Front Hum. Neurosci., 7:12:319, 2018.*
- Kim M, Lee TH, Kim JH, Hong H, Lee TY, Lee Y, Salisbury DF, **Kwon JS**. Decomposing P300 into correlates of genetic risk and current symptoms in schizophrenia: An inter-trial variability analysis. *Schizaphr. Res., 192:232-239, 2018.*
- Lee TY, Lee J, Kim M, Choe E, **Kwon JS**. Can we predict psychosis outside the clinical high-risk for psychosis? A systematic review of clinical risk syndromes for emergent non-psychotic mental disorders. *Schizaphr.Bull., 44(2): 276 , 285, 2018.*
- Lee J, Yoon YB, Wijtenburg SA, Rowland LM, CHen H, Gaston FE, Song IC, Cho KIK ,Kim M, Lee TY, **Kwon JS.** Lower glutamate level in temporo-parietal junction may predict a better response to tDCS in schizophrenia. *Schizaphr. Res., 201:422 , 423, 2018.*

Jinseop S. Kim, PhD

Invited Investigator
(SKKU, Professor)

Department of Biological Sciences,
Sungkyunkwan University (SKKU)

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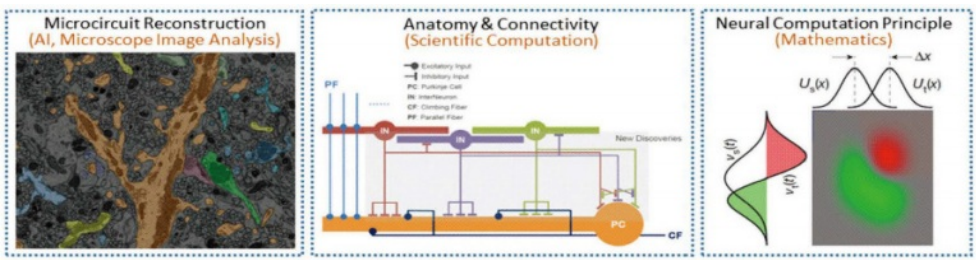
E-mail : jinseopkim@skku.edu
http://sites.google.com/view/cnsl-skku

Connectomics and computational neuroscience

Computational Neuroscience is a study based on the assumption that the brain is a biological computer. To truly understand a computer (brain), we need to understand the functions of its logic gates (neurons) and their wiring (neuronal circuits) that yields higher level functions, in a bottom-up manner. Historically, computational neuroscience has striven to suggest mathematical models of the neural computations based on biological and physiological experiments and thus to produce theoretical foundations for understanding the brain functions—firstly for individual neurons and then for neuronal circuits. Connectomics inherits and realizes these ideas by considering the ultrastructural connection specificity and the complete population of neurons in circuits—firstly for small samples or regions of the brain and ultimately for the entire brain. In our lab we observe the 3D structure of neurons and their connectivity from high-resolution images obtained by serial electron and light microscopes. We use deep learning artificial intelligence and other computational techniques to analyze the images. We mathematically model the functions of neural networks from the activity of neurons in the circuit.

Aim	Discovery of the fundamental principles of neural computation in microcircuits
Tool	Computer Engineering + Artificial Intelligence & Scientific Computation + Mathematics



Curriculum Vitae

2019~Present : Assistant Professor, SKKU
2015~2019 : Principal Researcher, KBRI
2014~2015 : Postdoctoral Associate, Princeton Univ., USA
2010~2014 : Postdoctoral Associate/Fellow, MIT, USA
2010 : Visiting Postdoctoral Associate, SNU, Korea

Academic Credential

2010 : Ph.D., Physics, SNU
2005 : M.S., Physics, SNU
2000 : B.S., Physics, SNU

Awards/Honors/Memberships

2016~Present : Board of Director, Korean Society for Computational Neuroscience
2016~Present : Member, Korean Society for Brain and Neuroscience
2018~Present : Editorial Board, Experimental Neurobiology

Research keyword

Connectomics, Neural Computation, Neural Microcircuit, ICT, Artificial Intelligence

Key techniques

1) Software engineering technologies including artificial intelligence and image processing for the analyses of neural microscope images
2) Computational and data-science approaches to investigate the anatomy of neural cells and circuits
3) Mathematical methods to study the physiological activity and the information processing of neural circuits

Research Interests/Topics

- Anatomical studies on neural cells and connectome through the analyses of high-resolution neural microscope images
- Investigation on the functions and neural computation principles via the theoretical study of neural microcircuits

Research Publications (selected)

- Bae JA*, Mu S*, **Kim JS***, Turner NL*, artavull I, Kemnitz N, Jordan CS, Norton AD, Silversmith WM, Prentki R, Sorek M, David C, Jones DL, Bland D, Sterling ALR, Park J, Briggman KL, Seung HS, EyeWirers. Digital Museum of Retinal Ganglion Cells with Dense Anatomy and Physiology. *Cell, 173(5):1293-1306, 2018.* (*equal contribution)
- Greene MJ*, **Kim JS***, Seung HS, EyeWirers. Analogous Convergence of Sustained and Transient Inputs in Parallel On and Off Pathways for Retinal Motion Computation. *Cell Rep., 14(8):1892-1900, 2016.* (*equal contribution)
- **Kim JS***, Greene MJ*, Zlateski A, Lee K, Richardson M, Turaga SC, Purcaro M, Balkam M, Robinson A, Behabadi BF, Campos M, Denk W, Seung HS, EyeWirers. Space-time wiring specificity supports direction selectivity in the retina. *Nature, 509(7500):331-336, 2014.* (*equal contribution)

PATENT

- Kim GT, Rah JC, **Kim JS,** Bahn SK, Apparatus for photographing synapse image and operating method thereof. (Application No. 10-2018-0038831, Date 2018/04/03)

Jin Young Kim, PhD

Invited Investigator
(KBSI, Principal Investigator)

Research Center for Bioconvergence Analysis
Korea Basic Science Institute (KBSI)

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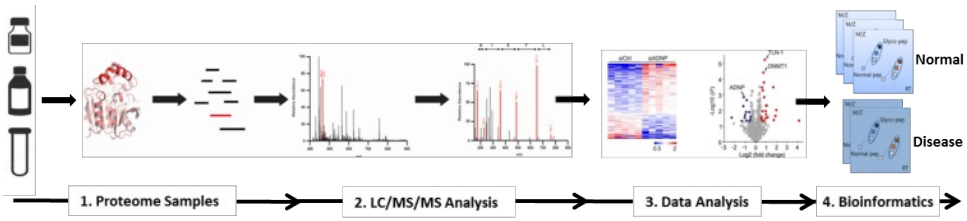
http://kbsi.re.kr

Mass Spectrometry based Proteomics

The goal of my research is to development of analytical methods using mass spectrometry to conduct integrative proteomics. Proteome is downstream of genome and transcriptome in the closest proximity to the phenotype, reflecting the dynamic interactions between the genotype and the environment that determine health and disease. High-throughput proteomic technologies compliment genomic and transcriptomic approaches providing further insights into the complex nature of disease and contributing to the development of personalized medicine. Since most cellular functions, regulatory switches, signal transducers, and structural components are composed of proteins, characterizing the proteins expressed by a cell can give important clues to the function, organization, and responsiveness inherent in a cell. By defining the variation between different cells, and between cells exposed to different stimuli, we can gain an understanding of cellular adaptation to environmental signals, mechanisms of cellular differentiation and organismal development, cellular aspects of disease processes, and difference between individuals within a species. We plan to conduct integrative proteomic analyses using non-targeted and targeted approach.

