Imagine the Impossible

School of Computational Sciences

School of Physics

School of Mathematics

Korea Institute for Advanced Study

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Seoul 02455, Republic of Korea

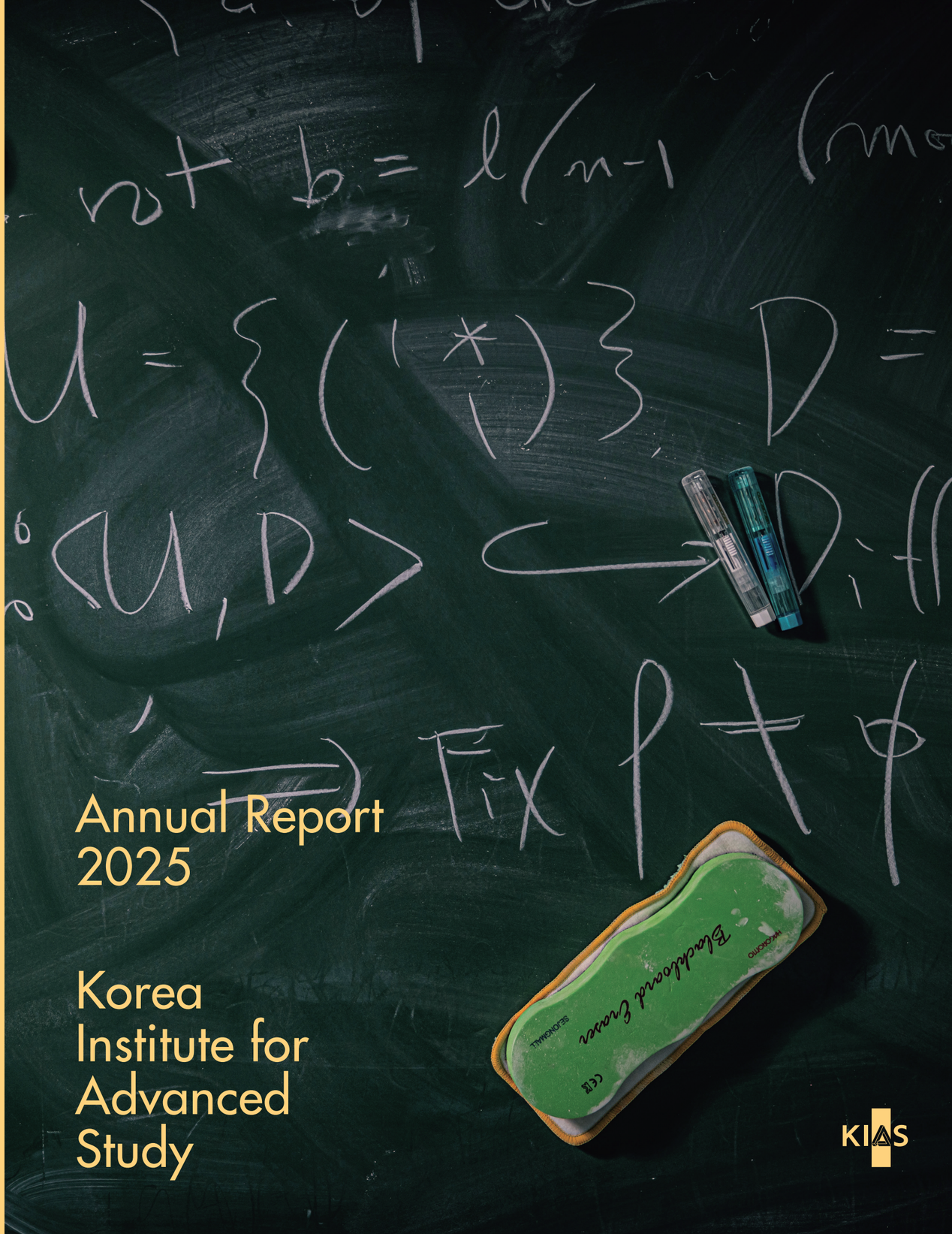
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HORIZON

KIAS

Annual Report 2025

Korea Institute for Advanced Study



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Imagine the Impossible

Annual Report 2025

Korea Institute for Advanced Study

KIAS

From Thirty to Infinity



The year 2025 was profoundly meaningful for the Korea Institute for Advanced Study (KIAS), as we prepared to celebrate our historic 30th anniversary in 2026. Over the past three decades, KIAS has remained steadfast in its commitment to advancing the frontiers of theoretical science while fostering a vibrant, world-class community of scholars. As global scientific challenges become increasingly complex, our role as a sanctuary for curiosity-driven, fundamental research is more vital than ever. The extraordinary milestones achieved over the past year reflect the unparalleled dedication of our research community and lay a powerful and resilient foundation for the next chapter of KIAS's journey.

Sincerely,

Tae Won Noh
President, Korea Institute for Advanced Study (KIAS)

Tae Won Noh

Advancing the Frontiers of Knowledge

Throughout 2025, KIAS researchers received significant recognition both nationally and internationally, demonstrating the foundational strength of our research community. Notably, Professor Masaki Kashiwara, a KIAS Scholar, was awarded the Abel Prize, one of the highest honors in mathematics, for his pioneering contributions to algebraic analysis and representation theory. On the national stage, Distinguished Professor Seokwoo Shin received the prestigious 2025 Ho-Am Prize in Science, and Professor Youngwoo Son was honored with the Korea Science Award, in recognition of their monumental contributions to basic science.

Adding to this global acclaim, Professors Sungjin Oh and Hee Oh have been selected as speakers for the International Congress of Mathematicians (ICM) 2026, with Professor Hee Oh appointed to deliver a plenary lecture. This exceptional distinction is a source of great pride to KIAS as we enter our 30th anniversary year. Together with the other prominent awards and prestigious academic appointments earned by our faculty and fellows, these accomplishments underscore the profound global impact of the research conducted at KIAS.

To sustain this exceptional momentum, our academic community welcomed Professor Jejoong Yoo to the School of Computational Sciences and Professor Sangmin Lee to the School of Physics. Their appointments represent our continued strategic investment in outstanding scholars who will expand the breadth and depth of research across the institute.

A Dynamic Global Community of Scholars

Scientific progress flourishes best where diverse minds converge. In 2025, KIAS served as a vibrant global hub, hosting over one hundred international academic events attended by approximately 8,000 visitors, as well as nearly six hundred specialized seminars. These gatherings provided fertile ground for researchers from across disciplines to cross-pollinate ideas and forge new intellectual paradigms. We were also privileged to welcome 169 international visiting scientists whose collaborative work with KIAS members greatly enriched our research ecosystem and reinforced KIAS's role as a vital nexus for global theoretical science.

Nurturing the Next Generation of Leaders

Equally core to our mission is the responsibility to discover and support emerging scientific talent. This year, 39 new research fellows joined KIAS, injecting fresh perspectives and vital intellectual energy into our community. Since our inception in 1997, more than 600 exceptional fellows have launched their careers at KIAS before transitioning to leading universities and research institutes across Korea and around the globe. The continued success of our alumni stands as a powerful testament to the lasting value of an environment that rigorously upholds academic freedom, rigorous inquiry, and dedicated mentorship.

Looking to the Future

The pursuit of fundamental science is a long-term endeavor that demands sustained commitment, open-minded exploration, and collaboration that transcends disciplines and national borders. As we stand on the threshold of our 30th anniversary in 2026, KIAS will continue to elevate its research excellence by attracting top-tier talent, expanding strategic global partnerships, and cultivating an institutional culture where groundbreaking discoveries can naturally emerge.

I would like to express my deepest gratitude to our faculty, staff, research fellows, visiting scientists, alumni, and partners for their profound dedication and contributions throughout this critical foundation year. As we prepare to celebrate thirty years of academic excellence, we reaffirm our commitment to deepening our understanding of the natural world and reinforcing KIAS's status as a premier global institution for basic science.

History

1995

Mar.
Feasibility study on the establishment of KIAS

Dec.
Formation of KIAS Establishment Committee

1996

Aug.
Appointment of Prof. Efim I. Zelmanov of University of California at San Diego (1994 Fields Medalist) as Distinguished Professor of the School of Mathematics

Nov.
Establishment of School of Mathematics and School of Physics

Official scientific operation began with research staff of 1 Distinguished Professor, 2 Professors, and 3 Research Fellows

1997

Dec.
Appointment of Prof. Chung Wook Kim of Johns Hopkins University as the 1st President

1998

Oct.
Publication of the 1st issue of the KIAS Newsletter

Dec.
Introduction of 'Associate Member Program'

1999

Aug.
Appointment of Prof. Leonard Susskind of Stanford University (1998 Sakurai Prize Awardee) as Distinguished Professor of the School of Physics

2000

Aug.
Stephen Hawking's visit to KIAS

Sep.
Establishment of School of Computational Sciences

2001

Jul.
Re-appointment of Prof. Chung Wook Kim as the 2nd President

2004

Jul.
Appointment of Prof. Mahn Won Kim of KAIST as the 3rd President

2006

Jan.
International Review of the School of Mathematics by an external review committee of experts

May
Introduction of the 'KIAS Scholar Program'

Oct.
The 10th Founding Anniversary of KIAS

Nov.
International Review of the School of Physics by an external review committee of experts

2007

Jul.
Appointment of Prof. Hyo Chul Myung as the 4th President

Aug.
Launch of 'Bright Africa Mathematics Competition' sponsorship program

2009

Jan.
Introduction of 'Open KIAS Program (OKC)'

Nov.
International Review of the School of Computational Sciences by an external review committee of experts

KIAS honored as the 'Research Excellence Institution' by the Ministry of Science and Technology in recognition of its exemplary achievements 'Associate Member Program' in scientific research

2010

Jul.
Appointment of Prof. Doochul Kim of Seoul National University as the 5th President

Dec.
Introduction of 'Center for Advanced Computation (CAC)'

2011

Sep.
Asian Institutes for Advanced Study Forum

Oct.
The 1st KIAS Advisory Board Meeting

2012

Aug.
Inauguration Conference of Transdisciplinary Research Program

2013

Jan.
Introduction of 'Center for Mathematical Challenges (CMC)'

Sep.
Appointment of Prof. JongHae Keum of KIAS as the 6th President

Oct.
KIAS held its 2nd KIAS Advisory Board Meeting

2014

Jan.
Introduction of 'Quantum Universe Center (QUC)'

2015

May
Appointment of Prof. Ashoke Sen of State University of New York at Stony Brook (2012 Fundamental Physics Prize Winner) as Distinguished Professor of the School of Physics

2016

May
Appointment of Prof. John Michael Kosterlitz of the Brown University (2016 Nobel Laureate in Physics) as Distinguished Professor of the School of Computational Sciences

Sep.
KIAS held its 3rd KIAS Advisory Board Meeting

Oct.
The 20th Founding Anniversary of KIAS

Nov.
Appointment of Prof. Yong-Hee Lee of KAIST as the 7th President

2017

Nov.
Appointment of Prof. Alexei Smirnov of MPIK Heidelberg and ICTP (2016 The Albert Einstein Medal) as Distinguished Professor of the School of Physics

2018

Jan.
Publication of KIAS web magazine 'HORIZON'

Sep.
International Review of the School of Mathematics and the School of Physics by an external review committee of experts

2019

Oct.
Appointment of Prof. Viatcheslav Mukhanov of Ludwig Maximilian University of Munich (2015 Max Planck Medal) as Distinguished Professor of the School of Physics

Sep.
International Review of the School of Computational Sciences by an External Review Committee of Experts

2020

Jan.
Appointment of Prof. Jaigyoung Choe of KIAS as the 8th President

2021

Jan.
IntroducIntroduction of 'Center for AI and Natural Sciences (CAINS)'

Publication of the KIAS Expositions

Launching of The Quadranscentennial KIAS Lectures

2022

Jun.
Publication of the KIAS Springer Series

Jul.
Distinguished Professor June E Huh, School of Mathematics, won the 2022 Fields Medal

2023

Jul.
Introduction of June E Huh Center for Mathematical Challenges (HCMC), the Expansion of the Former CMC

2024

Jun.
Appointment of Prof. Tae Won Noh of Seoul National University as the 9th President

2025

May
Appointment of Prof. Sug Woo Shin of UC Berkeley as the HCMC Distinguished Professor

Jul.
Appointment of Prof. Daniel D. Lee of Cornell Tech as a Distinguished Professor of the AI and Natural Sciences Center

Sep.
International Review by an External Review Committee of the Experts

Oct.
Appointment of Prof. Myungshik Kim of Imperial College as a QUC Distinguished Professor

KIAS 2025

Awards & Honors



Sungjin Oh
Mathematics
Professor
Invited Speakers for ICM 2026



Hee Oh
Mathematics
KIAS Scholar
Plenary Speaker for ICM 2026



Seokwoo Shin
Mathematics
Distinguished Professor
Ho-Am Prize in Science



Jaewan Kim
Computational Sciences
Endowed Chair Professor
Quantum Strategy Committee Member Under the Prime Minister of Korea



Masaki Kashiwara
Mathematics
KIAS Scholar
Abel Prize



Hoyeon Choi
Computational Sciences
Research Fellow
Young Statistical Physics Award of Korean Physical Society



Joongkyung Lee
HCMC
HCMC Fellow
Dissertation Award from the Korean Mathematical Society



Namgyu Kang
Mathematics
Professor
DI Mathematician of the Year Award from the Korean Mathematical Society



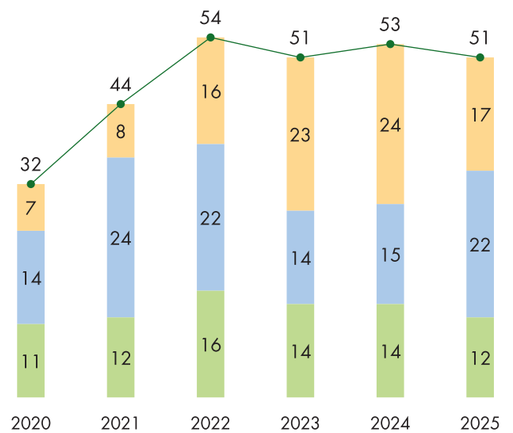
Kyungsoo Choi
Mathematics
Professor
Next-Generation Member of the Korean Academy of Science and Technology



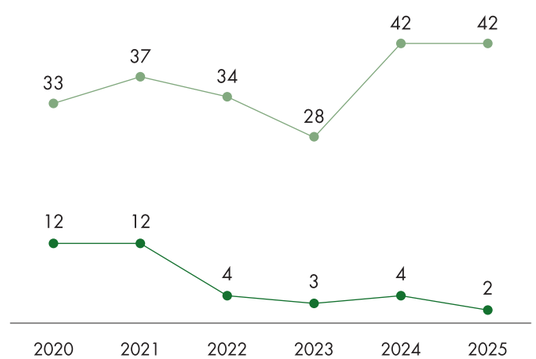
Inhyuk Choi
Mathematics
KIAS Fellow
Sangsan Young Mathematician Award

