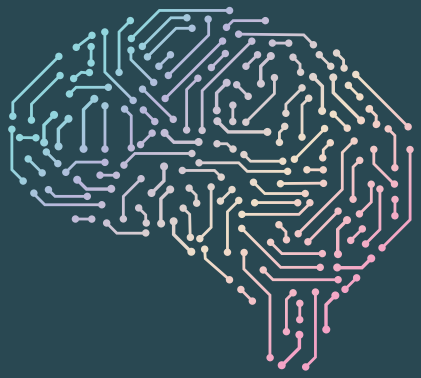
KOREA BRAIN RESEARCH INSTITUTE



RESEARCHER PROFILES

KBRI

KOREA BRAIN RESEARCH INSTITUTE

RESEARCHER PROFILES

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Message from the President

The 21st century is considered as the 'Era of the Brain'.

In these days, brain research is to emerge as a prioritized field in preparation for neurological disorders such as emotional, cognitive, and degenerative diseases resulting from rapidly evolving changes in the social environment.

The Korea Brain Research Institute is one of the government-funded research institutes, established in 2011.

To contribute to well-being of mankind through brain research, we will build the domestic and international networks with the aim of becoming 'a global leading institute for brain research'. Accordingly, we will make a concerted effort to advance neuroscience and technology, using virtuous cycle in multidisciplinary translational research as a strategy, which will grant competitive edge in the future.

KBRI completed the second research building in 2022 and the third research building in 2023, and is growing as a representative brain research institute in Korea despite a short period of time.

Eventually, KBRI will strive to improve human life through game-changing research based on world-class infrastructures. Thank you

President
Pann-Ghill Suh, DVM & Ph.D.

KBRI Organization

The Korea Brain Research Institute (KBRI) is a government-funded research institute which performs research on the brain and facilitates cooperation between academia, research institutes, and industries. The KBRI addresses all national agendas related to brain research, and functions as a key hub for brain science both domestically and internationally.

Foundation

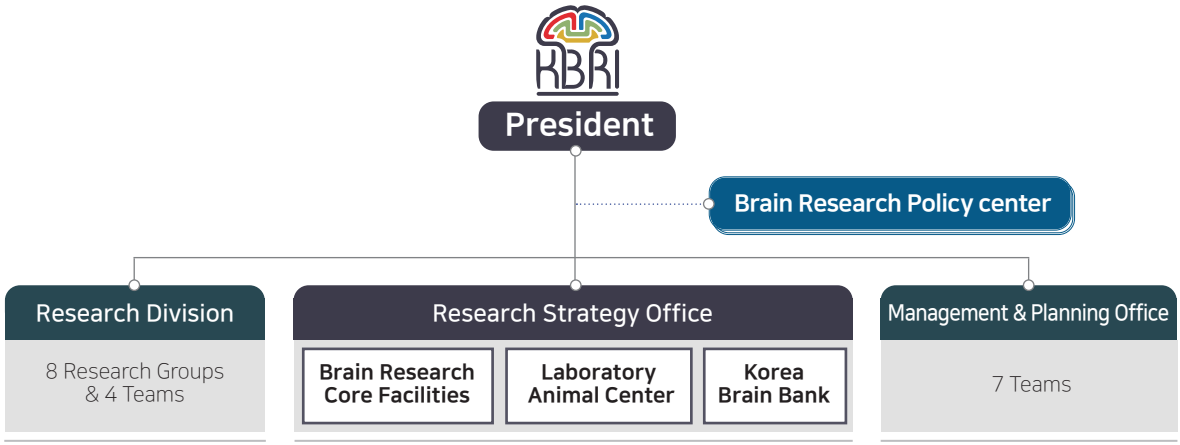
Advancement of brain research, establishment of infrastructure for neuroscience, and development of a collaborative system between academia, research institutes, and industries in the brain research field

- Brain Research Promotion Act (Act No. 5547, enacted on June 3, 1998) Article 17-

History

1988	June	**Enactment of the brain Research Promotion Act**
2011	December	**Establishment of KBRI**
2014	December	**Completion of KBRI Building A** (Left-hemisphere Building)
2019	September	**Host of the 10th IBRO World Congress of Neuroscience**
2021	December	**Inauguration of the 4th president** (Pann-Ghill Suh, DVM & PhD)
2022	November	**Completion of KBRI Building B** (Right-hemisphere Building)
2023	May	**Completion of KBRI Brain Tech Center**

Organization



Vision

Global leading institute for brain research

Mission

(1) Perform basic and applied brain research and establish cutting-edge research infrastructure
(2) Support collaborative research between domestic and international industries, academia, and research institutes, and contribute to the establishment of brain research-related policies
(3) Conduct projects with the aim of popularizing brain science, and disseminating knowledge

Goal

Creating a "Global KBRI Brand" through the establishment of an innovative R&D environment

Strategy

Securing global research competitiveness

Reinforce collaborative and translational research by securing and nurturing outstanding workforces and expanding global networks

Building world-leading infrastructure

Contribute to the creation of a brain convergence research system and lay the foundation for the brain industry through the establishment of specialized infrastructure (equipment, material, policy)

Promoting the organizational culture and mission

Promote institutional culture and transparent management, and contribute to the establishment of national brain research strategies

Main Project : Conduct brain researches in preparation for the future

Research projects

Neural networks and brain disorders research

- Structure and function of neural networks
- Mid- to long-term basic/applied research on brain evelopment and brain diseases

Hub-spoke based brain research

- Study brain functions and develop novel treatment targets for disabilities caused by neurological diseases
- Promote collaboration between domestic and international brain research institutes

Infras-tructures

Brain Research Core Facility

Collect small- and large-scale research equipment for brain research and build an effective sharing system

Laboratory Animal Center

Operate animal facilities for brain research to house animal models (rodents) and analyze behavior

Korea Brain Bank

Collect and distribute human brain tissue resources, and construct a related database

Brain Research Policy Center

Establish and support national brain research policies and strategies, and build global collaboration networks

Establish and utilize the advanced brain research Infrastructures

Facility

❶ Basic Research
(Bldg A, Left-hemisphere)

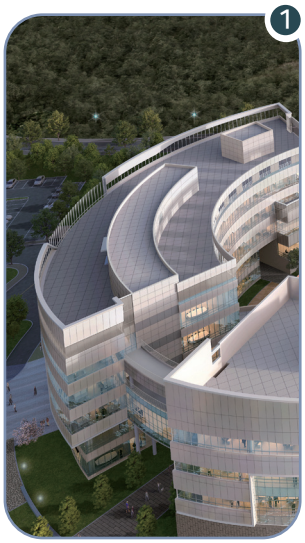
- Cost : 88.9 billion won
- Area : 20,583m²
- Construction : ’11~’14

❷ Brain Research for Social Issues
(Bldg B, Right-hemisphere)

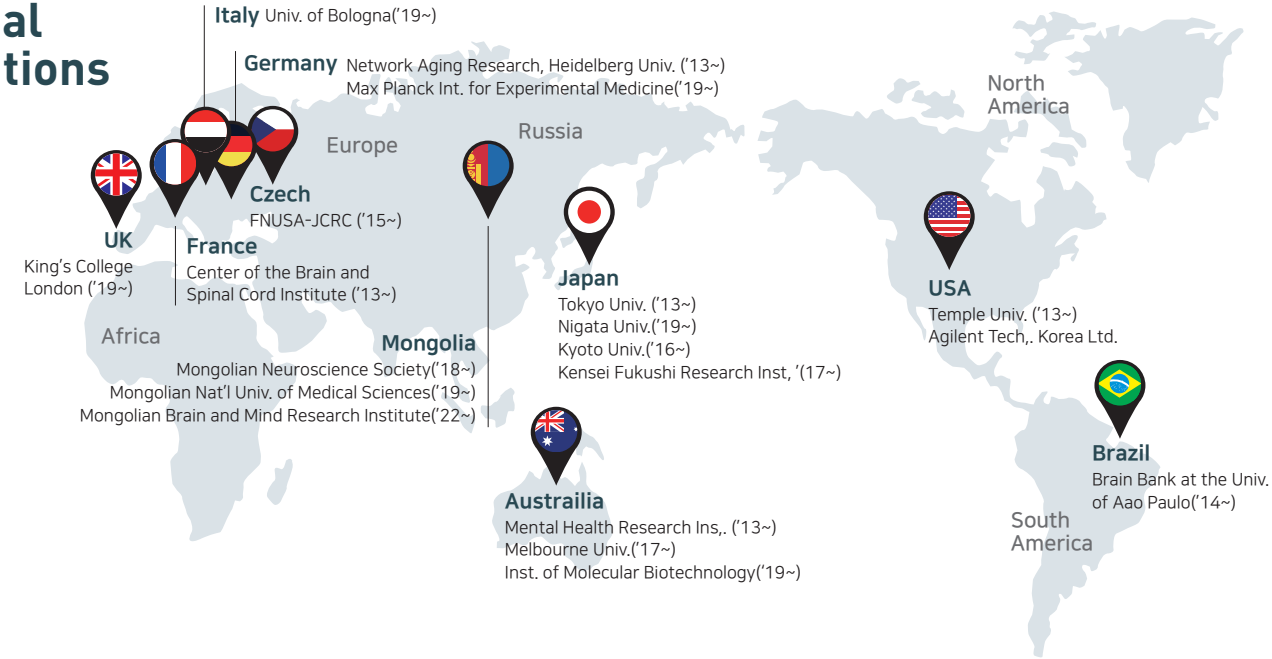
- Cost : 28.75 billion won
- Area : 11,055m²
- Construction : ’19~’22

❸ Brain Research Application
(Brain Tech Center)

- Cost : 18.9 billion won
- Area : 5,715m²
- Construction : ’19~’23



Global Relations



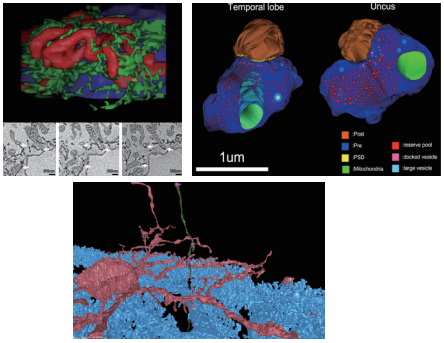
RESEARCH GROUPS

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 (EM) provides the ultra-high resolution and dense staining necessary for these investigations.
- We also study human neural circuits using brain organoids. Novel method development for live imaging with light microscopy (LM) expands our understanding of the human brain.
- 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
- Method development for live tracking of neural circuits

Organization

Mechanisms of Morphological Synaptic Plasticity

Molecular mechanisms of synapse remodeling in physiological and pathological conditions
Electron Microscopy of synaptic architecture
Evaluation of novel compounds using imaging and behavioral tests in mouse models

Structure and Function of Cellular Organelles' network

Ultrastructure and function of intracellular organelles and their interactions in neural circuit diseases
In vitro modeling using stem cells for studying neural disorders
Technical development of Correlative light electron microscopy, Array tomography, and Cryo-tomography

Neural circuit

Method development for live tracking of human brain neural circuit:

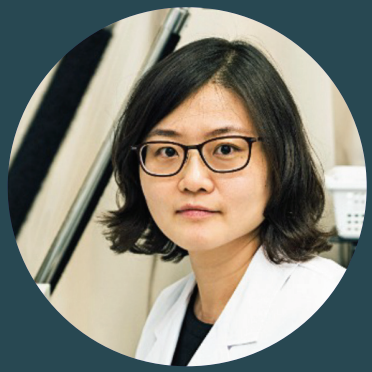
Miniaturizing human brain organoids
Development of a brain cell type-specific small fluorescent molecule

Efficient Differentiation of Neural and Glial Cells

Uncover the role of mechanical factors in neural differentiation
Regulation of neural and glial cell production from neural stem cells
Efficient production of new-born neurons in the adult hippocampus

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
- Physical factor-based neural and glial cell production for regenerative therapy



Ji Young Mun, PhD
Group Leader
Principal Investigator

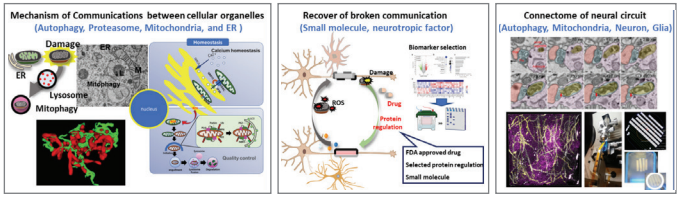
NEURAL CIRCUITS GROUP
Korea Brain Research Institute (KBRI)

Office : 5-4
Lab : Wet lab 5-2
Tel : +82-53-980-8470
Fax : +82-53-980-8339
E-mail : jymun@kbri.re.kr
http://www.mnblab.kr

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	



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)

- Propionic acid induces dendritic spine loss by MAPK/ERK signaling and dysregulation of autophagic flux. ***Mol Brain***. 2020 13(1):86 (Corresponding author)
- Correlative Light and Transmission Electron Microscopy Showed Details of Mitophagy by Mitochondria Quality Control in Propionic Acid Treated SH-SY5Y Cell. ***Materials***. 2020 13(19):4336 (Corresponding author)
- Contact-ID, a new tool for profiling organelle contact site, reveals regulatory proteins of mitochondrial-associated membrane formation. ***Proc Natl Acad Sci USA***. 2020 117(22):12109 (Co-Corresponding author)
- Direct Visualization of Actin Filaments and Actin-Binding Proteins in Neuronal Cells. ***Front Cell Dev Biol***. 2020 26;8:588556 (Corresponding author)
- Mitochondria and Endoplasmic Reticulum Imaging by Correlative Light and Volume Electron Microscopy. ***JoVE***. 2019 (Corresponding author)
- Dual Function of USP14 Deubiquitinase in Cellular Proteasomal Activity and Autophagic Flux. ***Cell Rep***. 2018 24(3):732 (Co-first author)
- TAGLN2 polymerizes G-actin in a low ionic state but blocks Arp2/3-nucleated actin branching in physiological conditions. Sci Rep. 2018 8(1):5503 (Co-Corresponding author)
- Skeletal myosin binding protein-C isoforms regulate thin filament activity in a Ca^{2+} dependent manner. ***Sci Rep***. 2018 8(1):2604 (Co-first author)

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

Kea Joo Lee, PhD
Principal Investigator

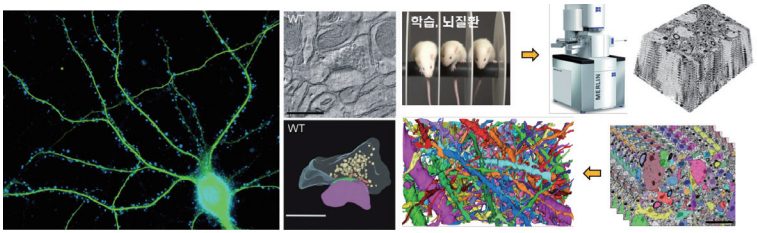
NEURAL CIRCUITS GROUP
Korea Brain Research Institute (KBRI)

Office : 5-4
Lab : Wet lab 5-2
Tel : +82-53-980-8320
Fax : +82-53-980-8339
E-mail : relaylee@kbri.re.kr
http://sites.google.com/view/relaylee-lab

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.



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)

- Kim et al., LRRTM3 regulates activity-dependent synchronization of excitatory synapse properties in topographically connected hippocampal neural circuits. *Proc Natl Acad Sci USA*, 119(3):e2110196119, 2022. correspondence.
- 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.
- Xu Z et al, Elevated protein synthesis causes autism-like synaptic and behavioral aberrations through microglia. *Nat Commun*, 11(1):1797, 2020.
- **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, Mossy fiber-CA3 synapses mediate homeostatic plasticity in mature hippocampal neurons. *Neuron*, 77(1):99-114, 2013.

Curriculum Vitae

2022~Present : Director of Strategic R&D Planning, KBRI
2019~2021 : Group Leader, KBRI
2019~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

2021~Present : IACUC Committee Member, KBRI
2020~Present : Guest Associate Editor, Frontiers Neuroanatomy
2020~2022 : Chairman, KBRI Personnel Committee
2020~2021 : Academic Director, Korean Society of Microscopy
2019~2019 : Financial Director, The Korean Brain Society
2018~Present : Editor, Microscopy
2018~Present : ReviewEditor, Frontiers 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
2014~2017 : Chairman, KBRI Institutional Review Board

Yoichi Kosodo, PhD
Principal Investigator

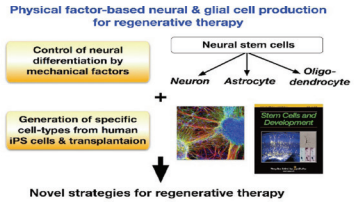
NEURAL CIRCUITS GROUP
Korea Brain Research Institute (KBRI)

Office : 4-2
Lab : Wet lab 4-1
Tel : +82-53-980-8440
Fax : +82-53-980-8309
E-mail : kosodo@kbri.re.kr
http://kosodo.wixsite.com/neuroregeneration

Neural Regeneration Lab

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.

Aim	Physical factor-based neural and glial cell production for regenerative therapy
Tool	Atomoic Force Microscopy (AFM), In utero electroporation, Brain organoids
TARGET	



Research keywords

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

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)

- Park G, … and **Kosodo Y***. (2022) Direct visualization of the transition status during neural differentiation by dual-fluorescent reporter human pluripotent stem cells. *Stem Cell Rep*. 17(9):1903-1913
- Ryu Y, … and **Kosodo Y***. (2021) A shift in tissue stiffness during hippocampal maturation correlates to the pattern of neurogenesis and composition of the extracellular matrix. *Front Aging Neurosci*. 13:709620
- Iwashita M, … and **Kosodo Y***. (2020) Comparative analysis of brain stiffness among amniotes using glyoxal fixation and atomic force microscopy. *Front Cell Dev Biol*. 8:574619
- Iwashita M, … and **Kosodo Y***. (2019) Brain-stiffness-mimicking tilapia collagen gel promotes the induction of dorsal cortical neurons from human pluripotent stem cells. *Sci Rep*. 9(1):3068

External grants (Korean)

- NRF (2022-27) Elucidation of human brain neural differentiation by mechanical factors using dual-fluorescence reporter iPSCs
- NRF (2017-19) Elucidation of mechanical factor - driven neural and glial differentiation of the CNS and PNS derived from human induced pluripotent stem cells
- NRF (2016-19) Investigation to Uncover How Mechanical Factors Control Brain Formation and Application for Neural Regeneration

Patents (Korean)

- **Kosodo Y**, Iwashita M. A method for inducing dorsal cortical neurons from pluripotent stem cells by using tilapia collagen gel (Registered #10-2207361)

Curriculum Vitae

2015~Present : Lab Head, 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

Beomsue Kim, PhD
Principal Investigator

NEURAL CIRCUITS GROUP
Korea Brain Research Institute (KBRI)

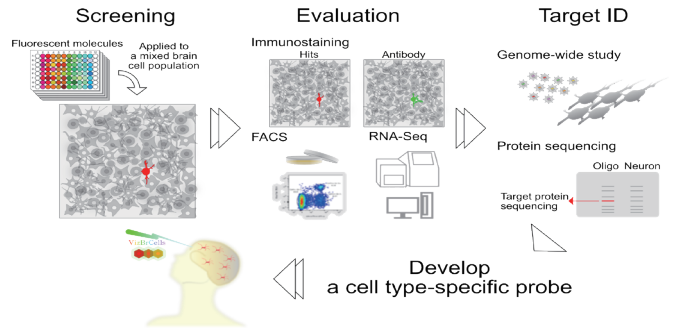
Office : 5-2
Lab : Wet lab 5-2
Tel : +82-53-980-8480
Fax : +82-53-980-8412
E-mail : kimbs@kbri.re.kr
http://vizbrcells.com

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



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.

Curriculum Vitae

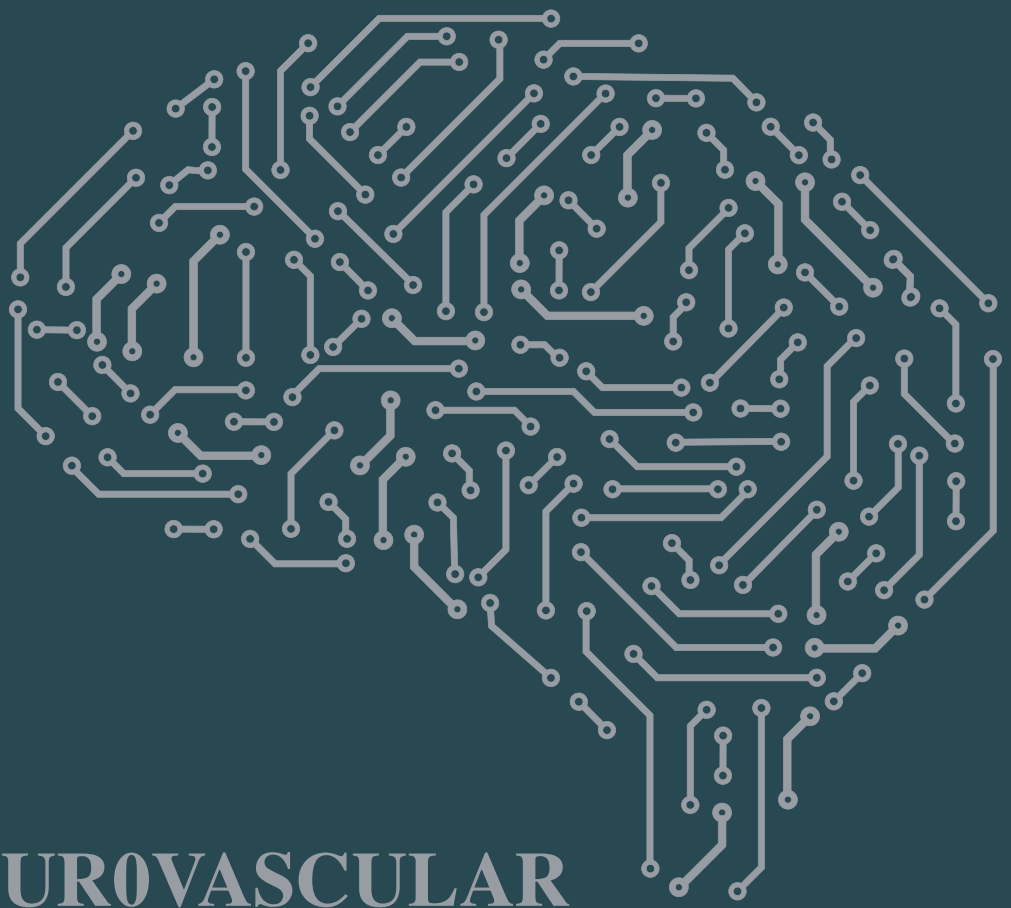
2020~ : Principal Investigator, KBRI
2014~2019 : Research Fellow / SBIC, A-STAR, Singapore
2013~2014 : Research Fellow / Dept. Chemistry, NUS, Singapore
2010~2013 : Postdoctoral Fellow / School of Medicine, Ajou University
2003~2004 : Visiting Scholar / Dept. Pediatrics, UTHSC, USA

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

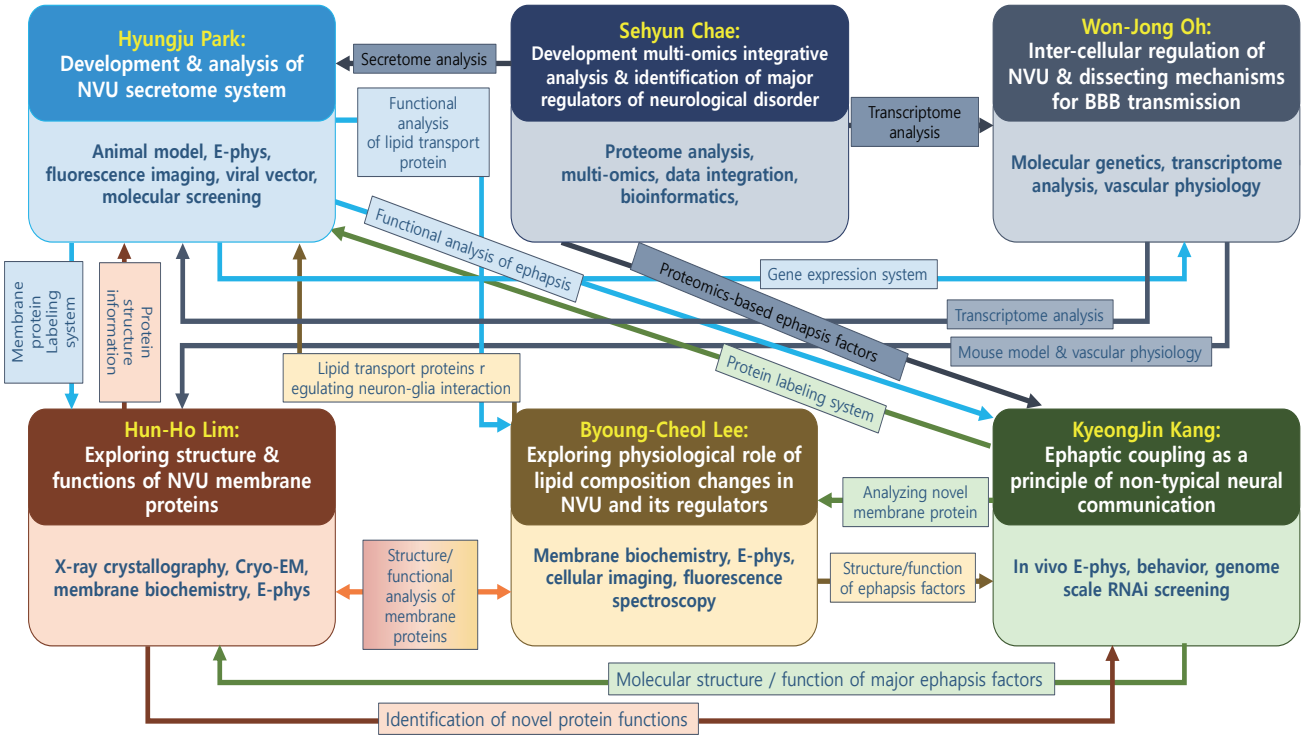
2020~Present : Fellow, KSIB
2020~Present : Member, KSM
2008~Present : Member, KSMCB
2007~Present : Member, KSBNS



NEUR0VASCULAR UNIT GROUP

NEUROVASCULAR UNIT GROUP

Organization



Major Tasks

- Investigate the molecular structure functions of membrane / secreted proteins in the neurovascular unit
- Develop integrative techniques for labeling and analyzing secretory and membrane proteins in the neurovascular unit
- Screening and molecular analysis of novel molecular targets regulating cognitive functions and neurological disorders in the neurovascular unit and blood-brain barrier

Hyungju Park, PhD
Group Leader
Principal Investigator

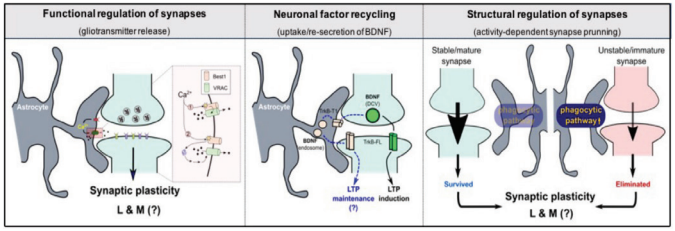
NEUROVASCULAR UNIT GROUP
Korea Brain Research Institute (KBRI)

Office : 4-6
Lab : Wet lab 4-3
Tel : +82-53-980-8450
Fax : +82-53-980-8339
E-mail : phj2@kbri.re.kr
http:// www.mnblab.kr

Intercellular communications regulating 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	

Research keyword

Learning and memory, Cognitive enhancement, Neuron-glia / body-brain interaction, Synaptic plasticity.