Aim	Development of Proteomics Platform
Tool	Nanoflow LC-MS/MS, Shotgun proteomics, Quantitative proteomics



Curriculum Vitae

1993-present : Principal Researcher, KBSII
2015-2020 : Research center for bio-convergence analysis, Head
2007~2009 : Postdoctoral Fellow, The Scripps Research Institute, SanDiego, USA

Awards/Honors/Memberships

2018 : Awards for contribution to scientific development of Korea
2007/2008 : Awards for year's research paper
2014-present : Committee member of The Korean Human Proteome Organization
2018-2019 : Committee member of Korean Chemical Society
2020-present : Associated Editor, Journal of Analytical Science and Technology

Academic Credential

2002 : Ph.D., Analytical Chemistry, Yonsei University
1993 : M.S., Analytical Chemistry, Yonsei University

Research keyword

Proteomics, Mass spectrometry, Biomarker, Precision medicine

Key techniques

Nanoflow LC-MS/MS, Shotgun proteomics, Quantitative proteomics

Research Interests/Topics

- Development of proteomic technology
- Post translational modification proteomics
- Proteogenomiocs

Research Publications (selected)

- Hwang H, Im JE, Yang Y, Kim H, Kwon KH, Kim YH, **Kim JY***, Yoo JS. Bioinformatic Prediction of Gene Ontology Terms of Uncharacterized Proteins from Chromosome 11. *J Proteome Res. doi: 10.1021/acs.jproteome.0c00482, 2020.*
- Kim KH, Lee SY, Kim DG, Lee SY, **Kim JY***, Yoo JS. Absolute Quantification of N-Glycosylation of Alpha-Fetoprotein Using Parallel Reaction Monitoring with Stable Isotope-Labeled N-Glycopeptide as an Internal Standard. *Anal Chem. doi: 10.1021/acs.analchem.0c02563. 2020.*
- Park GW, Lee J, Lee HK, Shin JH, **Kim JY***, Yoo JS. Classification of Mucin-Type O-Glycopeptides Using Higher-Energy Collisional Dissociation in Mass Spectrometry. *Anal Chem. doi: 10.1021/acs.analchem.0c01218. 2020.*

PATENT

- Kim JY, Park GW, Ji ES, Yoo JS, MASS SPECTROMETRY BASED BIOINFORMATICS PLATFORM FOR HIGHTHROUGHPUT IDENTIFICATION OF GLYCATION PROTEINS AND ADVANCED GLYCATION ENDPRODUCTS (Application number 16296154) 2021, USA

Hyo Jung Kang, PhD

Invited Investigator
(CAU, Professor)

Department of Life Science,
Chung-Ang University (CAU)

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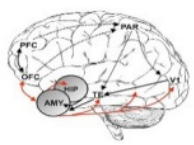
Molecular Neurogenomics of Brain development and Mental disorders

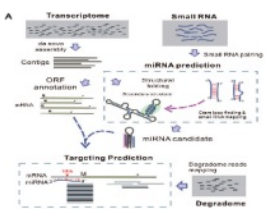
Research in our laboratory is focused on understanding how the transcriptome as a whole contributes to the development, structure, and function of the central nervous system. Our knowledge of genetic mechanisms controlling the brain formation and pathological disruption of the neural circuits is impeded by a lack of comprehensive data on the brain transcriptome. Thus, to reveal the genetic regulatory mechanisms involved in brain development and function, it is essential to first elucidate the transcriptional modalities specifically active during normal and abnormal brain development. The distinct characteristic feature of the brain compared to other systems is complexity in their structure and function, which is required to study as multidimensional approaches.

Aim	Understanding the functional gene network associated with brain development and disorders
Tool	Big data + Weighted gene co-expression network + mouse behavior

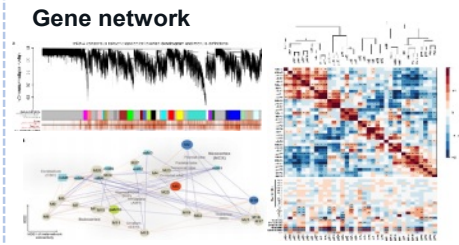
Multi-brain region transcriptome analysis



Brain areas involved in cognition-emotion interactions



Gene network



Curriculum Vitae

2016~Present : Associate Professor, Chung-Ang University
2013~2015 : Assistant Professor, Chung-Ang University
2009~2013 : Associate Research Scientist, Yale University, School of Medicine USA
2004~2009 : Postdoctoral Associate, Yale University, School of Medicine USA

Academic Credential

2003 : Ph.D, Neuroscience, Ajou University, School of Medicine
1997: M.S. Biological Sciences, Ewha Womans University
1995: B.S. Biological Sciences, Ewha Womans University

Awards/Honors/Memberships

2021~Present : Editorial Board Member, Molecules and Cells
2015 : Young Scientist Award, Japan Neuroscience Society
2012 : Green-Cross Fellowship, KASBP, USA
2004 : Travel Grant Award, Alzheimer's Association
2004 : Post-doctoral Fellowship, KOSEF

Research keyword

Brain development, Psychiatric disorders, Transcriptome, Co-expression gene network

Key techniques

Big data analysis, Weighted gene co-expression network analysis, NGS, Mouse behavior, Live cell imaging, Primary culture

Research Interests/Topics

- Study on changes in brain transcriptome network and regulation of the biological function of major networks in brain development and mental illness.
- Characteristics of the immune response in the central nervous system.

Research Publications (selected)

- Choi K, Lee J and **Kang HJ.** Myelination defects in the medial prefrontal cortex of Fkbp5 knock mice. *The FASEB Journal 35(2):e21297. 2021.*
- Li M, Santpere G, Imamura Kawasawa Y, Evgrafov OV, Gulden FO, Pochareddy S, Sunkin SM, Li Z, Shin Y, Zhu Y, Sousa AMM, Werling DM, Kitchen RR, **Kang HJ**, et al., BrainSpan Consortium and PsychENCODE Consortium. Integrative functional genomic analysis of human brain development and neuropsychiatric risks. *Science 362(6420): eaat7615. 2018.*
- Olmos-Serrano JL#, **Kang HJ#**, et al.,Down Syndrome developmental brain transcriptome reveals defective oligodendrocyte differentiation and myelination. *Neuron 89:1-15. 2016.* (#, co-first)
- **Kang HJ,** et al., Decreased expression of synapse-related genes and loss of synapses in major depressive disorder. *Nat. Med 18:1413-1417. 2012.* (516 citations)
- **Kang HJ,** et al., Spatio-temporal transcriptome of the human brain. *Nature 478:483-489. 2011*. (Recommended by F1000Prime, 1507 citations)

Patents (selected)

- Biomarkers for diagnosis or prediction of post-traumatic stress disorder and uses thereof (10-2019-0058902), 2019, Republic of Korea.

SangYun Kim,
M.D.&Ph.D

Invited Investigator
(SNU, Professor)

Clinical Neuroscience Center
Department of Neurology
Seoul National University Bundang Hospital
Seoul National University College of Medicine

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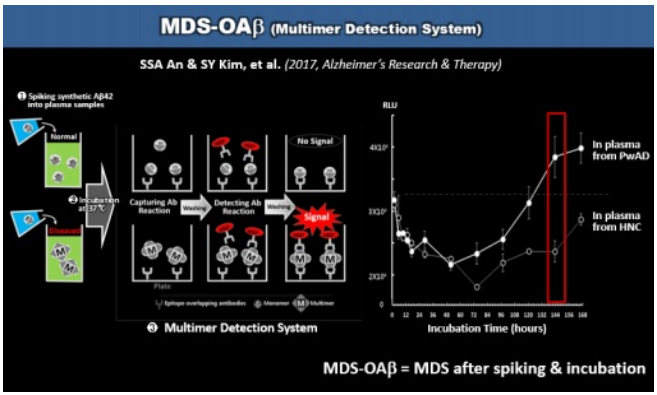
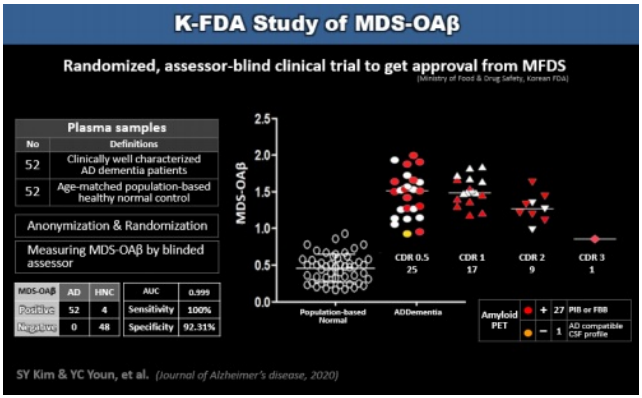
Diagnosis and treatment of neurodegenerative disease