Number of Research Activities

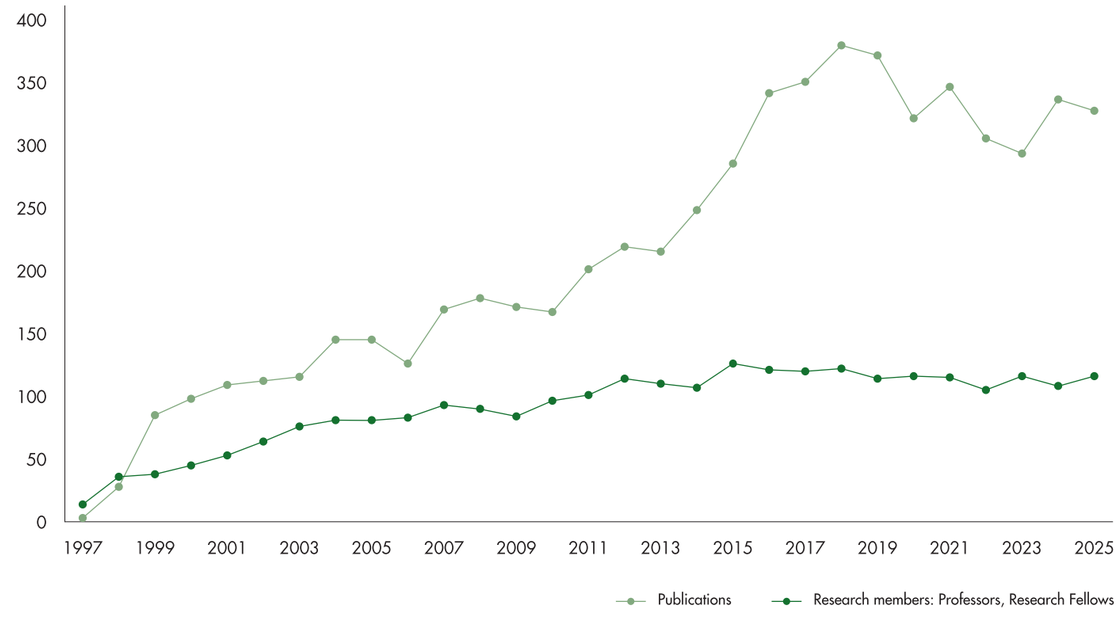
Conferences



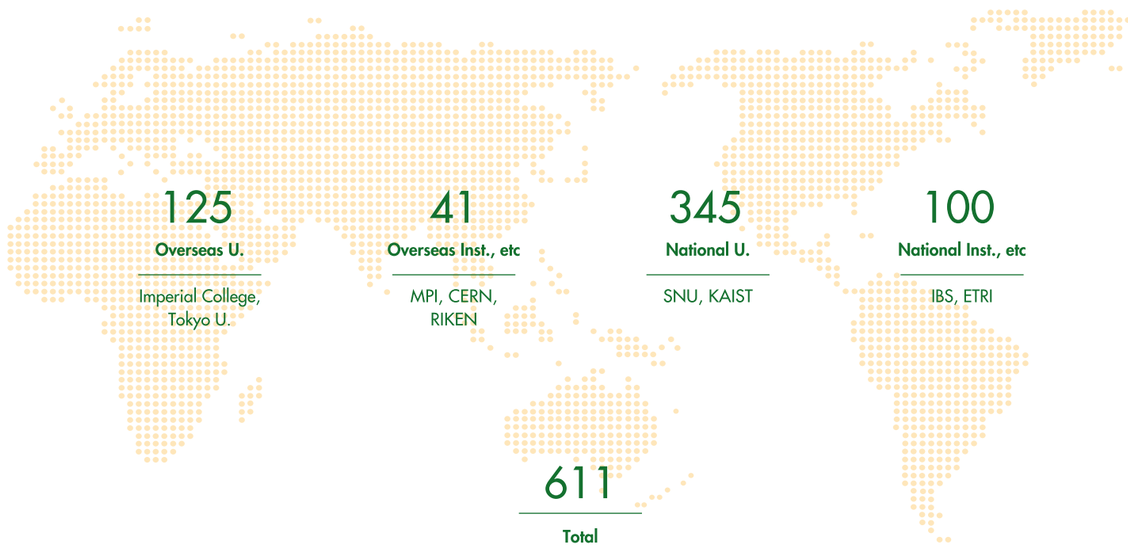
Visiting Faculty



KIAS at a glance



Transfer Record of Alumni

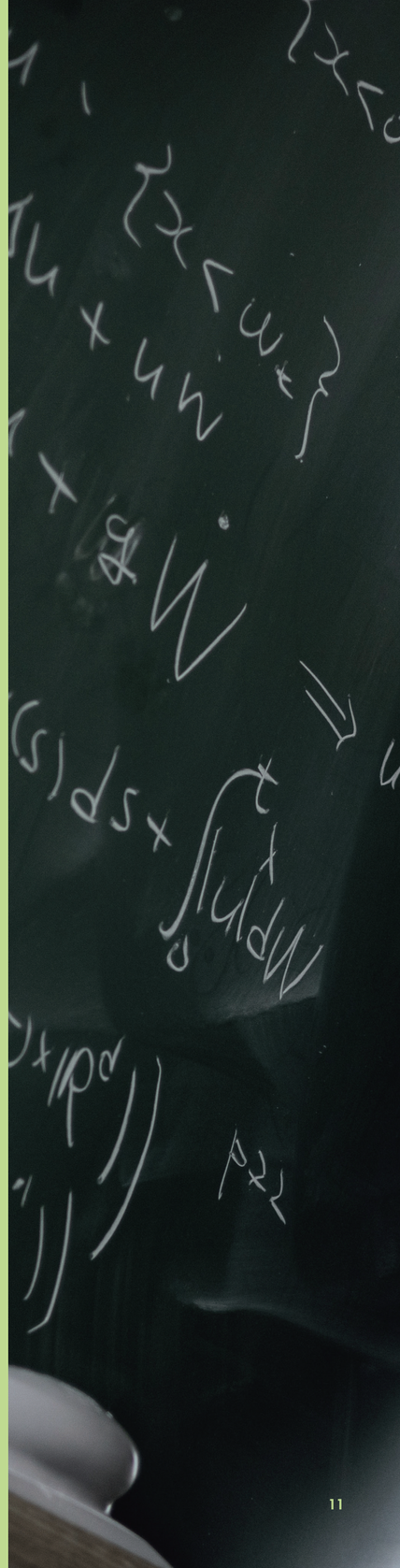


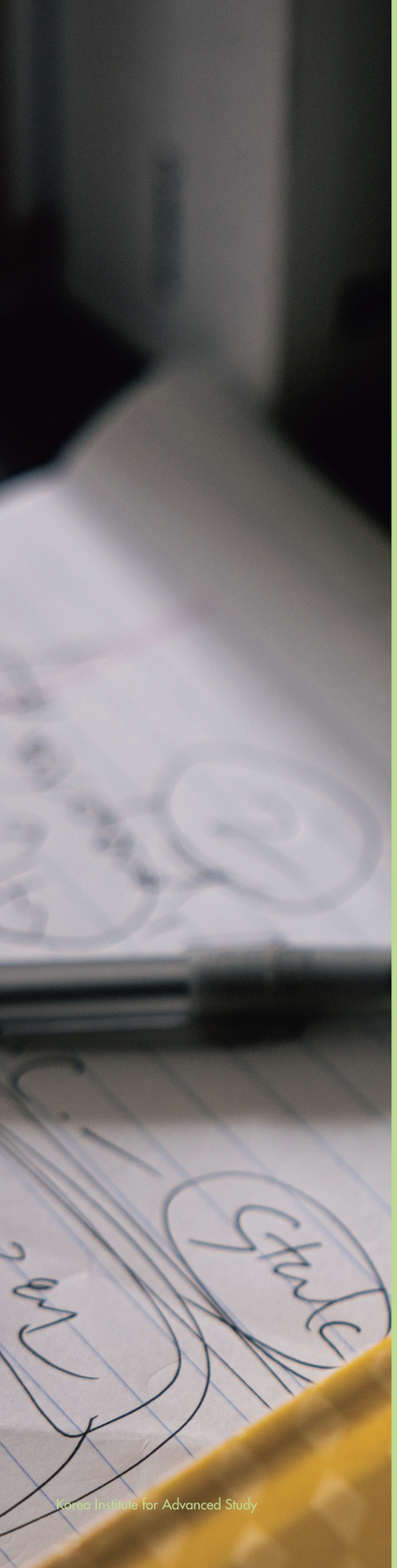


School of Mathematics

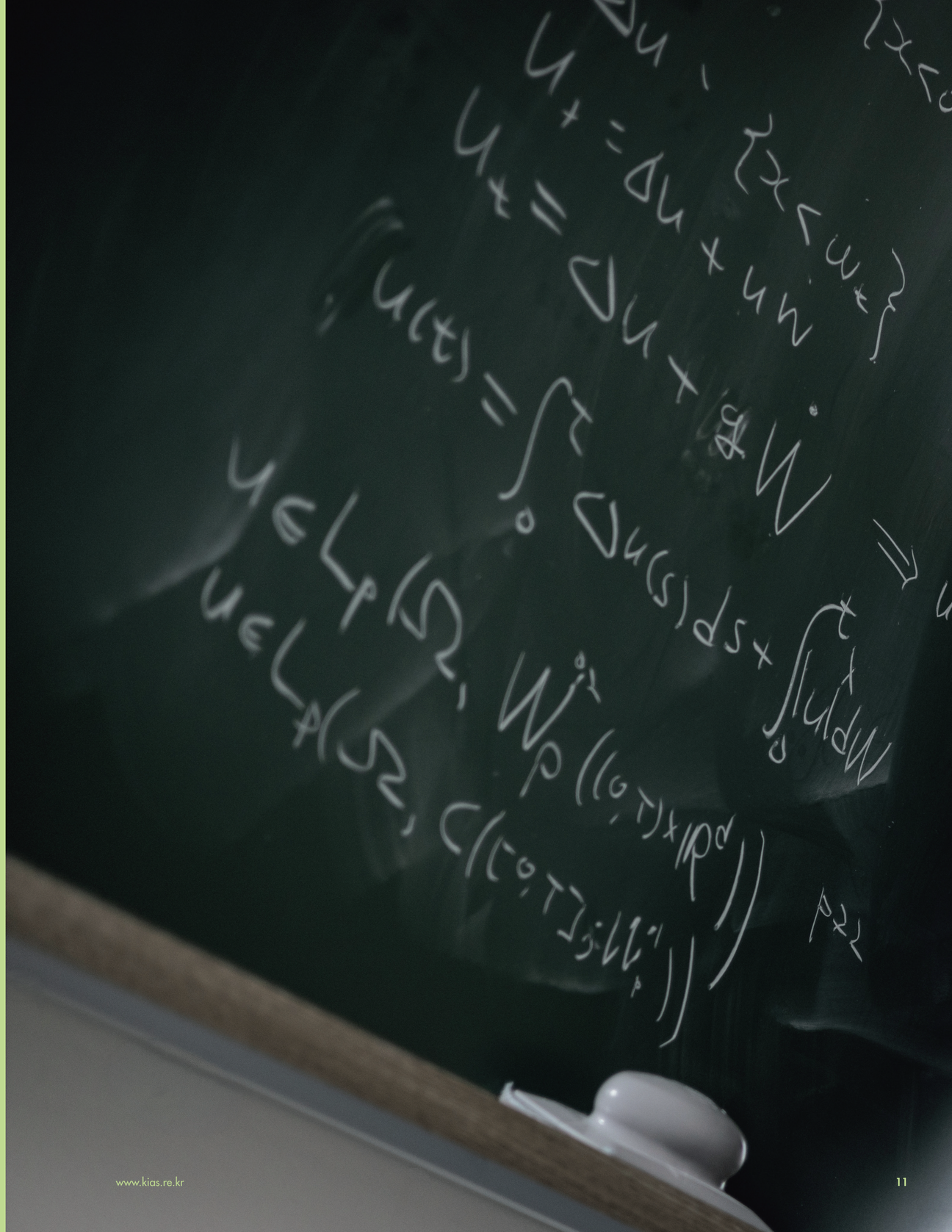
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Faculty and Research Fellows
Research Activities
Visiting Scientists
Conferences and Workshops
Publications





The great success of modern science can attributed in large part to mathematics, which provides the foundation for the models used to analyze various natural and social phenomena. Because the most significant mathematical discoveries have often benefited from the cross-fertilization of ideas from different mathematical fields, the School of Mathematics supports scholarship in a broad range of mathematical sciences, spanning both pure and applied mathematics such as algebraic geometry, number theory, differential geometry, low-dimensional topology, harmonic analysis, global analysis, mirror symmetry, and partial differential equations. The School of Mathematics' fundamental objective is to create new mathematical knowledge and nurture young mathematicians by providing them with a vibrant environment that encompasses the full spectrum of mathematical sciences.



Faculty and Research Fellows

Position	Name	Research Interest
Distinguished Professor	Zelmanov, Efim I.	Algebra, Group Theory
	Huh, June E	Combinatorics, Algebraic Geometry
Professor Emeritus	Choe, Jaigyoung	Differential Geometry
	Choi, Youn-Seo	Analytic Number Theory
Professor	Choi, Kyeongsu	Partial Differential Equations
	Kang, Nam-Gyu	Analysis, Probability
	Kiem, Young-Hoon	Algebraic Geometry
	Kim, Hyun Kyu	Physical Mathematics
	Kim, Inkang	Hyperbolic Geometry
	Kim, Sang-hyun	Geometric Group Theory
	La, Joonhyun	Partial Differential Equations
	Oh, Sung-Jin	Nonlinear Partial Differential Equations
	Park, Jinsung	Global Analysis
KIAS Scholar	Alberts, Thomas	Two-Dimensional Conformally Invariant Systems
	Jang, Juhi	Analysis and Partial Differential Equations
	Kim, Hyeongsin	Number Theory
	Kim, Minhyong	Arithmetic Geometry
	Lee, Kyungyong	Algebra, Combinatorics, Data Science, and Mathematical Physics
	Oh, Hee	Dynamical Systems
	Reid, Alan	Hyperbolic Manifolds, Geometric Group Theory and Low-Dimensional Topology
Research Fellow	Nyberg Brodda, Carl-Fredrik	Algebraic Geometry
	Chen, Hsin-Ku	Algebraic Geometry
	Chen, Yen-An	Algebraic Geometry
	Choe, Junho	Algebraic Geometry
	Choi, Do Young	Secant Variety, Hilbert Scheme
	Choi, Inhyeok	Geometric Group Theory
	Choi, Jae-Hwan	Probability, Pde
	Escayola Acosta, Maximiliano Nelson	Dynamical Systems
	Genz, Volker	Mathematical Physics
	Han, Jiyoung	Partial Differential Equations
	Han, Jong In	Algebraic Geometry
	Huang, Jiuzhou	Algebraic Combinatorics
	Hwang, Byung-Hak	Algebraic Combinatorics
	Jang, Hyeontae	Toric Topology
	Ji, Yong-Gwan	Spectral Analysis, Pdes
	Jung, Hong Taek	Geometric Topology
	Kim, Joonhee	Model Theory
	Kim, Minkyu	Algebraic Topology
	Kim, Tae Gyu	Partial Differential Equations
	Kim, Taehyeong	Homogeneous Dynamics
	Lee, Jaehoon	Differential Geometry
	Lee, Juho	Differential Geometry
	Lee, Juyoung	Harmonic Analysis
	Lee, Sanghoon	Differential Geometry
	Lee, Sangjin	Symplectic Topology
	Lee, Se-Chan	Partial Differential Equations
	Lee, Sin-Myung	Representation Theory
Research Fellow	Lee, Youngmin	Number Theory
	Moon, Hyunsuk	Algebraic Geometry
	Park, Hyangdong	Partial Differential Equations
	Rasul, Parvez	Algebraic Geometry
	Rogozinnikov, Eugen	Higher Teichmuller Theory
	Ryu, Junhee	Partial Differential Equations
	Seo, Jinsol	Analysis, Pde
	Seol, Seokbong	Noncommutative Differential Geometry, Higher Structures
	Song, Keong	Partial Differential Equations
	Wang, Zhihao	Skein Theory
	Wen, Yaoxiong	Algebraic Geometry
	Xu, David	Geometric Group Theory
	Yun, Hyungsung	Partial Differential Equations
	Zhu, Minzhe	Algebraic Geometry



Algebraic Geometry

Members of the Korea Institute for Advanced Study (KIAS) Algebraic Geometry group cover a wide range of research areas, including birational geometry, projective geometry, K-stability, Gromov–Witten theory, and Donaldson–Thomas theory.

In 2025, we hosted two international conferences on algebraic geometry:

(1) Hyeonjun Park and Young-Hoon Kiem organized the "Workshop on Moduli Spaces, Virtual Invariants, and Shifted Symplectic Structures 2025" in June, which attracted leading international experts on enumerative geometry and derived algebraic geometry.
(2) In February, In-Kyun Kim co-organized the conference "Affine Geometry and Birational Geometry," fostering interaction between researchers in birational geometry and affine geometry with lectures by Takashi Kishimoto, Masatomo Sawahara, and Atsushi Ito. It provided participants with an opportunity to discuss recent developments and problems of shared interest.

We also hosted two domestic conferences on algebraic geometry in 2025:

(1) In December, Young-Hoon Kiem co-organized the "Symposium in Algebraic Geometry 2025," which brought together experts in algebraic geometry from across Korea to promote collaboration.
(2) In September, In-Kyun Kim co-organized the conference "Algebraic Geometry in Korea," to promote academic exchange among algebraic geometers in Korea. It featured a total of 15 lectures and provided an opportunity for researchers to share recent advances and strengthen collaborations within the Korean algebraic geometry community.

A regular algebraic geometry seminar series was also organized by Jeongseop Kim, Junho Choe, In-Kyun Kim, and Hyeonjun Park, which served as a meeting ground for all members to share new developments.

The individual research activities directed by algebraic geometry group members in 2025 are presented below in alphabetical order.

Yen-An Chen published a paper titled "On toric and toroidal foliations" in *International Mathematics Research Notices*. He also studied slope-unstable Fano manifolds via foliation theory with Ching-Jui Lai and gave a conceptual proof of the classification of all slope-unstable weak del Pezzo surfaces.

Doyoung Choi collaborated with Jin-Hyung Park on two projects: (i) computing the Hilbert polynomial of a secant variety, closely related to the cohomology of symmetric powers of the tautological bundle on the Hilbert scheme; and (ii) a follow-up to their early-2025 joint work investigating singularities and syzygies of the four-secant variety. Despite the singularity of the Hilbert scheme of four points, he carried out the necessary cohomology analyses.

You-Cheng Chou worked on permutation equivariant quantum K-theory and found a closed formula for (non-permutation equivariant) on genus 1 invariants and conjectural formula for permutation equivariant genus 0 invariants. He further computed the relation between quantum K-invariants and Gokakumar-Vafa invariants and proved an integrality conjecture of J. Bryan about the GV invariants.

Jong In Han posted four preprints in 2025 on arXiv on tensors, sums of squares and syzygies, with titles as follows:

(1) Recursive Koszul flattenings of determinant and permanent tensors,
(2) The border rank of the 4 x 4 determinant tensor is twelve,
(3) On quadratic persistence and Pythagoras numbers of totally real projective varieties,
(4) Hierarchical structure of graded Betti numbers in the quadratic strand.

Young-Hoon Kiem published a paper titled "Characteristic polynomials of $\overline{\mathcal{M}}_{0,n}$ and log-concavity" in *Proceedings of London Math Society* and completed two preprints about shifted Lagrange multipliers method (with Hyeonjun Park) and about generalized intersection pairings on moduli spaces of vector bundles over curves (with Chenjiing Bu). He also published a volume "Moduli spaces, virtual invariants and shifted symplectic structures" in the *KIAS Springer* series as the editor. He delivered 11 invited talks in various places including Aarhus, Beijing, Geneva, Rome and Tainan.

In-Kyun Kim published three papers in 2025. First, in joint work with Joonyeong Won, he studied the K-stability of blow-ups of weighted projective planes, and the paper "On K-stability of blow-ups of weighted projective planes" was published in *Proceedings of the Royal Society of Edinburgh*. He also investigated the existence of cylinders in weighted Fano hypersurfaces through projections and unprojections; this work, titled "Cylinders in Weighted Fano Hypersurfaces via Projections and Unprojections," was co-authored with Takashi Kishimoto and Joonyeong Won and published in the *Taiwanese Journal of Mathematics*. In addition, together with Jinhyung Park and Joonyeong Won, he proved the K-polystability of the first secant varieties of rational normal curves, and this result appeared in *International Mathematics Research Notices*. He also completed four preprints. With Dae-Won Lee and Masatomo Sawahara, he studied the rationality and cylindricity of k-forms of singular del Pezzo surfaces. Together with Morihiko Saito, he investigated oscillation indices of oscillatory integrals of real analytic functions and clarified their subtle behavior. In joint work with Takashi Kishimoto and Joonyeong Won, he analyzed automorphism groups and cylindricity of weighted hypersurface Fano threefolds. Finally, with Dae-Won Lee, he studied the K-stability of del Pezzo surfaces with a single quotient singularity.

Hyeonjun Park published a paper titled "Virtual Localization Revisited," written with Dhyan Aranha, Adeel Khan, Aloysha Latyntsev, and Charanya Ravi, in *Advances in Mathematics*. He posted three papers on arXiv. With Young-Hoon Kiem, he wrote "Cosection localization via shifted symplectic geometry," With Adeel Khan, Tasuki Kinjo, and Pavel Safronov, he wrote "Perverse pullbacks" and "Period sheaves via perverse pullbacks." He was invited to deliver 17 presentations at Utrecht, Jussieu, Simons Center, Michigan, Shanghai, Imperial College, Edinburgh, Brin Center, Cambridge, ETH, Academia Sinica, and Tokyo.

Minzhe Zhu mainly worked on the boundedness of polarized log Calabi-Yau fibrations. He submitted one paper titled "Boundedness of polarized log Calabi-Yau fibrations with bounded bases" (with Xiaowei Jiang and Junpeng Jiao). In addition, he gave presentations at several events, including the Workshop on Algebraic Geometry in Yonsei University, and Conference on Algebraic Geometry in Tsinghua Sanya International Mathematics Forum. He also was invited to deliver presentations at Shanghai Jiaotong University and Xiamen University.

Physical Mathematics

The Physical Mathematics group, led by Prof. Hyun Kyu Kim, works on various mathematics topics related to physics, especially quantum aspects of geometry and the topology of low-dimensional manifolds, such as Teichmüller spaces and the higher Teichmüller spaces of surfaces, their cluster variety structures and quantization thereof, skein algebras, mapping class groups, and three-dimensional quantum gravity, as well as quantum algebra topics, such as the structures and representation theory of quantum groups and super quantum groups. Dr. Zhihao Wang joined KIAS in August 2025.

Prof. Hyun Kyu Kim, in the paper "Naturality of SL3 quantum trace maps for surfaces" published in 2025, established an important naturality equation for the SL3 quantum trace maps for surfaces, which had been developed by the author in a previous paper. Only with the result of this work, the previous construction was fully justified for its relevance to the Fock-Goncharov quantum duality conjecture, one of the most prominent research topics in the theory of cluster varieties. Prof. Hyun Kyu Kim completed two preprints "Frobenius homomorphisms for stated SLn-skein modules" and "Monoidal categorification of genus zero skein algebras" in 2025, and put them in the arXiv.

Dr. Sin-Myung Lee studied topics in the theory of q-characters of representations of quantum affine algebras. Dr. Lee proposed fundamental conjectures in this area, which leads to the understanding of the center of the affine vertex superalgebras at the critical level, through Y-algebras.

Dr. Zhihao Wang studied topics related to the skein algebras of surfaces, for various gauge groups. In particular, a large part of Dr. Wang's study was on the case when the quantum parameter q is a root of unity, for which the representation theory became rich. Dr. Wang established fundamental results on the centers of these algebras, which are crucial in the study of representation theory. After moving to KIAS, Dr. Zhihao Wang completed three preprints and posted them on arXiv: "Centers and representations of the SLn quantum Teichmuller spaces," "Centers of stated SL(n) skein algebras: even roots of unity," and "Quantum cluster realization for projected stated SLn-skein algebras."

Members of the Physical Mathematics group were also invited to give talks at international conferences and seminars. Prof. Hyun Kyu Kim was invited to give a talk at the conference New Trends in Teichmüller Theory held by ICTS in Bangalore, India. Prof. Kim was also invited to give a talk at the conference Representations of Quivers in Mathematics and String Theory held by the Institute of Basic Science (IBS) Center for Geometry and Physics, Pohang, Korea, as well as at the conference Quantum Groups, Monoidal Categorification and Related Topics held by the Center for Quantum Structures in Modules and Spaces at Jeju, Korea. Prof. Kim was also invited to give talks at seminars at institutes, including the University of Connecticut, Storrs, CT, USA, The University of Alabama, Tuscaloosa, AL, USA, Yau Mathematical Sciences Center, Beijing, China, and Yonsei University, Seoul, Korea. Dr. Sin-Myung Lee was invited to give a talk at the international conference Quantum Groups, Monoidal Categorification and Related Topics held by the Center for Quantum Structures in Modules and Spaces at Jeju, Korea, and to speak at seminars at Seoul National University and POSTECH. Dr. Zhihao Wang was invited to make a presentation at the Topology Workshop in the east China region, and in the special session "Physical Mathematics" at the 2025 Fall KMS Meeting.

Prof. Hyun Kyu Kim has organized the semi-regular seminar Geometry, Algebra and Physics Seminar at KIAS. Prof. Kim has uploaded some presentations to the YouTube channel for this seminar and has made them available to the public.

Prof. Hyun Kyu Kim organized the special session "Physical Mathematics" at the 2025 Fall KMS Meeting, as well as the KIAS Math-HCMC Workshop.

Differential Geometry & Analysis

The KIAS Differential Geometry and Analysis group consists of Professor Jinsung Park, Professor Kyeongsu Choi, Dr. Jaehoon Lee, Dr. Sanghoon Lee, Dr. Taehun Lee, Dr. Sewook Oh, Dr. Jaehyeon Ryu, and Dr. Jiuzhou Huang. The research group focuses on mathematical physics in terms of analytic aspect, geometric flows, minimal surfaces, Yang-Mills theory, and maximal functions on hypersurfaces.

Prof. Kyeongsu Choi classified every ancient noncollapsed mean curvature flow in Euclidean four-space, which provides the full list of possible singularities of noncollapsed mean curvature flow. He also proved the uniqueness of tangent flows at infinity for the curvature shortening flow with finite-entropy, which is the first result for geometric flows handling backward limits with multiplicity. Furthermore, he characterized every translating surface using the sub-affine-critical powers of the Gauss curvature.

Prof. Jinsung Park worked on the energy of generalized Gauss maps from the maximal disc in the Anti de Sitter three-space, whose boundary is given by the graph of quasisymmetric homeomorphism on the circle. In particular, it was proved that this energy is related to the Liouville action of the quasisymmetric homeomorphism under the Weil-Petersson class condition.

Dr. Jaehoon Lee mainly focused on research conducted jointly with Dr. Eungbeom Yeon on desingularizing a two-dimensional plane passing through the waist circle of a Lagrangian catenoid in R^4, similar to the Costa-Hoffman-Meeks surface in Euclidean three-space. A preprint is currently in preparation. From August 25 to December 16, Dr. Lee visited Stanford University as part of a KIAS overseas short-term research program for research collaboration.

Dr. Sanghoon Lee, in collaboration with Jaehwan Kim, proved the existence of an infinite-dimensional family of solutions to the Yang-Mills flow that converge to the SO(n)-equivariant homothetically shrinking soliton constructed by Weinkove. Additionally, in joint work with Fang Wang, he established a rigidity theorem for Poincaré-Einstein manifolds, demonstrating that the standard upper half-plane model of hyperbolic space is the only Poincaré-Einstein manifold close to itself in a certain sense.

Together with Prof. Kyeongsu Choi, Dr. Taehun Lee and Dr. Jiuzhou Huang constructed an I-family of ancient graphical mean curvature flows over minimal hypersurfaces with finite total curvature. These solutions exhibit rich geometric properties, including finite total curvature, finite mass drop, and, in one family, mean convexity.



Dr. Sewook Oh established the boundedness of the maximal operator associated with averages over hypersurfaces for all finite-type hypersurfaces. He also resolved the problem of obtaining optimal maximal bounds for hypersurfaces with a Fourier decay rate of one-half.

Together with Prof. Andreas Seeger, Dr. Jaehyeon Ryu established a boundedness result for maximal averages over a tilted sphere on a two-step nilpotent Lie group. This result demonstrates a striking phenomenon that the maximal average behaves completely differently from that over a non-tilted sphere in terms of its boundedness.

PDE & Probability

The KIAS PDE and Probability group consists of Professor Nam-Gyu Kang, Professor Sung-Jin Oh, Professor Joonhyun La, Dr. Jung-Kyoung Lee, Dr. Hyangdong Park, Dr. Jinsol Seo, Dr. Junhee Ryu, Dr. Jae-Hwan Choi, Dr. Taegyu Kim, Dr. Se-Chan Lee, and Dr. Wontae Kim. The research group focuses on various problems in PDE and Probability. Within PDEs, the group studies a wide range of topics, including regularity theory of elliptic and parabolic PDEs, fluid dynamics, dispersive PDEs, wave turbulence theory, quasilinear wave equations and general relativity. Also, the group focuses on various topics in probability, including but not limited to Coulomb gases.

■ Research works

With Byun, Seo, and Yang, Prof. Nam-Gyu Kang considered two-dimensional Coulomb gases on the Riemann sphere with determinantal or Pfaffian structures, under external potentials that are invariant under rotations around the axis connecting a magnetic dipole, and with microscopic point charges inserted at a pair of such poles. These models can be interpreted as Coulomb gases on the complex plane with weakly confining potentials, where the associated droplet is the entire complex plane. For these models, they derived precise asymptotic expansions of the free energies, including the constant terms.