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 glia-mediated synapse reorganization regulates synaptic plasticity and learning and memory.
- Identification of novel molecules mediating neuron-glia / body brain interaction and studying their roles in learning and memory.
- Mechanisms underlying body-brain interactions involved in cognitive enhancement

Research Publications (selected)

- Han JH, Yoon S, **Park H**. Endocytic BDNF secretion regulated by Vamp3 in astrocytes. *Scientific Reports*, 11: 21203, 2021.
- 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)

Curriculum Vitae

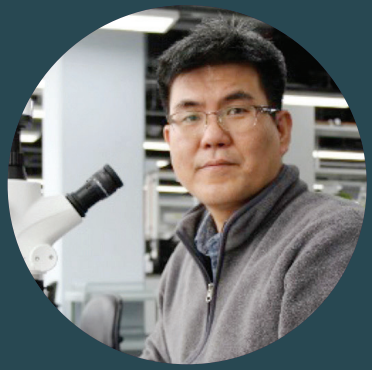
2015~Present : Principle Investigator / Principal Research Scientist/ Group leader of NVU (Neurovascular unit) research group, KBRI
2015~2023 : Adjunct Professor, Department of Brain & Cognitive Sciences, DGIST
2013~2015 : Associate Specialist,Univ. of California at Berkeley, USA
2009~2013 : Postdoctoral 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



Hyun-Ho Lim, PhD
Principal Investigator

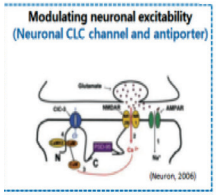
NEUROVASCULAR UNIT GROUP
Korea Brain Research Institute (KBRI)

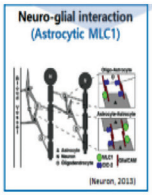
Office : 5-3
Lab : Wet lab 5-1
Tel : +82-53-980-8330
Fax : +82-53-980-8330
E-mail : hhlim@kbri.re.kr
http://www.kbri.re.kr/new/pages_lab/sub/page.html?mc=2020

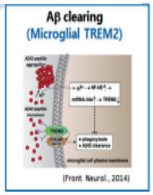
Molecular physiology & biophysics of the membrane proteins in the nervous system

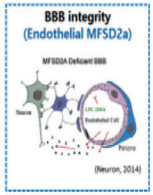
The cells are enclosed by the selective barrier, phospholipid bilayer, called the membrane. The membrane proteins of the cells are critical to respond to external stimulations, relay signals from outside to inside or vice versa, transport molecules in and out of the cell, catalyze enzymatic activities, 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	









Research keyword

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

Key techniques

Membrane protein structural biology (Cryo-EM, X-ray 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)

- Kim KW, Hwang J, Kim DH, Park HJ, and **Lim HH**. Cytoplasmic domain regulates the calcium sensitivity and surface expression of BEST1 channel. *BMB Reports*, 5770, 2023.
- Hwang J, Park K, Lee G, Yoon BY, Kim H, Roh SH, Lee BC, Kim K, and **Lim HH**. Transmembrane topology and oligomeric nature of an astrocytic membrane protein, MLC1. *Open Biology* 11: 210103, 2021.
- 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 C^{l-}/H^{+} antiporter. *Proc. Natl. Acad. Sci. USA*. 116: 17345-17354, 2019.

PATENT

1. Lim HH et al., Method for effective purification of human TREM2 proteins using recombinant baculovirus, 2020.
2. Lim HH et al., Monoclonal antibody with specificity for human TREM2 protein, hybridoma cell line producing the same and use thereof, 2020.

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
2007.4~2013.8 : Postdoctoral Associate, HHMI / Brandeis University, U.S.A.
2005.2~2007.3 : 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

2022~2023 : Vice President, Korean Biophysical Society
2020.12~2022.11 : 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
2018.1~2019.12 : Secretary, Korean Biophysical Society
2016~2017, 2022~2024 : Committee Member, Nat'l Brain Science Working Committee (Ministry of Sci. & Tech., KOREA)
2015 : International Collaboration Committee, Korean Society for Brain and Neuroscience
1998~Present : Member, Biophysical Society
1998~Present : Member, Society for Neuroscience

Won-Jong Oh, PhD
Principal Investigator

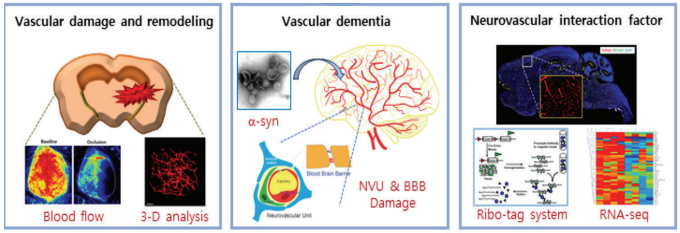
NEUROVASCULAR UNIT GROUP
Korea Brain Research Institute (KBRI)

Office : 4-7
Lab : Wet-lab 4-3
Tel : +82-53-980-8360
Fax : +82-53-980-8339
E-mail : ohwj@kbri.re.kr
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	Mouse model + Molecular histology + Vasculature physiology
TARGET	



Research keyword

Brain Vasculature, Neurovascular Unit, Blood-Brain Barrier, Axon guidance

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)

- Yu R, Kim NS, Li Y, Jeong JY, Park SJ, Zhou B and **Oh WJ**. Vascular Sema3E-Plexin-D1 signaling reactivation promotes post-stroke recovery through VEGF downregulation in mice. *Translational Stroke Research*, 13:142-159, 2022.
- 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

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

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

KyeongJin Kang, PhD
Principal Investigator

NEUROVASCULAR UNIT GROUP
Korea Brain Research Institute (KBRI)

Office : 4-5
Lab : Wet lab 4-3
Tel : +82-53-980-8490
Fax : +82-53-980-8000
E-mail : kangkj@kbri.re.kr

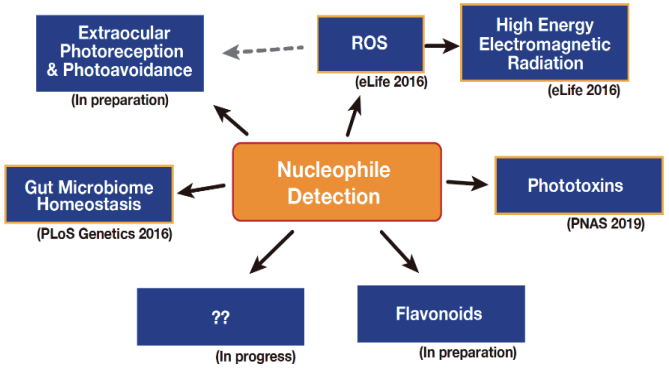
Understanding chemical information processing

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, Ca^{2+} imaging, behavioral assays

TARGET



Research keyword

Chemical nociception, gustation, behavior, ephaptic coupling, nucleophile

Key techniques

Behavioral assays, electrophysiology, Ca^{2+} 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.

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

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.

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

Byoung-Cheol Lee, PhD
Principal Investigator

NEUROVASCULAR UNIT GROUP
Korea Brain Research Institute (KBRI)

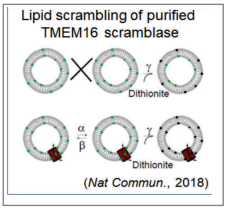
Office : 4-5
Lab : Wet lab 4-3
Tel : +82-53-980-8338
Fax : +82-53-980-8339
E-mail : lbc0523@kbri.re.kr

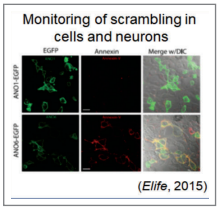
Molecular physiology of lipid scrambling in the brain

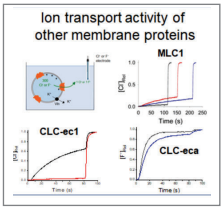
Lipid Scrambling & Ion Transport in Brain

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	







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)

- Kim H, Kim E, **Lee BC**. Investigation of Phosphatidylserine-Transporting Activity of Human TMEM16C Isoforms. *Membranes (Basel)* 2022 Oct 17;12(10):1005.
- Falzone ME, Feng Z, Alvarenga OE, Pan Y, **Lee B**, Cheng X, Fortea E, Scheuring S, Accardi A. TMEM16 scramblases thin the membrane to enable lipid scrambling. *Nat Commun* 2022 May 11;13(1):2604
- Hwang J, Park K, Lee GY, Yoon BY, Kim H, Roh SH, **Lee BC**, Kim K, Lim HH. Transmembrane topology and oligomeric nature of an astrocytic membrane protein, MLC1. *Open Biol*. 2021 Dec;11(12):210103
- Khelashvili G, Falzone ME, Cheng X, Lee BC, Accardi A, Weinstein H. Dynamic modulation of the lipid translocation groove generates a conductive ion channel in Ca^{2+}-bound nhTMEM16. *Nat Commun*. 2019 Oct 31;10(1):4972
- Park K, **Lee BC**, 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*. 2019 Aug 13 https://doi.org/10.1073/pnas.1901822116

Patents

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

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

2007~Present : Member, Biophysical Society

Sehyun Chae, PhD
Principal Investigator

NEUROVASCULAR UNIT GROUP
Korea Brain Research Institute (KBRI)

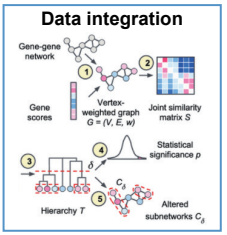
Office : 4-7
Lab : Wet lab 4-3
Tel : +82-53-980-8188
E-mail : shchae@kbri.re.kr

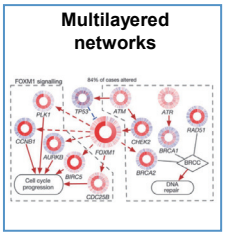
Systems biology approaches to understand multilayered spatiotemporal networks in neurodegenerative diseases

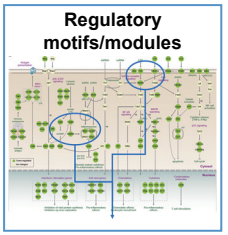
We are developing various systems approaches that decode multilayered spatiotemporal network models underlying the pathogenesis of neurodegenerative diseases by integrative analysis of multi-omics data.

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	







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.

Curriculum Vitae

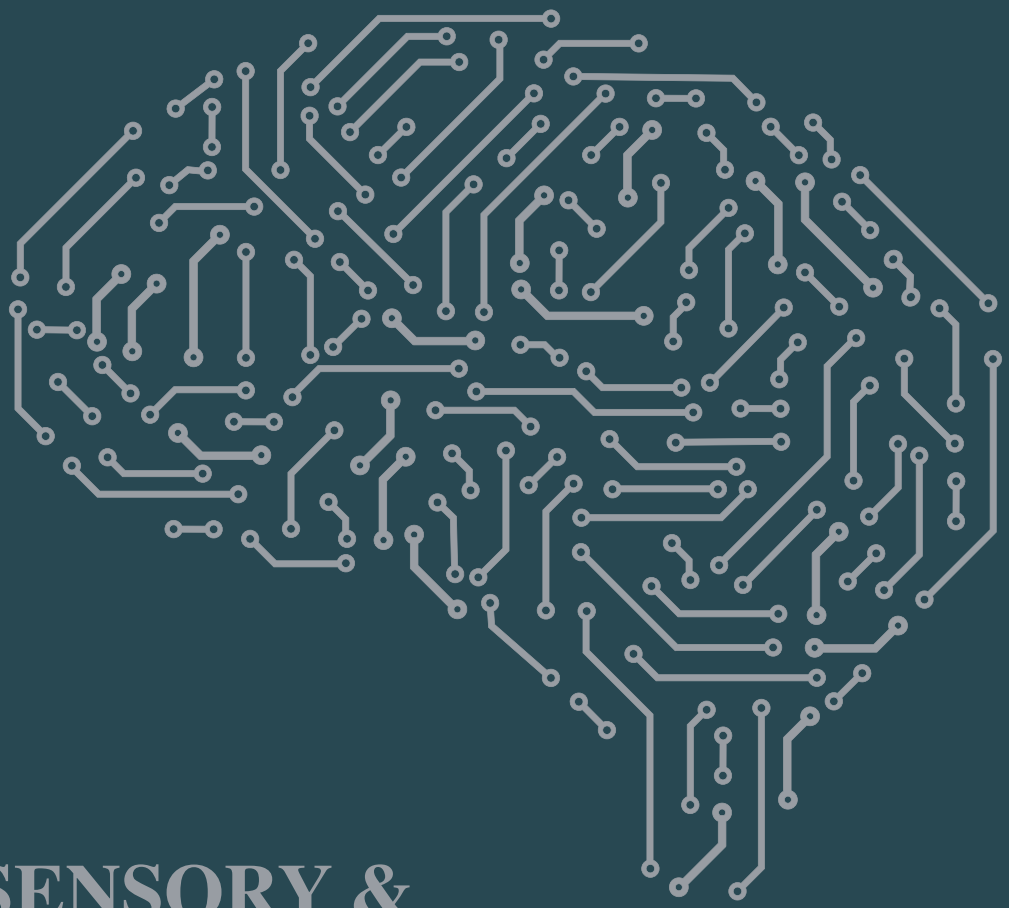
2018~Present : Principal Investigator, KBRI
2014~2018 : Postdoctoral Fellow, Department of New Biology, DGIST and Center for Plant Aging Research, Institute for Basic Science

Academic Credential

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

Awards/Honors/Memberships

2014~Present : Member, Korean Society for Mass Spectrometry

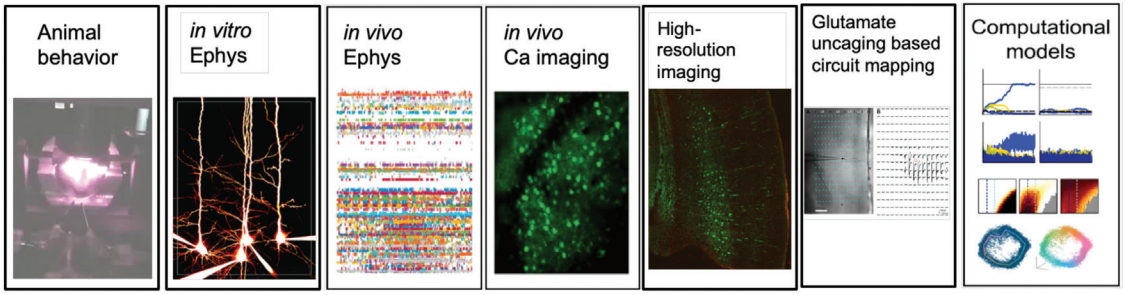


SENSORY & MOTOR SYSTEMS NEUROSCIENCE GROUP

SENSORY & MOTOR SYSTEMS NEUROSCIENCE GROUP

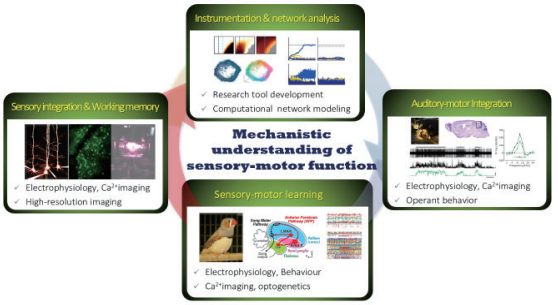
Overview

- 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



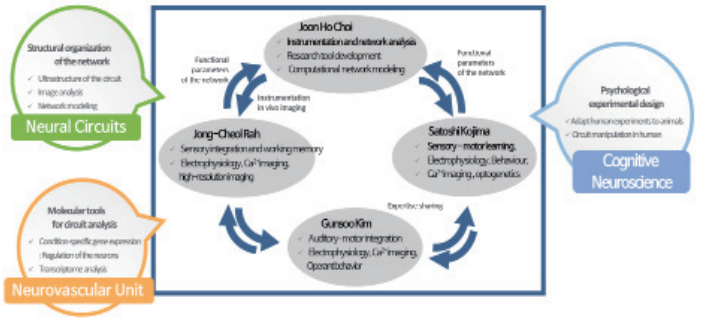
Research Objectives

- Circuit level understanding of sensory motor integration and learning
- Circuit level understanding of neural disorders
- Circuit level understanding of age-dependent decline of sensory-motor functions



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 modelingtional research

Gunsoo Kim, PhD
Group Leader
Principal Investigator

SENSORY & MOTOR SYSTEMS NEUROSCIENCE GROUP
Korea Brain Research Institute (KBRI)

Office : 5-3
Lab : Wet lab 5-2
Tel : +82-53-980-8465
Fax : +82-53-980-8339
E-mail : kgunsoo@kbri.re.kr
http://sites.google.com/site/gkimlab

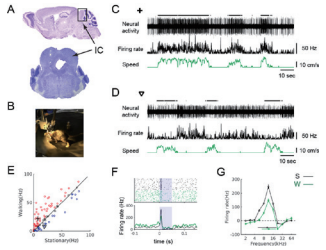
Neural circuits for auditory-motor integration

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.

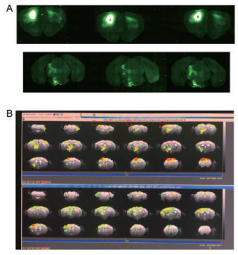
Aim	To understand neural mechanisms for auditory-motor integration
Tool	*In vivo* electrophysiology, optogenetics, operant behavior, fMRI

TARGET

Auditory- motor integration



Optogenetic circuit mapping



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.

Curriculum Vitae

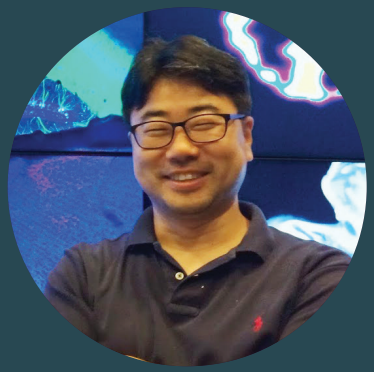
020~Present : Principal Investigator, KBRI
2015~2020 : Research Fellow / IBS, Center for Neuroscience Imaging Research
2011~2015 : Associate Specialist / Dept. Physiology, UCSF, USA
2005~2011 : Postdoctoral Fellow / Dept. Physiology, UCSF, USA

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



Jong-Cheol Rah, PhD
Principal Investigator

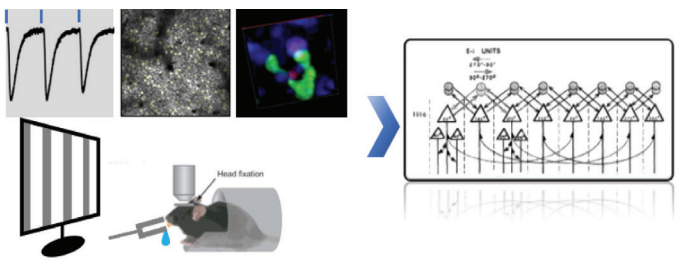
SENSORY & MOTOR SYSTEMS NEUROSCIENCE GROUP
Korea Brain Research Institute (KBRI)

Office : 5-1
Lab : Wet lab 5-1, Ephys room
Tel : +82-53-980-8350
Fax : +82-53-980-8359
E-mail : jcrah@kbri.re.kr
http://cortex-lab.org

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



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)

- Kim EH, Jeon S, Yang YS, Jin C, Kim J, Oh YS, **Rah JC***, Choi HS*, A neurosteroid-based microrobot for targeted neural connections in a hippocampal slice, *Advanced Materials*, 2023 Jan 14:e2208747. doi: 10.1002/adma.202208747, *Corresponding authors
- Kim YE, Kim YS, Lee HE, So KH, Choe Y, Suh BC, Kim JH, Park SK, Mathern GW, Gleeson JG, **Rah JC***, Baek ST*, Reversibility and developmental neuropathology of linear nevus sebaceous syndrome caused by dysregulation of the RAS pathway, *Cell Reports* 2023 Jan 31;42(1):112003. doi: 10.1016/j.celrep.2023.112003, *Corresponding authors
- Kim J, Lee J, Kim E, Choi JH, **Rah JC***, Choi JW*, Dopamine depletion can be predicted by the aperiodic component of subthalamic local field potential, *Neurobiology of Disease*, 2022 Mar 16;168:105692. DOI: 10.1016/j.nbd.2022.105692. *Corresponding authors
- Kim NR, Bahn SK, Choi JH, Kim JS and **Rah JC**, Synapses from the motor cortex and a high-order thalamic nucleus are spatially clustered in proximity to each other in the distal dendrites of the mouse somatosensory cortex, *Cerebral Cortex*, 2021 Aug 05 bhab236, DOI: 10.1093/cercor/bhab236
- 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*, 2021 Jan 1;31(1):356-378. doi:10.1093/cercor/bhaa230

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

KBRI Best research paper award (2021)
Review Editor, Frontiers in Behavioral Neuroscience
Review board, Communications Biology
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

Satoshi Kojima, PhD
Principal Investigator

SENSORY & MOTOR SYSTEMS NEUROSCIENCE GROUP
Korea Brain Research Institute (KBRI)

Office : 5-2
Lab : Wet lab 5-1
Tel : +82-53-980-8420
Fax : +82-53-980-8339
E-mail : satoshikojima.sk@gmail.com
http://sites.google.com/view/kojima-lab/home

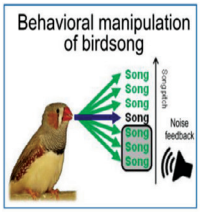
Behavioral and neural mechanisms of vocal learning and communication

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 unique 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.