- Alzheimer's disease and related disorders
- Parkinson's disease and related disorders
- Vascular cognitive disorders
- Prionopathies

Blood-based biomarkers of Alzheimer's disease





Curriculum Vitae

1998-Now Professor of Neurology, Seoul National University College of Medicine
Neurologist of Seoul National University Hospital (-2003) & Seoul National University Bundang Hospital, Clinical Neuroscience Institute
1998-1998 Research fellow in Columbia Presbyterian MC, NY, U.S.A.
1992-1998 Professor of Neurology, Hallym University College of Medicine Neurologist of Hallym University Hangang Sacred Heart Hospital & Hallym University Gangnam Sacred Heart Hospital
1989-1992 Residency of Neurology in Seoul National University Hospital

Academic Credential

1998 Ph.D. degree from Seoul National University Postgraduate School
1991 Master degree from Seoul National University Postgraduate School
1985 M.D. Seoul National University College of Medicine

Awards/Honors/Memberships

- Honorary president
  Korean Dementia Association
- Member of board of director
  Alzheimer Association
  VasCog Society
  Asian Society Against Dementia

Research Interests/Topics

Clinical (Geriatric Neurology)

- Alzheimer's disease and related disorders
- AD Control
- Parkinson's disease and related disorders
- Vascular cognitive impairment disorder
- Human prionopathies

Basic (Neurodegenerative proteinopathy)

- Biomarkers of Neurodegenerative proteinopathy
- Mechanisms of Neurogenerative diseases
- Clinical Genetics in dementia

Research Publications (selected)

- Han SW. Park YH. Ryoo NY. Kim KT. Pyun JM. **Kim SY**. Idiopathic normal pressure hydrocephalus with synucleinopathy: diagnosis and treatment. *Neurology 2021. (Accepted)*
- Suh J. Park SY. Park YH. Pyun JM. Ryoo NY, Kang MJ. **Kim SY.** Misplacement of something inside the refrigerator is not the sign of dementia: A probable symptom of attention deficit due to depression. *Scientific report 2021. (Accepted)*
- Choi Y. Joh YC. Ryu JS . Kim K. Seo D. **Kim SY.** Endogenous Aβ peptide promote Aβ oligomerization tendency of spiked synthetic Aβ in Alzheimer's disease plasma. *Molecular and Cellular Neuroscience 2021; 111: 103588.*
- JPyun JM. Ryoo NY, Park YH. **Kim SY**. Change in cognitive function to cholinesterase inhibitor use and amyloid PET in mild cognitive impairment. *Alzheimer's Research & Therapy 2021: 13:10*
- Han SH; Pyun JM; Yeo S; Kang DW; Jeong HT; **Kim SY**; Youn YC . Differences between encoding and retrieval failure in mild cognitive impairment: results from quantitative electroencephalography and magnetic resonance volumetry. *Alzheimer's Research & Therapy 2021; 13:3*

Woong Sun, PhD

Invited Investigator
(KUCM, Professor)

Department of Anatomy,
Korea University College of Medicine

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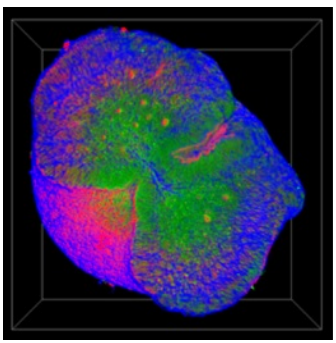
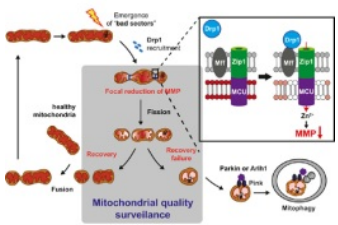
E-mail : woongsun@korea.ac.kr
http://woongsun53.wixsite.com/website

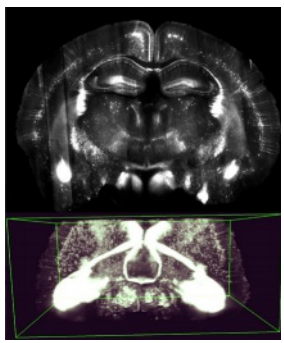
From organelle to organ biology for understanding brain development

The goal of my research is to understand the mechanisms of the morphogenesis and differentiation of neural cells and circuit integration during the embryonic CNS development. Currently I am focusing on the brain organoid production and their application to the understanding the human development and related diseases. I am also interested in the mitochondrial dynamics in the cells, which may serve for important mediators of the health and function of the cells. With the collection of these diverse research interests, I want to achieve novel discoveries which may greatly impact the unknown world of brain science.

Aim	Understanding human brain development using 3D culture of neural cells in vitro
Tool	Brain Organoids, mitochondria Live imaging, 3D histology







Curriculum Vitae

2009 ~ Present : Professor, KUCM
2009 ~ 2010 : Visiting Professor, Dept of Ophthalmology, UCSD
2000 ~ 2002 : Post-doc, Dept of Neurobiology and Anatomy, Wake Forest University School of Medicine North Carolina, USA (Oppenheim Lab)
1997 ~ 2000 : Post-doc, Dept of Biochemistry Osaka University School of Medicine, Japan(Nakamura Lab)

Academic Credential

1997 : Ph.D, Molecular Biology, SeoulNational Univ.
1993 : MS, Molecular Biology, SeoulNational Univ.
1991 : Bs, Molecular Biology, SeoulNational Univ.

Awards/Honors/Memberships

2020 : Pfizer Medical Research Award
2017 ~ 2019: International Brain Research Organization(IBRO) Local Organizing Committee member
2016 ~ Present : Council member of Asian-Pacific Society for Neurochemistry (APSN), and Korean Society for Brain and Neural Science (KSBNS)
2015 : Chair of School Committee for Asian-Pacific Society for Neurochemistry
2015 ~ Present : Editorial board member of Mol Cells (SCI Journal) and Animal Cells Sys (SCIE Journal)

Research keyword

Develoment, Spinal cord, Neural circuit, mitochondrial dynamics

Key techniques

3D imaging based on the tissue clearing techniques, Live cell imaging, Neural organoid culture, Molecular cell biology, Biochemistry, histological analyses.

Research Interests/Topics

- Recapitulation of brain development in vitro using hPSC-based organoid technology
- Development of new techniques for the advanced histological analysis
- Mitochondiral dynamics in neurons.