With Luk and Yu, Prof. Sung-Jin Oh studied late-time tails for quasi-linear wave equations satisfying weak null conditions, in connection with the Price law of decay in general relativity. In particular they provided a complete description of the global asymptotics of scalar quasilinear wave equation toward the future time in the small data regime.

With Germain and Menegaki, Prof. Joonhyun La studied kinetic wave equation derived from a one-dimensional chain of weakly anharmonic potential. The kinetic wave approach provides a new insight in understanding Fermi-Pasta-Ulam-Tsingou experiment, which deeply motivated various areas in theoretical physics and equidistribution of energy in Hamiltonian systems.

From April 7 to April 11, 2025, Prof. Nam-Gyu Kang, together with Professor Nicola Arcozzi (University of Bologna), Professor Ilia Binder (University of Toronto), Professor Alexei Poltoratski (University of Wisconsin-Madison), and Professor Stanislav Smirnov (Université de Genève), organized the conference Complex Faces in Venice. The conference addressed various topics in complex analysis that have had significant influence across several areas of mathematics, including harmonic analysis, functional analysis, probability theory, and mathematical physics. Among the speakers were ICM plenary lecturers Professor Mikhail Lyubich and Professor Greg Lawler, who delivered presentations titled “Mirrors of Conformal Dynamics: Julia Sets, Kleinian Groups, Schwarz Reflections, and Correspondences” and “Exploring a Paper of Kang and Makarov,” respectively. In total, 21 speakers presented on a broad range of topics in complex analysis, including Epstein’s construction and the holography of Loewner energy and Schwarzian action, Free energy of constrained planar Coulomb gases, Weil-Petersson curves, traveling salesman theorems and minimal surfaces, metrics on non-simple conformal loop ensemble gaskets, and random walk reflected off infinity.



The conference Universality, Nonlinearity, and Integrability - In Honor of Percy Deift was held at the Korea Institute for Advanced Study (KIAS) from May 12 to 16, 2025, with the aim of exploring the intersection of universality, nonlinearity, and integrability. These interconnected fields have provided a dynamic and rich foundation that promotes mutual progress, leading to many exciting new developments. The conference featured presentations on a variety of topics, including random matrix theory, integrable nonlinear partial differential equations, and KPZ theory. In addition, several presentations at the event highlighted and celebrated Percy Deift’s many contributions to these areas.

From June 10 to June 13, Prof. Joonhyun La, together with Myoungjean Bae, Mikhail Feldman, Hyangdong Park, and Wei Xiang, organized the conference The Future of PDEs: Interdisciplinary Connections Through Generations at KIAS. The conference addressed various topics in mathematical fluid dynamics, in both compressible fluid dynamics and incompressible fluid dynamics.

Topology

KIAS topology group consists of Professor Inkang Kim, Professor Sanghyun Kim, Dr. Inhyeok Choi, Dr. Eugen Rogozinnikov, Dr. Hongtaek Jung, Dr. David Xu, Dr. Carl-Fredrik Nyberg-Brodda.

Inkang Kim published a paper titled “Curvature of new Kähler metrics on the total space of Griffiths negative vector bundle and quasi-Fuchsian space” proving the existence of a mapping class group invariant Kahler metric on the space of Griffiths negative vector bundle, including the quasi-Fuchsian space, the space of convex real projective structures on surface, the space of complex projective structures on surface, and all holomorphic bundles whose fibers are at least cubic or higher holomorphic forms as important examples.

He also proved that a non-positively curved, non-zero Euler number closed four-manifold has a positive Gromov simplicial volume, settling a long-standing conjecture of Gromov for dimension 4 (to appear in

Duke Math J). He also worked on counting the number of connected components of relative character variety of representations from a fundamental group of a bordered surface into SL(2,R) with special holonomy conditions on the boundary, generalizing the work of W. Goldman, using the machinery of Atiyh-Singer signature theory.

Sang-hyun Kim, with Thomas Koberda and Javier de la Nuez-Gonzalez, published the paper "First order rigidity of homeomorphism groups of manifolds" in *Comm. Amer. Math. Soc.* 5 (2025), which is the only Diamond Open Access online journal by the American Mathematical Society. He proved in this paper that every compact connected manifold M admits a purely group theoretic first order sentence "I-am-M" in its homeomorphism group.

He also, with Nicolás Matte Bon, Mikael de la Salle and Michele Triestino, published "Subexponential growth and C1 actions on one-manifolds" in *International Mathematics Research Notices*, Volume 2025. He proved that if a countable group does not contain a finitely generated subgroup of exponential growth, then every topological action of the group on a compact connected one-manifold can be blown-up to a C1 action.

Sang-hyun Kim published, with Nhat Minh Doan, Mong Lung Lang, Ser Peow Tan, the paper "Optimal independent generating system for the congruence subgroups $\Gamma_0(p)$ and $\Gamma_0(pq)$" in *The Journal of Geometric Analysis* (2025).

Inhyeok Choi published a paper titled "Counting pseudo-Anosovs as weakly contracting isometries" in *Inventiones Mathematicae*, Vol. 242 (2025). In this paper, he proved that in every Cayley graph of the mapping class group of finite-type hyperbolic surface, the density of pseudo-Anosovs in a metric ball converges to 1 as the radius of the ball increases. He proved a similar result for rank-1 CAT(0) groups and hierarchically hyperbolic groups.

He also published a paper titled "Random walks and contracting elements II: Translation length and quasi-isometric embedding" in *Groups, Geometry, and Dynamics*, Vol. 19, No. 4 (2025). In this paper, he proved the strong law of large numbers and central limit theorem for translation lengths of random elements arising from random walks on the mapping class groups and hierarchically hyperbolic groups.

Eugen Rogozinnikov completed, with collaborators, the monograph Spectral Networks: Bridging Higher-Rank Teichmüller Theory and BPS States, presenting spectral networks as a framework linking higher-rank Teichmüller theory, character varieties, and BPS states in supersymmetric gauge theory. He also completed two papers: one develops symplectic groups over Lie subgroups of involutive algebras and associated geometric objects such as isotropic configurations and symmetric-space models, with particular emphasis on realizing classical groups, including the spin groups Spin(m,n), within this framework. The other studies geometric and Lie-theoretic aspects of symplectic and orthogonal groups over involutive algebras, including symmetric-space models and applications to Higgs bundles and reductive representations of surface groups. Further, he continued work on a quaternionic approach to Sp(2n,C)-Higgs bundles and on extending the Anosov property to surface-group representations into infinite-dimensional Lie groups of finite rank.

Hongtaek Jung showed that if a sequence of measured laminations converges weakly, then the associated sequence of cataclysm deformations also converges on compact sets. As an application, he proved that the set of strongly dense G-Hitchin representations is not open when the longest element in the Weyl group of G is -1. He also showed, in collaboration with Hyungryul Baik and KyeongRo Kim, that if a subgroup G acting on a circle preserves a veering pair of laminations, then it must admit a convergence action on a two-sphere. If the action of G on the circle is cofinite, he further proves that the induced action on the two-sphere is geometrically finite.

David Xu, with François Fillastre and Yusen Long, completed a preprint "An explicit exotic representation of a rank-one simple Lie group via convex bodies." In this paper, he produces a continuous and irreducible representation of the isometry group of the hyperbolic plane into the isometry group of the infinite-dimensional hyperbolic



space using the hyperbolic model for convex bodies in the Euclidean plane. He explicitly detailed the relation with the family of exotic representations introduced by Monod and Py and described some geometric properties of this representation.

He also worked on a generalization of Kazhdan's property (T) to inverse semigroups with Carl-Fredrik Nyberg-Brodda, and on Anosov and maximal representations in infinite dimension and finite rank with Eugen Rogozinnikov and Clarence Kineider.

Carl-Fredrik Nyberg-Brodda published the paper with Robert D. Gray, "Membership problems in braid groups and Artin groups" (*Journal of the London Mathematical Society* (2) 112, no. 4 (2025), 22 pp.) giving a complete classification of when the submonoid resp. rational subset membership problem is decidable in a given Artin group. In particular, they showed that the submonoid membership problem is undecidable in the four-strand braid group, answering a question posed by Potapov in 2013. He also, with Mark Kambites, Nóra Szakács, and Richard Webb, published an article "The growth of free inverse monoids" (*Journal of the Mathematical Institute of Jussieu*, to appear) computing the exponential growth rate of free inverse monoids.

Sang-hyun Kim, Sanghoon Kwak, Carl-Fredrik Nyberg-Brodda, Eugen Rogozinnikov, and David Xu organized the conference Mapping Class Groups at KIAS.

Visiting Scientists

Abe, Ken
Osaka Metropolitan Univ.

Abo, Hirotachi
Univ. of Idaho

Ahn, JinHoo
Changwon Nat'l Univ.

Bae, Myoungjean
KAIST

Bae, Hanwool
Center for Quantum Structures in Modules and Spaces, Seoul Nat'l Univ.

Bae, Youngjin
Incheon Nat'l Univ.

Bridson, Martin
Univ. of Oxford

Bu, Chenjing
Univ. of Oxford

Byun, Sungsoo
Seoul Nat'l Univ.

Calegari, Danny
Univ. of Chicago

Choi, Jinwon
Sookmyung Women's Univ.

Choi, Wonseok
DGIST

Chung, Kiryong
Kyungpook Nat'l Univ.

Chung, Tai-Hsuan
Nat'l Cheng Kung Univ.

Davison, Ben
The Univ. of Edinburgh

Eom, Junyong
Sungshin Women's Univ.

Escayola, Maximiliano
Univ. of Santiago, Chile

Fukushima, Shota
Gunma Univ.

Gim, Minjung
Nat'l Institute for Mathematical Sciences

Han, Jeongmin
Soongsil Univ.

Han, Kangjin
DGIST

Heo, Jaeseong
Hanyang Univ.

Higgins, Vijay
UCLA

Jang, Seunguk
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Jang, Wonyong
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Sogang Univ.

Jwa, Dongwook
Chungbuk Nat'l Univ.

Kang, Jaehoon
Hankyong Nat'l Univ.

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Kim, Minhyun
Hanyang Univ.

Kim, Takwon
Sungshin Women's Univ., Division of Mathematical Statistics and Data Science

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Pusan Nat'l Univ.

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Massachusetts Institute of Technology

Ko, Seungchan
Inha Univ.

Koberda, Thomas
Univ. of Virginia

Kricker, Andrew
Nanyang Technological Univ.

Kwon, Yongjae
Inha Univ.

Kwong, Kwok-Kun
Univ. of Wollongong

Lai, Ching-Jui
Nat'l Cheng Kung Univ.

Le, Khanh
Rice Univ.

Lee, Jinyeop
Univ. of British Columbia

Lee, Donggun
IBS-CCG

Lee, Jihyeon
IBS-CGP

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Lee, Sanghoon
The Chinese Univ. of Hong Kong

Lee, Seung-Yeop
Univ. of South Florida

Lee, Taehun
Konkuk Univ.

Lee, Youngkyu
Brown Univ.

Long, Yusen
Université Paris-Est Créteil

Makar-Limanov, Leonid
Wayne State Univ.

Marchand, Alexis
Kyoto Univ.

Martinez, Consuelo
Univ. of Oviedo

Masai, Hidetoshi
Musashino Art Univ.

Mimura, Masato
Tohoku Univ.

Minsky, Yair
Yale Univ.

Nam, Kyeongsik
KAIST

Oh, Jeongtae
Seoul Nat'l Univ.

Ohshika, Kenichi
Gakushuin Univ.

Okamura, Fumiya
Chuo Univ. (中央大学)

Oyakawa, Koichi
McGill Univ.

Park, Daehan
Kangwon Nat'l Univ.

Park, Jaemin
Yonsei Univ.

Park, Jinyoung
Courant Institute, NYU

Park, Sangwoo
Pusan Nat'l Univ.

Park, Sungwoo
Korea Univ.

Ryoo, Seung-Yeon
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Seo, Seong-Mi
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Spolaor, Luca
Univ. of California San Diego

Stoimenow, Alexander
Dongguk Univ.

Sturmfels, Bernd
Max Planck Institute for Mathematics

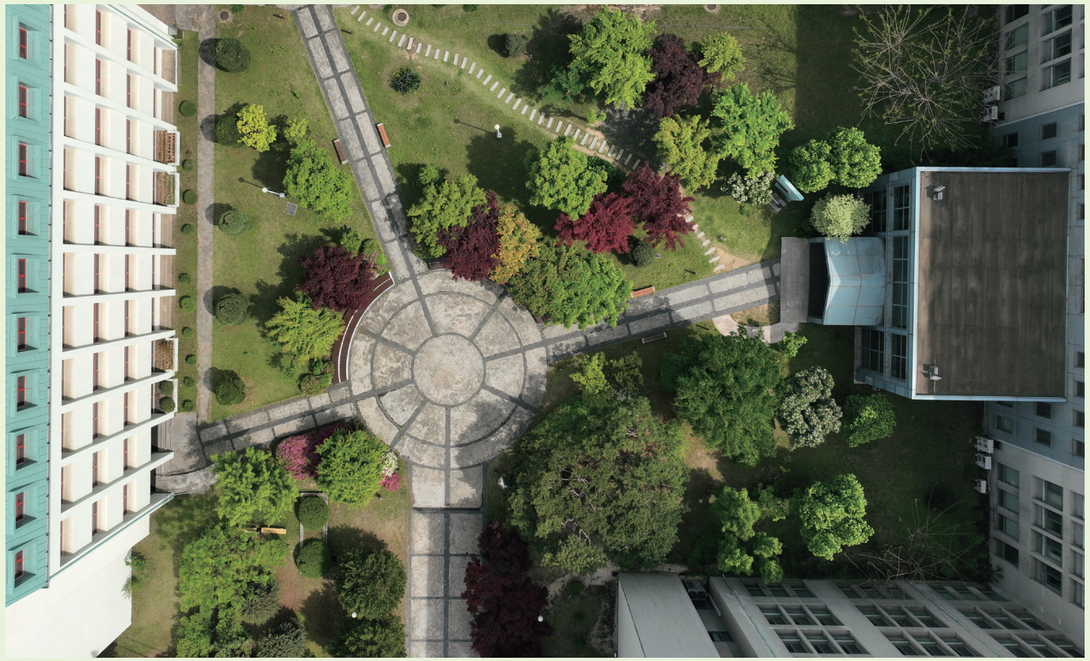
Wen, Xueqing
Chongqing Univ. of Technology

Wilkinson, Amie
Univ. of Chicago

Xu, Guangbo
Rutgers Univ.

Xu, Ping
Pennsylvania State Univ.

Conferences and Workshops



Geometry and Dynamics in Low Dimensions
Jan. 6 – Jan. 10

The 20th KIAS Winter School on Geometry
Jan. 19 – Jan. 24

KIAS Mathematics Colloquium: By Richard Schwarts
Mar. 12 – Mar. 12

2025 KMS Spring Meeting
Apr. 24 – Apr. 26

The 19th Korean Women in Mathematical Sciences
Jun. 30 – Jul. 1

2025 2K-GATE One day Geometric Topology Festival
Aug. 29

Dynamical Group Theory VI
Sep. 18

2025 KMS Autumn Meeting
Oct. 22 – Oct. 24

KIAS Math-HCMC Fall Workshop 2025
Nov. 19 – Nov. 21

Dynamical Group Theory VII
Nov. 26 – Nov. 28

The 9th KIAS Alumni Workshop in Mathematics
Dec. 19

Symposium in Algebraic Geometry 2025
Dec. 21 – Dec. 23

Publications

Catanese, Fabrizio
Manifolds with trivial Chern classes I: hyperelliptic manifolds and a question by Severi • ANNALI DELLA SCUOLA NORMALE SUPERIORE DI PISA-CLASSE DI SCIENZE

Escobedo, Miguel; Germain, Pierre; **La, Joonhyun**; Menegaki, Angeliki
Entropy maximizers for kinetic wave equations set on tori • BULLETIN OF THE LONDON MATHEMATICAL SOCIETY

Catanese, Fabrizio; Frapporti, Davide; Gleissner, Christian; Liu, Wenfei; Schuett, Matthias
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Kim, Kihyun; Kwon, Soonsik; **Oh, Sung-Jin**
SOLITON RESOLUTION FOR EQUIVARIANT SELF-DUAL CHERN-SIMONS-SCHRODINGER EQUATION IN WEIGHTED SOBOLEV CLASS • AMERICAN JOURNAL OF MATHEMATICS

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Band width estimates of CMC initial data sets • COMMUNICATIONS IN ANALYSIS AND GEOMETRY

Choi, Jae-Hwan; Kim, Ildoo; Lee, Jin Bong
A Regularity Theory for an Initial Value Problem with a Time-measurable Pseudo-differential Operator in a Weighted Lp-space • POTENTIAL ANALYSIS

Lee, Se-Chan
Nonlocal Harnack inequality in a disconnected region • MATHEMATICS IN ENGINEERING

Choi, Beomjun; **Choi, Kyeongsu**; Kim, Soojung
Continuous family of surfaces translating by powers of Gauss curvature • ADVANCES IN MATHEMATICS

Das, Shamik; **Lee, Yoonjin**
Quantitative Bounds on the Number of Non-Congruent Numbers of the form 2PQ • RESULTS IN MATHEMATICS

Bae, Hanwool; Cho, Cheol-Hyun; **Choa, Dongwook**; Jeong, Wonbo
Floer theory for the variation operator of an isolated singularity • JOURNAL OF TOPOLOGY

Choi, Jinwon; **Kiem, Young-hoon**; Lee, Donggun
Characteristic polynomial of $\overline{\mathcal{M}}_{0,n}$ and log-concavity • PROCEEDINGS OF THE LONDON MATHEMATICAL SOCIETY

Won, Byung-Sun; Kim, Jon-Lark; **Lee, Yoonjin**
Modified genetic algorithms for constructing new quaternary hermitian LCD codes • APPLIED SOFT COMPUTING

Karabas, Dogancan; **Lee, Sangjin**
The wrapped Fukaya category of plumbings • JOURNAL OF SYMPLECTIC GEOMETRY

Chlebicka, Iwona; **Song, Kyeong**; Youn, Yeonghun; Zatorska-goldstein, Anna
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Jang, Juhi; Liu, Jiaqi; Masmoudi, Nader
Waiting time solutions in gas dynamics • JOURNAL DE MATHEMATIQUES PURES ET APPLIQUEES

Kim, Jongmyeong; **Lee, Se-Chan**
Regularity for solutions of non-uniformly elliptic equations in non-divergence form • REVISTA MATEMATICA IBEROAMERICANA

Chung, Kiryong; Kim, Jaehyun; **Kim, Jeong-Seop**
Rational quartic curves in the Mukai-Umemura variety • JOURNAL OF PURE AND APPLIED ALGEBRA

Cascini, Paolo; **Catanese, Fabrizio**; Chen, Yifan; **Keum, JongHae**
MORI DREAM SPACES AND Q-HOMOLOGY QUADRICS • PACIFIC JOURNAL OF MATHEMATICS

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Weighted p-harmonic 1-forms on f-minimal hypersurfaces in smooth metric measure spaces • INTERNATIONAL JOURNAL OF MATHEMATICS

Byun, Sung-Soo; **Kang, Nam-Gyu**; Seo, Seong-Mi; Yang, Meng
Free energy of spherical Coulomb gases with point charges • JOURNAL OF THE LONDON MATHEMATICAL SOCIETY-SECOND SERIES

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Equidistribution of the eigenvalues of Hecke operators • MATHEMATISCHE NACHRICHTEN

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Choi, Jae-Hwan; Kim, Ildoo
An existence and uniqueness result to evolution equations with sign-changing pseudo-differential operators and its applications to logarithmic Laplacian operators and second-order differential operators without ellipticity • JOURNAL OF PSEUDO-DIFFERENTIAL OPERATORS AND APPLICATIONS

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Counting pseudo-Anosovs as weakly contracting isometries • INVENTIONES MATHEMATICAE

Lee, Sanghoon
Liouville-type theorems on the hyperbolic space • CALCULUS OF VARIATIONS AND PARTIAL DIFFERENTIAL EQUATIONS

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Global Calderón-Zygmund estimates for parabolic quasiminimizers • BULLETIN OF THE LONDON MATHEMATICAL SOCIETY

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HOLDER REGULARITY OF WEAK SOLUTIONS TO NONLOCAL p-LAPLACIAN TYPE SCHRODINGER EQUATIONS WITH Ap1-MUCKENHOUPT POTENTIALS • ELECTRONIC JOURNAL OF DIFFERENTIAL EQUATIONS

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Weighted Sobolev space theory for non-local elliptic and parabolic equations with nonzero exterior condition on C1, 1 open sets • JOURNAL OF EVOLUTION EQUATIONS

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On Existence of Sadovskii Vortex Patch: A Touching Pair of Symmetric Counter-Rotating Uniform Vortices • ANNALS OF PDE

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Kim, Daehwan; Park, Sung-ho
A MINIMAL SURFACE FOLIATED BY CIRCLES OR GEODESICS IN dS3 AND H3 • BULLETIN OF THE KOREAN MATHEMATICAL SOCIETY

Choi, Dohoon; **Lee, Youngmin**
Newman's conjecture for the partition function modulo integers with at least two distinct prime divisors • ADVANCES IN MATHEMATICS

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Monge-Ampère equations with right-hand sides of polynomial growth • NONLINEAR ANALYSIS-THEORY METHODS & APPLICATIONS

Dung, Nguyen Thac; **Pyo, Juncheol**; Tuyen, Nguyen Dang
Vanishing results on weighted manifolds with lower bounds of the curvature operator • NONLINEAR ANALYSIS-THEORY METHODS & APPLICATIONS

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The elliptic maximal function • JOURNAL OF FUNCTIONAL ANALYSIS

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Lp maximal bounds and Sobolev regularity of two-parameter averages over tori • ADVANCES IN MATHEMATICS

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Burcroff, Amanda; **Lee, Kyungyong**; Mou, Lang
Scattering diagrams, tight gradings, and generalized positivity • PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA

Hwang, Byung-Hak; Jang, Jihyeug; Kim, Jang Soo; Song, Minho; Song, U-Keun
Refined canonical stable Grothendieck polynomials and their duals, Part 2 • EUROPEAN JOURNAL OF COMBINATORICS

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Wellposedness of the Electron MHD Without Resistivity for Large Perturbations of the Uniform Magnetic Field • ANNALS OF PDE

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Preservation of NATP • JOURNAL OF MATHEMATICAL LOGIC