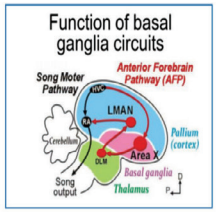
Aim	Understanding behavioral and neural mechanisms underlying vocal learning and communication
Tool	Electrophysiology + behavioral manipulation and analysis + pharmacology + gene expression analysis + Ca^{2+} imaging

TARGET

Behavioral manipulation of birdsong



Function of basal ganglia circuits



Recording, manipulation, and imaging of neural activity in free-moving birds

Research keyword

Vocal learning, Vocal communication, Songbird, Reinforcement learning, Basal ganglia, Intrinsic motivation, Skill learning, Critical period

Key techniques

Behavioral manipulation and analysis, *in-vivo* electrophysiology and pharmacological manipulation, $Ca2^{+}$ imaging, IEG expression analysis, Optogenetics

Research Interests/Topics

- Understand how songbirds regulate their vocal patterns using the basal ganglia-thalamo cortical circuit and the auditory feedback.
- Understand neural substrates underlying intrinsic motivation for spontaneous vocal practice in songbirds.
- Understand how young songbirds develop their song by imitating their tutor, and how such learning ability declines with age.
- Investigate 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)

- Tachibana, R. O., Lee, D., Kai, K., and **Kojima, S**. Performance-dependent consolidation of learned vocal changes in adult songbirds. J. *Neurosci. in press*. 2022.
- Kim, Y., Kwon, S., Rajan, R., Mori, C., and **Kojima, S**. Intrinsic motivation for singing in songbirds is enhanced by temporary singing suppression and regulated by dopamine. *Sci. Rep*. 11(1):20350. 2021.
- **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.

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

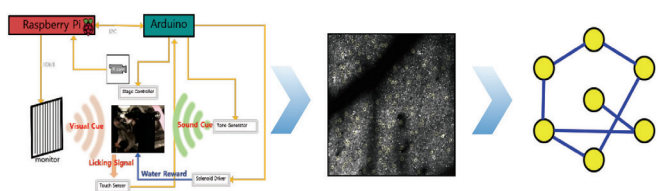
Joon Ho Choi, PhD
Principal Investigator

SENSORY & MOTOR SYSTEMS NEUROSCIENCE GROUP
Korea Brain Research Institute (KBRI)

Office : 5-2
Lab : Wet lab 5-1, Ephys room
Tel : +82-53-980--8335
Fax : +82-53-980-8339
E-mail : JoonChoi@kbri.re.kr
http://www.kbri.re.kr/

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	

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.

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/Memberships

2005 : Seoul Science Fellowship

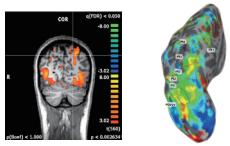
COGNITIVE SCIENCE GROUP

COGNITIVE SCIENCE GROUP

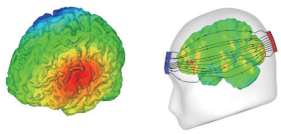
Overview

Cognitive science research group studies on high-level cognitive functions of the human brain using multifaceted approaches such as psychophysics, neuroimaging (fMRI, DTI and EEG) and other biosignals. We focus on understanding the mechanism and establishing cognitive models of memory, purchase, and so on. We also investigate developmental disorders in multidisciplinary way and electromagnetic and optic neuromodulation.

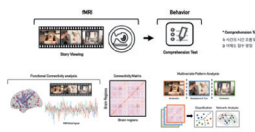
Macroscale functional brain imaging



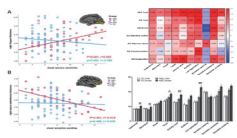
Numerical analysis on neuroelectromagnetics



High-level cognitive function



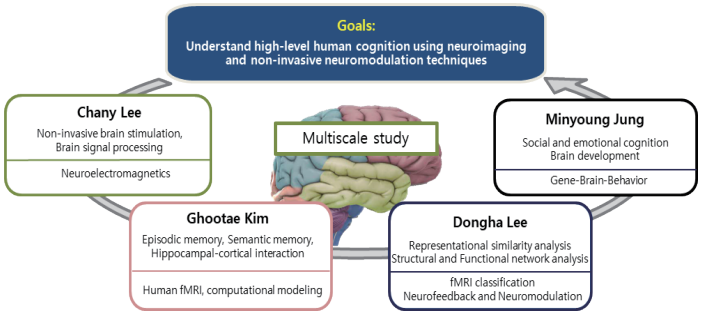
Multidisciplinary study on develomental disorder



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

Organization



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

Chany Lee, PhD
Group Leader
Principal Investigator

COGNITIVE SCIENCE GROUP
Korea Brain Research Institute (KBRI)

Office : 2-1
Lab : Wet lab 2-1, Brain engineering room
Tel : +82-53-980--8427
Fax : +82-53-980-8339
E-mail : chanylee@kbri.re.kr

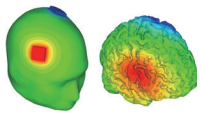
Numerical analysis on neuroelectromagnetics

Electromagnetic phenomena and modulation of neuronal activities using the techniques of computer simulation based on numerical analysis are researched 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 this 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 using deep learning. In near future, optical stimulation using near infrared light will be considered as a new stimulation modality.

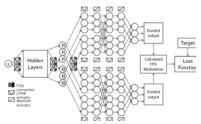
Aim	Noninvasive neuromodulation by electromagnetics and optics
Tool	Computer-based simulation

TARGET

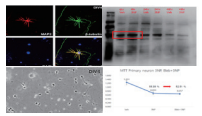
Developing Analysis Methods



Optimization by deep learning



Validation of photobiomodulation



Research keyword

Numerical analysis on neuroelectromagnetics, Electroencephalography (EEG), Magnetoencephalography (MEG), Transcranial electric stimulation (tES), Photobiomodulation (PBM).

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)

- Sangkyu Bahn, **Chany Lee**, and Bo-Yeong Kang, "A computational study on the optimization of transcranial temporal interfering stimulation with high-definition electrodes using unsupervised neural networks," *Human Brain Mapping*, 2022.
- Kuk-In Jang, Sungkean Kim, **Chany Lee**, and Jeong-Ho Chae, "Association between the loudness dependence of auditory evoked potentials and age in patients with schizophrenia and depression," *Journal of International Medical Research*, 50(7):1-15, 2022.
- Sangjun Lee, Jimin Park, Da Som Choi, **Chany Lee**, and Chang-Hwan Im, "Multipair transcranial temporal interference stimulation for improved focalized stimulation of deep brain regions: A simulation stydy," *Computers in Biology and Medicine*, 143:105337, 2022
- Sangjun Lee, **Chany Lee**, Euijin Kim, Song Ah Ko, Se-Na Kim, Young Bin Choy, and Chang-Hwan Im, "*In-Vivo* Estimation of Tissue Electrical Conductivities of a Rabbit Eye for Precise Simulation of Electric Field Distributions during Ocular Iontophoresis," *International Journal of Numerical Methods in Biomedical Engineering*, 38(1):e3540, 2021.
- Kuk-In Jang, Sungkean Kim, Soo Young Kim, **Chany Lee**, and Jeong-Ho Chae, "Machine Learning-Based Electroencephalographic Phenotypes of Schizophrenia and Major Depressive Disorder," *Frontiers in Psychiatry*, 12:745458, 2021.

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

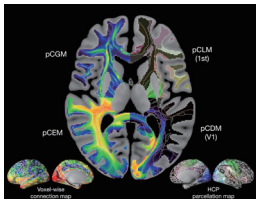
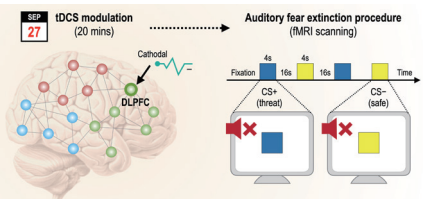
Dongha Lee, PhD
Principal Investigator

COGNITIVE SCIENCE GROUP
Korea Brain Research Institute (KBRI)

Office : 2-1
Lab : Wet lab 2-1
Tel : +82-53-980-8120
E-mail : donghalee@kbri.re.kr

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/lh5SmoxdIwI). It would be helpful for motor imagery learning in clinical application. We have studied object representations using neural, behavioral, and computational methods to better study the brain encoding.

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

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**, Raquel Guiomar, Óscar F. GonÇalves, Jorge Almeida, Ana Ganho-Ávila, Effects of transcranial direct current stimulation on neural activity and functional connectivity during fear extinction, *International Journal of Clinical and Health Psychology*, 2023, 23, 100342.
- **Dongha Lee**, Yujeong Lee, Yoonsang Lee, Kipom Kim, Functional connectivity in the mouse brainstem represents signs of recovery from a concussion, *Journal of Neurotrauma*, 2023, 40, 240-249
- **Dongha Lee**, Hae-Jeong Park, A populational connection distribution map for the whole brain white matter reveals ordered cortical wiring in the white matter space, *Neuroimage*, 2022, 254, 119167
- **Dongha Lee**, Taekwon Son, Structural connectivity differs between males and females in the object manipulation network, *Plos One*, 2021, https://doi.org/10.1371/journal.pone.0253273
- **Dongha Lee**, Which deep learning model can best explain object representations of within-category exemplars?, *Journal of vision*, 2021, 21(10):12, 1-10
- **Dongha Lee**, Elizabeth Q. Knight, Hyunjoo Song, Saebyul Lee, Chongwon Pae, Sol Yoo, Hae-Jeong Park, Differential structure-function network couplings in the inattentive and combined types of attention deficit hyperactivity disorder, *Plos One*, 2021, https://10.1371/journal.pone.0260295
- **Dongha Lee**, Jorge Almeida, Within-category representational stability through the lens of manipulable objects, *Cortex*, 2021, 137, 282-291

Patents

- **Dongha Lee**, Functional Connectivity and Gradient Analysis System and Method of Preclinical Functional Magnetic Resonance Imaging (Republic of Korea, 2022, 10-2022-0068942)
- **Dongha Lee**, Facial emotion-similarity judgement system (Republic of Korea, 2022, 10-2022-0074603)

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

Minyoung Jung, PhD
Principal Investigator

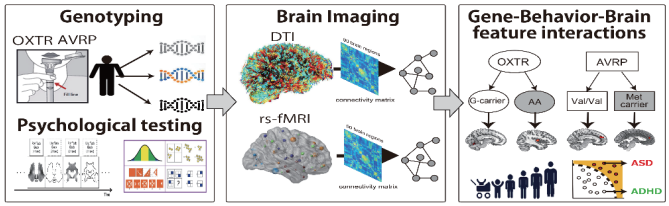
COGNITIVE SCIENCE GROUP
Korea Brain Research Institute (KBRI)

Office : 2-1
Lab : Wet lab 2-1, Cognition & Behavior testing room
Tel : +82-53-980-8120
Fax : +82-53-980-8339
E-mail : minyoung@kbri.re.kr
http: //minyoungjung.com

Brain Development Imaging Research

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



Research keyword

Social cognition, Emotion, Child development, Autism spectrum disorder, ADHD, Brain development

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)

- Cheong Y, Nishitani S, Yu J, Habata K, Kamiya T, Shiotsu D, Kamiya T, Omori I. M, Okazawa H, Tomoda A, Kosaka H, **Jung M** (Corresponding Author). The effects of epigenetic age and its acceleration on surface area, cortical thickness, and volume in young adults. *Cerebral Cortex*, 2022.
- Habata K, Cheong Y, Shiotsu D, Kamiya T, Omori I. M, Okazawa H, **Jung M** (Corresponding Author), KosakaH. Relationship between sensory characteristics and cortical thickness/volume in autism spectrum disorders. *Translational Psychiatry*, 2021.
- Shiotsu D, **Jung M** (Corresponding Author), Habata K., Kamiya, T, Omori, I. M, Okazawa H, KosakaH. Elucidation of the relationship between sensory processing and white matter using diffusion tensor imaging tractography in young adults. *Scientific Reports*, 2021.
- **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**, 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.

Patents

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

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

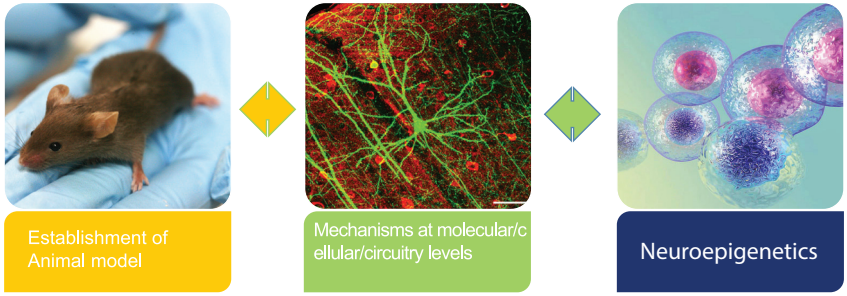
DEVELOPMENTAL DISORDERS & RARE DISEASES GROUP

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

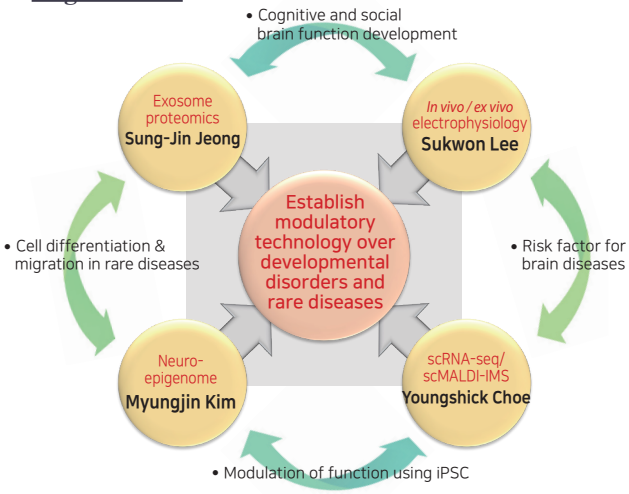
Research Objectives

- Molecular-level research on exosome proteins
- Molecula mechanisms for homeostasis based on neuroepigenome
- 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
- Study neuronal activity-dependent gene expression and protein modifications to understand brain homeostasis
- Analyze and modulate neural activation at the circuitry level
- Analyzing single cell resolution multi-omics features to understand development of circuit dysfuntion

Organization



Sukwon Lee, PhD
Group Leader
Principal Investigator

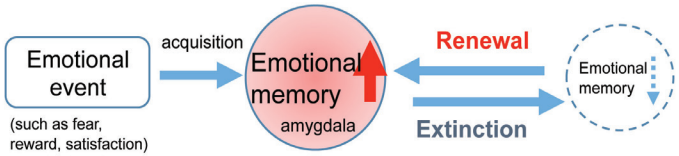
DEVELOPMENTAL DISORDERS & RARE DISEASES GROUP
Korea Brain Research Institute (KBRI)

Office : 2-2
Lab : Wet lab 2-1
Tel : +82-53-980-8433
Fax : +82-53-980-8339
E-mail : sukwon.lee@kbri.re.kr

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	



Research keyword

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)

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

Sung-Jin Jeong, PhD
Principal Investigator

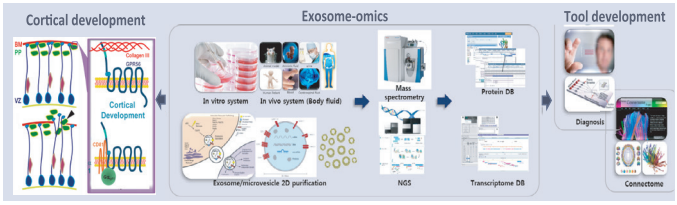
DEVELOPMENTAL DISORDERS & RARE DISEASES GROUP
Korea Brain Research Institute (KBRI)

Office : 4-4
Lab : Wet lab 4-2
Tel : +82-53-980-8410
Fax : +82-53-980-8550
E-mail : sjjeong@kbri.re.kr
http://www.kbri.re.kr/new/pages_lab/sub/page.html?mc=2050

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 keyword

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.

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)

- Heo JY, Jang YJ, and **Jeong SJ.** Method for predicting or diagnosing ciliary abnormalities through quantitative analysis of meningeal cell-derived extracellular vesicles . 2022. (10-2022-0160943)
- Ha BG, Jang YJ, and **Jeong SJ**. Effective extraction method for obtaining extracellular matrix derived from decellularized tissue scaffolds. 2021. (10-2021-0119577)

Ongoing Research Support

- NRF (PI, 04/01/21-12/31/25) Study on the identity and function of unknown-single cell during early cortical development
- NRF (PI, 06/01/19-12/31/23) International and domestic networking of neuroethics research

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

2023~ : Vice-President, Korean Society for Brain and Neural Sciences
2020~ : Secretary General, International Brain Research Organization
2020~ : Committee Member, Dana Foundation
2020 : Award of Ministry of Science and ICT
2019~2020 : Committee Member, Korea Society for Neural and Brain Science 2018~2020 :

Youngshik Choe, PhD
Principal Investigator

DEVELOPMENTAL DISORDERS & RARE DISEASES GROUP
Korea Brain Research Institute (KBRI)

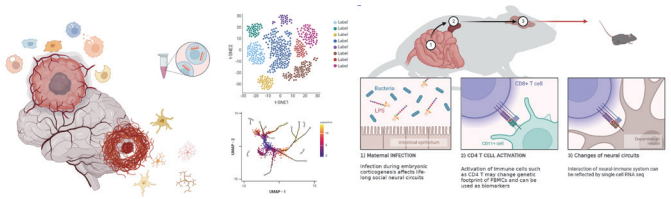
Office : 4-4
Lab : Wet lab 4-2
Tel : +82-53-980-8340
Fax : +82-53-980-8339
E-mail : dallarae@kbri.re.kr
http://www.kbri.re.kr/new/pages_lab/sub/page.html?mc=2038

Single cell omics & brain diseases

Each neuron is unique, and their heterogeneity is essential for brain function. The brain is an organ for processing and storing data. Neurons are essential for information processing, while glial scaffold protects the system. The dysfunctional activation of glial cells is an irreversible tipping point at which brain diseases, such as autism spectrum disorder and neurodegenerative diseases like Alzheimer's disease, become incurable. The following inquiries are of interest to us:
Which neurons are susceptible based on their transcriptomic signatures?
How do we know when the threshold of irreversible damage in brain diseases is reached?
Single-cell-level proteomics and transcriptomics analyses are being conducted to answer the questions. These methods provide information regarding neuronal vulnerability and the neuroimmune landscape when a disease becomes incurable. We believe that understanding individual neurons and neuro-glial-immune interactions will shed light on how to prevent the progression of the disease.

Aim	The neuro-immune interactions explain selective neuronal vulnerability
Tool	Single-cell proteo-transcriptomics, human brain organoids, mouse genetics

TARGET



Research keyword

Selective neuronal vulnerability, Neurodegeneration, Neuroimmune, Peripheral immune, Dystrophy

Key techniques

Quantitative single-cell proteomics, Exosomes, Proteotranscriptomics, Single-cell transcriptomics, Immuno-compatible 3D volume imaging, Mouse genetics

Research Interests/Topics

- Brain organoids: immunological interactions and vesicle-mediated neurite dystrophy
- Selective neuronal vulnerability: Single-cell omics analysis of mouse models and human patient biopsies (AD, ASD)

Research Publications (last 5 years)

- Kim YE, Kim YS, Lee HE, So KH, **Choe Y**, Suh BC, Kim JH, Park SK, Mathern GW, Gleeson JG, Rah JC, Baek ST. Reversibility and developmental neuropathology of linear nevus sebaceous syndrome caused by dysregulation of the RAS pathway. *Cell Rep*. 202331;42(1):112003
- Jung HJ, Yeo S, Jang J, Pleasure S, **Choe Y**. Brain heterotopia formation by ciliopathic breakdown of neuroepithelial and blood-cerebrospinal fluid barriers. B*rain Pathol*. 2023 9:e13148. doi: 10.1111/bpa.13148
- Oh Y, Nguyen N, Jung HJ, **Choe Y**, Kim JG. Changes in Cytochrome C Oxidase Redox State and Hemoglobin Concentration in Rat Brain During 810 nm Irradiation Measured by Broadband Near-Infrared Spectroscopy. *Photobiomodul Photomed Laser Surg*. 202240(5):315-324
- Kim J, Park I, Jang S, Choi M, Kim D, Sun W, **Choe Y**, Choi JW, Moon C, Park SH, Choe HK, Kim K. Pharmacological Rescue with SR8278, a Circadian Nuclear Receptor REV-ERBα Antagonist as a Therapy for Mood Disorders in Parkinson's Disease. *Neurotherapeutics*. 202219(2):592-607
- Kwon OK, Bang IH, Choi SY, Jeon JM, Na AY, Gao Y, Cho SS, Ki SH, **Choe Y**, Lee JN, Ha YS, Bae EJ, Kwon TG, Park BH, Lee S. SIRT5 Is the desuccinylase of LDHA as novel cancer metastatic stimulator in aggressive prostate cancer. *Genomics Proteomics Bioinformatics*. 2022 9:S1672-0229(22)00018-3

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

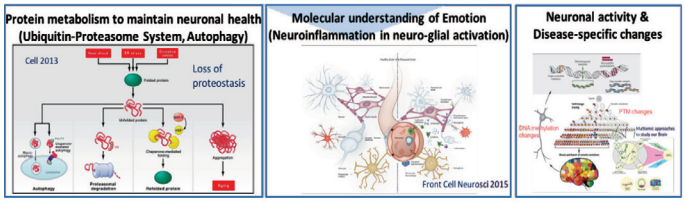
Myungjin Kim, PhD
Principal Investigator

DEVELOPMENTAL DISORDERS & RARE DISEASES GROUP
Korea Brain Research Institute (KBRI)

Office : 4-3
Lab : Wet lab 4-1
Tel : +82-53-980-8370
Fax : +82-53-980-8339
E-mail : myungjin@kbri.re.kr
http://www.kbri.re.kr/new/pages_lab/sub/page.html?mc=3136

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	

Research keyword

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)

Curriculum Vitae

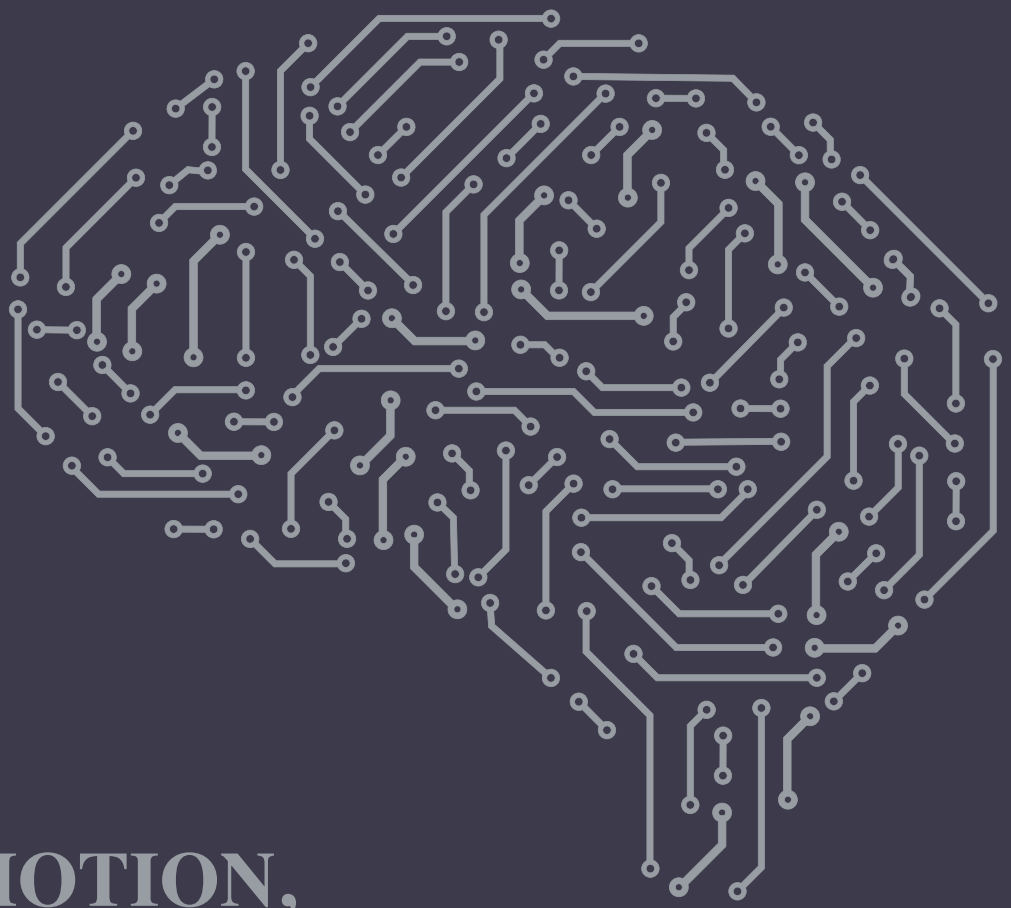
2017~Present : Principal Investigator, KBRI
2008~2017 : BK professor, Research Assistant Professor, Research Associate Professor, School of Biological Sciences, IMBG, RIBS, Seoul National University, Korea
2006~2007 : Postdoctoral Research Associate., USC/ Norris Cancer Center, USC Epigenome Center,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

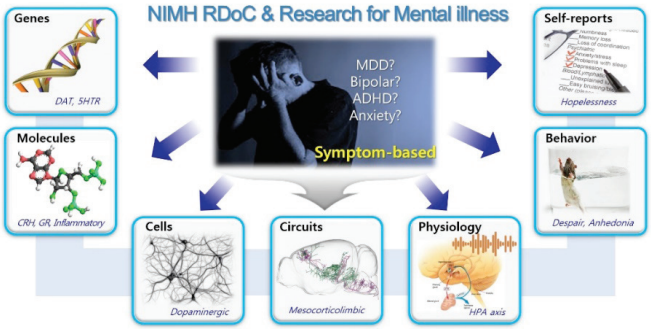


EMOTION, COGNITION & BEHAVIOR GROUP

EMOTION, COGNITION & BEHAVIOR GROUP

Overview

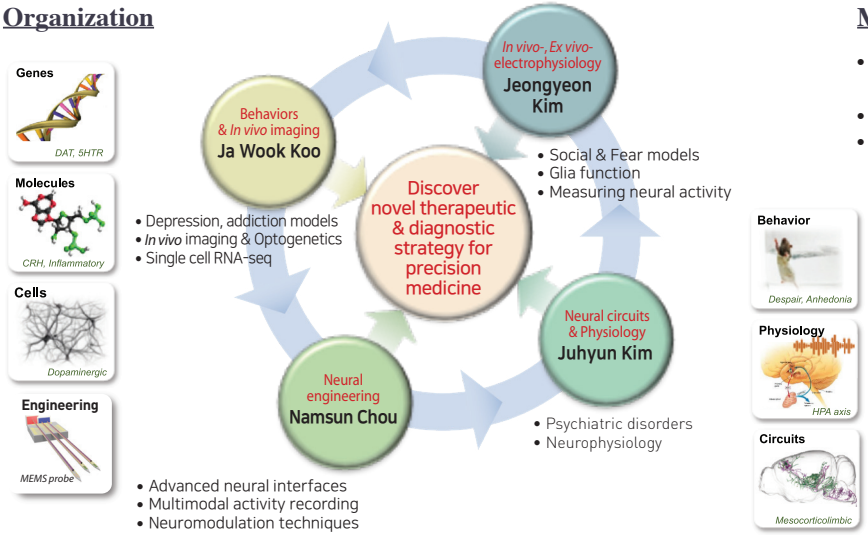
- Emotional-cognitive functional control by neuro-circuitry regulation
- Brain circuitry-based studies of transcriptomic and epigenetic mechanisms in psychiatric/cognitive disorders at the cell type and single-cell levels
- Multi-disciplinary approaches including optogenetics, electrophysiological, pharmacological 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
Group Leader
Principal Investigator

EMOTION, COGNITION & BEHAVIOR GROUP
Korea Brain Research Institute (KBRI)

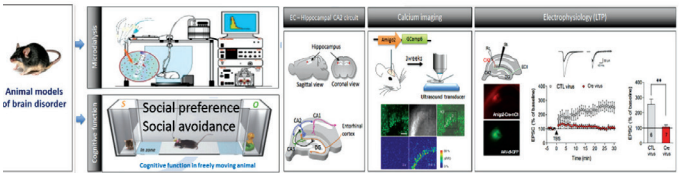
Office : 2-2
Lab : Wet lab 2-1
Tel : +82-53-980-8311
Fax : +82-53-980-8309
E-mail : jykim@kbri.re.kr

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 keyword

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.