Research Publications (selected)

- Wulansari N, Wahyu Handoko Wibowo Darsono, Woo HJ, Chang MY, Kim JI, Bae EJ, **Sun W,** Lee JH, Cho IJ, Shin HG, Lee SJ, Lee SH. Neurodevelopmental defects and neurodegenerative phenotypes in human brain organoids carrying Parkinson's disease-linked DNAJC6 mutations. *Science Advances., 7(8):1-18, 2021.*
- Ryu JR, Kim JH, Cho HM, Jo YH, Lee BR, Joo SH, Chae UK, Nam YK, Cho IJ, **Sun W**. A monitoring system for axonal growth dynamics using micropatterns of permissive and Semaphorin 3F chemorepulsive signals. *Lab on A Chip., 19:291-305, 2019.*
- Cho HM, Ryu JR, Jo YH, Seo TW, Choi YN, Kim JH, Chung JM, Cho BK, Kang HC, Yu SW, Yoo SJ, Kim H, **Sun W.** Drp1-Zip1 interaction regulates mitochondrial quality surveillance system. *Molecular cell., 73(2):364-376, 2019*
- Lee ES, Kim HJ, Ryu JR, Ham MS, Seo SH, Kim DH, Lee KW, Jung NC, Choe YS, Son GH, Rhyu IJ, Kim H, **Sun W.** High-performance acellular tissue scaffold combined with hydrogel polymers for regenerative medicine. *ACS Biomaterials Science & Engineering., 5(7):3462-3474, 2019.*
- Cho BK, Cho HM, Jo Yhm Kim DH, Song Mj, Moon CI, Kim HB, Kim KJ, Sesaki H, Kim H, **Sun W**. Constriction of the mitochondrial inner compartment is a priming event for mitochondrial division. *Nature communications.,8(1):1-17,2017.*

JaeHyung Koo, PhD

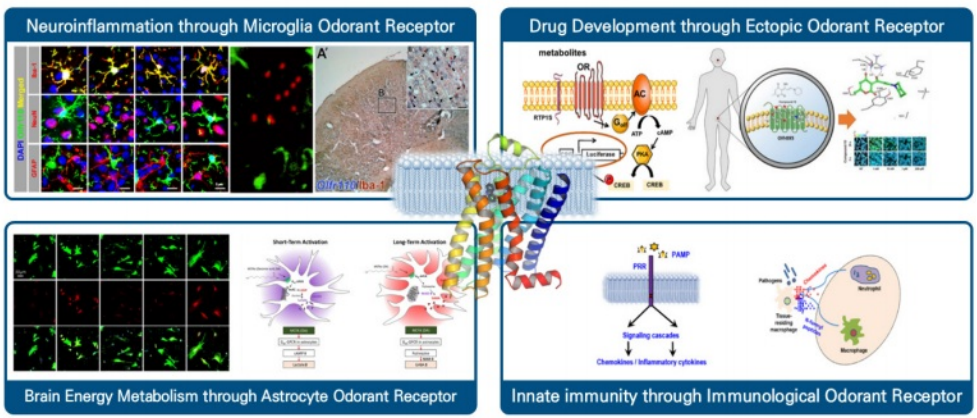
Invited Investigator
(DGIST, Professor)

Dept. of New Biology
Daegu Gyeongbuk Institute of Science and Technology (DGIST)

Office : Room 611, Building E4
Lab : Room 620, Building E4
Tel : +82-53-785-6112
Fax : +82-53-785-1819
E-mail : jkoo001@dgist.ac.kr
http://jkoo001.dgist.ac.kr

Ectopic Odorant Receptor's Lab

Odorant receptor (ORs) are the largest subfamily of G protein-coupled receptors (GPCRs), accounting for ~400 of more than 800 human GPCRs and 1,000 of an estimated 1,700 mouse GPCRs. ORs expressed in non-olfactory tissues of the body are called ectopic ORs. ORs can detect small metabolites in the brain and a variety of peripheral tissues, such as kidney, skin, and pancreatic tissues beyond the nose. They appear to have biological functions beyond smell perception, similar to those of common GPCRs. Furthermore, in the view of recent proposals to target ORs as therapeutic agents, we propose that ectopic ORs present targets, and their ligands as candidate drugs for the treatment of neuroinflammatory-related brain diseases as well as metabolic disorders. So, we are investigating the role of ectopic ORs, and applying the results to brain, metabolic, and inflammatory diseases.



Curriculum Vitae

2021~Present : Chair & Director, New Biology, DGIST
2021~Present : Director, New Biology Research Center (NBRC)
2017~2018 : Vice-President for Research Affairs, DGIST
2017~Present : Professor, New Biology, DGIST
2011~2016 : Visiting Professor, Johns Hopkins Sch. of Medicine
2010~2016 : Associate Professor, Brain/Cognitive Sciences, DGIST
2003~2008 : Assistant Professor, Univ. of Maryland Sch. of Medicine

Academic Credential

2000 : Ph.D, Biochemistry, Yonsei Univ.
1997 : MS, Biochemistry, Yonsei Univ.
1995 : BS, Biology, SungKyunKwan Univ.

Awards/Honors/Memberships

- 2017 DGIST Best Research Award
- 2016 1st DGIST Way Award
- 2017 General Secretary for KSBNS
- Editor for BMB Reports & Lab Anim Res.

Research Interests/Topics

- Brain/Microbiome/Pathogen Axis
- Host-Pathogen Interaction
- Immunology of Infectious Diseases
- Alzheimer's Disease

Research Publications (selected)

- Vadevoo, et al., The macrophage odorant receptor Olfr78 mediates the lactate-induced M2 phenotype of tumor-associated macrophages. *Proc. Natl. Acad. Sci. U.S.A. pnas.202102434.*
- Lee NH, et al., A pathogen-derived metabolite induces microglial activation via odorant receptor. *FEBS J. 287(17):3841-3870, 2020.*
- Cho TH, et al., Small-chain fatty acid activates astrocytic odorant receptor Olfr920. *Biochem Biophys Res Commun. 510: 383-387, 2019.*
- Lee NH, et al., Fatty Acid Increases cAMP-dependent Lactate and MAO-B-dependent GABA Production in Mouse Astrocytes by Activating a Gαs Protein-coupled Receptor. *Exp Neurobiol. 27(5):365-376, 2018.*
- Park BB, et al., Analogue of Dehydroacetic Acid as a Selective and Potent Agonist of Ectopic Odorant Receptor through a Combination of Hydrophilic and Hydrophobic Interactions. *ChemMedChem 12(7): 477-482, 2017.*
- Kim H, et al., MRPrimerV: A database of PCR primers for RNA virus detection. *Nucleic Acids Res. 45(D1): D475-D481, 2017.*
- Kim H, et al., MRPrimerW: A tool for rapid design of valid high-quality primers for multiple target qPCR experiments. *Nucleic Acids Res. 44(W1): W259-66, 2016.*

Jae-sung Bae,
DVM, PhD

Invited Investigator
(KNU, Professor)

Department of Physiology, School of Medicine,
Kyungpook National University (KNU)

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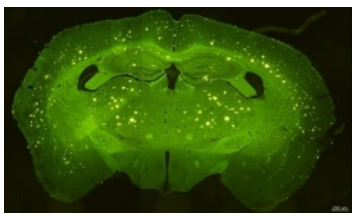
E-mail : jsbae@knu.ac.kr
http://kari.knu.ac.kr/

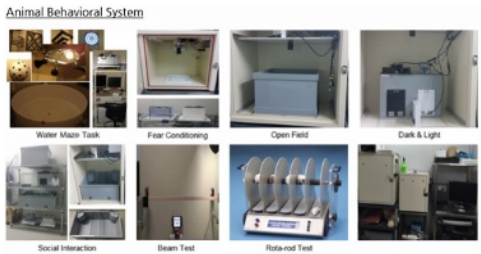
A Spotlight on novel pathogenesis & drug targets in Alzheimer's disease: Lessons from lipid metabolism

The global burden of Alzheimer's disease (AD), already the most common type of dementia, is expected to increase still further owing to population ageing. Current major challenges in AD include the lack of reliable biomarkers for its early diagnosis, as well as the lack of effective preventive strategies and treatments. Thus, increased understanding of the novel molecular pathogenesis of AD could lead to the development of improved diagnostic and therapeutic strategies. We are currently studying the development of biomarkers/therapeutics for AD in the context of novel neuropathological mechanisms including inflammation, immune responses, impairment of autophagy, and vascular dysfunction related with sphingolipid metabolism. The novel therapeutic strategies currently in development based on biological principles, especially two kinds of sphingolipid enzymes such as acid sphingomyelinase (ASM) and sphingosine kinase1 (SphK1), will provide promise for the development of a new generation of therapeutics to prevent and treat AD.