Kim, Hosung; **Kim, Jeong-seop**; Lee, Yongnam
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Jeon, Daeyeol; Kang, Soon-Yi; Kim, Chang Heon; Matsusaka, Toshiki
A unified approach to Rohrlich-type divisor sums • RESEARCH IN THE MATHEMATICAL SCIENCES

Choe, Jaigyoung
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Lee, Sanghun; Park, Sangwoo; **Pyo, Juncheol**
Capillary Stable Minimal Hypersurfaces in a High Dimensional Riemannian Manifold • JOURNAL OF GEOMETRIC ANALYSIS

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On Self-Similar Converging Shock Waves • ARCHIVE FOR RATIONAL MECHANICS AND ANALYSIS

Kineider, Clarence; **Rogozinnikov, Eugen**
On partial abelianization of framed local systems • MATHEMATISCHE ANNALEN

Choi, Kyeongsu; Seo, Dong-Hwi; Su, Wei-Bo; Zhao, Kai-Wei
Uniqueness of Tangent Flows at Infinity for Finite-Entropy Shortening Curves • GEOMETRIC AND FUNCTIONAL ANALYSIS

Jang, Juhi; Liu, Jiaqi; Schrecker, Matthew
CONVERGING/DIVERGING SELF-SIMILAR SHOCK WAVES: FROM COLLAPSE TO REFLECTION • SIAM JOURNAL ON MATHEMATICAL ANALYSIS

Catanese, Fabrizio
Manifolds with Trivial Chern Classes II: Manifolds Isogenous to a Torus Product, Coframed Manifolds and a Question by Baldassarri • INTERNATIONAL MATHEMATICS RESEARCH NOTICES

Chae, Dongho; **Jeong, In-Jee**; Na, Jungkyoung; **Oh, Sung-Jin**
Well-Posedness for Ohkitani Model and Long-Time Existence for Surface Quasi-geostrophic Equations • COMMUNICATIONS IN MATHEMATICAL PHYSICS

Jia, Jia; **Meng, Sheng**
Moishezon manifolds with no nef and big classes • PROCEEDINGS OF THE EDINBURGH MATHEMATICAL SOCIETY

Hadiji, Rejeb; **Han, Jongmin**; Sohn, Juhee
Quantization effects for multi-component Ginzburg-Landau vortices • ADVANCED NONLINEAR STUDIES

Choi, Kyeongsu; Sun, Liming
Classification of ancient flows by sub-affine-critical powers of curvature in R2 • JOURNAL OF FUNCTIONAL ANALYSIS

Kobayashi, Kei; **Park, Hyunchul**
Heat content for Gaussian processes: Small-time asymptotic analysis • BERNOULLI

Priddis, Nathan; Shoemaker, Mark; **Wen, Yaoxiong**
Wall Crossing and the Fourier-Mukai Transform for Grassmann Flops • SYMMETRY INTEGRABILITY AND GEOMETRY-METHODS AND APPLICATIONS

Gu, Wei; Guo, Jirui; Mihalcea, Leonardo; **Wen, Yaoxiong**; Yan, Xiaohan
A correspondence between the quantum K theory and quantum cohomology of Grassmannians • JOURNAL OF GEOMETRY AND PHYSICS

Cho, Sangbum; Lee, Jung Hoon
The separating disk complex for a handlebody • TOPOLOGY AND ITS APPLICATIONS

Catanese, Fabrizio
General birationality and hyperelliptic theta divisors • ANNALI DI MATEMATICA PURA ED APPLICATA

Lee, Juyoung; Lee, Sanghyuk; **Oh, Sewook**
Lp BOUND ON THE STRONG SPHERICAL MAXIMAL FUNCTION • PROCEEDINGS OF THE AMERICAN MATHEMATICAL SOCIETY

Choe, Junho
Castelnuovo-Mumford Regularity of Unprojections and the Eisenbud-Goto Regularity Conjecture • INTERNATIONAL MATHEMATICS RESEARCH NOTICES

Fukushima, Shota; **Ji, Yong-Gwan**; Kang, Hyeonbae; Li, Xiaofei
Finiteness of the stress in presence of closely located inclusions with imperfect bonding • MATHEMATISCHE ANNALEN

Kim, Inkang; Wan, Xueyuan
Harmonic maps between surfaces homotopic to a (branched) covering map • MATHEMATISCHE ZEITSCHRIFT

Song, Kyeong
Gradient estimates for irregular obstacle problems with measure data • JOURNAL OF MATHEMATICAL ANALYSIS AND APPLICATIONS

Jeong, In-Jee; Kim, Junha; Yao, Yao
ON WELL-POSEDNESS OF α-SQG EQUATIONS IN THE HALF-PLANE • TRANSACTIONS OF THE AMERICAN MATHEMATICAL SOCIETY

Germain, Pierre; **La, Joonhyun**; Zhang, Katherine Zhiyuan
Local Well-posedness for the Kinetic MMT Model • COMMUNICATIONS IN MATHEMATICAL PHYSICS

Lee, Sanghoon
Some uniformization problems for a fourth order conformal curvature • JOURNAL OF FUNCTIONAL ANALYSIS

Kim, Inkang; Wan, Xueyuan; Zhang, Genkai
Curvature of new Kähler metrics on the total space of Griffiths negative vector bundle and quasi-Fuchsian space • COMMUNICATIONS IN CONTEMPORARY MATHEMATICS

Han, Jiyoung; Lim, Seonhee; Mallahi-Karai, Keivan
Asymptotic distribution for pairs of linear and quadratic forms at integral vectors • ERGODIC THEORY AND DYNAMICAL SYSTEMS

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Noncommutative symmetric functions and skewing operators • DISCRETE MATHEMATICS

Byun, Sun-Sig; Lee, Ho-Sik; **Song, Kyeong**
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Turing Instability and Dynamic Bifurcation for the One-Dimensional Gray-Scott Model • STUDIES IN APPLIED MATHEMATICS

Lee, Jaehoon; Yeon, Eungbeom
Frankel's property for free boundary minimal hypersurfaces in the Riemannian Schwarzschild manifolds • CALCULUS OF VARIATIONS AND PARTIAL DIFFERENTIAL EQUATIONS

Lee, Ki-Ahm; **Yun, Hyungsung**
Boundary regularity for viscosity solutions of fully nonlinear degenerate/singular parabolic equations • CALCULUS OF VARIATIONS AND PARTIAL DIFFERENTIAL EQUATIONS

Park, Hyangdong
Transonic shocks for three-dimensional axisymmetric flows in divergent nozzles • JOURNAL OF MATHEMATICAL ANALYSIS AND APPLICATIONS

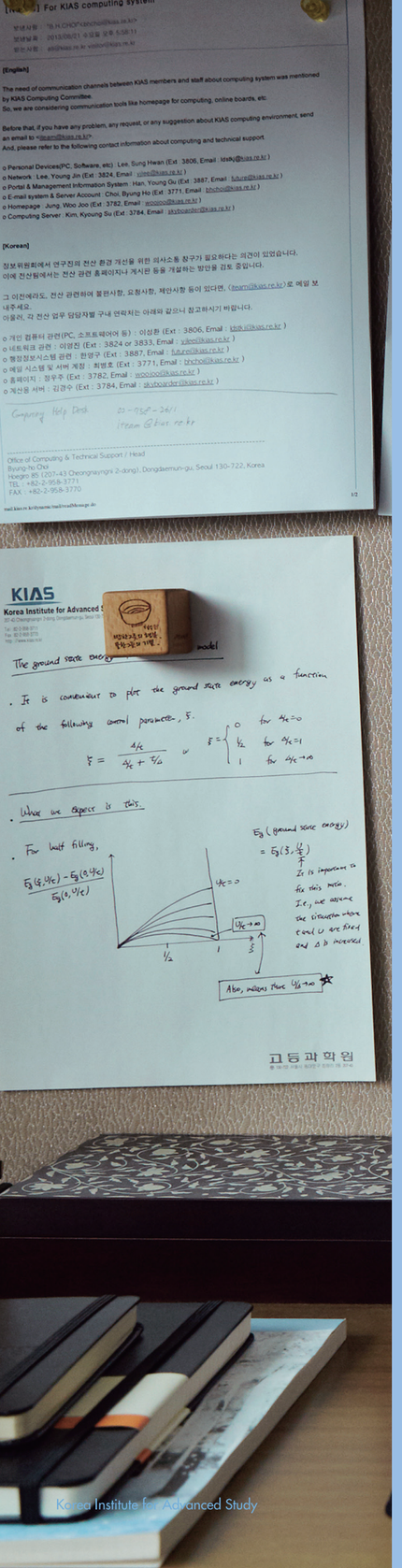




School of Physics

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Faculty and Research Fellows
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Over the last two centuries, the world has witnessed great improvements in the quality of life, many of which have been driven by accomplishments in the natural sciences, and physics in particular. Discoveries in physics have led to advancements in all fields of science and to the development of new technologies that have dramatically transformed the modern world. It is difficult to envision our technology-driven world without modern physics, from the significant paradigm shifts brought about by the theory of relativity and quantum mechanics to the invention of semiconductors. The Korea Institute for Advanced Study (KIAS) aspires to serve as a source of fundamental knowledge that will play a pivotal role in advancing human civilization. With this aim, the School of Physics conducts research in a broad range of areas of theoretical physics, including string theory, field theory, particle physics, statistical physics, condensed matter physics, astrophysics, and cosmology.

Faculty and Research Fellows

Position	Name	Research Interest
Distinguished Professor	Mukhanov, Viatcheslav	Theoretical Physics, Cosmology
Professor Emeritus	Lee, Kimyeong	Theoretical Physics
Professor	Chun, Eung Jin	Particle Physics
	Jeong, Donghui	Astrophysics
	Kim, Yong Baek	Condensed Matter Physics
	Ko, Pyungwon	Theoretical High Energy Physics
	Lee, Jae Sung	Statistical Physics
	Lee, Seung Joon	Particle Physics
	Lee, Sungjay	String Theory, Quantum Field Theory
	Park, Changbom	Astrophysics, Cosmology
	Park, Kwon	Condensed Matter Physics, Strongly Correlated Electron Systems
	Yi, Piljin	String Theory
KIAS Scholar	Pomarol, Alex	Theoretical Particle Physics
	Tong, David	Theoretical Physics
	Atsushi Taruya	Astrophysics
KIAS Fellow	Hwang, Kyusung	Condensed Matter Theory
Research Fellow	Lee, Sangyun	Nonequilibrium Statistical Physics
	Kim, Suro	Particle Physics
	Dutka, Tomasz P.	Particle Physics
	Lu, Yongchao	String Theory
	Pal, Priyo Shankar	Statistical Physics
	Mandal, Sanjoy	Particle Physics
	Li, Linfeng	String Theory
	Dupuy, Alexandra	Astrophysics
	Goyal, Priya	Astrophysics
	Kim, Youngjae	Condensed Matter Theory
	Chun, Hyun-Myung	Statistical Physics
	Kawana, Kiyoharu	Particle Physics
	Kim, Sungjoon	Fields and String Theory
	Kim, TaeHun	Particle Physics
	Jepsen, Christian Baadsgaard	Quantum Field Theory, String Theory
	Lee, Kyungsun	String Theory
	Hampton, Shaun David	String Theory
	Zheng, Yu-Hui	Paricle Physics
	Awasthi, Shakul	Statistical Physics
	Mishra, Preetish	Astrophysics
	Singh, Varinder	Statistical Physics
	Davari Dolatabadi, Zahra	Cosmology
	Ban, Kayoung	Particle Physics
	Lu, Philip	Astroparticle Physics
	Agrawal, Aayushi	Theoretical Condensed Matter
	Salim, Shahrukh	Condensed Matter Physics
	Kim, Jinheung	Particle Physics
	Vos, Gideon	String Theory
	Lin, Ban	String Theory, Quantum Field Theory
	Lopez, Martha	Astrophysics
Research Fellow	Xu, Bin	Particle Physics
	Bi, Da	Astrophysics
	Patil, Trupti	Cosmology
	Panopoulos, Pantelis	String Theory
	Yuan, Yin	Particle Physics
	Lee, Hojin	String Theory
	Choi, Jaehyeok	String Theory
	Sinha, Sudip	Condensed Matter Physics
	Oh, Boon Kiat	Astrophysics
	Shamma, Michael Christophe	Theoretical Particle Physics and Cosmology
	Jung, Narina	Statistical Physics
	Reichard, Merlin	Particle Physics
Project Research Fellow	Youn, Taewook	Particle Physics
	Yu, Bingrong	Particle Physics
	Song, Hanwool	String Theory
	Kim, Youngjae	Condensed Matter Theory

Research Activities

Statistical & Condensed Matter Physics

The Statistical & Condensed Matter Physics group started in 2025 with three professors: Prof. Kwon Park, Prof. Yong Baek Kim, and Prof. Jae Sung Lee. The group had one QUC Distinguished Professor, Prof. Hyunggyu Park, one KIAS fellow, Dr. Kyusung Hwang, and nine research fellows, Dr. Youngjae Kim, Dr. Aayushi Agrawal, Dr. Shahrukh Salim, Dr. Sudip Sinha, Dr. Sangyun Lee, Dr. Priyo Shankar Pal, Dr. Hyun-Myung Chun, Dr. Shakul Awasthi, and Dr. Varinder Singh.

Two members left the statistical physics group: Dr. Sangyun Lee moved to Johannes Gutenberg-University Mainz as a postdoc in March 2025, and Dr. Priyo Shankar Pal moved to the department of computational physics as a research fellow in November 2025. One new member joined the group: Dr. Narina Jung joined the statistical physics group in November 2025. A member left the condensed matter physics group. Dr. Kyusung Hwang left KIAS to become an associate professor in the Department of Applied Physics at Kyung Hee University in March 2025. A new member joined the condensed matter physics group. Dr. Sudip Sinha joined KIAS as a research fellow in September 2025, moving from the Indian Institute of Science Education and Research (IISER) Kolkata, India.

Various research activities were pursued by members of the group during the year. Here is a summary of selected work.

Prof. Jae Sung Lee focused on stochastic and quantum thermodynamics, as well as thermodynamic trade-off relations. Together with Dr. Hyun-Myung Chun and Prof. Hyunggyu Park, he discovered a unified hierarchical relationship among various fluctuation-response identities and bounds. This work was published in *Physical Review Letters*. In collaboration with Prof. Jae Hyung Jeon, he derived the thermodynamic uncertainty relation for systems with active Ornstein–Uhlenbeck particles, which was published in *PNAS Nexus*. Working with Prof. Hyunsuk Hong and Prof. Hyunggyu Park, he demonstrated that coherence of coupled oscillators can be enhanced by detrained oscillators. This study was published in *Chaos*. Finally, in collaboration



with Euijoon Kwon, he proposed a unified framework for classical and quantum uncertainty relations using stochastic representations. This work was published in *Communications Physics*.

Prof. Yong Baek Kim proposed a theory of the anomalous Hall crystal, an electronic crystal phase that arises from strong electron-electron interaction in the electronic band with non-trivial Chern number. He and his collaborators established that the anomalous Hall crystal has intrinsically much smaller stiffness due to their topological nature. He provided a general theory of the Chern number of the anomalous Hall Crystal phases in the presence of interaction and external potential. He has also shown that the phonon excitations in this system also carry non-trivial Chern number, which leads to finite thermal Hall conductivity. Some of these papers are published in *Physical Review B* and others are submitted to *Physical Review Letters*.

Prof. Kwon Park, in collaboration with Dr. Youngjae Kim (KIAS), explored a new quantum state that can form in irradiated graphene exposed to circularly polarized light. Throughout the history of condensed matter physics, zero-resistance phenomena have marked milestones in groundbreaking discoveries of new states of matter. A prime example of zero resistance is, of course, superconductivity, which is induced by Cooper pairing. Other notable examples include quantum Hall states and Chern insulators, which are induced by topological edge protection. Could there be another mechanism for zero resistance? In this work, Prof. Park and his collaborator predicted that irradiated graphene can host two novel nonequilibrium steady states of matter with zero resistance when exposed to circularly polarized light: (i) Floquet Chern insulators and (ii) a radiation-induced zero-resistance (RIZR) state with spontaneous formation of an inhomogeneous current distribution.

Prof. Kwon Park co-organized the Korean Quantum Materials Symposium (K-QMS) 2025 with the Korean Physical Society (KPS) and several Institute for Basic Science (IBS) centers. The symposium was held at the Busan Nongshim Hotel from February 2 to 7, 2025, focusing on strongly correlated condensed matter physics topics, including quantum spin liquid, multiferroics, oxide thin films, high-temperature superconductivity, topological superconductivity, heavy fermion, charge/spin density wave, spintronics, orbitronics, altermagnetism, skyrmions, topological matter, quantum Hall effect, Majorana fermions, moiré superlattices, and nonequilibrium matter. With more than 100 participants, K-QMS 2025 was one of Korea's most important domestic conferences in condensed matter physics, fostering in-depth discussions and collaborations among PI-level researchers.

In the field of statistical physics, Prof. Jae Sung Lee organized several schools and workshops in 2025. The first was the 22nd KIAS-APCTP Winter School on Statistical Physics (January 6–10), focusing on active matter, stochastic thermodynamics, and polymer physics for graduate students. The second event was the 13th Workshop on Nonequilibrium Fluctuation Theorems (June 25–27), addressing various topics related to quantum and stochastic thermodynamics. The third was the East Asia Joint Seminars on Statistical Physics 2025 (October 14–17), which covered major advances in statistical physics and its interdisciplinary applications achieved by colleagues from the East Asia region. Additionally, he regularly organized 26 NEST (Non-Equilibrium Statistical Mechanics Theory) meetings, a weekly gathering for in-depth discussions on various topics in statistical physics, as well as the 147th and 149th Statistical Physics Monthly Meetings for members of the statistical physics division of the Korean Physical Society.

Astrophysics and Cosmology

The Astrophysics and Cosmology group is headed by Profs. Changbom Park, Donghui Jeong, and Research Profs. Juhan Kim and Jeong-Gyu Kim. Postdocs in the group include Drs. Alexandra Dupuy, Priya Goyal, Jaewon Yoo, Preetish Mishra, Zahra Davari Dolatabadi, Jie Li, Martha Margarita Lopez Gutierrez, Da Bi, Trupti Patil, Boon Kiat Oh, and Naik Suvedha Suresh.

In 2025, Prof. Park, in collaboration with Dr. F. Dong (Yunnan University), constrained the CPL parameters of the dark energy equation of state using SDSS data and found that the equation of state is consistent with no evolution, implying no phantom divide crossing at redshifts below 0.7. He also analyzed the Dark Energy Spectroscopic Instrument (DESI) data and 56 multiverse simulations. Using the Horizon Run 5 (HR5) simulation, he worked on many scientific projects, such as finding the mechanism and epoch of emergence of the relation between galaxy properties and clustercentric radius. He collaborated with many astronomers in Korea to conduct multi-object spectroscopic surveys of galaxies such as A-SPEC (the All-sky Spectroscopic Survey of the nearby universe) and the KLST project, a plan for building a telescope system with an effective diameter of 9.2 m dedicated to spectroscopic observations.

CAC Research Professor Juhan Kim continued the scientific analysis of the Horizon Run 5 cosmological simulation, contributing to studies on intrahalo light formation history. In parallel, he developed LagEunha, a next-generation Lagrangian hydrodynamics code based on the Laguerre tessellation. He also developed Lumina-SN, a GPU-accelerated Monte Carlo radiative transfer code for Type Ia supernova spectral modeling, achieving automated five-dimensional parameter fitting and making the code publicly available.

Prof. Donghui Jeong focused on the HETDEX survey analysis, leading to the first detection of a Baryon Acoustic Oscillation (BAO) signal in the dataset. His group played a foundational role by measuring the Lyman-α emitter luminosity function and constructing survey-accurate random catalogs, enabling all subsequent cosmological clustering measurements. He contributed to a DESI–HETDEX cross-validation study of emission-line classification methods and to a search for sub-solar mass compact objects using LVK O4a data. On the theoretical front, he helped validate second-order general-relativistic descriptions of large-scale structure observables, providing essential groundwork for precision cosmological analyses.

QUC Research Professor Jeong-Gyu Kim has been developing a new semi-analytic model of density-bounded H II regions, working with Chanjin Lee of SNU to validate the model through numerical simulations. He has also mentored Gain Lee of SNU in cosmological hydrodynamic simulations using an improved mesh refinement strategy. He has been working with KIAS group members to develop new cosmological simulations with the SWIFT code. In addition, he has collaborated with Lachlan Lancaster of Columbia University on interstellar bubbles driven by stellar winds and radiation; with Samuel Crowe of Oxford on strongly magnetized H II regions; and with Chang-Goo Kim of Princeton University and other researchers to quantify the role of cosmic rays in driving galactic outflows using TIGRESS++ simulations of star-forming galactic disks.

Dr. Jaewon Yoo, a QUC postdoctoral fellow (until August 31, 2025), studied intracluster light (ICL) as a probe of dark matter and the dynamical evolution of galaxy clusters. Using the HR5 simulation, she demonstrated that ICL effectively traces the dark matter distribution over cosmological timescales. She analyzed galaxy clusters in the Illustris TNG300 simulation, examining virial ratios and similarities in their spatial distribution across radial scales. She also investigated Cluster-EAGLE simulations under different dark matter models, cold dark matter (CDM) and self-interacting dark matter (SIDM), to explore how ICL properties can constrain dark matter physics.

Dr. Alexandra Dupuy conducted research on the reconstruction of large-scale cosmic structures using deep learning techniques. She developed a convolutional neural network (CNN) framework to infer three-dimensional dark matter density, gravitational potential, and peculiar velocity fields from galaxy positions and radial peculiar velocities. The method was trained and validated on mock datasets designed to reproduce the observational geometry of Cosmicflows-4, and then applied to the actual Cosmicflows-4 data to probe structures hidden in the Zone of Avoidance. The reconstruction recovered known galaxy clusters and revealed a mass concentration consistent with the Great Attractor.

Dr. Priya Goyal continued her work on the morphology of galaxies in the HR5 simulation. She published a study on the redshift evolution of the Fundamental Plane of HR5 early-type galaxies and its physical origin. She is also investigating the impact of cosmological processes such as gravitational evolution, redshift-space distortions, and massive neutrinos on large-scale structure morphology using Minkowski functionals, Betti numbers, and Minkowski tensors. She contributed to a collaborative analysis of anomalies in ACT CMB lensing convergence maps and began exploring cross-correlations between CMB lensing and large-scale structure tracers to improve delensing efficiency in CMB maps.