Research Interests/Topics

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

Research Publications (last 5 years)

- 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)

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

Ja Wook Koo, PhD
Principal Investigator
Director of Global Emotion & Addiction Research Project

EMOTION, COGNITION & BEHAVIOR GROUP
Korea Brain Research Institute (KBRI)

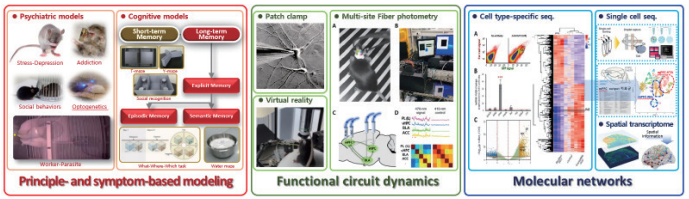
Office : 4-3
Lab : Wet lab 4-2
Tel : +82-53-980-8430
Fax : +82-53-980-8339
E-mail : jawook.koo@kbri.re.kr
http://www.kbri.re.kr/new/pages_lab/sub/page.html?mc=2056

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 is 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.

Aim	Elucidating how emotional and cognitive behaviors are modulated in health and disease
Tool	Behavioral models + Electrophysiology & Circuits + Next generation sequencing

TARGET



Research keyword

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

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 (last 5 years)

- Kim J*, Kang S*, Choi T-Y, Chang K-A*, **Koo JW*** Metabotropic glutamate receptor 5 in amygdala target neurons regulates susceptibility to chronic social stress. ***Biol Psychiatry (in press)***. 2022. (*contributed equally)
- Ahn S, Kang Y, Lee JW, Jeong SJ, Lee YJ, Lee S, **Koo JW***, Kim JJ*, Jung MW* A role of anterior cingulate cortex in the emergence of worker-parasite relationship. ***PNAS*** 118(48):e2111145118, 2021.
- Min S, Jeong YH, Kim J, **Koo JW***, Ahn YM* The aftermath: post-pandemic psychiatric implications of the COVID-19 pandemic, a South Korean perspective. ***Front Psychiatry*** 12:671722, 2021.
- Lee J, Ribeiro E, Kim J, Ko B, Kronman HG, Jeong YH, Kim JK, Janak PH, Nestler EJ*, **Koo JW***, Kim J-H* Dopaminergic regulation of nucleus accumbens cholinergic interneurons demarcates susceptibility to cocaine addiction. ***Biol Psychiatry*** 88:746-757, 2020.
- **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.

Curriculum Vitae

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

2022 : KBRI researcher of the year award 2022
2021 : Excellent Paper Award, KBRI
2020 : Best Paper Award, KBRI
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

Namsun Chou, PhD
Principal Investigator

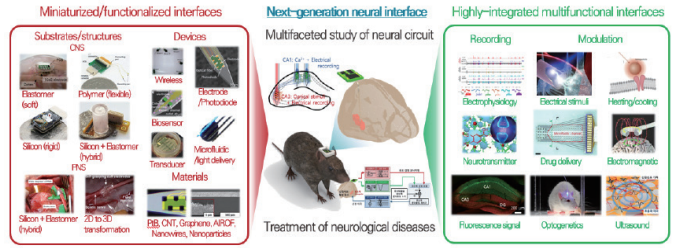
EMOTION, COGNITION & BEHAVIOR GROUP
Korea Brain Research Institute (KBRI)

Office : 2-2
Lab : Wet lab 2-1
Tel : +82-53-980-8501
Fax : +82-53-980-8339
E-mail : nschou@kbri.re.kr

Advanced neural interfaces for neuroscience

The neural interface Lab. aims at developing neural interfaces including neural probe, brain-machine interfaces (BMI), micro devices and systems that are to be implanted in the nerve systems for neurological disease monitoring, diagnosis, treatment, rehabilitation and neuroscience research. To develop the advanced neural interface, we explore multidisciplinary research areas such as mechanical, electrical, material, chemical, medical and neuroscience. Our research focus is to advance multifunctional neural interfaces including brain interfaces, peripheral nerve interfaces; silicon-/polymer-based microfabrication technologies for bio-MEMS (micro-electro-mechanical system); and electrophysiology, drug delivery, imaging, neuromodulation tools.

Aim	Development of advanced techniques for the next-generation neural interface
Tool	MEMS/semiconductor fabrication + various recording/ stimulation techniques + *in-vitro/-vivo* demonstration
TARGET	



Research keywords

Neural Interfaces, Biomedical devices, Microfabrication, Multimodal neural activity recording, Neuromodulation.

Key techniques

MEMS (Micro-ElectroMechanical Systems) and semiconductor design & fabrication, Soft material-based fabrications, Material/Electrochemical analysis, Optogenetics, Fluorescence imaging, Electrophysiology

Research Interests/Topics

- MEMS neural probe for multifaceted study of neural circuits
- Soft bioelectronic interfaces for diagnosis and treatment of neurological disorders

Research Publications (selected)

- **Chou** N, Shin H, Kim K, Chae U, Jang M, Jeong UJ, Hwang KS, Yi B, Lee SE, Woo J, Cho Y, Lee C, Baker J. B, Oh SJ, Nam MH, Choi N, Cho IJ. A Multimodal Multi-Shank Fluorescence Neural Probe for Cell-Type-Specific Electrophysiology in Multiple Regions across a Neural Circuit. *Advanced Science*, 9(2):advs.202103564, 2021. (Cover Paper)
- **Chou** *, Moon H*, Park J, Kim S. A Interfacial and surface analysis of parylene C-modified PDMS substrates for soft bioelectronics. *Progress in Organic Coatings*, 157:106309, 2021. (*contributed equally)
- Moon H*, **Chou** *, Seo HW, Lee K, Park J, Kim S. Transformation of 2D planes into 3D soft and flexible structures with embedded electrical functionality. *ACS applied materials & interfaces*, 11(39):36186-36195, 2019. (*contributed equally, Cover Paper)
- **Chou** , Kim Y, Kim S. A method to pattern silver nanowires directly on wafer-scale PDMS substrate and its applications. *ACS applied materials & interfaces*, 8(9):6269-6276, 2016.
- **Chou** , Yoo S, Kim S. A largely deformable surface type neural electrode array based on PDMS. *IEEE Transactions on neural systems and rehabilitation engineering*, 21(4):544-553, 2012. (Featured Article)

Patents (selected)

- Kim S, Chou N, Moon H. Selective bonding method of polymer substrates. US Pat. US11084898B2; Korea, Pat. 10-1824246, 2021.
- Cho IJ, Chou N. Neural probe structure for measuring multiple fluorescence signals and manufacturing method thereof. US Pub. No. US2021/0085996 A1; Korea, Pat. 10-2252113, 2021.
- Kim S, Moon H, Chou N. Drug delivery device and manufacturing methods thereof. US Pub. No. US2020/00353162 A1; Korea, Pat. 10-2075594, 2020.
- Kim S, Moon H, Chou N. Balloon-type retinal stimulation device and method for manufacturing same. US Pub. No. US2020/0376270 A1; Korea, Pat. 10-2095437, 2020.

Curriculum Vitae

2021~Present : Principal Investigator, KBRI
2017~2021 : Postdoctoral Researcher, Center for BioMicrosystem, Brain Science Institute, Korea Institute of Science and Technology (KIST), Republic of Korea
2016~2017 : Postdoctoral Researcher, Department of Robotics Engineering, Daegu Gyeongbuk institute of science & technology (DGIST), Republic of Korea

Academic Credential

2016 : Ph.D., Mechatronics, Gwangju Institute of Science and Technology (GIST)
2011 : M.S., Mechatronics, Gwangju Institute of Science and Technology (GIST)
2009 : B.S., Mechanical Engineering, Konkuk University

Awards/Honors/Memberships

2012~Present : Member, Society of Micro and Nano Systems

Juhyun Kim, PhD
Principal Investigator

EMOTION, COGNITION & BEHAVIOR GROUP
Korea Brain Research Institute (KBRI)

Office : 4-3
Lab : Wet lab 4-2
Tel : +82-53-980-8312
E-mail : Juhyun.kim@kbri.re.kr
https://sites.google.com/view/psyphylab

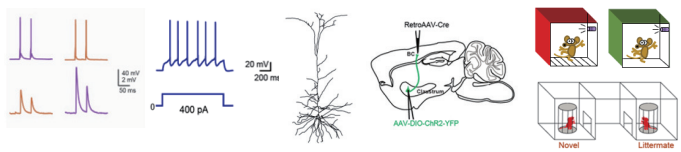
Neurophysiological mechanisms underlying mental disorders

Intrinsic excitability and synaptic activities of neurons are precisely regulated for normal brain functions. Disease-associated genetic mutations or environmental factors can change the tight regulation of neuronal activity and contribute to pathogenesis in brain disorders. We aim to understand how multiple different types of excitatory and inhibitory neurons form and maintain their normal synaptic networks and how their excitability and synaptic activity changes in pathological conditions. To perform this research, we utilize a wide range of techniques including molecular and biochemical methods, optogenetics-based multiple whole-cell patch-clamp recordings on acute brain slices, stereotaxic brain surgery, and behavioral analysis.

Aim	Characterizing neural circuits responsible for psychiatric disorders and developing novel strategies to cure them
Tool	Mouse models of psychiatric disorders + brain surgery + *in vitro* & *in vivo* electrophysiology + behavioral & histological investigation

TARGET

Circuit connectivity | Intrinsic property | Morphology | Circuit modulation | Behavioral assay



Research keyword

Neural circuit, Electrophysiology, Psychiatric disorders

Key techniques

Mouse models of psychiatric disorders, Brain and spinal cord surgery, Brain slice multiple whole-cell patch-clamp recording, optogenetics-based circuit mapping

Research Interests/Topics

- Cortical circuit alterations in neurodevelopmental disorders
- Neurophysiological changes in bipolar disorders
- Neural circuits controlling sensory perception and emotional behaviors
- Cellular and synaptic mechanisms mediating sexual behaviors

Research Publications (Selected)

- **Kim J***, Kim DW, Lee A, Mason M, Jouroukhin Y, Woo H, Yolken RH, Pletnikov MV. Homeostatic regulation of neuronal excitability by probiotics in male germ-free mice. *J Neurosci Res*. 2022 Feb;100(2):444-460 (*corresponding author)
- Yoo S*, **Kim J***, Lyu P*, Hoang TV, Ma A, Trinh V, Dai W, Jiang L, Leavey P, Won JK, Park SH, Qian J, Brown SP, Blackshaw S. Control of neurogenic competence in mammalian hypothalamic tanycytes. *Science Advances*, 2021 May 28;7(22):eabg3777 (*co-first author)
- Frandolig JE*, Matney CJ*, Lee K*, **Kim J***, Chevée M, Kim SJ, Bickert AA, Brown SP. The Synaptic Organization of Layer 6 Circuits Reveals Inhibition as a Major Output of a Neocortical Sublamina. *Cell Reports*. 2019 Sep 17;28(12):3131-3143 (*co-first author)
- **Kim J**, Hughes EG, Shetty AS, Arlotta P, Goff LA, Bergles DE, Brown SP. Changes in the Excitability of Neocortical Neurons in a Mouse Model of Amyotrophic Lateral Sclerosis Are Not Specific to Corticospinal Neurons and Are Modulated by Advancing Disease. *J Neurosci*. 2017 Sep 13;37(37):9037-9053
- **Kim J**, Matney CJ, Roth RH, Brown SP. Synaptic Organization of the Neuronal Circuits of the Claustrum. *J Neurosci*. 2016 Jan 20;36(3):773-84
- **Kim J**, Matney CJ, Blankenship A, Hestrin S, Brown SP. Layer 6 corticothalamic neurons activate a cortical output layer, layer 5a. *J Neurosci*. 2014 Jul 16;34(29):9656-64.
- **Kim J**, Park BH, Lee JH, Park SK, Kim JH. Cell type-specific alterations in the nucleus accumbens by repeated exposures to cocaine. *Biological Psychiatry*. 2011 Jun 1;69(11):1026-34.
- **Kim J***, Jung SY*, Lee YK, Park S, Choi JS, Lee CJ, Kim HS, Choi YB, Scheiffele P, Bailey CH, Kandel ER, Kim JH. Neuroligin-1 is required for normal expression of LTP and associative fear memory in the amygdala of adult animals. *Proc Natl Acad Sci U S A*. 2008 Jul 1;105(26):9087-92. (*co-first author)

Curriculum Vitae

2022~Present : Principal Investigator, KBRI
2022~2022 : Assistant professor, Psychiatry, Johns Hopkins
2019~2022 : Instructor, Psychiatry, Johns Hopkins
2011~2019 : Postdoctoral fellow, Neuroscience, Johns Hopkins

Academic Credential

2011 : Ph.D., Neuroscience, POSTECH, Korea
2004 : B.S., Life Science, POSTECH, Korea

Awards/Honors/Memberships

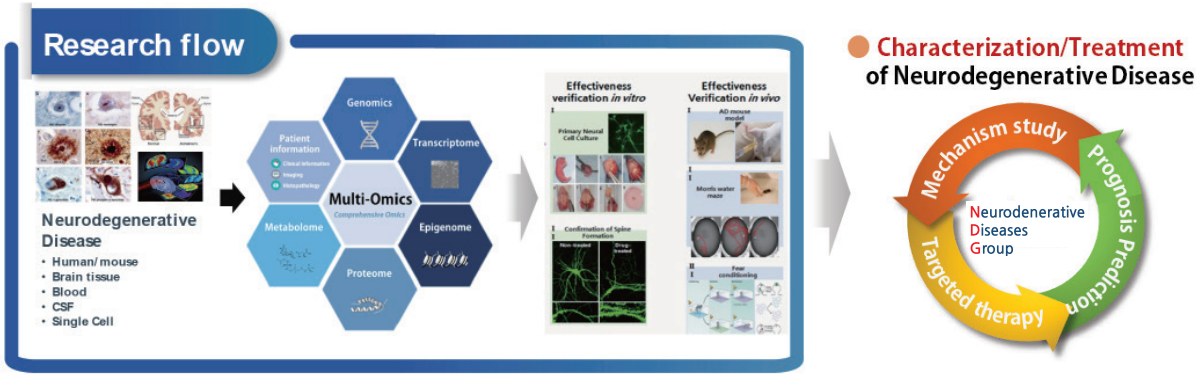
2023 : National Institute of Mental Health (NIMH) peer reviewer, USA
2020 : NARSAD Young Investigator Award, Brain & Behavior Research Foundation, USA
2011 : Postdoctoral Research Fellowship, National Research Foundation of Republic of Korea
2010 : National Junior Research Fellowship, National Research Foundation & The Ministry of Education, Science and Technology of Republic of Korea

NEURO-DEGENERATIVE DISEASES GROUP

NEURODEGENERATIVE DISEASES GROUP

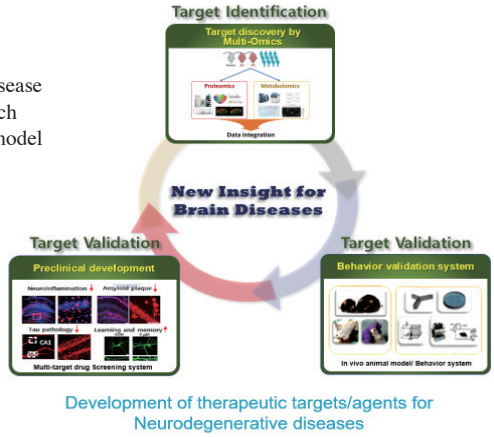
Overview

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

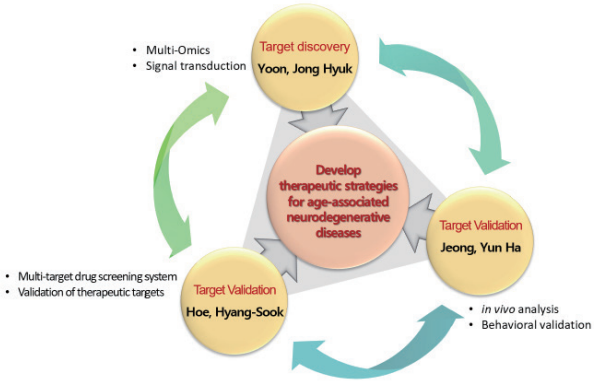


Research Objectives

• 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



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

Principal Investigator

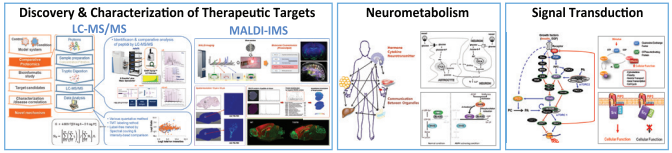
NEURODEGENERATIVE DISEASES GROUP
Korea Brain Research Institute (KBRI)

Office : 4-7
Lab : Wet lab 4-3
Tel : +82-53-980-8341
Fax : +82-53-980-8339
E-mail : jhyoon@kbri.re.kr
http://sites.google.com/view/yoons-team/home

Multi-Omics & Neurometabolism

I'm interested in a study on new signal modules and molecular targets of neurological disorders discovered by multi-Omics and data science technologies. This study aims at finding molecular targets of companion diagnostics for precision medicine. Metabolic organs, including the brain, skeletal muscle, and adipose, dynamically secrete various factors, communicate with each other, and orchestrate functions to maintain body homeostasis. I am also interested in the metabolic features of neural cells under a disordered state and the crosstalk between the brain and metabolic organs.

Aim	Elucidating molecular mechanisms in neurological disorders using Multi-Omics & Data science
Tool	Multi-Omics + Data science + Biochemistry + Molecular Biology + Cell Biology
TARGET	Discovery & Characterization of Therapeutic Targets (LC-MS/MS, MALDI-IMS) / Neurometabolism / Signal Transduction



Research keyword

Multi-Omics, Neurodegenerative diseases, Neurometabolism, Signal transduction, Stem cell therapy, Data science

Key techniques

Mass spectrometry-based Omics(proteomics, lipidomics), Data Science, Neuroscience, Biochemistry, Molecular Biology, Cell biology

Research Interests/Topics

- Discovery and characterization of new signal modules and molecular targets of neurological disorders using multi-Omics & data science study
- Characterization of metabolic features of brain cells under disorder states
- Characterization of crosstalk between brain and metabolic organs
- Development of the engineered stem cell therapy for neurodegenerative diseases
- Development of new methods for brain drug delivery

Research Publications (last 3 years/selected)

- Lee, Y.J, Shin, K.J, Jang, HJ,... **Yoon, JH**, Seo, JG, Kim, HJ,... Chae, YC. GPR143 regulates ESCRT-dependent exosome biogenesis and promotes cancer metastasis. *Developmental Cell* Feb 10:S1534-5807(23)00037-0, 2023.
- Jung, D, S. Shin,..., **Yoon, JH**,..., Yea, K, Baek, MC. Reprogramming of T cell exosomes using IL2 surface engineering induces potent anti-cancer effects. *J Extracell Vesicles*. Dec;11(12):e12287, 2022.
- Kim, JH, Ruqayya, A, Cho, E, **Yoon, JH**, Lim, YH, Lee, HW, Ryu, H, Suk, K. Soluble ANPEP released from human astrocytes as a positive regulator of microglial activation and neuroinflammation: Brain renin–angiotensin system in astrocyte–microglia crosstalk. *Mol Cell Proteomics*. Nov;21(11):100424, 2022.
- **Yoon, JH**[*&], Seo, Y[&], Jo, YS, Lee, S, Cho, E, Cazenave-Gassiot A, Shin, YS, Moon, MH, An, H.J, Wenk MR, Suh, PG. Brain lipidomics: From functional landscape to clinical significance. *Science Advances* Sep 16;8(37):eadc9317, 2022.
- Lim, HK, **Yoon, JH***, Song, M.* Autism spectrum disorder genes: disease-related networks and compensatory strategies." *Front Mol Neurosci*. Jun 3;15:922840, 2022.
- Kim, D[&], Jo, YS[&], Jo, HS,..., Oh, YS*, **Yoon, JH**.* Comparative phosphoproteomics of Neuro-2a cells under insulin resistance reveals new molecular signatures of Alzheimer's disease. *Int J Mol Sci*. Jan 17;23(2):1006, 2022.
- Kwon, YW, Bae, S, Jo, YS, Seo, Y, **Yoon, JH**. Stimulation of the migration and expansion of mouse adult neural stem cells by the FPR2-specific peptide WKYMVm. *Life* Nov 17;11(11):1248, 2021.
- Kwon, YW, Jo, HS, Bae, S, Seo, Y, Song, P, Song, M*, **Yoon, JH**.* Application of proteomics in cancer: Recent trends and approaches for biomarkers discovery. *Frontiers in Medicine* Sep 22;8:747333. 2021.