Aim	Discovery of the novel pathogenesis & therapeutics for Alzheimer's disease
Tool	Sphingolipid metabolism + Small molecule compounds + antibody + Animals and patients samples
TARGET	



AD mice brain



Curriculum Vitae

2007-Present : Professor, KNU
2017~2019 : Adjunct Professor, UNIST, Korea
2014~2021: Chair, Dept of Physiology, KNU
2005~2007 : Postdoctoral Fellow, UCL, London

Academic Credential

2005 : Ph.D., Veterinary Medicine, KNU
2003 : M.S., Veterinary Medicine, KNU
2001 : B.S., D.V.M., KNU

Awards/Honors/Memberships

2018 : Minister's Award, the Ministry of Health and Welfare
2016 : Award for 30 Young Scientist of Korea, POSTECH & Dong-A Daily
2015 : National R&D Outstanding Research Award, Ministry of Science, ICT and Future Planning
2015 : Bumsuk Award

Research keyword

Alzheimer's disease, Sphingolipid, Drug/biomaker development, Stem cells

Key techniques

Animal study (mice model, behavioral test, surgery etc), Ultra performance liquid chromatograph, Facs, Histological analysis, and Lipidomics

Research Interests/Topics

- Studying for novel pathogenesis, biomarkers, drug candidates of neurodegenerative disease by abnormal sphingolipid metabolism. The studies include molecular, biological, physiological and pathophysiological studies of sphingolipid metabolism in brain, blood, bone marrow and other organs

Research Publications (selected)

- N-AS-triggered SPMs are direct regulators of microglia in a mouse of Alzheimer's disease. *Nature Communications. 11:2358 | https://doi.org/10.1038/s41467-020-16080-4. 2020.*
- N,N'-Diacetyl-p-phenylenediamine restores microglial phagocytosis and improves cognitive defects in Alzheimer's disease transgenic mice. *PNAS. 116(47): 23426-23436. 2019.*
- Characterization of the subventricular-thalamo-cortical circuit in the Niemann-Pick type C mouse brain, and new insights regarding treatment. *Molecular Therapy. 27(8):1507-1526. 2019.*
- Vascular and neurogenic rejuvenation in aging mice by modulation of ASM. *Neuron. 100: 167-182. 2018.*
- Neuronal SphK1 acetylates COX2 and contributes to pathogenesis in a model of Alzheimer's Disease. *Nature Communications. doi:10.1038/s41467-018-03674-2. 2018.*
- Neuropeptide Y Induces Hematopoietic Stem/Progenitor Cell Mobilization by Regulating Matrix Metalloproteinase-9 Activity Through Y1 Receptor in Osteoblasts. *Stem Cells. 34(8):2145-2156. 2016.*

Byungheon Lee,
MD, PhD

Invited Investigator
(KNU, Professor)

Department of Biochemistry & Cell Biology,
School of Medicine,
Kyungpook National University (KNU)

Tel : +82-53-420-4824
Fax : +82-53-422-1466
E-mail : leebh@knu.ac.kr

Drug delivery crossing BBB

The goal of my research is to identify peptide probes that cross blood-brain-barrier (BBB) and deliver drugs to brain

Aim	Drug delivery crossing BBB
Tool	Identification of BBB-crossing peptide probes

Curriculum Vitae
2003~Present : Professor, KNU

Awards/Honors/Memberships
2007~Present : Member, American Association for Cancer Research
2020~Present : Member, National Academy of Medicine of Korea

Academic Credential
1995 : Ph.D, Biochemistry, Kyungpook National University

Research keyword
Peptide, Phage display, BBB, brain tumor, exosome

Key techniques
Phage display, drug delivery

Research Interests/Topics
- Identification of BBB-crossing peptide using phage display
- Drug delivery to brain using BBB-crossing peptides
- Targeted therapy against brain tumor

Research Publications (selected)

- A Peptide Probe Enables Photoacoustic-Guided Imaging and Drug Delivery to Lung Tumors in K-ras(LA2) Mutant Mice. *Cancer Research, 2019 Aug, 79(16), 4271-4282.*
- A Phage Display-Identified Peptide Selectively Binds to Kidney Injury Molecule-1 (KIM-1) and Detects KIM-1-Overexpressing Tumors in vivo. *Cancer Research and Treatment, 2019Jul, 51(3), 861-875.*
- Peptide-based targeted therapeutics and apoptosis imaging probes for cancer therapy. *ARCHIVES OF PHARMACAL RESEARCH. 2019 Feb;42(2):150-158*
- Non-genetic engineering of cytotoxic T cells to target IL-4 receptor enhances tumor homing and therapeutic efficacy against melanoma. *Biomaterials. 2018 Mar;159:161-173*
- Interleukin 4 receptor-targeted pro-apoptotic peptide blocks tumor growth and metastasis by enhancing anti tumor immunity. *Molecular Cancer Therapeutics. 2017 Dec;16(12):2803-2816*
- Interleukin-4 receptor-targeted delivery of Bcl-XL siRNA sensitizes tumors to chemotherapy and inhibits tumor growth. *Biomaterials. 2017 Oct 1;142:101-111*

In-Kyu Lee,
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Invited Investigator
(KNU, Professor)

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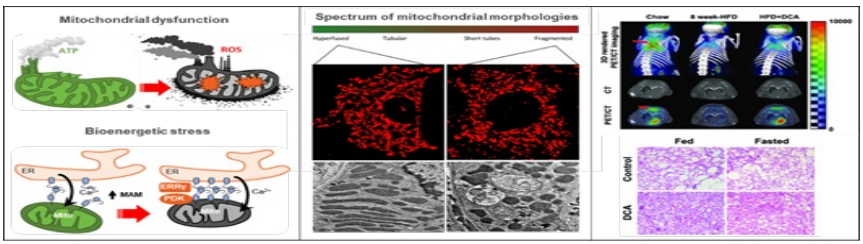
Molecular mechanisms and therapeutic strategies in metabolic syndrome

My lab is focused on the study of metabolic syndrome. Metabolic syndrome, a new non-communicable disease (NCD) has become the major health hazard of modern world, is defined by WHO as a pathologic condition fast reaching global pandemic proportions. My lab's main focus is to understand and unravel the complex biology of metabolic syndrome and to develop novel therapeutic approaches as well as to promote response to existing agents. Specifically, we have taken a comprehensive approach to study the altered cellular signaling pathways and metabolism via discovery of new targets and by using animal study and clinical evidence associated with this pathological condition. My group comprises of basic scientists and clinical fellows and we are actively engaged with international experts in this field of study.