Dr. Zahra Davari has been constraining different classes of quintessence potentials using Alcock-Paczynski test results. She published a study on the impact of a modified Compton effect on CMB anisotropies using Planck 2018 data. She is also a collaborator in the CosmoVerse working group WG2 (Data Analysis in Cosmology), which addresses observational tensions in cosmology through systematics and fundamental physics.

Dr. Preetish Mishra is studying the fundamental scaling relations of galaxies using both observational and simulation data. Using the HR5 simulation, he investigated the origin of the critical mass scale at which many galaxy scaling relations show transitions and identified the physical processes responsible for this threshold. He also explored optimal strategies to minimize the scatter in the Tully–Fisher relation using data from the SDSS-IV MaNGA survey. He developed a pipeline to analyze galaxy structural properties using early data from Rubin LSST Data Preview 1, and also contributed to the detection of a hidden dwarf galaxy embedded within a larger galaxy through its chemical signature using MUSE integral-field spectroscopic data.

Dr. Jie Li investigated the relationship between the initial conditions and the galactic properties across cosmic time in HR5, uncovering the relationship between spin vectors vs. the initial angular momentum from high redshifts to low redshifts. She is studying the spin relations between dark matter, gas, and stellar components.

Dr. Martha López joined the group in January 2025 and is working on the evolution of galaxies in galaxy clusters using the HR5 simulation and the upcoming LSST data. She joined the Korean Rubin Science Collaboration (KRSC) to use Legacy Survey of Space and Time (LSST) data to investigate galaxy distributions and the origin of the scaling relations, such as the Morphology-Star Formation Activity-Clustercentric Radius relation across different cosmic epochs. She is using HR5 lightcone data to implement a galaxy proto-cluster identification scheme based on a spherical collapse model to develop a method applicable to observational datasets such as Rubin LSST.





cosmological fluid comprising dark matter and quintessence, deriving the full set of evolution equations for density perturbations within the Newtonian sub-horizon regime. She has extended the analysis to compute the linear growth function for the variable-sound-speed scenario.

Dr. Boon Kiat Oh joined the group in October 2025 and is developing the black hole physics module in Enzo. He leads two projects in the AGORA collaboration: investigating dwarf-galaxy simulations across multiple codes to address the core–cusp problem, and comparing black hole physics implementations between codes. He also collaborates on filament properties in CAMELS, environmental impacts on galaxy properties, high-redshift simulations, and a fully automated optimization pipeline for simulations.

Dr. Naik Suvedha Suresh joined KIAS in November 2025. She has been working on inflation and testing the models using cosmological observations. She completed her work on the morphological analysis of inflationary signatures using 21 cm simulations during the epoch of reionization. At KIAS, she will focus on detailed investigations of new cosmological models that can be consistent with both low-redshift (AP test, BAO, and Type Ia supernovae) and CMB observations.

Dr. Da Bi joined the group in July 2025 and started the development and optimization of a high-performance cosmological hydrodynamics simulation framework for next-generation high-resolution simulations. Since joining the group, he has initiated a rigorous evaluation and selection process for an appropriate cosmological hydrodynamics code, with SWIFT currently emerging as the primary candidate. This process has involved comprehensive benchmarking focused on numerical accuracy, computational efficiency, and suitability for high-resolution applications.

Dr. Trupti Patil joined KIAS in July 2025 and initiated a theoretical investigation of quintessence dark energy perturbations with non-zero sound speed and a parameterized equation of state. Her work extends the standard clustering quintessence framework by incorporating pressure perturbations through an effective sound speed. She has developed the linear perturbation theory for a two-component

String Theory

The String Theory group consists of three full-time faculty members, Profs. Sangmin Lee, Sungjay Lee, and Piljin Yi, as well as two KIAS Scholars, Prof. David Tong of the University of Cambridge and Prof. Julio Parra-Martinez of the Institut des Hautes Études Scientifiques (IHES), and a Professor Emeritus, Prof. Kimeyong Lee. The group currently includes a QUC assistant professor, Prof. Kanghoon Lee, two KIAS junior fellows, Dr. Shaun Hampton and Dr. Christian Jepsen, and ten KIAS/QUC/project research fellows: Dr. Minsung Kim, Dr. Sungjoon Kim, Dr. Hojin Lee, Dr. Kyungsun Lee, Dr. Taehwan Oh, Dr. Ban Lin, Dr. Pantelis Panopoulos, Dr. Tabasum Rahnuma, Dr. Hanwool Song, and Dr. Gideon Vos.

The members who joined KIAS in 2025 are Prof. Sangmin Lee, Dr. Hojin Lee (from SNU), Prof. Kanghoon Lee, Dr. Tabasum Rahnuma, Dr. Pantelis Panopoulos (from APCTP), and Dr. Hanwool Song (from SKKU).

Selected research highlights of the group are summarized below.

Prof. Sungjay Lee led a collaboration including former KIAS members and authored a paper titled “Fermionic Non-invertible Symmetry Behind Supersymmetric ADE Solitons.” The authors proposed the superstrip algebra as a unified framework to catalog the categorical symmetry data in a massive fermionic model. The algebra and its representations explicitly encode the vacuum structure, soliton degeneracies, and their quantum numbers. They applied this framework to the N = 2 minimal models with their least relevant deformation.

Dr. Gideon Vos studied the real-time bulk AdS3 two-into-two scattering amplitude of conical defects. This was done using a previously developed method of systematic approximation of the monodromy problem for the Virasoro blocks of the four-point HHHH correlator in 2D CFT in the large central charge regime. He and his collaborator found that dialing the external scaling dimension triggers a transition from a scattering phase to an intermediate black hole phase. He also wrote a paper on coarse-graining in time and emergent temperature in 2D CFT at large central charge. Using the monodromy method, he obtained a compact expression for the identity block contribution to the expectation value of two low-energy probe operators on a broad class of time-dependent heavy pure states in large-c 2D CFTs.

Dr. Sungjoon Kim proposed a new 3D N = 2 Seiberg–like duality of adjoint SQCD with linear monopole superpotential terms, which encompasses known monopole-deformed Kim–Park dualities. Equipped with this, his paper classified all the monopole-deformed Kim–Park dualities up to quadratic powers of monopole deformations. In another project, he generalized a trace formula to a finite family of vertex operator algebras (VOAs) associated with a given 4D superconformal field theory. Applying this framework to Argyres-Douglas theories, he extracted the modular data of the family of boundary VOAs via topological field theory partition function calculations on Seifert manifolds.

Dr. Minsung Kim published a paper titled “Probing Quantum Curves and Transitions in 5d SQFTs via Defects and Blowup Equations.” The authors investigated codimension-2 defect partition functions and quantum Seiberg-Witten curves in 5D rank-1 supersymmetric QFTs, including non-Lagrangian and Kaluza-Klein theories. Using generalized blowup equations, they computed defect partition functions in the Ω-background and showed that, in the Nekrasov-Shatashvili limit, the partition functions satisfy certain difference equations that encode the quantization of classical Seiberg-Witten curves.

Prof. Kanghoon Lee is leading a collaboration, including Dr. Hojin Lee, where he presents a novel framework for computing differential cross-sections in quantum field theory using the optical theorem and loop amplitudes, circumventing the traditional method of squaring scattering amplitudes. This approach addresses two major computational challenges in high-multiplicity processes: complexity from amplitude squaring and the extensive summations over color and helicity. Our method employs quantum off-shell recursion, a loop-level generalization of Berends–Giele recursion, combined with Veltman’s largest time equation through a doubling prescription of fields.

Dr. Tabasum Rahnuma generalized a recent AdS S-matrix formulation for interacting massive scalars on AdS spacetimes to the case of massive vector fields. This method relies on taking the infinite radius limit for scattering processes perturbatively, which is analyzed using Witten diagrams in the momentum space formulation of global AdS with embedding space coordinates. It recovers the S-matrix with subleading corrections in powers of the inverse AdS radius about a flat spacetime region within the bulk.

Prof. Sangmin Lee and Dr. Hojin Lee published a paper on the classical eikonal in relativistic scattering. The classical eikonal is a single scalar function which encodes all dynamical information needed in the post-Minkowskian approach to the gravitational binary problem.

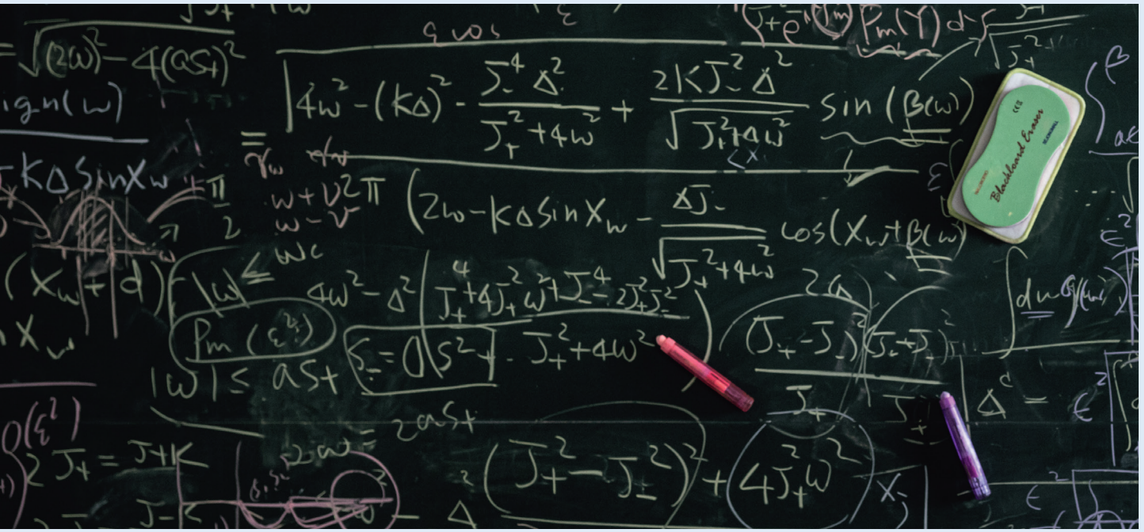
It can be further generalized to other models and to quantum field theory. The diagrammatic expansion based on the Magnus expansion has been generalized to relativistic fields and particles. They also worked on the approximate integrability of the source-probe system consisting of two Kerr black holes. Prof. Lee led the local organizing committee of the Amplitudes 2025 conference in June 2025 at Seoul National University slightly before he moved to KIAS. It marked the first Amplitudes conference held in Asia.

The String Theory group hosted two seasonal schools: the Summer Institute 2025, aimed at graduate students in theoretical physics, and the KIAS-SNU Physics Winter Camp 2025, designed for general physics undergraduate students. The group also organized a regular conference series Strings in Seoul and hosted the Amplitudes 2025 School which was accompanied the Amplitudes 2025 conference held at SNU. The group contributed to the wider string theory community in Korea by co-organizing conferences or workshops such as Quantum Geometry and Duality 2025 (Gwangju) and Frontiers in Theoretical Physics 2025 (Jeju).

High Energy Physics

The High Energy Physics (HEP) group started 2025 with three full-time faculty members, Prof. Eung Jin Chun, Prof. Pyungwon Ko, and Prof. Seung Joon Lee, and one KIAS Scholar, Prof. Alex Pomarol (Barcelona). Two members have moved to other places: Suro Kim to Ewha Womans University and Tomasz Dutka back to Australia. New members who have joined the HEP group include Bin Xu from Peking University in China, Merlin Reichard from TUM (Technical University, Munich) in Germany, Yuan Yin from Tsinghua University in China, Taewook Youn from the University of Texas at Austin in the USA, Michael Shamma from TRIUMF in Canada, and Heejoo Kim from KAIST.

Prof. Eung Jin Chun published papers on the possible common origin of the universe's baryon asymmetry and dark matter, in connection with neutrino mass generation, with Tae-Hyun Jeong (IBS), and on the phenomenology of Dirac-neutrino effective field theory with Sanjoy Mandal. He also formulated a complete framework of spontaneous leptogenesis within a type-I seesaw mechanism.



Prof. Pyungwon Ko worked on interpreting the KM3-230213A high-energy neutrino event as the decay of heavy Dirac fermion dark matter with spontaneously broken U(1) dark gauge symmetry and a type-I seesaw for neutrino masses and mixings (with Jongkuk Kim and Sarif Khan, postdocs at Chung-Ang University, who received faculty positions in Korea and India, respectively, at the end of 2025). All the mass scales in this work lie well below the Planck scale, in sharp contrast to other papers on the same event. The model has an interesting prediction of gravitational wave (GW) signals from cosmic string networks, which could be detected in the pulsar timing arrays (PTAs) or future space-based GW detectors. He also worked on a low-reheating scenario in the dark Higgs inflation and its implications for dark photon dark matter production (with Sarif Khan and Jinsu Kim), and on the Belle-2 excess on B → Kνν in the framework of the Z_3 scalar dark matter model with semi-annihilations for the correct relic density (with Jongkuk Kim). With Yu-Hui Zheng and Jaehoon Jeong, he has been working on Compton scattering of dark matter (with spin 0, ½, 1) and massive dark photon, using the Amplitude Method and requiring that the high energy behaviors of the Compton scattering amplitudes respect unitarity.

Prof. Seung Joon Lee has worked on topics spanning beyond-the-Standard-Model phenomenology, collider physics, cosmology, and astroparticle physics. Together with Jay Hubisz, He Li, and Bharath Sambasivam, he completed "Cosmological Quasiparticles and the Cosmological Collider" (published in *Physical Review D* 111, 023543), which studies how the interplay between cosmology and strongly coupled, approximately conformal dynamics can generate transient spectral features during inflation. In flat space the spectral density of a scalar operator in a conformal field theory forms a featureless continuum, but AdS/CFT arguments indicate that in an inflationary background with Hubble rate H this continuum becomes gapped. The resulting states—which the authors term "cosmological quasiparticles"—are transient and particle-like with a finite width; although they vanish at late times, they can leave distinctive imprints on the spectrum of primordial fluctuations relevant to the cosmological collider program. With Cédric Delaunay, Roee Ozeri, Gilad Perez, Wolfram Ratzinger, and collaborators, he completed "Probing New Forces with Nuclear Clocks" (published in *Physical Review D* 112), which uses high-precision nuclear clocks to search for new forces and ultralight fields that couple to the nuclear sector of the Standard Model. Together with Thomas Flacke, Benjamin Fuks, Dongchan Kim, Jinheung Kim, and Léandre Munoz-Aillaud, he also completed "New Physics in Toponium's Shadow?" (arXiv:2512.03220, accepted by *Physics Letters B*), which examines the enhancements in top–antitop production near threshold recently reported by ATLAS and CMS—a region where the nonperturbative QCD dynamics of toponium formation become important—and shows how a neutral pseudoscalar coupled to gluons and top quarks would reshape the viable parameter space, finding that current data remain compatible with such new-physics contributions alongside Standard Model threshold effects. In addition, he has an ongoing collaboration with researchers at KIAS and the Weizmann Institute on quantum-enhanced axion dark matter detection using Rydberg atoms in optical tweezer arrays.

Prof. Eung Jin Chun gave colloquium presentations on "After Higgs discovery" at KAIST and Jeonbuk National University. He was invited to participate in the workshops "Neutrinos and Dark Matter" at IHP, Paris, and "New ways to discover light new physics" at MITP in Mainz. He delivered research presentations on the cogenesis of the universe's baryon asymmetry and dark matter abundance driven by an axion or Majoron. He also gave lectures on "Cosmology of Neutrinos and Dark Matter" hosted by CPNR at Chonnam National University.

Prof. Pyungwon Ko was invited to the BSM Workshop at Chung-Ang University (Korea), the Ponta Delgada workshop on "Your favorite dark matter models," Scalars 2026 (University of Warsaw, Poland), the AEI Workshop (IPPP, Durham, UK), the CPNR Workshop (Chonnam National University), and the International Joint Workshop (National Taiwan University, Taiwan), and gave presentations on "Decaying heavy Dirac fermion DM for AMS-02, IceCube and KM3." He served as an International Advisory/Organizing Committee Member for the Dark Side of the Universe (DSU), the SUSY

Conference, and AEPSHEP, among others. He also visited the Fermilab Theory Group under the Summer Visitor's Program, the University of Wisconsin-Madison, and the Technical University of Munich, and presented his works on dark matter along the SM construction.

During the year, Prof. Lee delivered a number of invited presentations, plenary lectures, and seminars. At international conferences he gave plenary presentations on "Cosmological Quasiparticles and the Cosmological Collider" at the 5th Asian-European-Institutes Workshop for BSM (IPPP, Durham, UK, September 29, 2025), the International Joint Workshop on the Standard Model and Beyond 2025 (NTU, Taiwan, December 10, 2025), and the IBS Conference on Dark World (IBS, Daejeon, October 27, 2025). He also presented "Ultralight Axion Dark Matter from Inflation-driven Quantum Phase Transition" as a plenary talk at the International Joint Workshop on the Standard Model and Beyond 2024, held jointly with the 3rd Gordon Godfrey Workshop on Astroparticle Physics (UNSW, Sydney, Australia, December 12, 2024), and at the CTPU-CKC Joint Focus Program "Let there be light (particles)" (CTPU-IBS, Daejeon, December 5, 2024). Domestically, he gave invited seminars at KAIST (High Energy Theory seminar, April 22, 2025) and Chung-Ang University (theoretical physics seminar, May 7, 2025), a KIAS Journal Club talk on probing new forces with nuclear-clock quintessometers (March 22, 2025), and an invited presentation on continuum dark matter at the 2024 Samsung Annual Forum (The-K Hotel, November 8, 2024).

Prof. Lee was also active in conference organization and community service. He served as an International Advisory Committee member and local organizer for the 18th International Workshop on Top Quark Physics (Top2025, Seoul, Korea, September 21–26, 2025) and as an International Advisory Committee member for the 13th Large Hadron Collider Physics Conference (LHCP 2025, Taipei, Taiwan, May 4–9, 2025). He helped organize the 12th KIAS Workshop on Particle Physics and Cosmology together with the Korea-France STAR Workshop (November 17–23, 2025), and co-organized the 1st and 2nd Seoul Meetings on Particle Theory and Cosmology (June 13, 2025 and September 5, 2025).

Dr. Kayoung Ban works on machine learning applied to collider physics together with Prof. Myeonghun Park at Seoultech. Recently they developed a machine learning algorithm that reformulates stratification in Monte Carlo sampling, and studied quantum circuits as a promising alternative to conventional neural networks.

Dr. Tomasz Dutka completed a solo-authored study developing a statistical framework for identifying critical bubbles in first-order lattice phase transitions using the committor probability: the likelihood that a field configuration evolves to the true vacuum rather than returning to the false vacuum. This study has been accepted for publication in the *Journal of High Energy Physics*. Additionally, there are works in progress related to spin-aware spherical convolutional neural networks and anomaly detection in Planck CMB data to detect deviations from the standard ΛCDM model. In 2025, he also presented research at a number of workshops and conferences, including international presentations in Montreal, Katowice, and Warsaw.

Dr. Jaehoon Jeong has worked on theoretical high-energy physics with a focus on scattering amplitudes and bootstrap approaches. In 2025, he developed a new gauge framework for massive vector bosons. In this work, he clarified the origin of divergences associated with longitudinal modes and demonstrated the Goldstone boson equivalence theorem directly at the level of polarization vectors. Furthermore, this framework provides a systematic criterion to diagnose divergences across different gauge-fixing schemes. In addition, in collaboration with Prof. Alex Pomarol and Dr. Ziyu Dong, he completed a project on anomaly-induced interactions involving a pseudoscalar η, photons γ, and gravitons h. Using modern bootstrap techniques, he derived model-independent constraints on effective field theories containing these particles. In particular, he obtained universal bounds on the anomaly coupling ηhh and the nonminimal coupling $h\gamma\gamma$. He also investigated how these bounds constrain well-known UV completions, including large-N_c gauge theories and five-dimensional models related via the AdS/CFT correspondence.

Dr. Kiyoharu Kawana worked on several projects. In arXiv: 2503.14902, he studied various phases of p-branes using the effective brane field theory developed in the previous study, arXiv: 2310.07993. In arXiv:2507.06555, he discussed Kramers-Wannier duality among general lattice higher-form gauge theories. In arXiv:2602.08310, he developed a new variational technique in systems with higher-form global symmetries. This study is a natural generalization of the conventional variational method for interacting bosons to interacting bosonic surfaces.

Dr. Jinheung Kim conducts research on collider phenomenology of theories beyond the Standard Model, including searches for dark Z bosons at a muon collider, photon jets as a novel signature of neutral long-lived particles at the LHC, strong first-order phase transition in a two-Higgs-doublet model in collaboration with Prof. Jeonghyeon Song's Konkuk University group, as well as toponium production at the LHC together with Dr. Thomas Flacke and Prof. Seung Joon Lee.

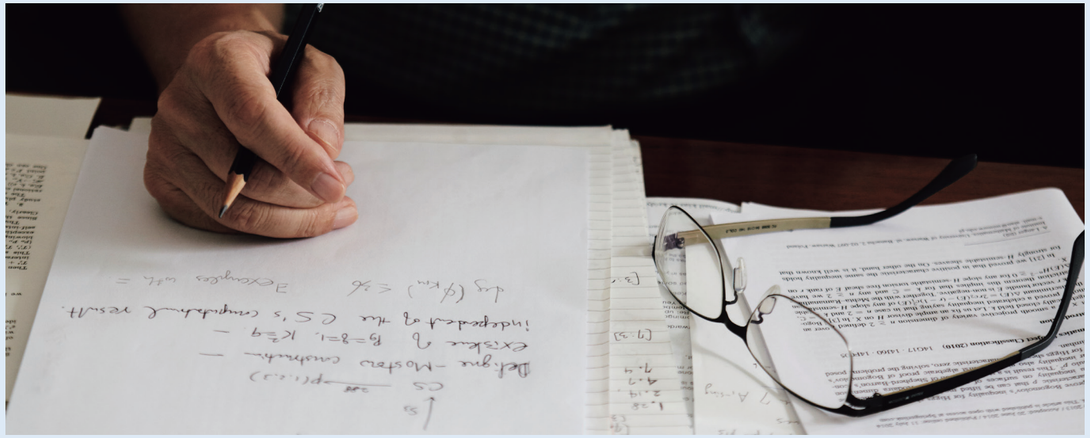


Dr. Suro Kim works on theoretical and phenomenological aspects of the positivity bounds, including the effects of stringy spectra on the positivity bounds and their application to the cosmological collider program.