Patents (registered/last 3years/selected)

- **Yoon, JH**, Joo, JY, Kim, DG, Lim, KH, Hue, HS. (2021) "Use of Ube2h for Diagnosis or Treatment of Alzheimer's Disease" (KR10-2202120)
- **Yoon JH**, Hwang D, Ryu SH, Park S, Park JH (2020) "Novel hepatocellular carcinoma diagnostic marker and use thereof" (KR10-2136643)

Curriculum Vitae

2020~Present : Principal Researcher, KBRI, South Korea
2019~Present : Group Leader, Neurodegenerative Diseases Research Group, KBRI, South Korea
2016~2020 : Senior Researcher, 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
2023~present : Member, Editorial Board, *Scientific Reports*
2021~present : Member, Editorial Board, *Molecules and Cells*
2022~present : Editor-in-Chief, Local Organizing Committee, 22th Human Proteome Organization (HUPO) World Congress
2020~present : Editor-in-Chief, Editorial Committee, KHUPO
2019~present : Manager, General Affairs, Signal Transduction Association (STA)
2019~2021: Member, Local Organizing Committee, 10th Asia-Oceania Human Proteome Organization (AOHUPO) Congress
2018~2020 : Member, Steering Committee, Korea Cancer ProteoGenomics Research Program, Ministry of Health and welfare

Yun Ha Jeong, PhD

Principal Investigator
Director of Brain Research Policy Center

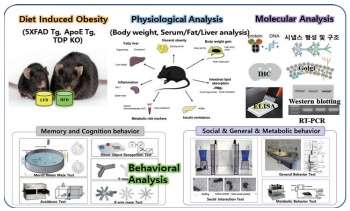
NEURODEGENERATIVE DISEASES GROUP
Korea Brain Research Institute (KBRI)

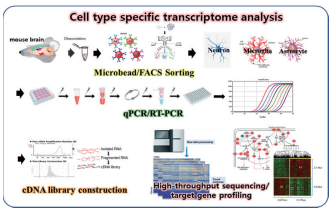
Office : 5-3
Lab : Wet lab 5-2
Tel : +82-53-980-8393
Fax : +82-53-980-8339
E-mail : yunha.jeong@kbri.re.kr
http://sites.google.com/view/braindisease/home

Behavior 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	





Research keyword

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 specificity, 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)

- Choi M, Kim D, Youn Y-J, Ryu J, **Jeong YH**. Effect of Obesity and High-Density Lipoprotein Concentration on the Pathological Characteristics of Alzheimer's Disease in High-Fat Diet-Fed Mice. *Int J Mol Sci* 23(20):12296. 2022
- Choi M, Lee S-M, Kim D, Im H-I, Kim H-S*, **Jeong YH***. Disruption of the astrocyte–neuron interaction is responsible for the impairments in learning and memory in 5XFAD mice: an Alzheimer's disease animal model. *Mol Brain*. 14(1):111. 2021 *Co-Corresponding
- 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. 2020 *Co-Corresponding
- 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*. 16(4):672-682. 2020 *Co-First
- Labonté B*, **Jeong YH***, Parise E, Issler O, Fatma M, Engmann O, Cho K, Neve Rachael, Nestler EJ, Koo JW. Gadd45b mediates depressive-like role through DNA demethylation. *Sci Rep*. 9(1):461. 2019 *Co-First

Curriculum Vitae

2022~Present : Director, Brain Research Policy Center, KBRI
2022~Present : Principal Researcher, Neurodegenerative Disease Group, KBRI
2013~2021 : Senior Researcher, Neurodegenerative Disease Group, 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

Hyang-Sook Hoe, PhD

Principal Investigator

NEURODEGENERATIVE DISEASES GROUP
Korea Brain Research Institute (KBRI)

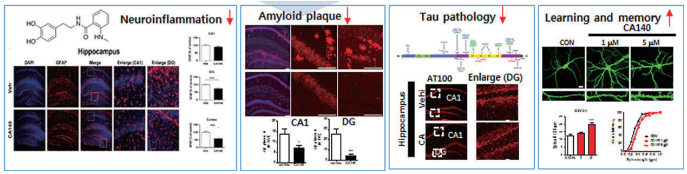
Office : 4-2
Lab : Wet lab 4-1
Tel : +82-53-980-8310
Fax : +82-53-980-8309
E-mail : sookhoe72@kbri.re.kr

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 keyword

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

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.

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

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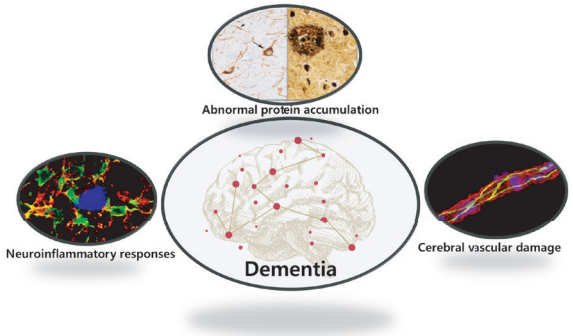
Overview

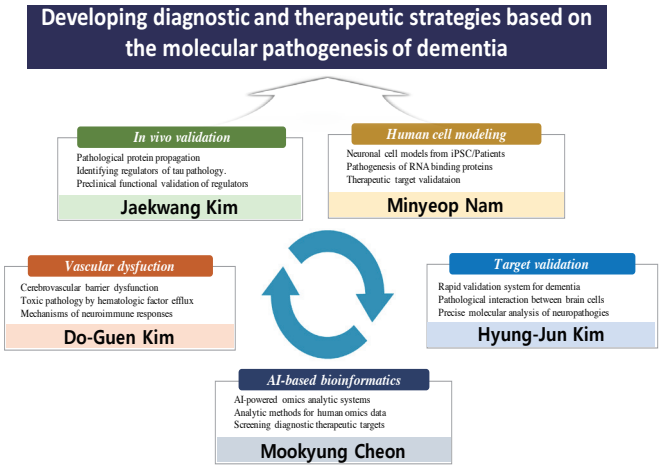
Dementia is a broad category of brain disorders with a gradual decline in memory and cognition, such as Alzheimer's disease, vascular dementia, Lewy body dementia, frontotemporal dementia, etc. Although prevalence of dementia worldwide is exponentially growing, there is currently no cure for dementia. 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

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

DEMENTIA GROUP
Korea Brain Research Institute (KBRI)

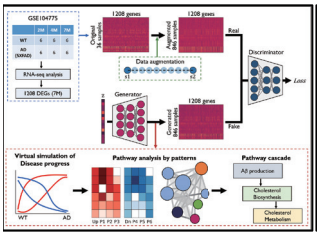
Office : 4-1
Tel : +82-53-980-8434
Fax : +82-53-980-8339
E-mail : mkcheon@kbri.re.kr
http://www.kbri.re.kr/new/pages_lab/sub/page.html?mc=3142

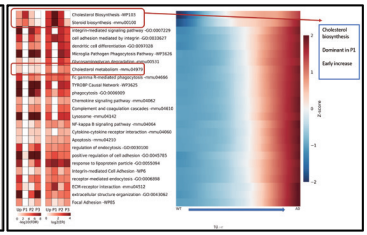
Bioinformatics, computational neuroscience and AI for dementia research

I'm interested in a study on new signal modules and molecular targets of neurological disorders discovered by multi-Omics and data science technologies. This study aims at finding molecular targets of companion diagnostics for precision medicine. Metabolic organs, including the brain, skeletal muscle, and adipose, dynamically secrete various factors, communicate with each other, and orchestrate functions to maintain body homeostasis. I am also interested in the metabolic features of neural cells under a disordered state and the crosstalk between the brain and metabolic organs.

Aim	Convergence omics study for dementia research
Tool	Bioinformatics (multi-omics) and AI deep learning (generative models)

TARGET





Research keyword

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

Key techniques

- AutoEncoder, Generative adversarial networks, RNA-seq, Molecular dynamics, Gradient Boosting

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 (last 5 years)

- Kim H, Kim Y, Lee C-Y, Kim D-G, **Cheon M**. Investigation of early molecular alterations in tauopathy with generative adversarial networks. *Scientific Reports*, 13:732, 2023.
- Lee K, Kim T, **Cheon M**, Yu W. Unveiling OASIS family as a key player in hypoxia-ischemia cases induced by cocaine using generative adversarial networks. *Scientific Reports*, 12:6734, 2022.
- 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.

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

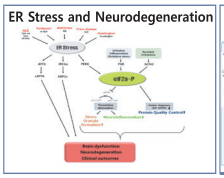
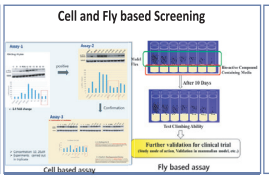
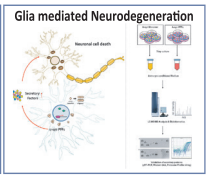
Hyung-Jun Kim, PhD
Principal Investigator
Director of the Research Headquarters

DEMENTIA GROUP
Korea Brain Research Institute (KBRI)

Office : 4-1
Lab : Wet lab 4-1
Tel : +82-53-980-9380
Fax : +82-53-980-9808
E-mail : kijang1@kbri.re.kr
http://www.kbri.re.kr/new/pages_lab/sub/page.html?mc=2062

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	  

Research keyword

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)

- 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** (2020). 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)
- 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**# (2020) The overexpression of TDP-43 in astrocytes causes neurodegeneration via a PTP1B mediated inflammatory response. *Journal of Neuroinflammation*, 17:299. (Corresponding author)
- Sun Joo Cha, Seongsoo Lee, Hyun-Jun Choi, Yeo Jeong Han, Yu-Mi Jeon, Myungjin Jo, Shinrye Lee, Minyeop Nahm , Su Min Lim, Seung Hyun Kim, **Hyung-Jun Kim**#, Kiyoung Kim# (2022). Therapeutic modulation of GSTO activity rescues FUS-associated neurotoxicity via deglutathionylation in ALS disease models. *Developmental cell*, 57(6), 783–798.e8. doi:10.1016/j.devcel.2022.02.022. (corresponding author)
- Yu-Mi Jeon, Younghwi Kwon, Shinrye Lee, Seyeon Kim, Myungjin Jo, Seongsoo Lee, Sang Ryong Kim, Kiyoung Kim, **Hyung-Jun Kim** (2022) Vitamin B12 Reduces Tdp-43 Toxicity by Alleviating Oxidative Stress and Mitochondrial Dysfunction. *Antioxidants*. 11(1): 82. (Corresponding author)

Curriculum Vitae

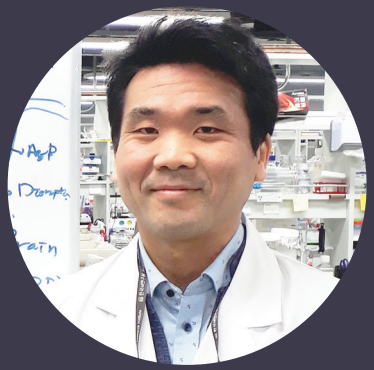
2020~Present : Director of research division, KBRI
2013~Present : Senior and Principal researcher, KBRI
2008~2013 : Postdoctoral fellow, HHMI / UPENN., USA
2007~2008 : Postdoctoral Fellow, School of biologicalsciences, Seoul National Univ., Korea

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 KoreanSociety 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
2022 : KBRI Outstanding paper award



Do-Geun Kim, DVM & PhD
Principal Investigator

DEMENTIA GROUP
Korea Brain Research Institute (KBRI)

Office : 5-4
Lab : Wet lab 5-2
Tel : +82-53-980-8364
E-mail : kimvet0911@kbri.re.kr

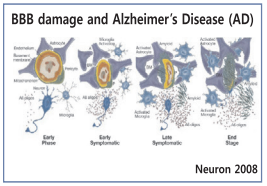
Elucidating the vascular pathophysilolgy in the development of neurodegenerative diseases

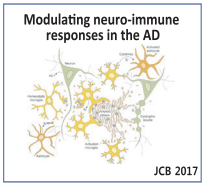
Research Description

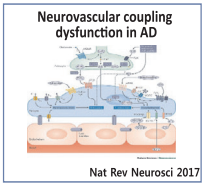
The brain is the center for the cognitive function and needs special means to protect itself from the peripheral insult and this entity of structural barrier of the vascular system is called blood brain barrier (BBB). It is unique in its structure delineating the vascular system of the CNS composed of 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







Research keyword

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.

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

Jaekwang Kim, PhD

Principal Investigator

DEMENTIA GROUP
Korea Brain Research Institute (KBRI)

Office : 4-2
Lab : Wet lab 3-1
Tel : +82-53-980-8390
Fax : +82-53-980-8339
E-mail : kim_jaekwang@kbri.re.kr
kimjaekwang96@gmail.com
http://www.kbri.re.kr/new/pages_lab/sub/page.html?mc=4003

Neurobiology of Alzheimer's disease

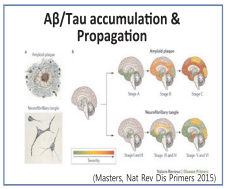
Alzheimer's disease (AD) is the most common form of dementia in the elderly. Although details of AD pathogenesis still remain elusive, abnormal accumulation of amyloid-β (Aβ) and Tau in the brain is hypothesized to trigger pathogenic cascades that lead to AD. Abnormal accumulation of Aβ and Tau starts 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.

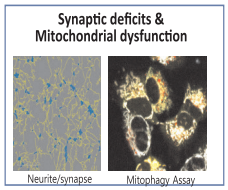
Mounting evidence suggests that clearance of damaged mitochondria, termed mitophagy, is dysregulated, thereby leading to accumulation of damaged mitochondria and synaptic deficits in neurons. However, the underlying mechanisms for mitochondrial dysfunction and mitophagy deficits are largely unknown.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

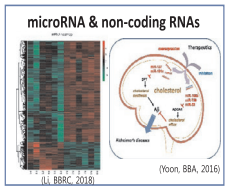
Accumulating evidence suggests that dysregulation of microRNAs is closely linked to the pathogeneses of various human diseases. However, the functional and therapeutic implication of microRNAs in AD remains largely unknown. Understanding the role of miRNAs in AD may provide new opportunities to develop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







Research keyword

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

- Molecular and cellular pathology of Alzheimer's disease
- Pathogenic role of lipid metabolism in Alzheimer's disease
- Function of microRNAs in neurodegenerative disease
- Mitochondrial dysfunction in neurodegenerative disease

Research Publications (last 5 years)

- **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)

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~Present : Member, Korean Society for Neurodegenerative Disease
2019~Present : Member, Korean Society for Brain and Neural Sciences

Minyeop Nahm, PhD
Principal Investigator

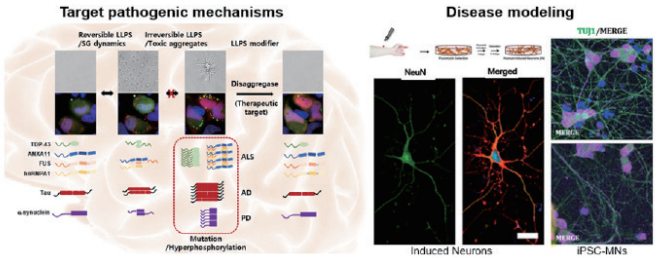
DEMENTIA GROUP
Korea Brain Research Institute (KBRI)

Office : 4-4
Lab : Wet lab 3-1
Tel : +82-53-980-8333
E-mail : nmy92@kbri.re.kr

RNP granule dynamics in neurodegenerative disease

Cellular homeostasis of protein (proteostasis) and RNA metabolism (ribostasis) are the essential processes for maintenance of brain structure and function. Aging, cellular stress conditions, and genetic mutations can cause impairment of proteostasis and/or ribostasis, leading to protein misfolding, insoluble aggregates deposition, and abnormal RNP granule dynamics. Indeed, these defects are common pathogenic components of age-related neurodegenerative disease including Alzheimer's disease (AD), Parkinson's disease (PD), and Amyotrophic lateral sclerosis (ALS). Recent evidence suggest that aberrant RNP granule dynamics through irreversible phase separation induce intracellular aggregates formation in target neurons. We are currently working to identify the molecular mechanisms for RNP granule dynamics and to find drug targets with disaggregase/molecular chaperone activity as novel therapeutic strategies.

Aim	Elucidating pathogenic mechanisms of neurodegenerative disease and developing therapeutic strategies
Tool	Disease-relevant cell modeling (iPSC technology, direct reprogramming), Analysis of biomolecular condensates
TARGET	



Research keyword

Neurodegenerative diseases, Proteostasis, Ribostasis, Biomolecular condensates

Key techniques

Disease modeling: iPSC-derived neuron and direct converted neuron, Liquid-liquid phase separation assay, Stress granule dynamics assay

Research Interests/Topics

- Molecular mechanisms of RNP granule dynamics in physiological and pathological conditions
- Discovery of drug targets based on phase separation properties of disease-linked proteins/RNAs complex

Research Publications (selected)

- Joohyung Kim#, Sungdae Kim#, **Minyeop Nahm**#, Tsai-Ning Li, Hsin-Chieh Lin, Yeongjin David Kim, Jihye Lee, Chi-Kuang Yao, Seungbok Lee. ALS2 regulates endosomal trafficking, postsynaptic development, and neuronal survival. *J Cell Biol*., 220(5), 2021. (# equally contributed)
- **Minyeop Nahm**#, Su Min Lim#, Young-Eun Kim, Jinseok Park, Min-Young Noh, Sanggon Lee, Ju Eun Roh, Sung-Min Hwang, Chul-Kyu Park, Yong Ho Kim, GyuTae Lim, Jinhyuk Lee, Ki-Wook Oh, Chang-Seok Ki, Seung Hyun Kim. ANXA11 mutations in ALS cause dysregulation of calcium homeostasis and stress granule dynamics. *Sci Tranl med*., 12(566), 2020. (#equally contributed)
- Najin Kim#, Sungdae Kim#, **Minyeop Nahm**#, Danielle Kopke, Joohyung Kim, Eunsang Cho, Min-Jung Lee, Mihye Lee, Seung Hyun Kim, Kendal Broadie, Seungbok Lee. *Nat Commun*., 10(1), 2019. (#equally contributed)
- **Minyeop Nahm**#, Min-Jung Lee#, William Parkinson, Mihye Lee, Haeran Kim, Yoon-Jung Kim, Sungdae Kim, Yi Sul Cho, Byung-Moo Min, Yong Chul Bae, Kendal Broadie, Seungbok Lee. Spartin regulates synaptic growth and neuronal survival by inhibiting BMP-mediated microtubule stabilization. *Neuron*., 77(4), 2013. (#equally contributed)

Curriculum Vitae

2021~Present : Principal Investigator, KBRI
2016~2021 : Research Professor, Cell Therapy Center for Neurological Disorders, Hanyang Univ., Korea
2010~2015 : Postdoctoral Fellow, Seoul National Univ., Korea

Academic Credential

2010 : Ph.D., Interdisciplinary Program in Brain Science, Seoul National Univ. Korea
1998 : M.S., Genetic Engineering, Kyunghee Univ. Korea
1996 : B.S., Genetic Engineering, Kyunghee Univ. Korea

Awards/Honors/Memberships

2020~Present : Member, Korean Society for Brain and Neural Science

Shinrye Lee, PhD
Senior Researcher

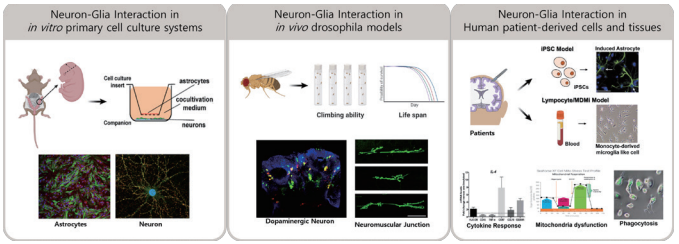
DEMENTIA GROUP
Korea Brain Research Institute (KBRI)

Office : 4-1
Lab : Wet lab 4-1
Tel : +82-53-980-8381
Fax : +82-53-980-8389
E-mail : srlee@kbri.re.kr

Neuron-Glia interaction in Neurodegenerative disease

Alterations in Neuron-Glia interactions have been implicated in numerous neurodegenerative diseases, such as Amyotrophic Lateral Sclerosis (ALS), Alzheimer's disease (AD), Parkinson's disease (PD), and Huntington's disease (HD). Glia plays a crucial role in regulating various functions of neurons, including synaptic plasticity, neuronal activity, neuronal cell death, and neuronal homeostasis. Pathological changes in glial cells, both morphological and functional, have been associated with neuronal dysfunction in neurodegenerative diseases. This suggests that targeting the regulation of Neuron-Glia interactions could hold promise as a therapeutic approach for these conditions. However, the precise role of neuron-glia interactions in neurodegeneration remains largely unknown. In our laboratory, we are currently investigating the functional and molecular mechanisms underlying Neuron-Glia interactions using various disease models, such as Neuron-Glia Interaction in primary cell culture models, Neuron-Glia Interaction in Drosophila models, and Neuron-Glia Interaction in human patient-derived iPSC and MDMi models. By utilizing these experimental systems, we aim to unravel common pathological mechanisms shared among neurodegenerative diseases. Specifically, we are studying the dysfunction of the protein quality control system, endoplasmic reticulum stress, mitochondrial dysfunction, and neuroinflammation. These investigations will contribute to a better understanding of the complex interplay between neurons and glia in the context of neurodegenerative diseases and potentially identify novel therapeutic targets.

Aim	The role of Neuron-Glia interaction in Neurodegenerative disease
Tool	*in vitro* Mammalian cell culture systems + in vivo Drosophila models + Human patient-derived cells and tissues + Molecular cell biology + Behavioral analysis
TARGET	Neuron-Glia Interaction in *in vitro* primary cell culture systems / Neuron-Glia Interaction in *in vivo* drosophila models / Neuron-Glia Interaction in Human patient-derived cells and tissues



Research keyword

Neuron-Glia interaction, Neuroinflammation, Neurodegenerative disease, Mitochondrial dysfunction, Ubiquitin Proteasome System impairment

Key techniques

Neuron-Glia co-culture, *in vitro* primary cell culture systems, *in vivo* Drosophila diseases models, Human patient-derived cells and tissues, Mitochondrial activity assay, Drosophila behavioral test, Molecular cell biology

Research Interests/Topics

- Secretory neurotoxic factors in Neurodegenerative diseases
- Protein Quality Control system impairment in Neurodegenerative diseases
- Neuroinflammation in Neurodegenerative diseases
- Mitochondrial dysfunction in Neurodegenerative diseases

Research Publications (selected)

- Minchul Seo *, **Shinrye Lee** *, Jong-Heon Kim, Won-Ha Lee, Guang Hu, Stephen J Elledge, Kyoungho Suk (2014). RNAi-based functional selection identifies novel cell migration determinants dependent on PI3K and AKT pathways. *Nature Communications*, 5:5217. (*equally contributed)
- **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 (2020). PTK2/FAK regulates UPS impairment via SQSTM1/p62 phosphorylation in TARDBP/TDP-43 proteinopathies. *Autophagy*, 1-17.
- **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 (2020). The overexpression of TDP-43 in astrocytes causes neurodegeneration via a PTP1B mediated inflammatory response. *Journal of Neuroinflammation*, 17:299.
- **Shinrye Lee** *, Younghwi Kwon *, Seyeon Kim, Myungjin Jo, Yu-Mi Jeon, Mookyung Cheon, Seongsoo Lee, Sang Ryong Kim, Kiyoung Kim & Hyung-Jun Kim (2020). The Role of HDAC6 in TDP-43-Induced Neurotoxicity and UPS Impairment. *Frontiers in Cell and Developmental Biology*, 8:581942.
- **ShinryeLee***, Myungjin Jo*, Hye Eun Lee, Yu-Mi Jeon, Seyeon Kim, Younghwi Kwon, Junghwa Woo, Shin Han, Ji Young Mun & Hyung-Jun Kim (2021). HEXA-018, a Novel Inducer of Autophagy, Rescues TDP-43 Toxicity in Neuronal Cells. *Frontiers in Pharmacology*, 12:747975.

Curriculum Vitae

2023~Present : Senior researcher, KBRI
2013~2023 : Researcher, KBRI
2012~2013 : Research Associate, Kyungpook National University

Academic Credential

2008~2012 : Ph.D., Pharmacology, Kyungpook National University
2006~2008 : M.S., Pharmacology, Kyungpook National University
2001~2006 : B.S., Biological Sciences, Daegu Catholic University

Awards/Honors/Memberships

2021 ~ Present : Grant, General Researcher Program(Young Researchers), National Research Funding of Korea
2020 : KBRI junior Paper Award
2019 : KBRI Best Paper Award
2015~ Present : Member, Korean Society for Biochemistry and Molecular Biology
2013~Present : Member, Korean Society for Brain and Neuroscience
2013~Present : Member, Korean Society for Molecular and Cellular Biology

RESEARCH STRATEGY OFFICE

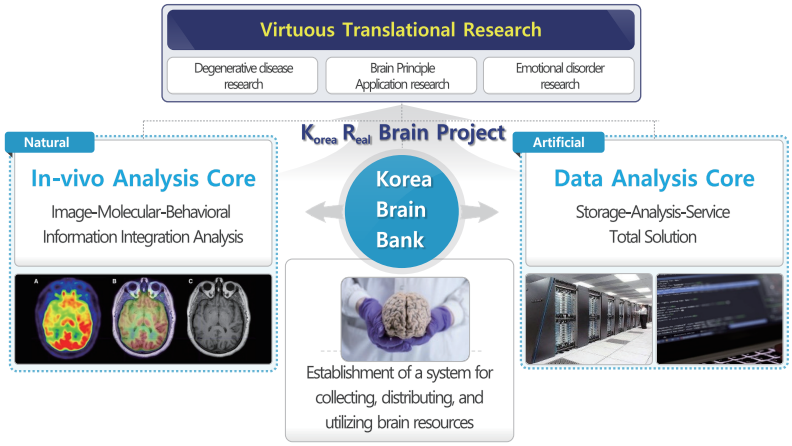
RESEARCH STRATEGY OFFICE

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

Kipom Kim, PhD

Principal Investigator

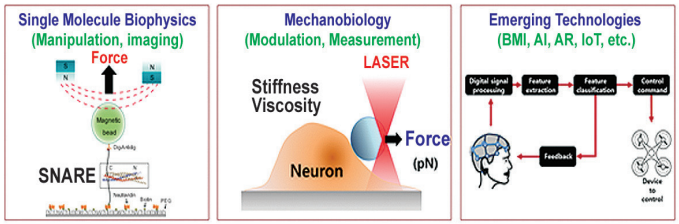
RESEARCH STRATEGY OFFICE
Korea Brain Research Institute (KBRI)

Office : Brain Resesarch Core Facilities (3rd floor)
Lab : Wet lab 3-1
Tel : +82-53-980-8530
Fax : +82-53-980-8539
E-mail : kpkim@kbri.re.kr
http://www.piconewton.com

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.