Aim	Unraveling the key drivers of metabolic diseases to develop novel therapeutic strategies
Tool	Molecular and Cellular Biology, Signaling Pathways, In vivo models, Transcriptomics-Proteomics-Metabolomics
TARGET	

Curriculum Vitae

2012-2014 : Director, Bio-Medical Research Institute, Kyungpook National University Hospital, Daegu, Korea
2009~Present : Director, Research Institute of Aging and Metabolism, Kyungpook National University, Daegu
2005~Present : Professor, Section of Endocrinology, Dept. of Int. Med., Kyungpook National University Hospital, Kyungpook National University Medical School, Daegu, Korea

Academic Credential

1988 : Ph.D., School of Medicine, KNU
1985 : M.S., School of Medicine, KNU
1982 : M.D., School of Medicine, KNU
1978 : B.S., College of Liberal Arts and Sciences, KNU

Awards/Honors/Memberships

2016 : Minister of Health and Welfare's Commendation, Government Award for the Promotion of Health and Medical Technology Award in Excellence Research
2018 : President, Korean Diabetes Association
2009~Present : Associate Editor, Editorial Board, Journal of Diabetes Investigation(JDI)

Research keyword

Mitochondrial dysfunction; Mitochondrial dynamics; Metabolic Syndrome

Key techniques

- Cellular Imaging and molecular biological analysis
- Signal transduction pathway analysis and omics
- Drug design and targeted therapy
- In vivo models and pre-clinical trials

Research Interests/Topics

Understanding the complex biology of metabolic diseases at the cellular and molecular level
Discovering novel therapeutic targets and drug designing

Research Publications (selected)

- Singh TD, Song J, Kim J, Chin J, Ji HD, Lee JE, Lee SB, Yoon H, Yu JH, Kim SK, Yoon GS, Hwang H, Lee HW, Oh JM, Lee SW, Lee J, Choi HS, Na SY, Choi WI, Park YJ, Song YS, Kim YA, **Lee IK**, Cho SJ, Jeon YH. A novel orally active inverse agonist of estrogen-related receptor gamma (ERRγ), DN200434, a booster of NIS in anaplastic thyroid cancer. *Clin Cancer Res. 2019 Aug 15;25(16):5069-5081. doi: 10.1158/1078-0432.CCR-18-3007. 2019.*
- Thoudam T, Ha CM, Leem J, Chanda D, Park JS, Kim HJ, Jeon JH, Choi YK, Liangpunsakul S, Huh YH, Kwon TH, Park KG, Harris RA, Park KS, Rhee HW, **Lee IK.** PDK4 Augments ER-Mitochondria Contact to Dampen Skeletal Muscle Insulin Signaling During Obesity. *Diabetes. 2019 Mar;68(3):571-586. doi: 10.2337/db18-0363. 2018.*
- Park BY, Jeon JH, Go Y, Ham HJ, Kim JE, Yoo EK, Kwon WH, Jeoung NH, Jeon YH, Koo SH, Kim BG, He L, Park KG, Harris RA, **Lee IK.** PDK4 deficiency suppresses hepatic glucagon signaling by decreasing cyclic AMP levels. *Diabetes. 2018 Oct;67(10):2054-2068. doi: 10.2337/db17-1529. 2018.*

Je-Yong Choi,
DDS, PhD

Invited Investigator
(KNU, Professor)

Department of Biochemistry and Cell Biology
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Director, Center for Laboratory Animal Resources (CLAR) in KNU

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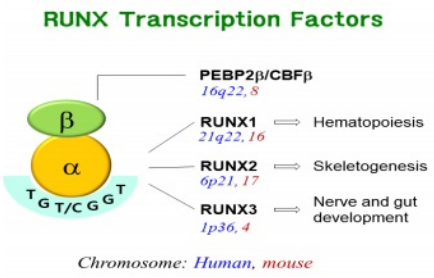
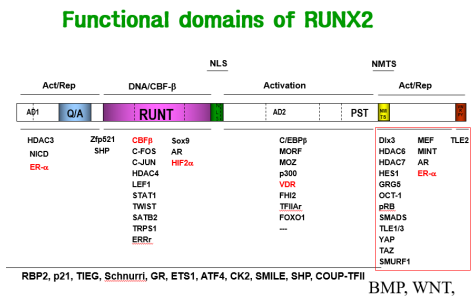
Bone Diseases Research Center

Our goal is to find out how bone cells are made and by which genes their unique functions are achieved. To do this, we are currently analyzing RUNX/CBFβ complex genes using various mouse genetic models. These efforts will be of great help in understanding the physiology of bone tissue as well as developing diagnostic methods and treatments for bone-related diseases such as osteoporosis and osteoarthritis.





BMP, WNT, Estrogen, Notch, Hippo pathways

RUNX/CBFβ complex genes. The α-subunit that binds to DNA is composed of RUNX1 (blood stem cell formation), RUNX2 (bone formation), RUNX3 (neural and gastro-intestinal development and tumor suppression), and CBFβ is a partner protein of them (Left panel). Partners that bind to each domain of RUNX2 (red color: performed in the lab or being performed). **The functional domains of RUNX2.** The carboxy-terminus of RUNX2 is the site of information gathering for several signaling pathways during bone formation (right panel).

Curriculum Vitae

2000~Present : Professor, KNU, Korea
2018-present : Director, CLAR in KNU
2018-present : Member of advisory committee, STEPI, Korea
2017-18 : Head, Office of Research & Business Affairs of KNU
2006 : Visiting Professor, University of Tokyo, Japan
1998-99 : Instructor, Cell Biology,UMASS Medical Center, USA
1996-97 : Postdoc, Cell Biology, UMASS Medical Center, USA

Academic Credential

1994 : Ph.D., Biochemistry, KNU
1990 : M.S., Biochemistry, KNU
1988 : D.D.S., Dentistry, KNU

Awards/Honors/Memberships

- Editorial board member
  2002/16-present, BMB Reports/Molecules & Cells
  2009-present, Crit Rev Eukaryot Gene Expr
  2011-2018 Journal of Bone and Mineral Research
- Awards
  2000 : Young investigator award, ASBMR, USA
  2006 : Dong-Chun Award, KSBMB, Korea
  2009 : Outstanding paper award, KOFST,Korea
  2013 : Most cited paper award, BMB reports
- Memberships
  KSBMB, KSMCB, KSBMR, KSO, KSCOA, KES, ASBMR

Research keyword

Biomineralization, Bone remodeling, Bone growth, Bone regeneration, Osteoporosis, Osteoarthritis,

Key techniques

Bone histomorphometry, Mouse molecular genetics, Molecular cell biology, Biochemistry, Serum biochemistry.

Research Interests/Topics

- Molecular signaling mechanisms of Runx/Cbfβ complex during bone cell development.
- Pathophysiology of osteoporosis and osteoarthritis
- Biomineralization and its related diseases
- Development of biomaterials for bone regeneration

Research Publications (selected)

- Che X, Park NR, Jin X, Jung YK, Han MS, Park CY, Chun JS, Kim SG, Jin J, Kim HJ, Lian JB, Stein JL, Stein GS, **Choi JY**. Hypoxia-inducible factor 2α is a novel inhibitor of chondrocyte maturation. *J Cell Physiol, doi: 10.1002/jcp.30356, 2021.*
- Kim HJ, Yoon HJ, Lee DK, Jin X, Che X, **Choi JY**. The estrogen-related receptor γ modulator, GSK5182, inhibits osteoclast differentiation and accelerates osteoclast apoptosis. *BMB Rep. 5222, 2021.*
- Kim HJ, Yoon HJ, Park JW, Che X, Jin X, **Choi JY**. G protein-coupled receptor 119 is involved in RANKL-induced osteoclast differentiation and fusion. *J Cell Physiol, 234(7):11490-99, 2019.*
- Park NR, Lim KE, Han MS, Che X, Yongjoo Park C, Kim JE, Taniuchi I, Bae SC, **Choi JY**. Core binding factor β plays a critical role during chondrocyte differentiation. *J Cell Physiol. 231(1):162-71, 2016.*
- Lim KE, Park NR, Che X, Han MS, Jeong JH, Kim SY, Park CY, Akiyama H, Kim JE, Ryoo HM, Stein JL, Lian JB, Stein GS, **Choi JY**. Core Binding Factor β of Osteoblasts Maintains Cortical Bone Mass Via Stabilization of Runx2 in Mice. *J Bone Miner Res. 30(4):715-22, 2015.*

Patents (Selected)

- Patent number : 10-2249135-00-00, “Spontaneous osteoarthritis animal model and use thereof”
- Patent number : 10-1705353-00-00, “Reagent for Diagnosis of Osteoarthritis Comprising Peptide Probe of ApoPep-1”
- Patent number : 10-1460884-00-00 , “Composition for detecting or treating kidney fibrosis 1”
- Patent number : 10-1197610-00-00, “Composition for Treating Bone Disease Comprising Glyceollins as Active Ingredient”
- Patent number : 10-1151821-00-00, “Novel Use of Runx2 Proteint”