Dr. Philip Lu and Dr. Taehun Kim work together on the active frontier between particle physics, astrophysics, and cosmology. Their research focuses on theoretical properties and observational signatures of extended dark matter objects such as primordial black holes, axion stars, and Q-balls. Recently, they performed detailed numerical calculations of wake formation and gas heating and applied their results to a dwarf galaxy, establishing new constraints on dark matter properties.

Dr. Sanjoy Mandal has been working closely with Prof. Eung Jin Chun on neutrino effective field theory and investigated novel phenomena for detecting a right-handed neutrino produced by Z' interactions via forward search experiments at the LHC in collaboration with researchers at Hokkaido University in Japan. He also wrote an extensive review on theoretical and experimental studies of dark matter as the source of neutrino mass together with the Valencia group in Spain.

Dr. Raymundo Ramos collaborated with Profs. Pyungwon Ko, Stefano Moretti, and Amit Chakraborty as well as Dr. Ahmed Hammad in an exploration of the parameter space of the next-to-minimal Supersymmetric Standard Model using deep learning techniques. They successfully fitted hints of new scalars around masses of 95 GeV and 650 GeV, while also meeting several experimental constraints. He also got two papers accepted for publication in *Computer Physics Communications*, titled "DLScanner: A parameter space scanner package assisted by deep learning methods," in collaboration with Dr. Ahmed Hammad, and "LeStrat-Net: Lebesgue-style stratification for Monte Carlo simulations powered by machine learning," in collaboration with Dr. Kayoung Ban and Prof. Myeonghun Park. He also visited the University of Colima in Mexico, where he collaborated with Prof. Alfredo Aranda and Prof. Alexander Stuart in applying



machine learning techniques to the search and classification of neutrino mass matrix textures. Finally, he gave presentations on his work domestically in Seoul, Daejeon, and Pohang, and internationally in California, USA and at an online CERN meeting.

Dr. Merlin Reichard continued working on electromagnetic interactions of dark matter with Alejandro Ibarra and Onur Yonar from the Technical University of Munich.

Dr. Bin Xu joined the School of Physics as a Research Fellow in June 2025. His research focuses on quantum-enhanced detection of ultralight dark matter. He completed a study titled “Symmetric Dicke States as Optimal Probes for Wave-Like Dark Matter” (arXiv:2512.14821), identifying symmetric Dicke states as optimal entangled probes. He initiated a project exploring entanglement between two haloscopes as a probe of non-classical dark matter properties, mentoring Dr. Ping He and Yu Dong (Peking University). He also joined a collaboration on axion detection using Rydberg atoms in optical tweezer arrays with Prof. Seung Joon Lee and collaborators, including researchers from KIAS and the Weizmann Institute. In addition, he participated in a study group on neural networks for field theories, exploring interdisciplinary applications of physics in AI. He presented his work at several domestic and international workshops and conferences, including meetings in Korea, CERN, and KEK, and delivered an invited seminar at IBS.

Dr. Xing-Yu Yang authored two papers in 2025. The first paper investigates a system of a self-gravitating condensate, a boson star, formed from scalar ultralight dark matter (ULDM), hosting a black hole at its center. The authors numerically solve the equations of hydrostatic equilibrium in the non-relativistic limit, consistently incorporating the gravitational potential of the black hole, and propose an analytic expression for the density profile. Considering the inspiral of this BS-BH system with a second, smaller black hole, they study the dephasing of gravitational waves due to the presence of the ULDM environment. The second paper shows that oscillating (real-scalar) boson stars can act as strictly periodic gravitational lenses and generically host an oscillating radial caustic. Sources near this caustic cross it every half-period, producing achromatic phase-locked photometric spikes synchronized with an astrometric wobble, providing a promising target for time-domain astronomy. He gave four contributed presentations at conferences and workshops, including the “joint GR24/Amaldi16,” “PASCOS 2025,” “2025 CERN-CKC,” and “2025 KIAS QUC Workshop.”

Visiting Scientists

Ahn, Byoungjoon
GIST

Aoki, Sinya
YITP

BHANDARI, DIPENDU
Indian Inst. Tech., Guwahati

Bhaskar, Arvind
IoP, Bhubaneswar, India

Bielli, Daniele
APCTP

Cederwall, Martin
Chalmers Univ. of Technology

Chamseddine, Ali
American Univ. of Beirut

Chate, Hugues
Saclay

Chen, Jin
Xiamen Univ.

Choi, Changha
Perimeter Institute

Colombo, Edoardo
Univ. of Turin

Fuks, Benjamin
LPTHE & Sorbonne Univ.

Ge, Dongsheng
Osaka Univ.

Georgoudis, Alessandro
Queen Mary Univ. of London

Han, SangEun
Simon Fraser Univ.

Hayden Lee
Univ. of Pennsylvania

Heiko Rieger
Saarland Univ.

Heydeman, Matthew
Harvard Univ.

HUANG, Yuanfei
APCTP

Hwang, Jai-chan
IBS-CTPU

Jia, Qiang
KAIST

Kee, Hae Young
Toronto Univ.

Kim, Hee-Cheol
POSTECH

Kim, Jeail
POSTECH

Kim, Kyoungmin
APCTP

Kim, Manki
Stanford Univ.

Kosower, David
IPhT CEA Saclay

Kotlewski, Soren
IBS

Kwon, Hyunwoong

Lee, Sangyun
Johannes Gutenberg Univ.

Lu, Yongchao

Malvimat, Vinay
APCTP

Min, Ui
TDLI/SJTU

Panopoulos, Pantelis
APCTP

Papadimitriou, Ioannis
National and Kapodistrian Univ. of Athens

Poppitz, Erich
Univ. of Toronto

Rahnuma, Tabasum
APCTP

Roh, Sunghan
Harvard Univ.

SAHA, INDRAJIT
IIT Guwahati

Salgado, Sebastián
Universidad de Tarapacá

Seidel, Alexander
Washington Univ.

Sengupta, Dipan
Univ. of Adelaide, Australia

Sunyaev, Rashid
Institute of Physics and Technology in Moscow

Tilen, Cadez
APCTP

Turetta, Enrico
Università degli Studi di Padova

Venuti, Laura
Univ. of New South Wales

Vijayakumar, Kiran
APCTP

Wang, LianTao
Univ. of Chicago

Yun, Seok Hoon
IBS & CTPU

Conferences and Workshops

The 22nd KIAS-APCTP Winter School on Statistical Physics
Jan. 6 – Jan. 10

High 1 Joint Workshop on Particle, String and Cosmology
Jan. 12 – Jan. 18

Korean Quantum Material Symposium 2025
Feb. 2 – Feb. 7

2025 KIAS Physics Spring Colloquium
Apr. 2 – Jun. 4

2025 KPS Spring Meeting - Special Session
Apr. 24

The 27th CUBES
Apr. 25 – Apr. 28

Symmetries in QFT and Particle Physics 2025
Jun. 30 – Jul. 11

SITP 2025
Aug. 4 – Aug. 14

Summer Institute 2025
Aug. 18 – Aug. 22

The 23rd Workshop for Statistical Physics 2025
Aug. 18 – Aug. 20

Particle Physics Summer Camp 2025
Aug. 25 – Aug. 28

2025 KIAS Physics Fall Colloquium
Sep. 3 – Nov. 26

Strings in Seoul 2025
Sep. 22 – Sep. 26

East Asia Joint Seminars on Statistical Physics 2025
Oct. 14 – Oct. 17

2025 KPS Fall Meeting - OPEN KIAS Special Lecture
Oct. 23

Distinguished Lectures by Rashid Sunyaev
Nov. 10 – Nov. 11

The 13th KIAS Workshop on Particle Physics and Cosmology
Nov. 16 – Nov. 21

Emergent Correlated and Topological Phases of Quantum Matter
Nov. 18 – Nov. 20

Quantum Geometry and Duality 2025
Nov. 20 – Nov. 22

Frontiers in Theoretical Physics 2025
Nov. 28 – Dec. 2

Special Winter Colloquia by Slava and Ali
Dec. 3 / Dec. 10

KIAS-SNU Physics Winter Camp 2025
Dec. 22 – Dec. 30



Publications

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Goyal, Priya; **Park, Changbom**; Lee, Jaehyun; Hong, Sungwook E.; Gibson, Brad K.; Pichon, Christophe; **Kim, Juhan**
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Emergent factorization of the Hilbert space at large N and the black hole information paradox • PHYSICAL REVIEW D

Kwon, Euijoon; **Lee, Jae Sung**
A unified framework for classical and quantum uncertainty relations using stochastic representations • COMMUNICATIONS PHYSICS

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Cogenesis by a sliding pseudo-Nambu-Goldstone boson with symmetry nonrestoration • PHYSICAL REVIEW D

Hong, Hyunsuk; **Lee, Jae Sung**; **Park, Hyunggyu**
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Hunting Axion Dark Matter Signatures in Low-Frequency Terrestrial Magnetic Fields • PROGRESS OF THEORETICAL AND EXPERIMENTAL PHYSICS

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Kim, Seulong; **Kim, Kihong**
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Kim, Youngjae
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Di Valentino, Eleonora; Said, Jackson Levi; Riess, Adam; Pollo, Agnieszka; Poulin, Vivian; Gomez-Valent, Adria; Weltman, Amanda; Palmese, Antonella; Huang, Caroline D.; van de Bruck, Carsten; Saraf, Chandra Shekhar; Kuo, Cheng-Yu; Uhlemann, Cora; Grandon, Daniela; Paz, Dante; Eckert, Dominique; Teixeira, Elsa M.; Saridakis, Emmanuel N.; Colgain, Eoin O.; Beutler, Florian; Niedermann, Florian; Bajardi, Francesco; Barenboim, Gabriela; Gubitosi, Giulia; Musella, Ilaria; Banik, Indranil; Szapudi, Istvan; Singal, Jack; Haro Cases, Jaume; Chluba, Jens; Torrado, Jesus; Mifsud, Jurgen; Jedamzik, Karsten; Said, Khaled; Dialektopoulos, Konstantinos; Herold, Laura; Perivolaropoulos, Leandros; Zu, Lei; Galbany, Lluis; Breuval, Louise; Visinelli, Luca; Escamilla, Luis A.; Anchordoqui, Luis A.; Sheikh-Jabbari, M. M.; Lembo, Margherita; Dainotti, Maria Giovanna; Vincenzi, Maria; Asgari, Marika; Gerbino, Martina; Forconi, Matteo; Cantiello, Michele; Moresco, Michele; Benetti, Micol; Schoneberg, Nils; Akarsu, Ozgur; Nunes, Rafael C.; Bernardo, Reginald Christian; Chavez, Ricardo; Anderson, Richard I.; Watkins, Richard; Capozziello, Salvatore; Li, Siyang; Vagnozzi, Sunny; Pan, Supriya; Treu, Tommaso; Irsic, Vid; Handley, Will; Giare, William; Murakami, Yukei; Banihashemi, Abdolali; Poudou, Adele; Heavens, Alan; Kogut, Alan; Domi, Alba; Lenart, Aleksander Lukasz; Melchiorri, Alessandro; Vadala, Alessandro; Amon, Alexandra; Rivera, Alexander Bonilla; Reeves, Alexander; Zhuk, Alexander; Bonanno, Alfio; Ovgun, Ali; Pisani, Alice; Talebian, Alireza; Abebe, Amare; Aboubrahim, Amin; Gonzalez Moran, Ana Luisa; Kovacs, Andras; Lymperis, Andreas; Papatriantafyllou, Andreas; Liddle, Andrew R.; Paliathanasis, Andronikos; Borowiec, Andrzej; Yadav, Anil Kumar; Yadav, Anita; Sen, Anjan Ananda; William, Anjitha John; Davis, Anne Christine; Shajib, Anowar J.; Walters, Anthony; Lonappan, Anto Idicherian; Chudaykin, Anton; Capodagli, Antonio; da Silva, Antonio; De Felice, Antonio; Racioppi, Antonio; Soler Oficial, Araceli; Montiel, Ariadna; Favale, Arianna; Bernui, Armando; Crystal Velasco, Arrianne; Heinesen, Asta; Bakopoulos, Athanasios; Chatzistavrakidis, Athanasios; Khanpour, Bahman; Sathyaprakash, Bangalore S.; Zgirski, Bartek; L'Huillier, Benjamin; Famaey, Benoit; Jain, Bhuvnesh; Zhang, Bing; Karmakar, Biswajit; Dragovich, Branko; Thomas, Brooks; Correa, Carlos; Boiza, Carlos G.; Marques, Catarina; Escamilla-Rivera, Celia; Tzerefos, Charalampos; Zhang, Chi; De Leo, Chiara; Pfeifer, Christian; Lee, Christine; Venter, Christo; Gomes, Claudio; De Bom, Clecio Roque; Moreno-Pulido, Cristian; Iosifidis, Damianos; Grin, Dan; Blixt, Daniel; Scolnic, Dan; Oriti, Daniele; Dobrycheva, Daria; Bettoni, Dario; Benisty, David; Fernandez-Arenas, David; Wiltshire, David L.; Sanchez Cid, David; Tamayo, David; Valls-Gabaud, David; Pedrotti, Davide; Wang, Deng; Staicova, Denitsa; Totolou, Despoina; Rubiera-Garcia, Diego; Milakovic, Dinko; Pesce, Dominic W.; Sluse, Dominique; Borka, Dusko; Yusofi, Ebrahim; Giusarma, Elena; Terlevich, Elena; Tomasetti, Elena; Vagenas, Elias C.; Fazzari, Elisa; Ferreira, Elisa G. M.; Barakovic, Elvis; Dimastrogiovanni, Emanuela; Holm, Emil Brinch; Mottola, Emil; Ozulker, Emre; Specogna, Enrico; Brocato, Enzo; Jensko, Erik; Antonette Enriquez, Erika; Bhatia, Esha; Bresolin, Fabio; Avila, Felipe; Bouche, Filippo; Bombacigno, Flavio; Anagnostopoulos, Fotios K.; Pace, Francesco; Sorrenti, Francesco; Lobo, Francisco S. N.; Courbin, Frederic; Hansen, Frode K.; Sloan, Greg; Farrugia, Gabriel; Lynch, Gabriel; Garcia-Arroyo, Gabriela; Raimondo, Gabriella; Lambiase, Gaetano; Anand, Gagandeep S.; Poulot, Gaspard; Leon, Genly; Kouniatalis, Gerasimos; Nardini, Germano; Csornyei, Geza; Galloni, Giacomo; Bargiacchi, Giada; Papagiannopoulos, Giannis; Montani, Giovanni; Otalora, Giovanni; De Somma, Giulia; Fiorentino, Giuliana; Fanizza, Giuseppe; Gaetano Luciano, Giuseppe; Sarracino, Giuseppe; Olmo, Gonzalo J.; Djordjevic, Goran S.; Canas-Herrera, Guadalupe; Cheng, Hanyu; Desmond, Harry; Abdalla, Hassan; Chen, Houzun; Chiang, Hsu-Wen; Feldman, Hume A.; Gohar, Hussain; Ben-Dayan, Ido; Sevilla-Noarbe, Ignacio; Antoniadis, Ignatios; Cimdiker, Ilim; Albuquerque, Ines S.; Gialamas, Ioannis D.; Saltas, Ippocratis; Vavilova, Iryna; Gomez-Vargas, Isidro; Ayuso, Ismael; Zeynalabdi, Ismailov Nariman; De Martino, Ivan; Zavala, Ivonne; Vazquez, J. 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School of Computational Sciences

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In an age of increasing complexity in scientific research, computation has taken center stage as a major research tool in exploring nature. Established in 2000, the School of Computational Sciences is a product of the institute's endeavors to embrace this rapid paradigm shift in scientific investigations. The School supports research in a broad range of fields where computational methods are appropriate, including theoretical and computational physics, materials science, data science, biophysics, quantum materials and information science, and combinatorics and discrete mathematics. The School is thus uniquely positioned to promote interdisciplinary research and cross-pollination of ideas between different disciplines.



Faculty and Research Fellows

Position	Name	Research Interest
Professor Emeritus	Lee, Jooyoung	Protein Folding, Bioinformatics, Global Optimization
Professors	Choi, Sangkook	Quantum Materials and Quantum Information Science
	Hyeon, Changbong	Theoretical and Computational Biophysics
	Kim, Jeong Han	Combinatorics, External Graph Theory, Random Structure
	Kim, Myungshik	Quantum Information
	Kwon, Hyukjoon	Quantum Information
	Lee, Deok-Sun	Data Science
	Son, Young-Woo	Theory of Materials
KIAS Scholar	Ha, Bae-Yeun	Biophysics
	Jang, Seogjoo J.	Theoretical and Computational Biophysics
KIAS Fellow	Kim, Won Kyu	Theoretical and Computational Soft Matter Physics
	Lee, Changmin	Algorithm
KIAS Assistant Professor	Kim, Minjae	Theoretical and Computational Materials Science
	Kim, Choong Hyun	First-principles Investigation of Quantum Materials
	Park, Changwon	Theoretical and Computational Materials Science
KIAS Junior Fellow	Giraldo Munoz, Andrus Allan	Dynamical Systems
	Kang, Sungmo	Theoretical and Computational Materials Science
	Kechrimparis, Spyridon	Quantum Information
	Ko, Taehee	Stochastic Algorithms
	Moon, Sunyo	Combinatorics
Research Fellow	Ahn, Jungho	Graph Theory and Algorithms
	Cho, Minho	Discrete Geometry
	Chu, Hojin	Graph Theory
	Goh, Segun	Biological Physics
	Han, Mancheon	Quantum Information Science
	Heo, Cheolwon	Graph Theory, Matroid Theory
	Jung, Narina	Computational Biological Physics
	Kim, Heeju	Quantum Materials and Quantum Information Science
	Kim, Jeongsu	Cryptography
	Kim, Taeyoung	Deep Learning Theory, Neural Operators, and Scientific Computing
	Kwon, Hyemin	Combinatorics, Graph Theory
	Lee, Eunwoo	Quantum Information
	Lee, Hyun gyu	Data Science
	Lee, YeongKyu	Theoretical and Computational Biophysics
	Liu, Tsai-Jung	Theoretical and Computational Materials Science
	Pal, Priyo Shankar	Theoretical and Computational Biophysics
	Sarder, Md Tahir Hossain	Quantum Materials and Quantum Information Science
	Sharma, Andri	Theoretical and Computational Biophysics
	Son, Gangmin	Statistical Physics of Complex Networked Systems
	Yananose, Kunihiro	Theoretical and Computational Materials Science
	Yang, Hyeyun	Computational Geometry, Graph Neural Network
	Yee, Ki Hyuk	Quantum Information
	Yi, Sudo	Statistical Physics
Project Research Fellow	Choi, Hoyun	Data Science
	Choi, Jibeom	Theoretical Biology
	Hawkins, Adam George	Quantum Information
	Lim, Youngrong	Quantum Information
	Seo, Youngjin	Quantum Information

Combinatorics



The Combinatorics Group at KIAS consists of Prof. Jeong Han Kim and Research Fellows Drs. Minho Cho, Hojin Chu, Jeongsu Kim, Hyemin Kwon, and Hyeyun Yang. Their research interests include discrete geometry, matroid theory, algorithmic and structural graph theory, graph coloring theory, homomorphic cryptography, computational geometry, and graph neural network. Recent results from Research Fellows are summarized below.

Dr. Minho Cho studied a set of rainbow problems on oriented matroids and other related objects. An *oriented matroid* is a family of sign vectors satisfying certain elimination properties and serves as a purely combinatorial model of separation properties between points in Euclidean space. Being a very natural concept, oriented matroids have applications and connections to various fields including discrete and computational geometry, operation research, topology and algebraic geometry. In collaboration with two external researchers, Dr. Cho showed the existence of rainbow topes and circuits from sets of topes and circuits under moderately general conditions. As an application, they showed an oriented matroid generalization of the conic colorful Carathéodory theorem by Bárány (1982). As a key lemma, they also introduced a common generalization of Sperner's lemma and Meshulam's lemma, which entails the existence of a rainbow simplex in vertex-colored simplicial complexes. Application of this lemma is of independent interest, and it is expected to be applied to topological combinatorics and matching theory.

A central theme in structural and extremal graph theory is to understand how local or forbidden configurations impose global restrictions on a graph. Dr. Hojin Chu has studied such problems, especially concerning cycles with prescribed modular lengths and connectivity-preserving subgraph deletion. One of his recent research directions concerns graphs avoiding cycles whose lengths belong to a prescribed residue class. These problems are closely related to classical questions in extremal graph theory on the existence and maximum number of edges in graphs with restricted cycle lengths. Dr. Chu, in collaboration with Boram Park and Homoon Ryu, studied 2-connected graphs avoiding cycles of length divisible by 4. He also studied the existence of cycles of length divisible by 3 or 4 with Ilkyoo Choi, Ringi Kim, and Boram Park. In another direction, together with Shinya Fujita, Boram Park, and Homoon Ryu, he investigated connectivity-keeping trees in triangle-free graphs, a problem concerning when a prescribed subgraph can be deleted while preserving graph connectivity.

Dr. Chu has also obtained results connecting graph theory with other areas of combinatorics and linear algebra. With Myungho Choi and Suh-Ryung Kim, he studied directed analogues of the Friendship Theorem and common-neighbor conditions in digraphs, which are related to combinatorial design theory. With Homoon Ryu, he studied symmetric Toeplitz and Hankel matrices using graph-theoretic decompositions and developed a linear-time algorithm for computing the Frobenius normal form of symmetric Toeplitz matrices. These works illustrate how structural ideas from graph theory can be applied to problems in extremal combinatorics, directed graphs, and combinatorial matrix theory.

Dr. Jeongsu Kim investigated a method for constructing an adaptively secure fully homomorphic message authentication code with desirable properties. In collaboration with Prof. Aaram Yun, he developed a construction that achieves adaptive security and pre-processable verification without relying on nested cryptographic primitives.

Graph coloring is an assignment of colors to the vertices of a graph. The square of a graph is the graph obtained from the original graph by adding edges between every pair of vertices at distance two. A *square coloring* of a graph is a proper coloring of the square of a graph. In 1977, Wegner conjectured an upper bound on the minimum number of colors required a square coloring of planar graphs. Since then, square coloring problems have attracted considerable attention, and several relaxations of square coloring have been introduced. An *odd coloring* of a graph is a proper coloring of a graph such that every non-isolated vertex has a color that appears an odd number of times in its neighborhood. A *proper conflict-free coloring* of a graph is a proper coloring of a graph such that each non-isolated vertex has a color that appears exactly once in its neighborhood. Odd coloring and proper conflict-free coloring are relaxations of square coloring, introduced in 2022, and 2023, respectively. Since their introduction, numerous papers have studied these new coloring concept across various graph classes. Dr. Hyemin Kwon studied odd coloring and proper conflict-free coloring of sparse graphs, including planar graphs with several authors. (doi.org/10.1016/j.dam.2024.11.016, and 10.1016/j.disc.2025.114648) In addition, they introduced new concepts of coloring of a graph, called a strong odd coloring (arXiv:2401.11653) and a proper *h*-con-

flict-free coloring (doi.org/10.1016/j.disc.2024.114233), which are relaxations of square coloring. Since their introduction, these new concepts have attracted significant attention, and active follow-up research has been carried out.