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)

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

KOREA BRAIN BANK

KOREA BRAIN BANK

Vision & Goals

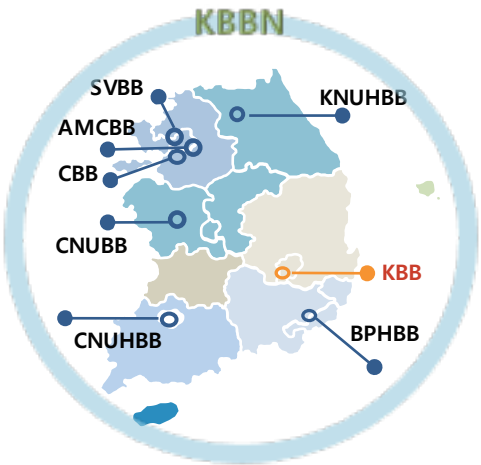
The Construction of a creative and smart research ecosystem for the global leading brain research

Brain Banking 1.0 (2014~2018)
Infrastructure construction for the bank operation

Brain Banking 2.0 (2019~2023)
Establishment of strategic collection-utilization system of human resources

Brain Banking 3.0 (2024~2028)
Establishment of smart service and sharing system

Korea Brain Bank Network



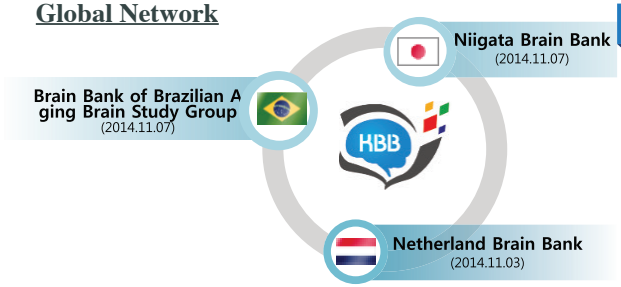
Korea Brain Bank

- 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

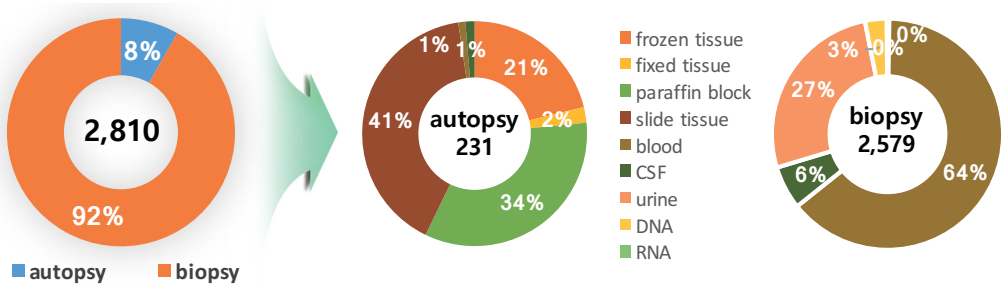
History

- (2014.01) Establishment of Korea Brain Bank
- (2014.12) BioBank authorized by KCDC
- (2016.02) Launching of Korea Brain Bank Network(KBBN)
- (2017.09) Designation of Biological Resource Center by MSIT

Major Project

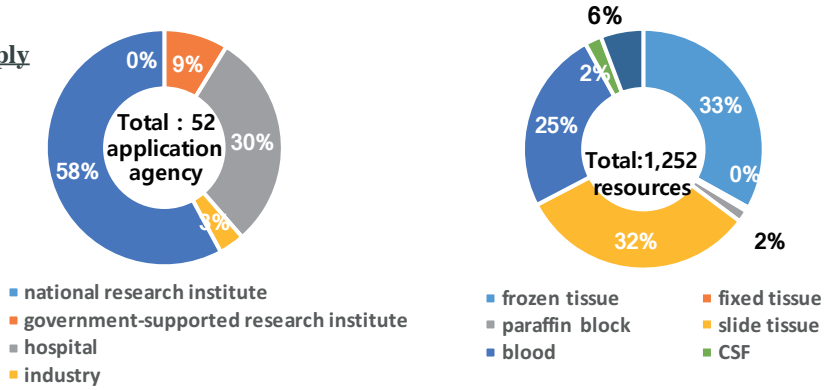
- Korea Brain Bank Network (KBBN) project
  - Promotion activities for brain donation and establishment of brain resource collection-utilization system with local brain banks
  - KBBN portal(https://kbbn.kbri.re.kr) & Brain Resource Archive Management System(BRAMS) operation and update
- Neuropathology infrastructure construction project
  - Standardization of brain autopsy process
  - Construction of KBBN brain histology atlas
- Promotion of the Korean Brain Banks cluster project
  - Establishment of a community-type brain research resource utilization system through brain research resource information integration-connection network(K-Brain Net) and neuropathology infrastructure.

Brain Resource Collection As of Dec 31, 2022



Brain Resource Supply

As of Dec 31, 2022



Se Hoon Kim, MD, PhD
Director

KOREA BRAIN BANK
Korea Brain Research Institute (KBRI)

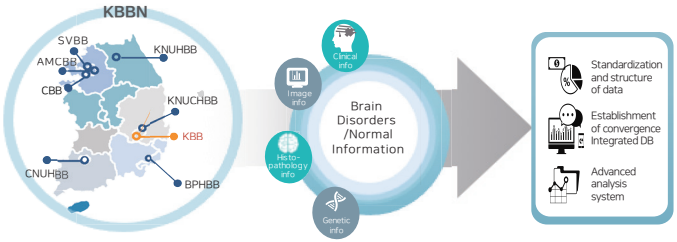
Tel : +82-53-980-8520
Fax : +82-53-980-8529
E-mail : paxco@kbri.re.kr
PAXCO@yuhs.ac
https://kbbn.kbri.re.kr

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.

Aim	Implementation of Research-Support Core Infrastructure
Tool	Establishment Integrated DB & Development Open platform

TARGET



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

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

Yeonjin Ryu, PhD
Senior Researcher

KOREA BRAIN BANK
Korea Brain Research Institute (KBRI)

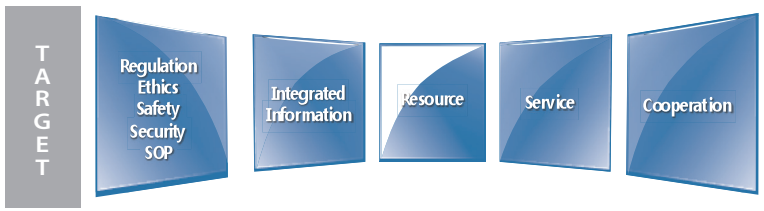
Office : Korea Brain Bank (3rd floor)
Tel : +82-53-980-8523
Fax : +82-53-980-8529
E-mail : yjryu@kbri.re.kr

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



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 Project. (2007~2008)
- Comprehensive management plan for healthcare and biological resources. (2007~2008)
- Research resource bank project. (2008~2014)
- National brain bank project. (2015~Present)
- Promotion of Korean Brain Banks Cluster (2021~Present)

Best practice guidelines Publications for Biobank operation

- KNRRC best practice guidelines. (15 volumes, 2011~2013)
- Standards of Private Sectors approved by KSA.
- Ethical Code for the establishment and operation of brain banks. (2022)
- Best practice for the establishment and operation of brain banks. (2022)
- Best practice for the management of brain reseach resources. (2022)

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)

Curriculum Vitae

2015~Present : Senior researcher, 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

Heon Seok, PhD
Senior Researcher

KOREA BRAIN BANK
Korea Brain Research Institute (KBRI)

Tel : +82-53-980-8525
Fax : +82-53-980-8519
E-mail : heonseok@kbri.re.kr
https://kbbn.kbri.re.kr/portal/page/main/home

Development of global brain research resources

Bridge the domestic and global brain resource needs, fostering the expansion and industrialization of brain research through active international collaborations and a consistent supply of resources.

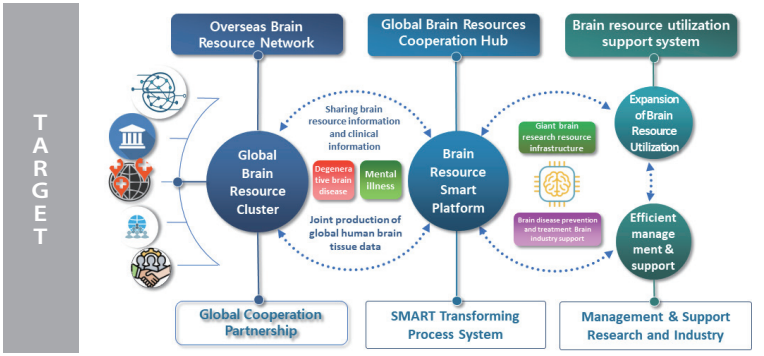
Global Brain Resources Development : Develop global resources through communication with international institutions and researchers

Establish Global Brain Resources Network : Build and maintain a network of global brain resource providers, facilitating communication, cooperation, and collaboration to promote mutual growth and development in brain research.

Plan a Global Brain Resource Sharing System : Design and implement a global sharing system that allows easy access to brain resources across borders.

Guide & Support : Provide crucial assistance to researchers in accessing global brain resource information and in making allocation applications. providing up-to-date and relevant information on global brain resource analysis technologies. This knowledge sharing will facilitate the exchange of technical skills and expertise among researchers worldwide.

Aim Establishment of Global Brain Resource Cooperation Hub



Research keywords

Korea Brain Bank, Global, Development

Key techniques

Brain research innovation 2030 (Brain Research Promotion Basic Plan 2018)
Brain Research Promotion Implementation Plan 2018~2020
Brain Library establishment 2019

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 Ca2+ 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.

Curriculum Vitae

2021~Present : Senior Researcher, Korea Brain Bank, KBRI, Korea
2018~2020 : Senior Researcher, Brain Research Policy Center, KBRI, Korea
2011~2018 : Assistant Professor, Dept. of Biomedical Science, Jungwon University, Korea
2010~2011 : Postdoctoral Fellow, School of Life Sciences, UNIST, Korea
2007~2009 : Postdoctoral Fellow, School of Clinical Science, University of Bristol, Korea

Academic Credential

2007 : Ph.D., Dept. of Biomedical Science, University of Sheffield, UK
2000 : 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 : Evaluation committee Small and Medium Business Technology Information Promotion Agency
2012 : Advisory committee, Korea Industrial Complex Corporation
2012 : Director, Biomedical research center, Jungwon University, Korea

Taekwon Son, PhD
Senior Researcher

KOREA BRAIN BANK
Korea Brain Research Institute (KBRI)

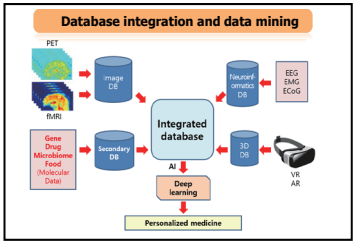
Office : Korea Brain Bank (3rd floor)
Tel : +82-53-980-8526
Fax : +82-53-980-8529
E-mail : taekwon@kbri.re.kr

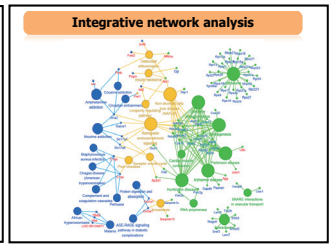
Mining neuroscience big data for precision medicine

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





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 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.

Curriculum Vitae

2020~Present : Principal Investigator, KBRI
2018~2020 : 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

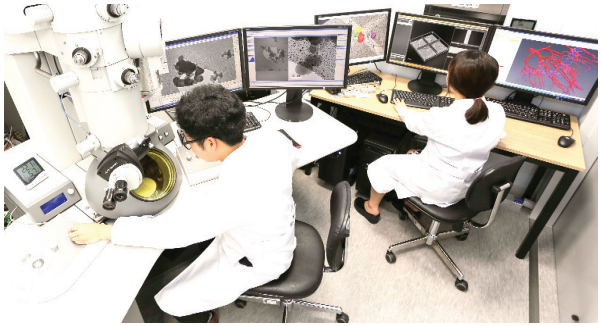
2022~Present : Member, International Society for Biocuration
2019~Present : Member, Korean Society for Vascular Biology and Medicine
2017~2018 : Grant, Foundation for Medical Innovation, Korea

BRAIN RESEARCH CORE FACILITIES

BRAIN RESEARCH CORE FACILITIES

Overview

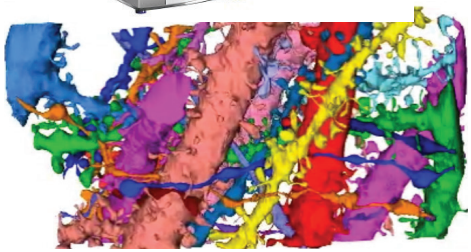
- Brain research has recently become a global hot topic in science and technology, along with artificial intelligence issues. Major countries have made massive investments in funding for brain research.
- As part of this global trend, KBRI organized the Brain Research Core Facilities which are responsible 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 140 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 : Taekwan Lee(Ph.D)
- Professional operators : Sang-Hoon Lee (Ph.D), Yoon-Ju Kim (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

Taekwan Lee, PhD
Director
Director of Resesarch Strategy Office
Principal Investigator

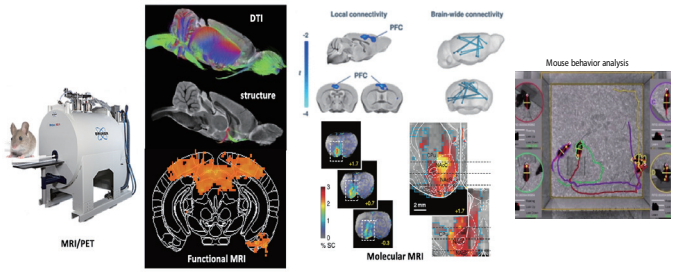
BRAIN RESEARCH CORE FACILITIES
Korea Brain Research Institute (KBRI)

Office : Brain Research Core Facilitites (3rd floor)
Tel : +82-53-980-8531
Fax : +82-53-980-8539
E-mail : tklee@kbri.re.kr

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	



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.

Curriculum Vitae

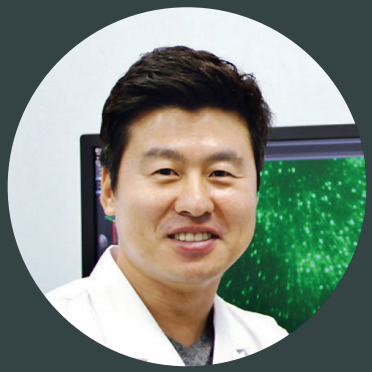
2020~Present : Principal Investigator, KBRI
2013~2020 : Principal Investigator, DGMIF
2009~2013 : Research Associate, Bio-engineering, MIT, USA
2007~2009 : Research Associate, Psychology, Univ of Wisconsin-Milwaukee, USA

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



Chang Man Ha, PhD
Principal Investigator

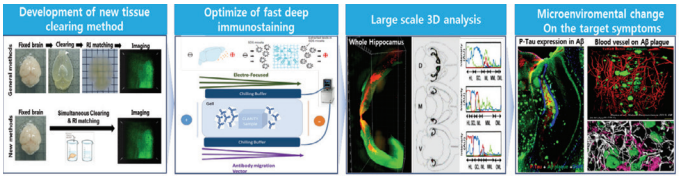
BRAIN RESEARCH CORE FACILITIES
Korea Brain Research Institute (KBRI)

Office : Brain Research Core Facilities (3rd floor)
Lab : Wet lab 3-1
Tel : +82-53-980-8568
Fax : +82-53-980-8568
E-mail : changman@kbri.re.kr
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 to use these technique because clear methods is complicating 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 to whole hippocampus mouse brain (5 mm) and immunostaining to 2 mm of brain slice for one day using our methods innovatively. We are further studying for three dimensionally microenvironment changes 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	Research for the multi-dimensional microenvironment changes of tissue during the neurodevelopment and neurodegenerative disease
Tool	Tissue clearing, Fast immunostaining, Large scale 3D analysis, Super-resolution, Vesicle dynamics, live cell imaging, nanodevice assay.
TARGET	



Research keywords

Neurodevelopmental disorder, Tissue clearing, Molecular imaging, Microenvironment of tissue

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

- Functional changes of 3D structural neuron network in large brain tissue using tissue clearing technique & fast-deep tissue immunostaining methods
- Identify the multi-dimensional micro-environment changes in neurodevelopmental and neurodegeneration disease

Research Publications (Last 5 years/ selected)

- **CM Ha**, HR Kim, DH Kim, J Choi, JW Park, SR Ojeda, JK Jeong and BJ Lee Transcriptional regulatory role of NELL2 in preproenkephalin gene expression. *Mol Cells*. 2022, 45(8), 537-549.
- Y Ryu, Y Kim 1, HR Lim, HJ K, BS Park, JG Kim, SJ Park and **CM Ha**. Single-Step Fast Tissue Clearing of Thick Mouse Brain Tissue for Multi-Dimensional High-Resolution Imaging. *Int J Mol Sci*. 2022 23: 6826.
- AN Le, SS Park, MX Le, UH Lee, BK Ko, HR Lim, R Yu, SH Choi, BJ Lee, SY Ham, Jeong Woo Park, **CM Ha**. DRG2 Depletion Promotes Endothelial Cell Senescence and Vascular Endothelial Dysfunction. *Int J Mol Sci*. 2022 23(5): 2877.
- J Na, BS Park, D Jang, D Kim, TH Tu, Y Ryu, **CM Ha**, M Koch, S Yang, JG Kim, and S Yang. Distinct Firing Activities of the Hypothalamic Arcuate Nucleus Neurons to Appetite Hormones. *Int J Mol Sci*. 2022, 23, 2609.

Patents (Last 5 years/ selected)

- **Ha CM**. Apparatus for holding sample of microscope. 2020 (10-2095516, patent)
- **Ha CM**. Pipette tip for preventing loss of sample. 2021 (10-2237531, patent)
- **Ha CM**. JW Park, HR Rim. The usage of DRG2 protein for dopamine release regulation 2022 (10-2478215, patent)
- **Ha CM**. HR Rim, YJ Ryu. A new aqueous refractive index matching and tissue clearing solution for biological imaging (10-2020-0141354, patent application)

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 NeuroScience), 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

LABORATORY ANIMAL CENTER

LABORATORY ANIMAL CENTER

Overview

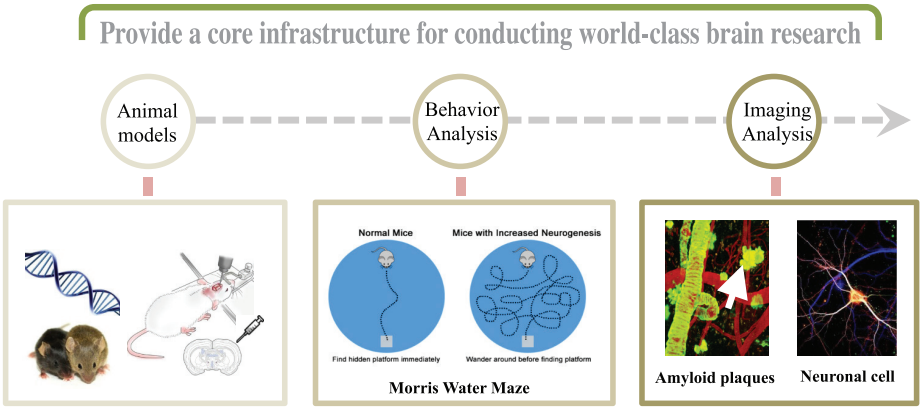
- KBRI Laboratory Animal Center accommodates more than 30,000 rodents
- Animal facility area of approximately 3,760m2 (Two floors and four zones)
- Breeding and strain management of various transgenic animal resources
- Conducting convergent brain research using animal behavior and image analysis

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

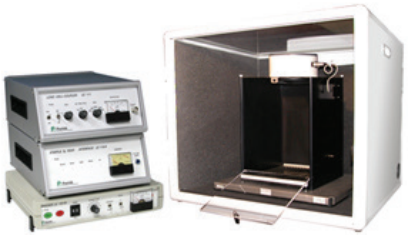


Major Tasks

- 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>

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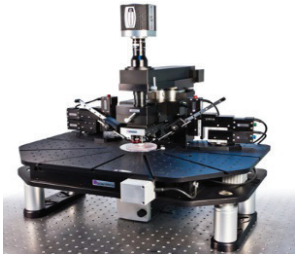
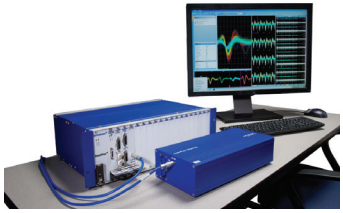


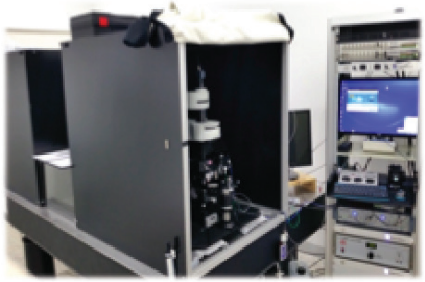
<Multi-photon Laser Microscope>



<*in-vivo* Recording System>

<Behavior analysis room>

<Surgery room>



<Imaging analysis room>

Young Pyo Choi, MD, PhD
Director
Principal Investigator

LABORATORY ANIMAL CENTER
Korea Brain Research Institute (KBRI)

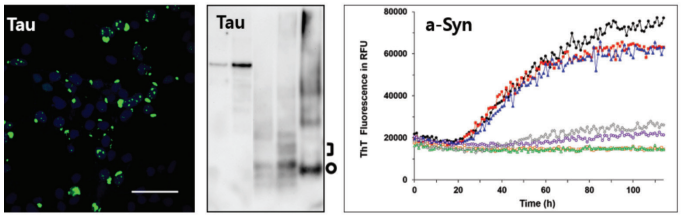
Office : Laboratory Animal Center (3rd Floor)
Lab : Wet lab 3-1
Tel : +82-53-980-8564
Fax : +82-53-980-8569
E-mail : kpkim@kbri.re.kr
http://piconewton.com

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



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.

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

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, https://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

- ✓ Establishment of the national policies and strategies
- ✓ Development of national mid- to long-term plans
- ✓ Responsible for R&D strategies of KBRI

Hub for Information on Brain Science

- ✓ Analysis of domestic and international information
- ✓ Management of Brain Library website
- ✓ Distribution of weekly "Brain News"

Building Cooperation Network

- ✓ Planning of international Academic events and symposiums to explore agenda for domestic and international cooperation and partnerships
- ✓ Organization of worldwide transdisciplinary collaborative networks
- ✓ Fostering Industry-Academia-Research-Medicine collaboration

Objectives

- Brain Research Plans
  - Establishment of strategies and policies for innovative national brain research
  - Building strategic planning of mid- to long-term national brain science
  - Planning R&D strategies for KBRI
  - Publication of 'Brain Insight'
- Brain Research Information Hub
  - Domestic and international Research Trend Analysis
  - Operation of a website (Brain Library, https://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

Providing research information service

Brain Information Hub
- Brain Library
- Brain News

Reinforcing strategic planning for brain research by institutions

Domestic and international networks
- Support for identifying internal project themes
- Brain industry planning
- International cooperation project planning for utilizing global network
- Expansion of experts networks to identify policy tasks

Soobin Cho, PhD
Senior Researcher

BRAIN RESEARCH POLICY CENTER
Korea Brain Research Institute (KBRI)

Office : Laboratory Animal Center (2rd Floor)
Tel : +82-53-980-8512
Fax : +82-53-980-8519
E-mail : sbcho@kbri.re.kr

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 project planning for utilizing global network.