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Artificial Intelligence in Medical Information Analysis

The goal of my research is to elucidate the underlying relations between many parameters in medical data including image data, bioinformatics data, and clinical data using artificial intelligence based analysis tools and develop a new application process to handle big data. A better understanding of complicated data as a result of my study can facilitate medical use

Aim	Medical Artificial Intelligence
Tool	Analysis of Data using Artificial Intelligence
TARGET	1. Automation of data acquisition and curation 2. Decision supporting of big data analysis 3. Unsupervised analysis of data 4. Merging of diverse data including image, bioinformatics data, clinical data and etc. 5. Integrated and automated analysis of big data

Curriculum Vitae

2003~Present : Professor, Kyungpook National University (KNU)
2000~2002 : Postdoctoral Fellow /Stanford University, USA

Academic Credential

1991 : MD, KNU Medical School
1997 : Ph.D, Pharmacology, KNU

Awards/Honors/Memberships

2000~Present : Society for Neuroscience

Research keyword

Artificial intelligence, Image, NGS analysis, Precision Medicine

Key techniques

Analysis of image data (CT, MRI, Microscopy and gross image), NGS data (RNAseq, whole genome sequencing, etc.), and clinical data using artificial intelligence algorithm and statistical tools.

Research Interests/Topics

- Development of biomarkers which can be used for diagnosis & prediction
- Investigation of disease mechanism which can be used as therapeutic targets
- Development of application tools based on artificial intelligence

Research Publications (selected)

- Kang GU, Jung DR, Lee YH, Jeon SY, **Han HS,** Chong DO, Shin JH. Dynamics of Fecal Microbiota with and without Invasive Cervical Cancer and Its Application in Early Diagnosis. *Cancers (Basel), 12(12):3800, 2020.*

Sung-Yon Kim, PhD

Invited Investigator
(SNU, Professor)

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Institute of Molecular Biology and Genetics
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The Neurobiology of Brain-Body Communication, Homeostasis, and Innate Behavior

In our laboratory, we aim to understand how the brain receives sensory information from both within and outside the body, integrates the multiple streams of information, and generates appropriate behavioral responses. We want to find the mechanistic explanations for how it all begins, how it all ends, and everything in-between.

To achieve this ambitious goal, we focus on **innate survival behaviors** — such as **ingestion, thermoregulation, and aggression** — as these behaviors and the underlying brain regions are evolutionarily well-conserved and thus amenable for investigation in rodents. These robust behaviors can be triggered or moderated by sensory stimuli (e.g. touch, heat, and pheromones) that can be experimentally controlled in a precise and quantitative manner, permitting relatively facile identification and parametric characterization of the sensory neural pathways. With the solid knowledge of the sensory afferent circuits, we systematically deconstruct the neural circuitry underlying the integration of sensory information and generation of behavioral and physiological responses. We also seek to answer how these mechanisms become dysregulated in metabolic and affective disorders, such as obesity and depression.

Towards these problems, we employ an arsenal of cutting-edge techniques such as optogenetics, chemogenetics, deep-brain calcium imaging, as well as single-cell RNA-seq. In addition, we develop and use new tools that enable the extraction of structural and molecular information from biological tissues, which helps to reveal the anatomical organization of specific neural circuits in exquisite detail.

Aim	The Neurobiology of Brain-Body Communication, Homeostasis, and Innate Behavior
Tool	Optogenetics, Chemogenetics, Two-photon Ca^{2+} imaging, Multiphoton ensemble stimulation, Single-cell RNA-seq

Curriculum Vitae

2021~Present : Associate Professor, Seoul National Univ.
2015~2021 : Assistant Professor, Seoul National Univ.
2006~2013 : Postdoctoral Fellow, Massachusetts Institute of Technology, USA

Academic Credential

2013 : Ph.D, Neurosciences, Stanford Univ., USA
2009 : B.S., Chemistry and Biology (double major), Seoul National Univ.

Awards/Honors/Memberships

2020~Present : Member of Young Korean Academy of Science and Technology
2020 : Commendation for the Promotion of Healthcare Technology, Ministry of Health and Welfare
2020 : Scitech Korea Young Neuroscientist Award, Korean Society for Brain and Neural Sciences
2018 : Young Researcher Award, National Research Foundation of Korea
2014 : Donald B. Lindsley Prize in Behavioral Neuroscience, Society for Neuroscience
2014~2015 : Life Sciences Research Foundation Postdoctoral Fellowship
2013~2014 : Simons Postdoctoral Fellowship

Research keyword

Innate behavior, body-brain communication, integrative physiology, homeostasis, emotion, stress

Key techniques

Two-photon Ca^{2+} imaging, Multiphoton ensemble stimulation, Optogenetics, Chemogenetics, Single-cell RNA-seq, Mouse behavior, Patch-clamp electrophysiology

Research Publications (selected)

- Jung S, Lee M, Kim DY, Son S, Ahn BH, Heo G, Kim M, Park HE, Koo DJ, Park JH, Lee JW, **Kim SY**. A forebrain neural substrate for behavioral thermoregulation. *Neuron. In press.*
- Kim M, Heo G, **Kim SY.** Neural signaling of gut mechanosensation in ingestive and digestive processes. *Nature Reviews Neuroscience. In press.*
- Kim DY, Heo G, Kim M, Kim H, Jung S, An M, Ahn BH, Park JH, Park HE, Lee M, Lee JW, Schwartz GJ, **Kim SY.** A neural circuit mechanism for mechanosensory feedback control of ingestion. *Nature. 580(7803):376–380.2020.*
- **Kim SY,** Adhikari A, Lee SY, Marshel JH, Kim CK, Mallory CS, Lo M, Pak S, Mattis J, Lim BK, Malenka RC, Warden MR, Neve R, Tye KM, Deisseroth K. Diverging neural pathways assemble a behavioural state from separable features in anxiety. *Nature. 496(7444):219-23.2013.*
- Tye KM*, Prakash R*, **Kim SY*,** Fenno LE, Grosenick L, Zarabi H, Thompson KR, Gradinaru V, Ramakrishnan C, Deisseroth K. Amygdala circuitry mediating reversible and bidirectional control of anxiety. *Nature. 471(7338):358-62.2011.* *Equal contribution

Minah Kim, MD, PhD

Invited Investigator
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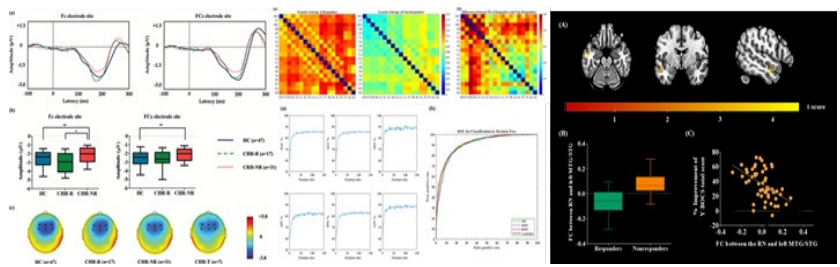
Brain biomarkers in psychiatric patients

Current diagnosis of psychiatric disorders based on symptomatic phenotype leads to tremendously increased heterogeneity not only in the underlying pathophysiology but also in their treatment responses. Therefore, we need to research the characteristic biomarkers that indicate structural and functional brain abnormalities rather than limit our perspectives in symptomatology, as psychiatric symptoms occur when brain abnormalities have progressed considerably. The Clinical Cognitive Neuroscience Center (CCNC) lab is currently utilizing various neuroimaging and neurophysiological methods and neurocognitive tests covering multifacet cognitive domains to study the mechanisms of psychiatric disorders. In particular, we are trying to discover the mechanisms of schizophrenia onset and develop early diagnostic methods by researching high-risk groups in their prodromal phase. Furthermore, we are investigating reliable brain biological markers for predicting prognosis and treatment responses to medication and neuromodulation in schizophrenia, high-risk groups, and obsessive-compulsive disorder.