Computational Quantum Many-Body Theory

In materials with a large number of electrons, the quantum mechanical interactions between these particles often dictate the material's properties. These interactions, collectively referred to as electron correlation, can lead to a variety of emergent phenomena, such as transitions from metal to insulator states, colossal magnetoresistance, and high-temperature superconductivity. Materials exhibiting strong electron correlation, known as correlated quantum materials, are of particular importance for their potential role in the second quantum revolution, including their possible use as next-generation qubit materials. At the core of correlated quantum materials lies the quantum many-body problem, which is central to fully understanding and exploiting their properties.

In order to address this issue, the Computational Quantum Many-body Theory Group was established on September 1, 2022 at KIAS. The group members are Dr. Sangjin Lee, Dr. Heeju Kim, Dr. Mancheon Han, Dr. Taehee Ko, Mr. Seongjun Mo, Mr. Chulwan Lee, and Prof. Sangkook Choi. The group is developing classical and quantum algorithms to solve the quantum many-body problem and investigate the potential of correlated quantum materials for quantum information science. Based on these research activities, the group published three papers with three additional papers under review.



One of the group's most important achievements was the development of a fully self-consistent *ab initio* implementation of GW+EDMFT, published in Computer Physics Communication. This work represents the first fully self-consistent implementation of the GW+EDMFT approach from first principles and marks a critical step forward in the accurate modeling of correlated quantum materials. The group is currently preparing this computational package for open-source release with an improved user interface, which will make this powerful tool accessible to the wider research community.

The other notable achievement was the development of a new classical-quantum algorithm called Quantum Zeno Monte Carlo (QZMC), published in *npj Quantum Information*. The authors proposed a new hybrid algorithm to calculate static and dynamical observables with polynomial time complexity for a gapped system. This algorithm demonstrates intrinsic resilience to device noise and Trotter errors. QZMC computes static and dynamic properties without requiring overlap between the initial and target states or the use of variational parameters, while offering reduced quantum circuit depth. This algorithm could play an important role in the early fault-tolerant quantum computing era.

Data Science

The Data Science Group at the KIAS School of Computational Sciences, is led by Prof. Deok-Sun Lee, and includes Dr. Andrus Giraldo, Dr. Gangmin Son, Dr. Jibeom Choi, Dr. Taeyoung Kim, and Dr. Hoyun Choi. The group's research focuses on uncovering the organizational and functional principles of macroscopic complex systems by analyzing large-scale datasets from biological, ecological, economic, and social systems. They employ methods from data science, statistical physics, and network science to explore these intricate systems. In 2025, the group made significant contributions to the theory of higher-order networks and dynamical processes in complex systems, publishing several key papers on social dynamics on hypergraphs, renormalization group theory for complex networks, and traveling-wave stability on networks.

In collaboration with Korea University and several international researchers, Prof. Lee studied opinion dynamics driven by group interactions on hypergraphs. Extending the classical voter model, the study introduced a group-driven voter model that incorporates nonlinear reinforcement within groups represented as hyperedges. By analyzing the competition between nonlinear interaction strength and group size, the work demonstrated that consensus formation can occur faster than in the standard voter model and that there exists an optimal level of group interaction that minimizes the time to consensus. Analytical mean-field theory and numerical simulations revealed how higher-order social interactions fundamentally alter collective dynamics. This work was published in *Physical Review E*.

In another study, Prof. Lee and collaborators, including former group members Drs. Sudo Yi and Seong-Gyu Yang, developed an equilibrium-preserving Laplacian renormalization group (LRG) framework for networks and hypergraphs (arXiv:2507.04977). Renormalization methods have been widely used in statistical physics, but their application to complex networks has often relied on heuristic coarse-graining procedures. The new framework provides a principled formulation that preserves the equilibrium state and dominant spectral properties of diffusion dynamics while constructing renormalized Laplacian and adjacency matrices. Applying the method to various hypergraph structures revealed how connectivity distributions evolve across scales and how structural, dynamical, and informational scale invariance are interrelated. This work provides a rigorous theoretical foundation for multiscale analysis of complex networks and hypergraphs.

In addition, Dr. Andrus Giraldo investigated the stability of traveling waves in dynamical systems on networks. Traveling waves arise in many physical and biological systems, including neural activity, chemical reactions, and coupled oscillators. The study introduced a master stability framework that allows the stability of traveling waves to be analyzed independently of network size by computing master stability curves. By transforming the Floquet spectral problem into a delay differential equation, the method provides an efficient way to analyze wave stability in large networks with symmetries. This framework generalizes the classical master stability function approach for synchronization and offers a powerful tool for studying wave propagation and multistability in networked dynamical systems. This work was published in *Physical Review Letters*.

Through these studies, the group continues to advance the theoretical foundations of complex systems and higher-order networks, developing analytical frameworks that connect network structure, nonlinear dynamics, and collective behavior across multiple scales.

Computational and AI-Driven Biophysics

While protein structure prediction has been revolutionized by AI methods like AlphaFold, these models remain heavily reliant on computationally intensive multiple sequence alignments (MSAs) to capture the evolutionary covariation that defines structural constraints. Standard MSA search methods are computationally slow and often fail to identify remote homologous sequences—particularly for "orphan" proteins with sparse evolutionary context—creating a major bottleneck in high-throughput structural biology. To overcome these limitations and expand the search range, the group developed DeepFold-PLM, a novel framework that integrates advanced

protein language models (PLMs). By utilizing high-dimensional PLM embeddings and contrastive learning, the system's plmMSA module achieves MSA generation 47 times faster than standard methods like JackHMMER while increasing sequence diversity by a factor of two to uncover hidden sequence space. The framework, fully reimplemented in a scalable PyTorch environment with multi-GPU support, extends beyond monomers to predict multimeric complexes by incorporating interchain coevolutionary signals and using high-confidence monomer predictions as templates. Furthermore, DeepFold-PLM paves the way for a KIAS-based foundation model for protein structure prediction and design. This work was published as an original paper in *Bioinformatics* (2025), 41(11), btaf579.

In collaboration with experimentalists at Sungkyunkwan University, the researchers elucidated the molecular mechanisms underlying the malate-dependent and voltage-gated activation of the plant vacuolar anion channel AtALMT9. The microsecond-long molecular dynamics (MD) simulations were pivotal in revealing a unique conduction mechanism where negative membrane potential drives the channel from non-conductive basal states to a conductive state. By simulating unplugged structures, the group observed that R143 and R226 rotamers undergo opposing movements, relieving hydrophobic constrictions to create a new anion-binding site between the entry and exit. At high malate concentrations, the simulations demonstrated a "knock-on" mechanism where entering ions push preexisting ones through the pore. Furthermore, the MD simulations revealed that while high chloride concentrations can lead to ion trapping, even low malate levels disrupt chloride retention, facilitating the subsequent passage of chloride ions. Validating these findings, the simulated single-channel currents calculated from the simulations were highly consistent with experimental measurements. This work was published in *Nature Communications* (2025)16:1817.

Quantum Information Science

The 2025 research activities of the Quantum Information Science group at KIAS were led by Hyukjoon Kwon (HK), Spiros Kechrimparis (SK), Ki Hyuk Lee (KL), Eunuo Lee (EL), Youngjin Seo (YS), Youngrong Lim (YL), and Eunok Bae (EB).

EB left KIAS to become a senior researcher at ETRI. YL left KIAS to become an assistant professor at Chungnam National University. A former member, Minki Hhan (MH), recently accepted a position as an assistant professor at the KAIST School of Computing.

KIAS co-hosted the KIAS Quantum Information Workshop 2025 with KAIST.

HK conducted research on quantum algorithms and the simulation of quantum dynamics. HK published a paper on non-destructive entangled state discrimination [*Quantum Sci. Technol.* 10, 025048] in collaboration with YL and MH. He collaborated with Myungshik Kim (KIAS QUC distinguished professor) and Lijian Zhang at Nanjing University on the experimental demonstration of quantum fluctuation theorems [Sci. Adv. 11, eadq6014]. HK also explored a sample-based open quantum system simulation [Quantum Sci. Technol. 10, 045058] in collaboration with Mark Wilde at Cornell University, and published a paper on pseudochaotic quantum dynamics [*Nat. Commun.* 16, 6800] in collaboration with Gilyoung Cho's group at KAIST. As part of internal collaboration at KIAS, HK worked with Prof. Chanbong Hyeon (School of Computational Sciences) and Dr. Kwang Hyun Cho (CAINS) on the thermodynamic uncertainty relation for a quantum-mechanical system [*Phys. Rev. Research* 7, 033132].

HK and James Moran (JM, QUC Junior Fellow) are preparing the manuscript on their results on non-destructive discrimination of two-mode squeezed states with Gaussian operations in collaboration with Korea University. This extends the results previously obtained for finite-dimensional systems by HK and former members of KIAS, YL and MH.

EB and HK published a paper on an improved quantum approximate algorithm with a recursive procedure [J. *Phys. A* 58, 485304].



SK, along with JM and HK, studied both known and newly introduced supermaps exhibiting indefinite causal order and demonstrated advantages in the task of probabilistic channel distillation [*Phys. Rev. Research* 7, 043257].

SK and HK demonstrated a phenomenon termed the ambiguity of complexity of strategies, in which access to quantum memory can change the relative complexity of two strategies, and established lower bounds on the memory required to realize them [arXiv:2508.08092].

SK derived a protocol for secure quantum communication through measurement protection, where an optimal measurement remains unchanged under unknown noisy channels, often enhancing state distinguishability, suppressing quantum-bit error rates, and improving the noise tolerance in the BB84 quantum key distribution protocol. It was also demonstrated in proof-of-principle experiments [*IEEE J. Sel. Areas Commun.* 43(8), 2025].

KL investigated how overlap-determinability between quantum states relates to several no-go theorems in quantum information theory. KL and HK are also working on the symmetry-preserving, one-dimensional linear generalized uncertainty principle (GUP) and its implications for the estimation of the GUP parameter.

EL collaborated with Anuj Apte, Kunal Marwaha, Ojas Parekh, Lennart Sinjorgo, and James Sud on advancing the state of the art for Quantum Max Cut approximation [arXiv:2504.15276 (presented at ESA 2025), arXiv:2512.09896]. He also defined and proposed a quantum algorithm for a quantum analogue of convex optimization [arXiv:2510.02151].

YS and HK studied sample-based Hamiltonian and Lindbladian simulation, focusing on upper-bound behavior and typical-case performance. In particular, this work examined how the upper bound on sample-based Lindbladian simulation depends on the rank and the ensemble of Lindblad operators, using analytical calculations and numerical simulations.

Theoretical and Computational Biophysics

The Theoretical and Computational Biophysics group led by Prof. Changbong Hyeon works on problems involving biological systems. The primary research interest is to understand how the interactions between self-organized biopolymers contribute to defining living systems under non-equilibrium conditions. The group is currently working on (1) non-equilibrium statistical-mechanical principles underlying biological systems, (2) the structure, dynamics, and function

of human chromosomes, (3) the neuroscience of olfaction, and (4) problems in polymer physics. Described below are the selected publications in 2025.

Recent experiments show the emergence of metachronal waves (MCWs) from a chain of symmetrically beating nematodes aligned at the edge of sessile droplets. To gain physical understanding of the phenomenon, Dr. Narina Jung employed a coupled elastohydrodynamic model of active filaments and showed that a misalignment caused by a tilt against the bounding wall disrupts the synchronization and generates a constant time lag between adjacent filaments, giving rise to MCWs. It was further found that the MCWs, enhancing the fluid circulation, achieve their maximum thermodynamic efficiency over the same range of tilt angles observed in the nematode experiments. This study was published in *Phys. Rev. Research* 7, (2025) 023029.

It has been known that the minimal bound of the thermodynamic uncertainty relation (TUR) is modulated from that of the classical counterpart ($Q_{min} = 2$) when a quantumness is present in the dynamical process far from equilibrium. A study on a dissipative two-level system (TLS) subject to an external field, previously performed by Dr. Davinder Singh and Prof. Hyeon, indicates that quantum coherence can suppress the fluctuations of the irreversible current and loosen the TUR bound to $Q_{min(TLS)} \approx 1.25$. With Profs. Hyukjoon Kwon and Changbong Hyeon, Dr. Kwang Hyun Cho extended the field-driven single TLS to a quantum mechanically coupled two-qubit system (TQS), and explored how the quantum coupling between the two qubits, an additional complexity introduced to the problem of TLS, affects the photon current, fluctuations, and the TUR bound. He found that the TUR bound of the TQS depends on the strength of coupling, such that $Q_{min(TQS)} = Q_{min(TLS)} \approx 1.25$ when the two qubits are effectively decoupled under weak coupling, whereas another loose bound $Q_{min(TQS)} \approx 1.36$ was identified for two strongly coupled qubits under strong fields. By contrasting the TQS against two coupled noisy oscillators, this study has illuminated the quantumness unique to the TQS and its effect on the TUR. The findings, which were published in *Phys. Rev. Research* 7, (2025) 033132, form the basis for understanding the TUR of more general N-qubit systems.

Glycocalyx, a layer of glycolipids and glycoproteins that densely coats the cell surface, is known to enhance integrin nanocluster-associated downstream cell signaling. However, quantitative understanding of the effect of glycocalyx on the integrin nanocluster formation has been left unclear. Noting that glycocalyx can be modeled as a dense polymer brush on the cell membrane, two AI Research Fellows, Drs. Daeseong Yong and Ji Woong Yu, in collaboration with Profs. Bae-Yeun Ha and C. Hyeon, proposed that brush-induced depletion interactions are a potential force behind protein nanocluster formation. They considered a simplifying situation that cylindrical inclusions are embedded in mobile polymer brushes on 2D surfaces, and argued that a thermodynamic force of minimizing the depletion zone around the inclusions, thereby maximizing the overall entropy of the entire system, leads the cylindrical inclusions to experience apparent attraction and to form clusters. Indeed, the numerics showed that as long as the brush is shorter than the inclusions, the depletion attraction strengthens with the brush height. Brushes taller than the inclusions, on the other hand, weakens the attraction. As a result, the depletion interactions change non-monotonically with the brush height. Without any ad-hoc assumptions, this study explains the simulation results by solely relying on the entropy argument and the concept of correlation blob. The additional length scale introduced by the size of brush polymers relative to the size of inclusions necessitates further considerations beyond the theoretical argument adopted in the traditional studies of colloid-polymer mixtures in free space, making the brush-induced depletion interactions unique. This study was reported in *Macromolecules* (2025) 58, 8099-8106 and *J. Chem. Theor. Comp.* (2025) 21, 6161-6173.

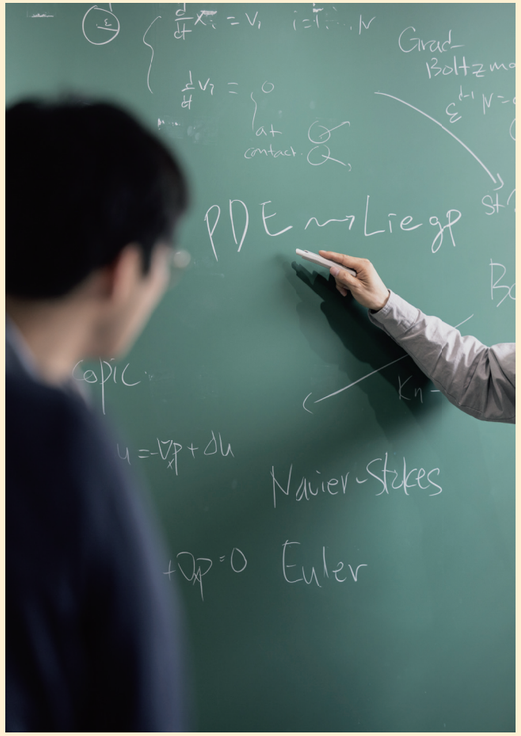
Theoretical and Computational Materials Science

The Theoretical and Computational Materials Science group at the KIAS School of Computational Sciences, led by Prof. Young-Woo Son, studies fundamental problems in first-principles electronic structure calculation methods and their applications to condensed matter systems. This report highlights three representative research directions pursued in 2025.

First, in collaboration with researchers at Seoul National University, the group uncovered new structural phenomena in layered materials. When multiple periodic patterns coexist on an atomic lattice, complex defect structures can emerge. Twisted trilayer graphene provides an ideal platform to explore such phenomena because the relative twist angles between layers can be precisely controlled. These twists generate moiré-of-moiré patterns that strongly modify the atomic structure. At small twist angles, interlayer interactions produce extended networks of structural domains that may host unusual electronic states. Combining transmission electron microscopy with large-scale simulations, the researchers observed triangular, kagome, and hexagram-shaped domain patterns separated by domain-wall networks. At extremely small twist angles, competition between stacking configurations leads to lattice reconstruction and symmetry breaking, emphasizing the importance of long-range interlayer interactions. This work was published in *Nature*.

Second, the group investigated the atomic and electronic structures of several ferroelectric oxides using the DFT + U + V method, in which on-site and inter-site interaction parameters are determined self-consistently through the pseudohybrid functionals for extended Hubbard interactions. Calculations of band structures, ferroelectric distortions, polarization, Born effective charges, and switching barriers were compared with results from LDA, GGA, meta-GGA, and the HSE06 hybrid functional. The DFT + U + V approach reproduces experimental trends well. In particular, inter-site interactions increase predicted band gaps and restore polar distortions that are often suppressed when only the on-site Hubbard U is included. The method achieves accuracy comparable to HSE06 while reducing computational cost by more than an order of magnitude, enabling efficient high-throughput studies of phenomena such as the bulk photovoltaic effect and band alignment in ferroelectric heterostructures. This work was published in *npj Computational Materials*.

Third, the group conducted a benchmarking study of first-principles methods based on DFT to evaluate the fundamental and optical band gaps of nanoporous materials, including metal–organic frameworks, covalent-organic frameworks, and zeolites. HSE06 hybrid-functional calculations tend to underestimate fundamental band gaps relative to the non-self-consistent GW approach, whereas DFT with self-consistent extended Hubbard interactions shows material-dependent agreement with GW results. Optical band gaps and absorption spectra calculated using GW+BSE and TDDFT (PBE) agree well with experiments, with GW+BSE providing higher overall accuracy. The group further found that exciton binding energies in nanoporous materials are significantly larger than those in conventional inorganic systems due to the spatial localization of the valence and conduction band edges within the same structural unit. These results provide practical guidance for selecting computational approaches for highly porous materials. This work was published in *Journal of Theoretical and Computational Chemistry*.



Visiting Scientists

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UNIST

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KISTI

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Bo, Stefano
King's College London

Choi, Ilkyoo
Hankuk Univ. of
Foreign Studies

Datta, Chandan
Indian Institute of
Technology Jodhpur

Ganardi, Ray Fellix
Nanyang Technological
Univ., Singapore

George, Jason
Texas A&M Univ.

Ghim, Cheol-Min
UNIST

Ha, Meesoon
Chosun Univ.

Hhan, Minki
The Univ. of Texas
at Austin

Hwang, Wonmuk
Texas A&M Univ.

Jang, Jaekyung
Pusan Nat'l Univ.

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Austria

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DGIST

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Kim, Jiseung
Jeonbuk Nat'l Univ.

Kim, Sejoong
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Koshino, Mikito
Osaka Univ.

Kwon, Hyukgun
Univ. of Chicago

Lee, Hae Seong
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Lee, Hyun Gyu
Sejong Univ.

Lee, Juhee
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Lee, Mi Jin
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Lie, Seok Hyung
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Inha Univ.

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Yeungnam Univ.

Shin, Seogwook
Freie Univ. Berlin

SLJOKA, Adnan
RIKEN

Yang, Seong-Gyu
Umeå Univ.

Yi, Sudo
Korea Institute of
Energy Technology

Yousefzadeh, Behrooz
Concordia Univ.

Conferences and Workshops

The 5th Biophysics Division Conference
Jan. 20 – Jan. 22

The 33rd KIAS Combinatorics Workshop
Feb. 20 – Feb. 21

2025 NCTS-KIAS Workshop on Theoretical Approaches to Quantum Materials
Apr. 17 – Apr. 19

2025 KIAS Computational Sciences Workshop
May 21 – May 23

The 34th KIAS Combinatorics Workshop
May 29 – May 31

Computational Quantum Many-Body Theory
Jul. 2 – Jul. 4

2025 Computational Science Division Strategic Planning Committee
Jul. 7 – Sep. 30

The 20th KIAS Workshop on Electronic Structure Calculations
Jul. 10 – Jul. 11

2025 Complex Systems Summer School
Aug. 12 – Aug. 14

KIAS-KAIST Workshop on Quantum Information
Aug.12 – Aug. 14

The 26th Discussion Meeting on Polymer Physics Theory
Sep. 5 – Sep. 7

International Assessment for Research
Sep. 14 – Sep. 17

2025 KIAS Workshop on Advancing Fundamental Science
Oct. 30 – Oct. 31

The 8th Quantum Information Conference
Nov. 13 – Nov. 14

International Conference on Quantum Technologies 2025
Dec. 8 – Dec. 10

KIAS Workshop on Complex Systems and Data Science
Dec. 17 – Dec. 19

The 35th KIAS Combinatorics Workshop
Dec. 22 – Dec. 24

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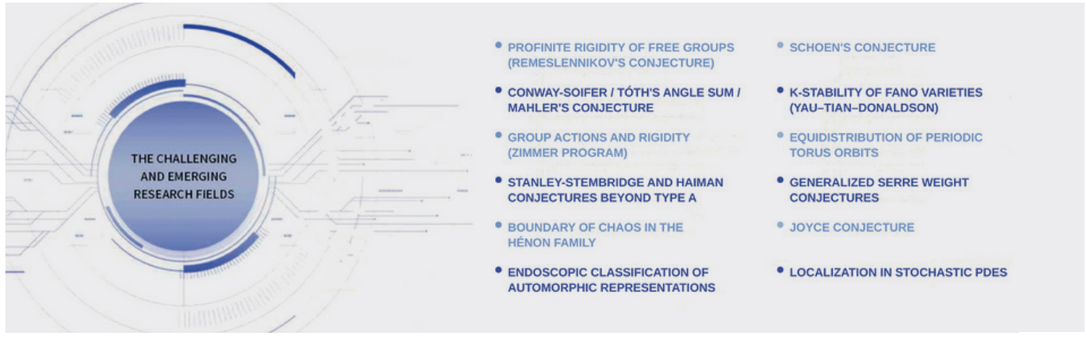
June E Huh Center for Mathematical Challenges

Introduction

The June E Huh Center for Mathematical Challenges (HCMC) was established by the Korea Institute for Advanced Study (KIAS) to resolve mathematical challenges and present emerging strategies in new fields. The HCMC also seeks to serve as a global hub for solving mathematical problems and satisfying the intellectual curiosity of young and adventurous mathematicians worldwide.