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 Research planning

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

- Planning for Brain industry
- International cooperation project planning for utilizing global network
- Expanding of expert networks to identify policy tasks

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 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)

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

ADJUNCT RESEARCHERS

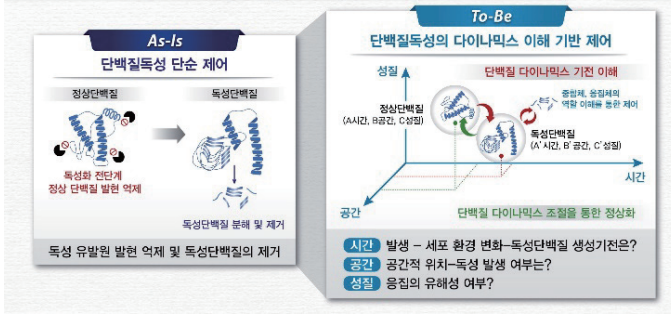
Sung Bae Lee, PhD
Invited Investigator
(DGIST, Professor)

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

Office : Room 413, Building E4
Lab : Room 420, Building E4
Tel : +82-53-785-6122
Fax : +82-53-785-6109
E-mail : sblee@dgist.ac.kr
http://sblee.dgist.ac.kr

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	

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)

- Propionic acid induces dendritic spine loss by MAPK/ERK signaling and dysregulation of autophagic flux. ***Mol Brain***. 2020 13(1):86 (Corresponding author)
- Correlative Light and Transmission Electron Microscopy Showed Details of Mitophagy by Mitochondria Quality Control in Propionic Acid Treated SH-SY5Y Cell. ***Materials***. 2020 13(19):4336 (Corresponding author)
- Contact-ID, a new tool for profiling organelle contact site, reveals regulatory proteins of mitochondrial-associated membrane formation. ***Proc Natl Acad Sci USA***. 2020 117(22):12109 (Co-Corresponding author)
- Direct Visualization of Actin Filaments and Actin-Binding Proteins in Neuronal Cells. ***Front Cell Dev Biol***. 2020 26;8:588556 (Corresponding author)
- Mitochondria and Endoplasmic Reticulum Imaging by Correlative Light and Volume Electron Microscopy. ***JoVE***. 2019 (Corresponding author)
- Dual Function of USP14 Deubiquitinase in Cellular Proteasomal Activity and Autophagic Flux. ***Cell Rep***. 2018 24(3):732 (Co-first author)
- TAGLN2 polymerizes G-actin in a low ionic state but blocks Arp2/3-nucleated actin branching in physiological conditions. Sci Rep. 2018 8(1):5503 (Co-Corresponding author)
- Skeletal myosin binding protein-C isoforms regulate thin filament activity in a Ca^{2+}-dependent manner. ***Sci Rep***. 2018 8(1):2604 (Co-first author)

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

Jae-sung Bae, PhD
Invited Investigator
(KNU, Professor)

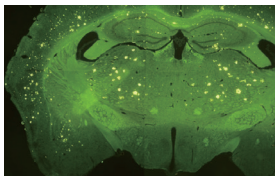
Dept. of Physiology, School of Medicine, Kyungpook National University (KNU)

Tel : +82-53-420-4815
Fax : +82-53-424-3349
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

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)

- Immunotherapy targeting plasma ASM protects against Alzheimer's disease in mice. *Nature Communications*. Accepted
- Discovery of a novel, dual-action small molecule that improves neuropathological features of Alzheimer's disease mice. *Proc. Natl. Acad. Sci. USA*. Jan 18; 119(3): e2115082119. 2022.
- 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
- Neuropeptide Y regulates the hematopoietic stem cell microenvironment and prevents nerve injury in the bone marrow. *The EMBO Journal*. 34(12): 1648-60. 2015.
- Pathological roles of the VEGF/SphK pathway in Niemann-Pick Type C neurons. *Nature Communications*. doi: 10.1038/ncomms6514. 2014.
- Acid sphingomyelinase modulates the autophagic process by controlling lysosomal biogenesis in Alzheimer's disease. *Journal of Experimental Medicine*. 211(8):1571-1583. 2014.

Curriculum Vitae

2007~Present : Professor, KNU
2022~Present : SAB, Amyloid Solution Inc.
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

2022 : Minister's Award, the Ministry of Education
2020 : Yudang academic Award, The Korean Physiology Society
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

Ho-Won Lee, MD, PhD
Invited Investigator
(KNU, Professor)

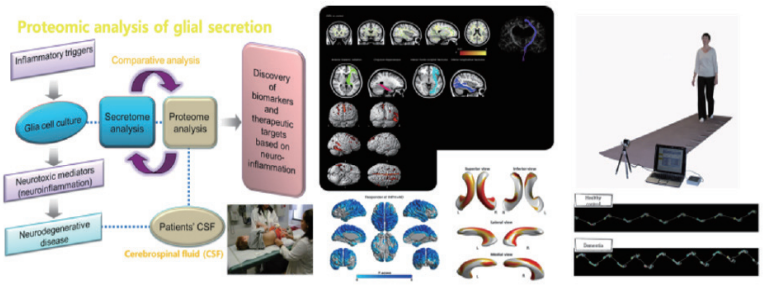
Dept. of Neurology, School of Medicine/
Brain Science & Engineering Institute,
Kyungpook National University(KNU)
Dept. of Neurology, Kyungpook National University
Chilgok Hospital (KNUCH)

Tel : +82-53-200-2751
Fax : +82-53-200-3299
E-mail : neuromd@knu.ac.kr
http://www.knuch.kr/index.asp

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.



Research keywords

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.

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

Kyung-In Jang, PhD
Invited Investigator
(DGIST, Professor)

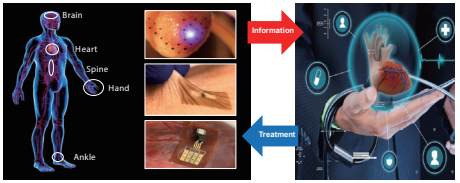
Dept. of Robotics Engineering,
Daegu Gyeongbuk Institute of Science and Technology (DGIST)

Office : E5-410, DGIST
Tel : +82-53-785-6218
Fax : +82-53-785-6209
E-mail : kijang@dgist.ac.kr

Bio-integrated Electronics

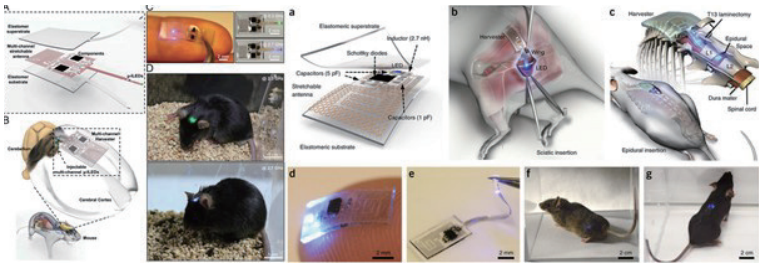
Goal of Our Approach

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

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.

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

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

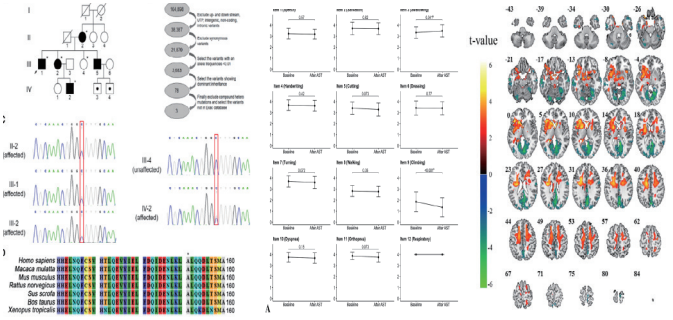
Jin-Sung Park, MD, PhD
Invited Investigator
(KNUCH, Professor)

Dept. of Neurology, Kyungpook National University (KNU)
Kyungpook National University Chilgok Hospital (KNUCH)

Tel : +82-53-200-2753
Fax : +82-53-200-2029
E-mail : neurojspark@gmail.com /
neurojspark@knu.ac.kr
http://www.knuch.kr:442/content/02depart/detail_area01.asp?m_num=288&ct_idx=3370

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

The goal of my research is to understand and correlate the clinical and genetic relationship in rare neuromuscular and motor neuron disease (amyotrophic lateral sclerosis and Kennedy disease). The final goal is to establish the most appropriate target of treatment 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 motor neuron disease
Tool	Genetics, neuro-imaging and electrophysiology
TARGET	

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 (Kennedy disease, Spinal muscular atrophy)

Research Publications (selected)

- Cho HJ, Shin JH, Park YE, Sohn E, Nam TS, Kang MG, Park JM, Park D, **Park JS**. Characteristics of spinal and bulbar muscular atrophy in South Korea: a cross-sectional study of 157 patients. *Brain* 2022 May 27;. doi: 10.1093/brain/awac198. [Epub ahead of print].
- 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 Sep;268(9):3344-3351.
- 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.

Curriculum Vitae

2022~Current : Associate Professor at Kyungpook National University, Kyungpook National University Chilgok hospital
2017~2021 : Assistant Professor at 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
2007 : Graduated Kyungpook National University School of Medicine

Academic Credential

2023 : Ph.D School of Medicine, Pusan National University
2011 : M.S School of Medicine, Department of Neurology, Kyungpook National University
2011 : Ph.D., Mechanical Engineering, Yonsei University
2007 : B.S School of Medicine, Department of Neurology, Kyungpook National University
2005 : B.S., Mechanical Engineering, Chung-Ang University, Korea

Awards/Honors/Memberships

2023~Present : Editorial Board in Journal of Clinical Neurology (SCIE)
2020~Present : Editorial Board of Korean Journal of Korean Neurological Association
2019~2022 : Insurance director of Korean society of Neuromuscular Disorders
2023 : Young investigator award from SK chemical, awarded from Korean Neurological Association
2020 : Best Presentation Award at Korean society of Neuromuscular Disorder
2010, 2017, 2019 : Best Presentation Award at Annual Korean Neurological Association

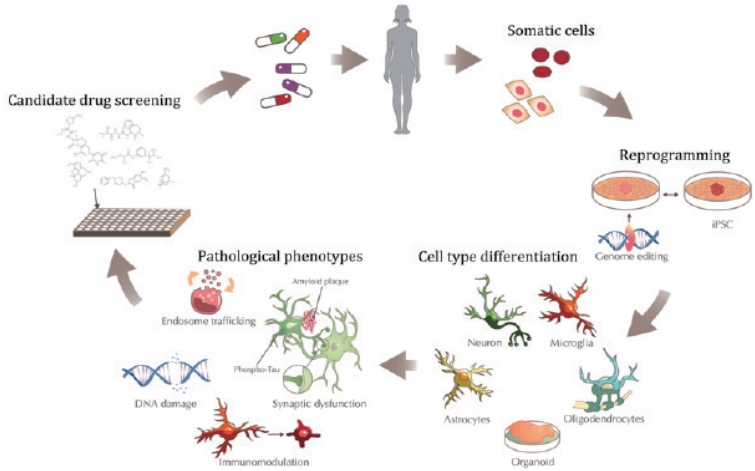
Jinsoo Seo, PhD
Invited Investigator
(DGIST, Professor)

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

Office : E4-5124
Lab : seolaboratory.org
Tel : +82-53-785-6156
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.

Research keywords

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.

Curriculum Vitae

2017~Present : Assistant, Associate 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

Jun Soo Kwon, PhD
Invited Investigator
(SNU, Professor)

Dept. of Brain & Cognitive Sciences/Dept. of Psychiatry, Seoul National University(SNU)

Office : Daehak-ro 101, Seoul 03080
Lab : E4-320
Tel : +82-2-2072-2972
Fax : +82-2-747-9063
E-mail : kwonjs@snu.ac.kr

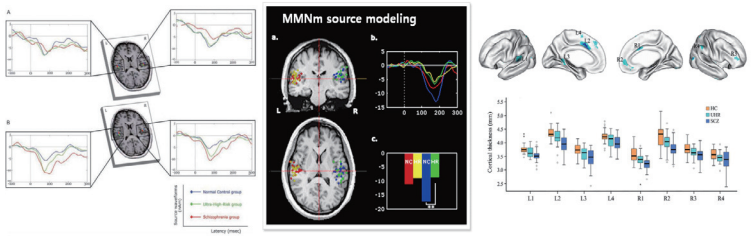
Clinical Cognitive Neuroscience Center (http://neuroimage.net)

Goal of Our Approach

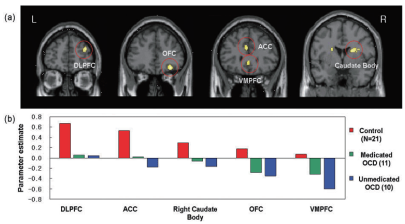
Our aim is to study fundamental mechanisms of cognitive functions in normal subject and the pathological conditions such as Schizophrenia and Obsessive-Compulsive Disorder (OCD). We also investigate the biomarkers for conversion to psychosis in the high risk subjects for psychosis and develop effective 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.

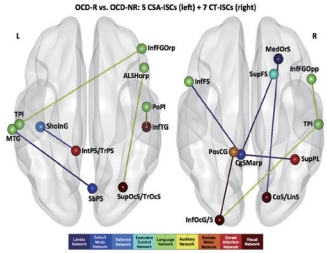
Research Interests and Topics

- 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.





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.

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

Jinseop S. Kim, PhD
Invited Investigator
(SKKU, Professor)

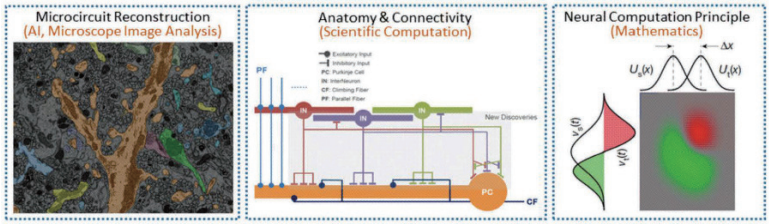
Dept. of Biological Sciences,
Sungkyunkwan University (SKKU)

Tel : +82-31-290-7014
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



Research keywords

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)

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

Jin Young Kim, PhD
Invited Investigator
(KBSI, Principal Investigator)

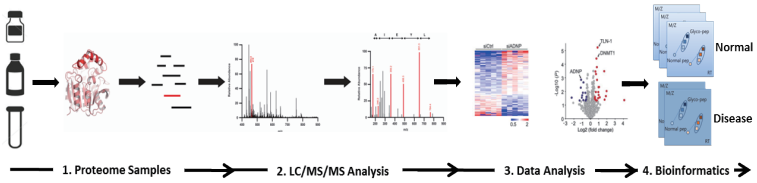
Research Center for Bioconvergence Analysis,
Korea Basic Science Institute (KBSI)

Tel : +82-43-240-5142
E-mail : jinyoung@kbsi.re.kr
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



Research keywords

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

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

Academic Credential

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

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

Hyo Jung Kang, PhD
Invited Investigator
(CAU, Professor)

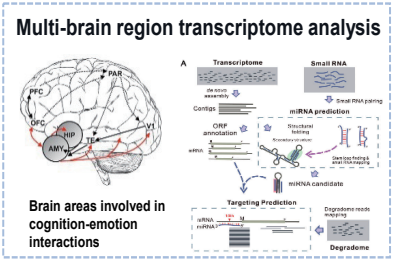
Dept. of Life Science,
Chung-Ang University (CAU)

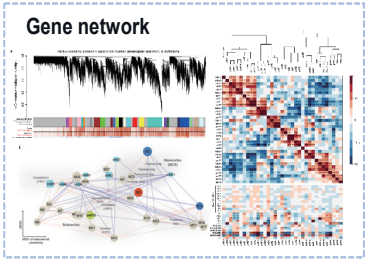
Tel : +82-2-820-5899
Fax : +82-2-825-5206
E-mail : hyokang@cau.ac.kr
http://bio.cau.ac.kr

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





Research keywords

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.

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

SangYun Kim, M.D.&Ph.D
Invited Investigator
(SNU, Professor)

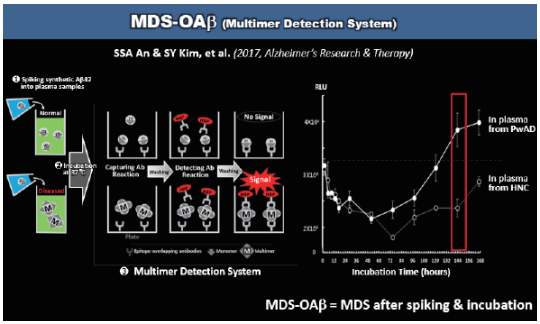
Clinical Neuroscience Center,
Dept. of Neurology,
Seoul National University Bundang Hospital (SNUBH)
Seoul National University College of Medicine (SNUCM)

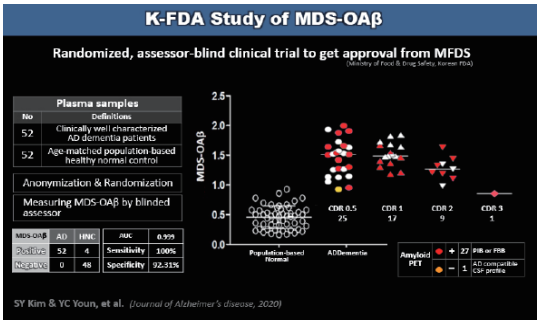
Tel : +82-31-787-7462
E-mail : neuroksy@snu.ac.kr

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





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

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

Woong Sun, PhD
Invited Investigator
(KUCM, Professor)

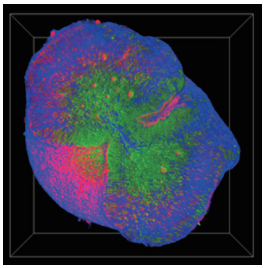
Dept. of Anatomy,
Korea University College of Medicine (KUCM)

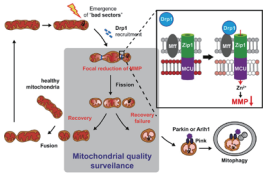
Tel : +82-2-2286-1440
E-mail : woongsun@korea.ac.kr
http://woongsun53.wixsite.com/website

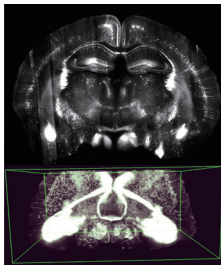
From organelle to organ biology for understanding brain development

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







Research keywords

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.

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 Universty 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)

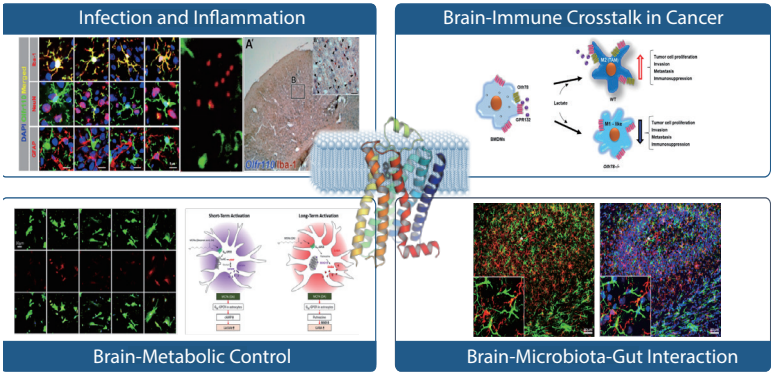
JaeHyung Koo, PhD
Invited Investigator
(DGIST, Professor)

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

Brain-Immune Axis Laboratory

Our lab is to explore the interface between the brain and immune systems during health and disease. We will examine the mediators, mechanisms, regulations, behaviors, and implications of brain-immune crosstalk. This research is to facilitate exciting new concepts and developments in both fields of neurobiology and immunology. Notably, we studied and applied ectopically expressed odorant receptors (ORs) for this study. 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. GPCRs are a major type of drug target and have been extensively studied. However, studies have focused on the functions of ORs in the nose, and investigations of their expression and functions in extra-nasal tissues are lacking. The development of next-generation sequencing techniques has made it possible to detect and analyze genes that are lowly expressed or expressed in certain cell types. Consequently, research into the functions of extra-nasal ORs is growing rapidly, and such ORs have been suggested as potential drug targets.



Research Interests/Topics

- Brain-Microbiota-Gut Interactions
- Infection and Inflammation
- Brain-Immune Crosstalk in Cancer
- Brain-Metabolic Control
- Exploring and Therapeutically Exploiting

Research Publications (selected)

- Oh, et al., (2022) Olfactory marker protein regulation of glucagon secretion in hyperglycemia. *Exp Mol Med*. doi: 10.1038/s12276-022-00843-8
- 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.

Curriculum Vitae

2021~2022 : Chair & Director, New Biology, DGIST
2021~2022 : 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.

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

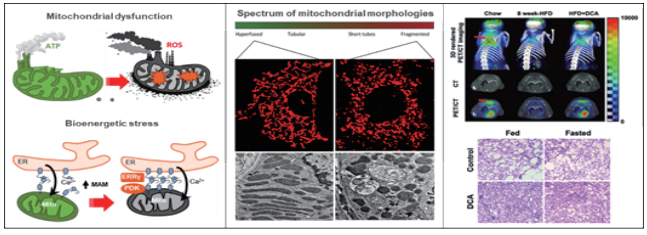
Dept. of Endocrinology,
Kyungpook National University (KNU)

Tel : +82-53-420-5564
Fax : +82-53-200-3155
E-mail : leei@knu.ac.kr

Molecular mechanisms and therapeutic strategies in metabolic syndrome

Organismal aging is accompanied by progressive loss of cellular function and systemic deterioration of multiple tissues, leading to impaired function and increased vulnerability to death. Mitochondria, the cellular powerhouses, tightly regulate cellular energy supply and demand balance. A growing body of evidence suggests that mitochondrial dysfunction is the key underlying factor in the development of diseases associated with aging, such as neurodegenerative and cardiovascular diseases. Aging and age-related diseases are tightly related to an energy supply and demand imbalance, which might be alleviated by a variety of interventions, including physical activity and calorie restriction, as well as by targeting the mitochondrial molecular machinery. My laboratory's focus is to understand, delineate and unravel the complex biology underlying mitochondrial homeostasis and to develop novel therapeutic strategies targeting mitochondrial dysfunction-related pathologies. 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 aging-related pathological conditions. 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	



Research keywords

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)

- Themis Thoudam, Dipanjan Chanda, Jung Yi Lee, Min-Kyo Jung, Ibotombi Singh Sinam, Byung-Gyu Kim, Bo-Yoon Park, Woong Hee Kwon, Hyo-Jeong Kim, Myeongjin Kim, Chae Won Lim, Hoyul Lee, Yang Hoon Huh, Caroline A Miller, Romil Saxena, Nicholas J Skill, Nazmul Huda, Praveen Kusumanchi, Jing Ma, Zhihong Yang, Min-Ji Kim, Ji Young Mun, Robert A Harris, Jae-Han Jeon, Suthat Liangpunsakul, **In-Kyu Lee.** Enhanced Ca2+-channeling complex formation at the ER-mitochondria interface underlies the pathogenesis of alcohol-associated liver disease. *Nat Commun*. 2023 Mar 27;14(1):1703. doi: 10.1038/s41467-023-37214-4.
- Ibotombi Singh Sinam, Dipanjan Chanda, Themis Thoudam, Min-Ji Kim, Byung-Gyu Kim, Hyeon-Ji Kang, Jung Yi Lee, Seung-Hoon Baek, Shin-Yoon Kim, Bum Jin Shim, Dongryeol Ryu, Jae-Han Jeon, **In-Kyu Lee.** Pyruvate dehydrogenase kinase 4 promotes ubiquitin-proteasome system-dependent muscle atrophy. *J Cachexia Sarcopenia Muscle*. 2022 Dec;13(6):3122-3136. doi: 10.1002/jcsm.13100.
- Themis Thoudam, Dipanjan Chanda, Ibotombi Singh Sinam, Byung-Gyu Kim, Mi-Jin Kim, Chang Joo Oh, Jung Yi Lee, Min-Ji Kim, Soo Yeun Park, Shin Yup Lee, Min-Kyo Jung, Ji Young Mun, Robert A Harris, Naotada Ishihara, Jae-Han Jeon, **In-Kyu Lee.** Noncanonical PDK4 action alters mitochondrial dynamics to affect the cellular respiratory status. *Proc Natl Acad Sci USA*. 2022 Aug 23;119(34):e2120157119. doi: 10.1073/pnas.2120157119.