Aim	Discovering the brain biomarkers for brain-based diagnosis, prognosis and treatment response prediction in psychiatric patients
Tool	Structural and Functional Magnetic Resonance Imaging Electroencephalography and Event-related potentials
TARGET	

Curriculum Vitae

2019~Present : Research Associate Professor, SNUH
2017~2018 : Clinical Assistant Professor, SNUH
2014~2016 : Clinical and Research Fellow, SNUH
2012~Present : Investigator, Clinical Cognitive Neuroscience Center

Academic Credential

2018 : Ph.D., Mismatch Negativity in Clinical High Risk for Psychosis, Seoul National University (SNU), Korea
2009 : M.D., SNU, Korea
2005 : B.S., Psychology, SNU, Korea

Awards/Honors/Memberships

2021~Present : Editorial board member, Comprehensive Psychiatry
2018~Present : Review editor, Frontiers in Computational Psychiatry
2014~Present : Korean Society for Human Brain Mapping
2014~Present : Korean Society for Schizophrenia Research
2010~Present : Korean Neuropsychiatric Association
2018 : Dr. Paul Janssen Schizophrenia Research Award
2018 : SIRS Travel Award
2014 : In-Song Investigation Award

Research keyword

Schizophrenia, Obsessive-compulsive disorder, Neuroimaging, Electrophysiology, Neuromodulation

Research Interests/Topics

- Brain biomarkers for schizophrenia and high-risk population of the disorder, Obsessive-compulsive disorder
- Prediction of prognosis and treatment responses in psychiatric disorders using brain biomarkers
- New psychiatric treatment modalities and interventions including neuromodulations

Research Publications (selected)

- Kim M, Hwang WJ, Park J, Kim T, Oh S, Kwon JS. Neurophysiological correlate of emotion regulation by cognitive reappraisal and its association with psychotic symptoms in early psychosis. *Schizophr Bull. 2021 Jan;47(1):87-96.*
- Min B, Kim M,* Lee J, Byun J, Chu K, Jung K, Lee SK, Kwon JS. Prediction of individual responses to electroconvulsive therapy in patients with schizophrenia: Machine learning analysis of resting-state electroencephalography. *Schizophr Res. 2020 Feb;216:147-153.*
- Kim M, Kwak S, Yoon YB, Kwak YB, Kim T, Cho KIK, Lee TH, Kwon JS. Functional connectivity of the raphe nucleus as a predictor of the response to selective serotonin reuptake inhibitors. *Neuropsychopharmacol. 2019 Nov;44(12):2073-2081.*
- Kim M, Lee TH, Yoon YB, Lee TY, Kwon JS. Predicting remission in subjects at clinical high risk for psychosis using mismatch negativity. *Schizophr Bull. 2018 Apr;44(3):575-583.*
- Kim M, Yoon YB, Lee TH, Lee TY, Kwon JS. The effect of tDCS on auditory hallucination and P50 sensory gating in patients with schizophrenia: A pilot study. *Schizophr Res. 2018 Feb;192:469-470.*
- Kim M, Cho KIK, Yoon YB, Lee TY, Kwon JS. Aberrant temporal behavior of mismatch negativity generators in schizophrenia patients and subjects at clinical high risk for psychosis. *Clinical Neurophysiol. 2017 Feb;128(2):331-339.* (selected as a cover)

George J. Augustine,
PhD

Invited Investigator
(NTU, Professor)

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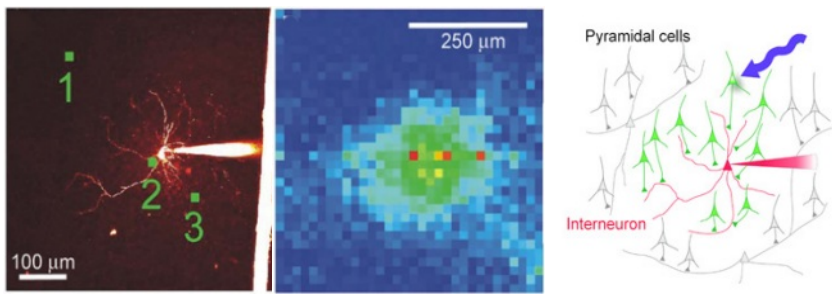
Synaptic mechanisms and circuits

The goal of my research is to understand how synapses work and how these specialized junctions between neurons transmit information within neural circuits. My lab has advanced understanding of how neurotransmitters are released from presynaptic terminals by characterizing the local calcium signaling that triggers neurotransmitter release and the molecular mechanisms involved in synaptic vesicle trafficking. We have also examined the role of postsynaptic calcium signaling in synaptic plasticity, specifically the induction of cerebellar long-term synaptic depression by IP3-mediated release of intracellular calcium in Purkinje cell spines. We are currently using optogenetics to map the function and spatial organization of local circuitry in several brain areas, including cerebellum, cortex, hippocampus and claustrum. This powerful technology is also proving useful in identifying the changes in circuit function associated with dementia and other brain disorders.

Aim	Map brain circuitry
Tool	Combine optogenetics with electrophysiology to map local circuits

TARGET



Curriculum Vitae

2013~Present : Professor of Neuroscience & Mental Health, Lee Kong Chian School of Medicine
2009~2014 : Founder & Director, Center for Functional Connectomics, KIST,
1992~2010 : Professor of Neurobiology, Duke Medical School, USA

Academic Credential

1980 : Ph.D, Neurobiology, Univ. Maryland

Awards/Honors/Memberships

Max Planck Research Prize
Irene Tan Liang Kheng Chair Professor of Neuroscience, NTU
G.B. Geller Professor of Neurobiology, Duke
Society for Neuroscience Member since 1976
Editorial Boards: Current - Frontiers in Neural Circuits, Biomolecules, Frontiers in Synaptic Neuroscience, Neurophotonics Previous - Neuron, Journal of Neuroscience, Journal of Physiology, Claustrum, Neuronal Signalling, Eye & Brain, Brain Cell Biology, Journal of Neurocytology, Pfluegers Archiv, Neuroscience Research, Biological Bulletin

Research keyword

Synapses, Brain circuits, Synaptic plasticity, Dementia

Key techniques

Optogenetics, patch-clamp electrophysiology, fluorescence imaging, molecular biology.

Research Interests/Topics

- Molecular mechanisms of synaptic vesicle trafficking
- Mechanisms of long-term synaptic plasticity
- Local circuits
- Brain disorders, including dementia, schizophrenia and depression.

Research Publications (selected)

- Kim, J., Lee, S., Tsuda, S., Zhang, X., Asrican, B., Gloss, B., Feng, G. and **G.J. Augustine**, Optogenetic mapping of local inhibitory circuitry in cerebellum reveals spatial coordination of interneurons via electrical synapses. *Cell Reports 7: 1601-1613. 2014.*
- Berglund, K., Wen, L., Dunbar, R.L., Feng, G. and **G.J. Augustine**. Optogenetic visualization of presynaptic tonic inhibition of cerebellar parallel fibers. *J. Neurosci. 36:5709-5723. 2016.*
- S-H. Song and **G.J. Augustine**. Synapsin isoforms regulating GABA release from hippocampal interneurons. *J. Neurosci. 36:6742-6757. 2016.*
- S. Chen, **G.J. Augustine** and P. Chadderton. Serial processing of kinematic signals by cerebellar circuitry during voluntary whisking. *Nature Comm. 8: 232. 2017.*
- Z. Chia, **G.J. Augustine** and G. Silberberg, Selective targeting of anterior cingulate projecting-claustrum neurons reveals a modular organization of the connectivity between the claustrum and cortex. *Current Biology 30: 2777-2790. 2020.*