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)

Min-Ho Nam, KMD, PhD
Invited Investigator
(KIST, Senior Researcher)

Brain Science Institute,
Korea Institute of Science and Technology (KIST)

Tel : +82-2-958-6970
E-mail : dr.namminho@kist.re.kr
https://nam-lab.org

Neuro-glia-immune interaction: the main player of neurological disorders and the neurobiological basis of acupuncture

Astrocytes are the most abundant subtype of glial cells in the brain. In physiological conditions, astrocytes biochemically support neighboring neurons, form the blood-brain barrier, maintain the extracellular ion balance, and contribute to excitation/ inhibition balance. When a physical or chemical insult is given, astrocytes become reactive to produce an aberrant amount of GABA and H2O2 to suppress and kill the neighboring neurons. Beyond the glia-neuron interaction, astrocytes are interacting with immune cells which are originated from the meninges or penetrated through the damaged blood-brain barrier. The glia-immune interaction finally affects neighboring neurons. We are investigating the neuro-glia-immune interaction as the main player of neurological disorders including Parkinson's disease, stroke, and traumatic brain injury. In addition, because the glia-immune interaction may connect between brain and periphery, we postulate that the effect of acupuncture (skin needling) in neurological disorders could be mediated by the neuro-glia-immune interaction. To address these hypotheses, we are conducting multidisciplinary approaches including electrophysiology, *ex vivo* imaging (calcium and neurotransmitters), molecular biology, and behavioral assays.

Research keywords

Astrocyte, Neuroinflammation, Parkinson's disease, Stroke, Opioid, Electrophysiology

Key techniques

Optogenetics, patch-clamp electrophysiology, fluorescence imaging, molecular biology. Patch-clamp recordings, Immunohistochemistry, Behavioral neuroscience, *Ex vivo* imaging (Calcium, glutamate)

Research Interests/Topics

- The contribution of reactive astrocytes to neuro-immune interaction in various brain diseases
- The neurobiological basis of medical acupuncture

Research Publications (selected)

- Yoon HH*, Ye S*, Lim S*, Jo A, Lee H, Hong F, Lee SE, Oh SJ, Kim NR, Kim K, Kim BJ, Kim H, Lee CJ, **Nam MH**#, Hur JW#, Jeon SR#, CRISPR/Cas9-mediated gene editing induces neurological recovery in an A53T-SNCA overexpression rat model of Parkinson's disease, *The Crispr Journal*, 2022, DOI: 10.1089/crispr. 2021.0025 (#cocorresponding authors)
- Cho HU*, Kim S*, Shim J, Yang S, **Nam MH**#, Jang DP#, Lee CJ#, Redefining differential roles of MAO-A in dopamine degradation and MAO-B in tonic GABA synthesis, *Experimental & Molecular Medicine*, 2021. DOI: 10.1038/s12276-021-00646-3 (#co-corresponding authors)
- An H, Lee H, Yang S, Won W, Lee CJ#, **Nam MH**#, Adenovirus-induced reactive astrogliosis exacerbates the pathology of Parkinson's disease, *Experimental Neurobiology*, 2021;30(3):222-231. DOI: 10.5607/en21013 (#cocorresponding authors)
- **Nam MH***, Cho J*, Kwon DH, Park JY, Woo J, Lee J, Lee S, Ko HY, Won W, Kim RG, Song H, Oh SJ, Choi JW, Park KD, Park EK, Jung H, Kim HS, Lee MC, Yun M, Lee CJ#, Kim HI#, Excessive astrocytic GABA causes cortical hypometabolism and impedes functional recovery following subcortical stroke, *Cell Reports*, 2020, 32, 107861.DOI: 10.1016/ *j.celrep*.2020.107861
- 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 inanimal models of Parkinson's disease, *Current Biology*, 2020;30(2):276-291. DOI: 10.1016/ j.cub.2019.11.079

Curriculum Vitae

2022~Present : Adjunct associate professor, KIST school, UST
2021~Present : Adjunct professor, Kyung Hee University
2020~Present : Senior Researcher, KIST
2018~2020 : Researcher, KIST
2013~2018 : Visiting graduate student / Post-doctoral fellow, KIST

Academic Credential

2017 : Ph.D., Basic Science in Korean Medicine (Neuroscience) Kyung Hee University
2013 : M.S., Basic Science in Korean Medicine (Pathology) Kyung Hee University
2011 : K.M.D, Kyung Hee University

Awards/Honors/Memberships

2010 : Korea Presidential Youth Talent Award
2012~2015 : Korea Junior Research Fellowship
2015, 2017 : Poster awards at Glia Meeting Korea
2015, 2017 : Poster awards at Korea Society of Brain and Neural Science
2018 : Poster award at Korea Society of Neurodegenerative Disease
2021 : Travel award at Japan Neuroscience Society
2022 : KIST Young Fellow

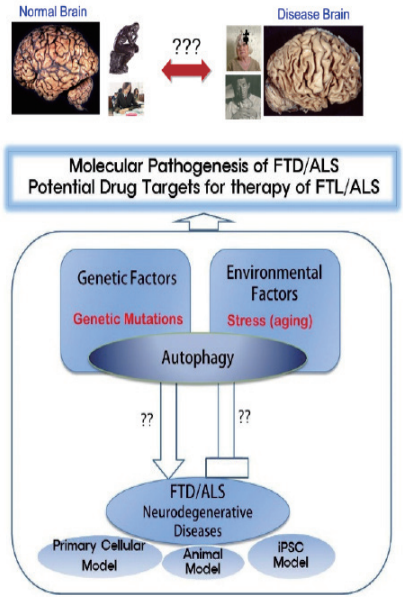
Jin-A Lee, PhD
Invited Investigator
(HNU, Professor)

Laboratory Molecular Disease of Brain,
Hannam University (HNU)

Tel : +82-42-629-8785
Fax : +82-42-629-8769
E-mail : leeja@hnu.kr

Molecular and cellular pathogenesis of neurodegenerative diseases associated autophagy

Autophagy is a bulk lysosomal degradation process important in development, differentiation and cellular homeostasis in multiple organs. Interestingly, neuronal survival is highly dependent on autophagy due to its post-mitotic nature, polarized morphology and active protein trafficking. A growing body of evidence now suggests that alteration or dysfunction of autophagy causes accumulation of abnormal proteins and/or damaged organelles, thereby leading to neurological disorders. Although autophagy generally prevents neuronal cell death, it plays a protective or detrimental role in neurological disorders depending on various cellular contexts.
Our goal is to understand how autophagy is associated with various neurological disorders including amyotrophic lateral sclerosis (ALS) and frontotemporal dementia (FTD) using primary ccellular model, animal model, and iPSC model



Research keywords

Autophagy, Neurological disorders, induced pluripotent stem cells (iPSCs)

Key techniques

Generation of induced pluripotent stem cells (iPSCs), 3D organoids, autophagy assay

Research Interests/Topics

- Molecular and cellular mechanism of pathogenesis of neurodegenerative diseases (Frontotemporal dementia/amyotrophic later sclerosis)
- The regulation of autophagy on neurological disorders

Research Publications (selected)

- Lim CS1, Kim MJ1, Choi JE1, Islam MA1, Lee YK1, Xiong Yinyi, Shim KW, Yang J, Lee RU, Lee J, Park P, Kwak JH, Seo H, Kim CH, Lee J, Lee YS, Hwang SK, Lee K*, **Lee JA***, Kaang BK*. Dysfunction of NMDA receptors in neuronal models of an autism spectrum disorder patient with a DSCAM mutation and in Dscamknock mice. *Mol Psychiatry*. Jul 12. doi: 10.1038/s41380-021-01216-9. Online ahead of print. 2021.
- Lee YK, Jun YW, Choi HE, Huh YH, Kaang BK*, Jang DJ*, **Lee JA***. Development of LC3/GABARAP sensors containing a LIR and a hydrophobic domain to monitor autophagy. *EMBO J* 13;36(8):1100-1116. doi: 10.15252/embj.20169631 (Selected as the featured article in EMBO International Autophagy Meeting 2017 in Japan). 2017.
- Ryu HH, Jun MH, Min KJ, Jang DJ, Lee YS*, Kim HK*, and **Lee JA***. Autophagy regulates ALS-linked FUS-positive stress granules in neurons. *Neurobiol. Aging* Dec;35(12):2822-31 (Selected as the featured article and editorial review in Neurobiology of Aging). 2014.
- **Lee JA**, Liu Lei, Gao FB. Autophagy defects contribute to neurodegeneration induced by dysfunctional ESCRT-III. *Autophagy* Oct 15;5(7). 2009.
- **Lee J-A**, Beigneux A, Ahmad ST, Young SG, Gao F-B. ESCRT-III dysfunction causes autophagosome accumulation and neurodegeneration. *Curr. Biol.* 17, 1561–1567 (Citation: 358). 2007.

Patents (selected)

- **Lee JA** (2017) A method for screening an agent (materials) for treating a neurodegenerative disease (10-1755530)
- **Lee JA**, Kaang BK, Jang DJ (2018) Probes for detecting autophagosome derived from FYCO1 (10-1883593)

Curriculum Vitae

2009~Present : Professor, Hannam University
2008~2009 : Research Associate, GIND, UCSF USA
2005~2008 : Postdoctoral Fellow, GIND, UCSF USA

Academic Credential

2005 : Ph.D., Neuroscience, Seoul National University
2001 : M.S., Biological Science, Seoul National University
1999 : B.S., Biological Science Seoul National University

Awards/Honors/Memberships

2006~2008 : CIRM (California Institute of Regenerative Medicine) fellowship for human stem cell research (California, USA)
2009 : L'Oreal-Unesco Awards for Women in Science-Fellowship

Sungkean Kim, PhD
Invited Investigator
(HYU ERICA, Professor)

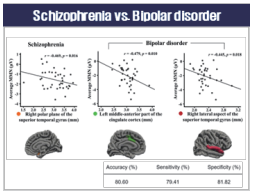
Dept. of Human-Computer Interaction
Hanyang University ERICA (HYU ERICA)

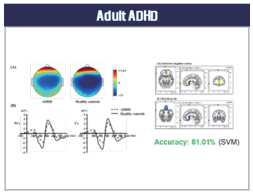
Office : 610 Hakyeonsan Cluster Center,
55 Hanyangdaehak-ro, Sangnok-gu,
Ansan, Gyeonggi-do, 15588, Korea
Lab : Digital Healthcare Lab (DHL.hanyang.ac.kr)
Tel : +82-31-400-1055
E-mail : kimsk@hanyang.ac.kr

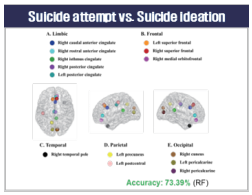
Digital healthcare research for mental health monitoring and cognitive rehabilitation treatment

Based on neural engineering and artificial intelligence technologies, Digital Healthcare Lab at Hanyang University is conducting research in several domains of digital healthcare that can aid in mental health monitoring and cognitive rehabilitation treatment. The necessity for untact medical services has grown as a result of the corona pandemic, making digital healthcare an increasingly challenging field. In particular, mental health field is in dire need of innovative digital healthcare tools for objective diagnosis, condition monitoring, and cognitive rehabilitation treatment of patients.

Our research encompasses a variety of research topics, including the development of AI-based digital biomarkers through bio-signal and neural image data analysis, the development of computer-aided diagnostic system based on neural engineering and AI for mental diseases, the development of AI technique for digital healthcare system, the development of early diagnostic system through the construction of digital medical big data, and the development of VR-based personalized digital therapeutics with bio-signal measurement for cognitive rehabilitation treatment.







Research keywords

Biomedical engineering, Neural engineering, Medical AI, Bio-signal processing, Digital healthcare

Key techniques

Bio-signal processing and analysis, Machine learning analysis, Medical statistical analysis

Research Interests/Topics

- Development of AI-based digital biomarkers through bio-signal and neural image data analysis
- Development of computer-aided diagnostic system based on neural engineering and AI for mental diseases
- Development of AI technique for digital healthcare system
- Development of early diagnostic system through the construction of digital medical big data
- Development of VR-based personalized digital therapeutics with bio-signal measurement for cognitive rehabilitation treatment

Research Publications (Last 5 years / selected)

- **S Kim**, JH Baek, YJ Kwon, HY Lee, JH Yoo, SH Shim, JS Kim. Machine-Learning-Based Diagnosis of Drug-Naïve Adult Patients with Attention-Deficit Hyperactivity Disorder using Mismatch Negativity. *Translational Psychiatry*, 2021.
- **S Kim**, JS Kim, YJ Kwon, HY Lee, JH Yoo, YJ Lee, SH Shim. Altered Cortical Functional Network in Drug-Naïve Adult Male Patients with Attention-Deficit Hyperactivity Disorder: A Resting-State Electroencephalographic Study. *Progress in Neuropsychopharmacology & Biological Psychiatry*, 2020.
- **S Kim**, YW Kim, H Jeon, CH Im, SH Lee. Altered Cortical Thickness-Based Individualized Structural Covariance Networks in Patients with Schizophrenia and Bipolar Disorder. *Journal of Clinical Medicine*, 2020.
- **S Kim**, SK Jang, DW Kim, M Shim, YW Kim, CH Im, SH Lee. Cortical Volume and 40-Hz Auditory-Steady-State Responses in Patients with Schizophrenia and Healthy Controls. *NeuroImage:Clinical*, 2019.
- **S Kim**, H Jeon, KI Jang, YW Kim, CH Im, SH Lee. Mismatch Negativity and Cortical Thickness in Patients With Schizophrenia and Bipolar Disorder. *Schizophrenia Bulletin*, 2019.

Curriculum Vitae

2021.03~Present : Assistant Professor, Hanyang University ERICA
2019.06~2021.02 : Postdoctoral Researcher, University of Florida
2019.03~2019.05 : Postdoctoral Researcher, Hanyang University
2015.03~2019.05 : Researcher, Clinical Emotion and Cognition Research Lab, Ilsan Paik Hospital

Academic Credential

2015.03~2019.02 : Ph.D., Biomedical Engineering, Hanyang University
2012.03~2014.08 : M.S., Biomedical Engineering, Yonsei University
2004.03~2012.02 : B.S., Biomedical Engineering, Yonsei University

Awards/Honors/Memberships

2019.05 : Most Promising Biomedical Engineer Award, Korean Society of Medical & Biological Engineering
2019.04 : Best Poster Award, Korean NeuroPsychiatric Association
2017.11 : Best Poster Award, Korean Academy of Anxiety and Mood
2017.09 : Best Poster Presentation Award, Korean College of Neuropsychopharmacology
2013.09 : AFOS Traveling Award, Asian Federation of Osteoporosis Societies

Sang Ryong Kim, PhD
Invited Investigator
(KNU, Professor)

School of Life Sciences & Biotechnology
Neurodegeneration Control Laboratory
Kyungpook National University (KNU)

Office : Bldg 219 Rm 528
Lab : Bldg 219 Rm 529/503
Tel : +82-53-950-7362
Fax : +82-53-943-6925
E-mail : srk75@knu.ac.kr
http://ncl.knu.ac.kr

Development of novel gene constructs and drugs to treat neurodegeneration in CNS

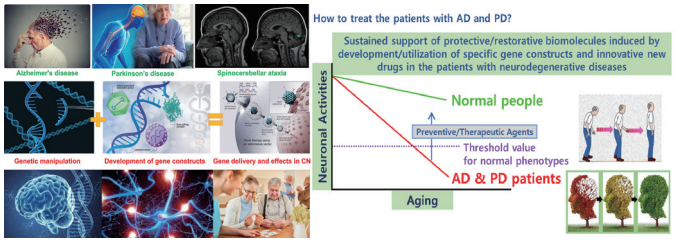
The etiology of many neurological diseases such as Alzheimer's disease (AD) and Parkinson's disease (PD) affecting the central nervous system (CNS) is still unclear and needs more effective and specific therapeutic approaches to treat patients with neurodegeneration in the CNS.

The long-term research focuses on the following:

- Identification of pathogenic factors contributing to AD, PD, and spinocerebellar ataxia (SCA) pathogenesis
- Roles of specific genes and neurorestorative/protective agents against neurodegenerative diseases in vivo and application of novel AAV gene constructs
- Development of anti-neuroinflammatory drugs against AD, PD, and SCA

Aim	Utilization of novel gene constructs and drugs against neurodegeneration in CNS
Tool	Brain Surgery, Development of Therapeutic Agents, Evaluation in Animals, Biochemical & Molecular Analysis

TARGET



Research keywords

PD, AD, SCA, Neuro-Protection/Neuro-Restoration in vivo, Gene therapy, Neuroinflammation

Key techniques

Brain surgery, Biochemistry & Molecular Biology, Behavioral analysis in rat/mouse, Animal models with PD/AD/SCA

Research Interests/Topics

- Development of therapeutic agents against neurodegenerative diseases *in vivo*
- Identification of pathogenic factors in AD/PD/SCA

Research Publications (selected)

- Park et al. Mesenchymal Stem Cell Transplantation Ameliorates Ara-C-Induced Motor Deficits in a Mouse Model of Cerebellar Ataxia. ***J Clin Med***. 2023;12(5):1756. doi: 10.3390/jcm12051756.
- Kim et al. pKr-2 induces neurodegeneration via upregulation of microglial TLR4 in the hippocampus of AD brain. ***Brain Behav Immun Health***. 2023;28:100593. doi: 10.1016/j.bbih.2023.100593.
- Kim et al. Control of hippocampal prothrombin kringle-2 (pKr-2) expression reduces neurotoxic symptoms in five familial Alzheimer's disease mice. ***Br J Pharmacol***. 2022;179(5):998-1016. doi: 10.1111/bph.15681.
- Sharma C, Kim SR. Linking Oxidative Stress and Proteinopathy in Alzheimer's Disease. ***Antioxidants (Basel)***. 2021;10(8):1231. doi: 10.3390/antiox10081231.
- Hong J, Yoon D, Nam Y, Seo D, Kim JH, Kim MS, Lee TY, Kim KS, Ko PW, Lee HW, Suk K, Kim SR. Lipopolysaccharide administration for a mouse model of cerebellar ataxia with neuroinflammation. ***Sci Rep***. 2020;10(1):13337. doi: 10.1038/s41598-020-70390-7.
- Jeon et al. Neurotrophic interactions between neurons and astrocytes following AAV1-Rheb(S16H) transduction in the hippocampus *in vivo*. ***Br J Pharmacol***. 2020;177(3):668-686. doi: 10.1111/bph.14882.
- Kwon et al. Perspective: Therapeutic Potential of Flavonoids as Alternative Medicines in Epilepsy. ***Adv Nutr***. 2019;10(5):778-790. doi: 10.1093/advances/nmz047.
- Leem et al. Upregulation of neuronal astrocyte elevated gene-1 protects nigral dopaminergic neurons *in vivo*. ***Cell Death Dis***. 2018;9(5):449. doi: 10.1038/s41419-018-0491-3.
- Kim et al. Protection of nigral dopaminergic neurons by AAV1 transduction with Rheb(S16H) against neurotoxic inflammation *in vivo*. ***Exp Mol Med***. 2018;50(2):e440. doi: 10.1038/emm.2017.261.2018.

Curriculum Vitae

2012~Present : Professor, School of Life Sciences & Biotechnology, KNU
2020~2022 : Vice Dean, College of Natural Sciences, KNU
2019~2021 : Director, Brain Science and Engineering Institute, KNU
2008~2011 : Associate Research Scientist, Columbia University, USA

Academic Credential

2006~2008 : Postdoctoral Research Scientist, Columbia University, USA
2002~2006 : Ph.D. Neuroscience graduate program, Ajou University School of Medicine
1994~2002 : B.S. Life Science, Ajou University

Awards/Honors/Memberships

2021~Present : Academic committee, KSND
2019~Present : Review Editor, Frontiers in Cellular Neuroscience.
2018~Present : Editor, Journal of Clinical Medicine.
2018~Present : Associate Editor, Experimental Neurobiology.
2016~2017 : Review Editor, Journal of Medicinal Food.
2015 : Research Award - The Korean Society of Food Science and Nutrition
2010 : KASBP Fellowship Award - Korean American Society in Biotech and Pharmaceuticals.
2005 : AKN President's Excellence In Research Award, AKN
2003 : AKN President's Outstanding Research Award, AKN

Kwang Pyo Kim, PhD
Invited Investigator
(KHU, Professor)

Dept. of Applied Chemistry/
Kyung Hee Medical Science Research Institute,
Kyung Hee University (KHU)

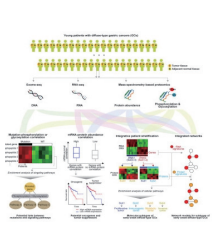
Lab : +82-31-201-3868
Tel : +82-31-201-3868
Fax : +82-53-980-8
E-mail : kimkp@khu.ac.kr
http://www.fsb.khu.ac.kr

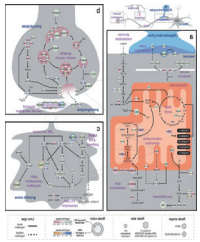
Mass spectrometry-based Proteomics and Metabolomics

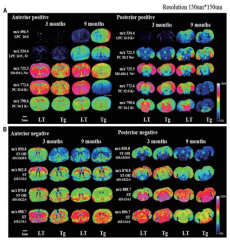
My group focuses on identifying potential therapeutic targets and biomarkers for various diseases, such as cancers, non-alcoholic steatohepatitis, major depressive disorder and Alzheimer's disease, using a multidisciplinary approach that combines proteomics, genomics, and metabolomics. In addition, we also investigates the role of posttranslational modifications and extracellular vesicles in disease pathogenesis. Our recent work has resulted in the identification of novel targets for drug development, such as paraoxonase for lipid metabolism and LEMT1/GRP78 axis for lung cancer. Furthermore, we has made significant contributions to the field of proteomics by developing new techniques to analyze novel posttranslational modifications including protein tyrosine nitration and lipidation.

Aim	Identify potential therapeutic targets and biomarkers for various diseases through multi-omics approaches
Tool	Mass spectrometry technique using LC-MS/MS and MALDI-TOF/TOFfor proteomics, lipidomics metabolomics and multiomics

TARGET







Research keywords

Multiomics, Proteomics, Lipidomics, Metabolomics, Mass spectrometry

Key techniques

LC-MS/MS(proteomics, lipidomics, metabolomics), MALDI imaging

Research Interests/Topics

- Discover disease-specific biomarkers through quantitiative analysis of proteome and metabolome
- Imaging Mass Spectrometry with MALDI-TOF-MS
- Mass spectrometric analysis of proteins, lipids, and metabolites
- Multiomics Technology

Research Publications (selected)

- Jang WE, Park JH, Park GE, Bang G, Na CH, Kim JY, Kim KY, **Kim KP**, Shin CY, An JY, Lee YS, Kim MS. . Cntnap2-dependent molecular networks in autism spectrum disorder revealed through an integrative multi-omics analysis. *Mol Physciatry*. 2023 Feb;28(2):810-821
- Tran Q, Lee H, Jung JH, Chang SH, Shrestha R, Kong G, Park J, Kim SH, Park KS, Rhee HW, Yun J, Cho MH, **Kim KP**, Park J., Emerging role of LEMT1/GRP78 axis in lung cancer. *Cell Death Dis*. 2022 Jun 10;13(6):543.
- Han B, Jung BK, Park SH, Song KJ, Anwar MA, Ryu KY, **Kim KP**., Polyubiquitin gene Ubb is required for upregulation of Piwi protein level during mouse testis development., *Cell Death Discov*. 2021 Jul 26;7(1):194
- Noh SA, Kim SM, Park SH, Kim DJ, Lee JW, Kim YG, Moon JY, Lim SJ, Lee SH, **Kim KP**. Alterations in Lipid Profile of the Aging Kidney Identified by MALDI Imaging Mass Spectrometry. *J Proteome Res*. 2019 Jul 5;18(7):2803-2812
- Kim EY, Jae Won Lee, Lee MY, Kim SH, Hyuck Jun Mok, Ha K, Ahn YM, **Kim KP**. Serum lipidomic analysis for the discovery of biomarkers for major depressive disorder in drug-free patients. *Psychiatry Res*. 2018.

Curriculum Vitae

2013~Present : Professor, Kyung Hee University Department of Applied Chemistry
2004~2013 : Assistant/Associate Professor, Konkuk University Department of Molecular Biotechnology

Academic Credential

2002 : Ph.D. Biochemistry, University of Illinois at Chicago, USA
1992 : M.S, Chemistry, Seoul National University, Korea
1990 : B.S, Chemistry, Seoul National University, Korea

Awards/Honors/Memberships

2002~Present : Member, American Society for Mass Spectrometry
2004~Present : Member, Vice President (2022-2023), Korea Society for Mass Spectrometry
2012~Present : Member, International Society of Extracellular Vesicles
2012~Present : Member, President (2020), Korean Society of Extracellular Vesicles
2004~Present : Member, Korean Chemical Society
2003~Present : Member, Human Proteome Organization
2004~Present : Member, Korean Human Proteome Organization
2004~Present : Member, Korean Society for Biochemistry and Molecular Biology
2004~Present : Member, Korean Society for Molecular and Cellular Biology,
2015~2021 : Associate Editor, Journal of Extracellular Vesicles

KBRI
61, Cheomdan-ro, Dong-gu, Daegu, Korea [41608]
Tel. +82-53-980-8114 www.kbri.re.kr