The HCMC aspires to exhibit international leadership by focusing on well-known mathematical challenges and creating synergy as a national brand for South Korea. It will contribute to enhancing national competitiveness in basic science and technology, which will ultimately have a positive impact on humanity.

The HCMC deals with problems in the following challenging and emerging research fields:



Research Activities

In 2025, its thirteenth year of operation, the HCMC successfully promoted research exchanges by organizing 25 domestic and international conferences and 83 seminars, including events focused on a single thematic core. In doing so, the HCMC has taken another step toward becoming a place for mathematicians to share their research and ultimately to solve important mathematical problems.

Conferences and Workshops

■ KIAS-LFANT Winter School on Number Theory

At the KIAS–LFANT Winter School on Number Theory, participants were introduced to recent developments in topics such as murmuration of modular forms (weight aspect), the moduli stack of elliptic curves over function fields, and the distribution of quantum modular forms. In addition, a graduate-level school was organized to cover more accessible topics—including murmuration of elliptic curves, the moduli stack of elliptic curves, and modular symbols—to help participants better understand the key ideas presented in the main lectures.

The event was held over four days and three nights and was attended by approximately 75 researchers and students from diverse regions, nationalities, and academic backgrounds. Participants engaged in lively discussions during the lectures and throughout the informal sessions of the program. The event concluded successfully, and the research networks and active exchanges fostered during the workshop are expected to lead to future collaborations and further developments in these research areas.

■ 2025 Spring FOA Colloquium: Function Theory, Operator Theory and Applications

This program was organized as a series of colloquia focusing on the interaction between function theory and operator theory, an area that has seen significant recent research activity. In particular, the program aimed to invite both leading experts and emerging scholars to discuss recent developments and explore future research directions related to Toeplitz operators, composition operators, and Hankel operators.

The colloquium consisted of ten lectures delivered by ten speakers. The topics of the lectures were as follows:

(1) Vector-valued measurable functions (In Sung Hwang, Sungkyunkwan University)
(2) Free probability and free entropy (Jaeseong Heo, Hanyang University)
(3) Logarithmic order in analytic function spaces (Hyungwoon Koo, Korea University)
(4) Complex symmetric Toeplitz operators on function spaces (Ji Eun Lee, Sejong University)
(5) Twisting in abstract harmonic analysis (Hun Hee Lee, Seoul National University)
(6) C*-algebras of étale groupoids (Ja A Jeong, Seoul National University)
(7) Hyponormality of Toeplitz operators on the Drury–Arveson spaces (Jongrak Lee, Sungkyunkwan University)
(8) Fock–Sobolev spaces and their applications (Hong Rae Cho, Pusan National University)
(9) Invariant subspaces among the linear pencil, a pair of operators, and their operator transforms (Jasang Yoon, University of Texas–Rio Grande Valley)
(10) Convergence of the powers of composition operators on weighted spaces of holomorphic functions (Inyoung Park, Korea University)

There were 101 participants in the program, and the lectures generated lively discussions that led to the emergence of many new research questions in this field.



KIAS-LFANT Winter School on Number Theory (January 7–10)



2025 Spring FOA Colloquium: Function Theory, Operator Theory and Applications (March 14–June 20)

■ **Complex Analysis Conference: Complex Faces**

From April 7 to 11, 2025, Prof. Nam-Gyu Kang (KIAS) co-organized the conference "Complex Faces" in Venice together with Nicola Arcozzi (University of Bologna), Ilia Binder (University of Toronto), Alexei Poltoratski (University of Wisconsin–Madison), and Stanislav Smirnov (Université de Genève). The conference focused on various topics in complex analysis, a field that has had profound influence on several areas of mathematics, including harmonic analysis, functional analysis, probability theory, and mathematical physics.

The program featured 21 invited speakers, including ICM plenary speakers Mikhail Lyubich and Greg Lawler, who delivered lectures titled "Mirrors of Conformal Dynamics: Julia Sets, Kleinian Groups, Schwarz Reflections, and Correspondences" and "Exploring a Paper of Kang and Makarov," respectively. Other talks covered a broad range of topics in complex analysis, such as Epstein's construction and holography of Loewner energy and Schwarzian action, Free energy of constrained planar Coulomb gases, Weil–Petersson curves, traveling salesman theorems and minimal surfaces, metrics on non-simple conformal loop ensemble gaskets, and random walks reflected off infinity.

In addition to the formal lectures, participants engaged in active discussions, exchanging feedback on the presentations and sharing insights on recent research developments in complex analysis.

■ **Universality, Nonlinearity, and Integrability - In honor of Percy Deift**

The conference was held at the Korea Institute for Advanced Study (KIAS) from May 12 to 16, 2025, with the aim of exploring the intersection of universality, nonlinearity, and integrability. These interconnected areas have long provided a dynamic and fertile framework that stimulates mutual development and has led to many exciting new results.

The program featured presentations on a wide range of topics, including random matrix theory, integrable nonlinear partial differential equations, and KPZ theory. In addition, several presentations during the conference were dedicated to celebrating the many contributions of Percy Deift. Participants actively engaged in discussions with the speakers, exchanging ideas and insights on the lectures as well as on future research directions.

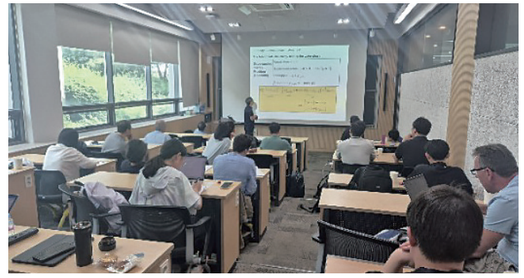
■ **2nd KIAS Graduate Student Meeting in Pure Mathematics**

The 2nd KIAS Graduate Student Meeting in Pure Mathematics was held on May 23, 2025 at KIAS, organized by C.-F. Nyberg-Brodda and Sang-hyun Kim. Eleven graduate students from all over Korea gave 15-minute research presentations on their topics of research, ranging from knot theory, Teichmüller theory, rerepresentation theory, differential equations, category theory, and algebraic geometry. A one-hour plenary lecture by Prof. Nam-Gyu Kang (KIAS) started the event, and included both a good introduction to his area of research, including his joint work with many Fields Medalists, as well as much good advice for the early career researchers and graduate students in the audience; many participants specifically emphasized how meaningful this was for them. The event was attended by around 40 people, with over half having registered an interest in giving a presentation. The participants had many opportunities to discuss mathematics and engage in networking.

■ **The Future of PDEs: Interdisciplinary Connections Through Generations**

The conference "The Future of PDEs: Interdisciplinary Connections Through Generations" was held from June 10 to 13, 2025, in Room 8101 of Building 8 at the Korea Institute for Advanced Study (KIAS). The four-day program consisted of 21 invited lectures and discussion sessions by leading researchers in the field of partial differential equations (PDEs) from Korea and abroad.

Distinguished mathematicians including Mikhail Feldman (University of Wisconsin–Madison), Dehua Wang (University of Pittsburgh), and Chunjing Xie (Shanghai Jiao Tong University) presented recent research results on topics such as transonic shocks, vortex sheets, and the incompressible Euler system. Through active questions and discussions, the conference fostered lively scholarly exchange among participants and provided valuable insights into recent developments in PDE research.



The Future of PDEs: Interdisciplinary Connections Through Generations (June 10–13)

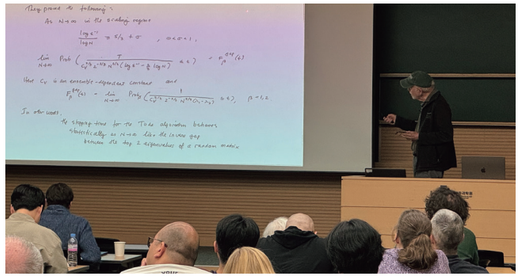
■ **2K-GATE Workshop I**

The 2K-GATE Workshop featured invited researchers from leading institutions such as Rice University, the City University of New York (CUNY), the University of Pisa, and KAIST, who presented cutting-edge results in geometric group theory, low-dimensional topology, hyperbolic geometry, and dynamics. The talks covered a wide range of topics, including boundary theory of groups, quasi-isometry and rigidity, pseudo-Anosov maps, infinite-dimensional hyperbolic spaces, and boundary reconstruction of 3-manifolds.

The academic depth and international standing of the speakers significantly enhanced the level of the workshop and provided

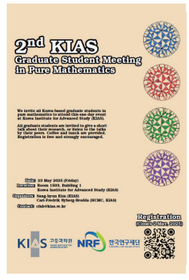


Complex Analysis Conference: Complex Faces (April 7–11)



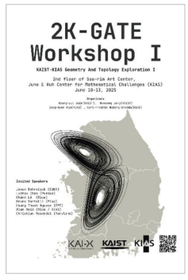
Universality, Nonlinearity, and Integrability - In honor of Percy Deift (May 12–16)





2nd KIAS Graduate Student Meeting in Pure Mathematics (May 23)





2K-GATE Workshop I (June 10–13)

participants with a comprehensive overview of current developments in these areas. More than fifteen lectures were delivered, each followed by lively discussions and in-depth research exchanges. In addition, a lightning session for early-career researchers allowed participants to share diverse ideas and explore new research directions in this fast-paced format. By bringing together interdisciplinary themes and intergenerational dialogue, the workshop proved to be a highly successful event with substantial academic impact.

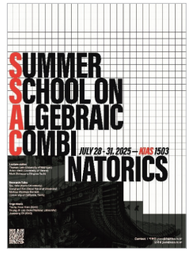
■ **Workshop on Moduli Spaces, Virtual Invariants and Shifted Symplectic Structures 2025**

The Workshop on Moduli Spaces, Virtual Invariants and Shifted Symplectic Structures 2025 was held from June 15 to 20, 2025, at the June E. Huh Center. The workshop brought together experts in enumerative geometry and derived geometry, two important areas of algebraic geometry, to share recent advances and developments in the field.



Workshop on moduli spaces, virtual invariants and shifted symplectic structures 2025 (June 15–20)





Summer School on Algebraic Combinatorics (July 28–31)

The 19 specialists from around the world—including Japan, China, Spain, France, the United States, and Australia—delivered presentations to about 50 participants in the workshop. The event provided a vibrant forum for discussion and exchange on a wide range of research topics in these areas.

■ **Summer School on Algebraic Combinatorics**

The program consisted of three lecture series and three research presentations. The lecture series provided in-depth coverage of major areas of algebraic combinatorics, offering a systematic introduction ranging from fundamental background material to recent research developments. In addition, the research presentations highlighted cutting-edge work in progress by the speakers, providing participants with opportunities for lively discussion and engagement.

This summer school offered a rare opportunity for participants to learn about the latest developments in core areas of algebraic combinatorics through lectures and presentations delivered by leading scholars in the field. In particular, the three lecture series guided participants from theoretical foundations to applications, helping them develop a comprehensive understanding of current research trends and future directions. The research presentations introduced emerging topics that connect algebraic combinatorics with related areas, leading to active discussions among participants.

The event provided a valuable platform for graduate students and early-career researchers in Korea to interact directly with internationally renowned mathematicians. This interaction contributed to the development of international academic networks and helped foster opportunities for future research collaboration. As a result, the event strengthened the algebraic combinatorics research community in Korea and is expected to have a positive long-term impact on the growth and vitality of the field.

■ **KIAS-KAIST Workshop on Current Challenges in Mathematics**

This workshop brought together three central areas of mathematics—probability, geometry, and combinatorics—under a broad interdisciplinary theme. The program achieved a high level of academic depth by inviting seven distinguished scholars, including June E. Huh (Princeton University) and Michel Talagrand of the French National Centre for Scientific Research (CNRS).

Over the course of seven lectures, participants explored advanced research topics such as stochastic processes and geometric group theory. These talks brought together diverse perspectives across disciplines, fostering lively and constructive discussions as well as meaningful exchanges of research ideas.

Overall, the workshop proved to be academically very successful, inspiring new connections between fields while providing a valuable forum for sharing recent developments in contemporary mathematical research.

■ **2025 International Review Committee (HCMC & School of Mathematics)**

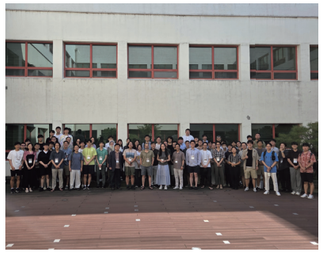
The international review committee, held for the first time since 2018, took place from September 14 to 17, 2025, with five distinguished mathematicians serving as committee members. The reviewers conducted interviews not only with faculty members, postdoctoral researchers, and long-term visitors from the School of Mathematics and the June E. Huh Center for Mathematical Challenges, but also—unexpectedly—with administrative staff. In addition to the materials initially provided, they actively requested supplementary data, including information on the career trajectories of researchers trained at the institute over the past ten years, demonstrating a highly engaged and thorough evaluation process.

Notably, the international reviews of the three divisions of KIAS—Mathematics, Physics, and Computational Sciences—were conducted simultaneously, which was unusual. Opportunities were arranged for reviewers from different divisions to exchange views and interact with one another, allowing the evaluation to proceed from multiple perspectives and adding further significance to the process.

Furthermore, taking advantage of the presence of these distinguished scholars, additional academic events were organized after the formal review schedule. Martin Bridson and Amie Wilkinson participated as speakers in a workshop, while Bernd Sturmfels delivered a seminar. These lectures provided valuable opportunities for the institute's researchers to engage with leading scholars and contributed to a meaningful conclusion of the international review.

■ **2025 Fall Colloquium: Challenging Mathematical Problems**

This lecture series was held from September 25 to December 18, 2025, in the seminar room of the June E. Huh Center for Mathematical Challenges at Soorim Foundation. The program was designed to introduce major open problems from various areas of mathematics—including topology, algebraic geometry, and probability theory—to researchers from different fields.





KIAS-KAIST Workshop on current challenges in mathematics (August 25–28)



International Review Committee (September 14–17)

The speakers included Homin Lee (KIAS), Hyungryul Kim (KIAS), Yongnam Lee (IBS-CCG), Junghwan Park (KAIST), Hyeongju Hwang (POSTECH), Heejong Lee (KIAS), Byunghan Kim (Yonsei University), and Jaeseong Oh (Sungkyunkwan University).

Their lectures covered a wide range of topics, including Rigidity in group actions, Canonical bases for moduli spaces of local systems on a surface, Deformation and moduli of varieties, four-dimensional topology and knot theory, Physics-informed AI for learning to solve PDEs, Families of mod p local Galois representations, model-theoretic perspectives on Schanuel's conjecture for the complex field with exponentiation, and combinatorics of knot homology.

Through the discussion of these challenging problems, the series provided mathematicians from diverse backgrounds with valuable opportunities to learn about important questions and perspectives from other areas of mathematics.

Including this one, 24 conferences were held in 2025. These conferences spurred the intellectual curiosity of researchers and provided opportunities for in-depth communication and interaction between mathematicians from all over the world.



2025 Fall Colloquium: Challenging Mathematical Problems
(September 25–December 18)

- KIAS-LFANT Winter School on Number Theory (Jan. 7–10)
- Harmonic Anaysis Winter School (Jan. 7–10)
- The 20th ILJU School of Mathematics - Banach Spaces and Related Topics (Feb. 4–8)
- 2025 Spring FOA Colloquium: Function Theory, Operator Theory and Applications (Mar. 14–Jun. 20)
- 2025 Spring KIAS June E Huh Center for Mathematical Challenges Public Lecture Series (Mar. 15–Jun. 14)
- 2025 Spring Colloquium: Challenging Mathematical Problems (Mar. 20–Jun. 12)
- Complex Analysis Conference: Complex Faces (Apr. 7–11)
- Random Matrices and Related Topics in Jeju (May. 6–10)
- Universality, Nonlinearity, and Integrability - In honor of Percy Deift (May. 12–16)
- 2nd KIAS Graduate Student Meeting in Pure Mathematics (May 23)
- Future of Mathematics by June E Huh Fellows (Jun. 4–5)
- The Future of PDEs: Interdisciplinary Connections Through Generations (Jun. 10–13)
- 2K-GATE Workshop I (Jun. 10–13)
- Workshop on moduli spaces, virtual invariants and shifted symplectic structures 2025 (Jun. 15–20)
- Ho-Am Prize Commemorative Colloquium by Prof. Sug Woo Shin (Jul. 3)
- Summer School on Algebraic Combinatorics (Jul. 28–31)
- 2025 Ho-Am Prize Commemorative Public Lecture by Prof. Sug Woo Shin, HCMC Distinguished Professor (Aug. 7)
- Quantum Analysis & Geometry (Aug. 17–20)
- KIAS-KAIST Workshop on current challenges in mathematics (Aug. 25–28)
- 2025 Fall FOA Colloquium: Function Theory, Operator Theory and Applications (Sep. 5–Dec. 12)
- 2025 Fall KIAS June E Huh Center for Mathematical Challenges Public Lecture Series (Sep. 13–Dec. 13)
- 2025 International Review Committee (HCMC & School of Mathematics) (Sep. 14–17)
- 2025 Fall Colloquium: Challenging Mathematical Problems (Sep. 25–Dec. 18)
- Mapping Class Groups at KIAS (Oct. 13–17)
- 2025 KIAS Winter School on Mathematics and AI (Dec. 2–5)

HCMC Faculty and Research Fellows

Keum, JongHae
HCMC Distinguished Professor

Lee, Woo Young
HCMC Distinguished Professor

Kim, Minhyong
HCMC Distinguished Professor

Shin, Sug Woo
HCMC Distinguished Professor

Baek, Jineon
June E Huh Fellow

Kim, Seonwoo
June E Huh Fellow

Kim, Wooyeon
June E Huh Fellow

Lee, Heejong
June E Huh Fellow

Lee, Homin
June E Huh Fellow

Park, Hyeonjun
June E Huh Fellow

Yang, Jonguk
June E Huh Fellow

Chou, You-Cheng
HCMC Fellow

De la Nuez Gonzalez, Javier
HCMC Fellow

Jung, Mingu
HCMC Fellow

Kwak, Sanghoon
HCMC Fellow

Kim, In-Kyun
HCMC Fellow

Kim, Wontae
HCMC Fellow

Lee, Chul-hee
HCMC Fellow

Nyberg Brodda, Carl-Fredrik
HCMC Fellow

Oh, Jaeseong
HCMC Fellow

Oh, Sewook
HCMC Fellow

Ryu, Jaehyeon
HCMC Fellow

Publications

Kim, In-Kyun; Kishimoto, Takashi; Won, Joonyeong
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Lee, Chul-hee; Yamauchi, Takuya
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Quantum Universe Center

The Quantum Universe Center (QUC) aims to become a research center that focuses on developing and sharing new insights into the fundamental properties of matter and physical forces, condensed matter and emergent phenomena, quantum information, and quantum-inspired mathematics. We hope these activities lead to a deeper understanding of nature and result in new real-world applications.

The QUC, established in 2014, engages in five fields of research: cosmology and astrophysics (the Korea Dark Energy Survey [KDES]), information science and technology, quantum gravity and superstring and M-theory, elementary particle physics and quantum states of matter.

The KDES is headed by Prof. Changbom Park, along with QUC fellow Dr. Jeong-Gyu Kim, research fellows Dr. Jie Li and Dr. Naik Suvedha Suresh.

The Information Science and Technology Group is led by four professors, Prof. Jaewan Kim, Prof. Hyukjoon Kwon, Prof. Sangkook Choi and Prof. Myungshik Kim, who are aided in their work by research fellows Dr. James Moran, Dr. Nikolaos Georgios Eftaxias, Dr. Bagchi Shrobona, Dr. Prabuddha Roy and Dr. Sangjin Lee.

The Quantum Gravity and Superstring & M-Theory Group consists of three full-time faculty members, Profs. Piljin Yi, Sangmin Lee and Sungjay Lee. The group currently includes a QUC fellow Dr. Kanghoon Lee as well as three research fellows Dr. Minsung Kim, Dr. Tabasum Rahnuma, and Dr. TaeHwan Oh.

The Elementary Particle Physics Group is led by Prof. Pyungwon Ko, Prof. Eung Jin Chun, and Prof. Seung Joon Lee with research fellows Dr. Jae Hoon Jeong, Dr. Xing-Yu Yang, Dr. Raymundo Ramos, Dr. Flacke Thomas and Dr. Heejoo Kim.

The Quantum States of Matter Group consists of four professors – Prof. Hyunggyu Park, Prof. Jae Sung Lee, Prof. Kwon Park and Prof. Young-Woo Son – with QUC fellow Dr. Jinwoong Kim and research fellow Dr. Hee Seung Kim.

The QUC hosted a wide range of academic events in 2025 to fulfill the QUC's main purpose of fostering collaborative research.

QUC successfully hosted 13 academic events:

- "Focused workshop on AI in High Energy Physics" (organized by Prof. Seung Joon Lee)
- "Computational Quantum Many-Body Theory School" (organized by Prof. Sangkook Choi)
- "Survey Science Group Workshop 2025" (organized by Prof. Changbom Park)
- "Quantum Resources 2025" (organized by Prof. Hyukjoon Kwon)
- "Amplitudes 2025 Summer School" (organized by Prof. Sungjay Lee)
- "Quantum Information Dynamics and Non-Equilibrium Physics" (organized by Prof. Hyukjoon Kwon)
- "KIAS Summer School 2025 on Extragalactic Astronomy and Cosmology" (organized by Prof. Changbom Park)
- "AstroAI Asian Network Summer School" (organized by Prof. Changbom Park)
- "18th International Workshop on Top Quark Physics (TOP 2025)" (organized by Prof. Seung Joon Lee)
- "East Asia Joint Seminars on Statistical Physics 2025" (organized by Prof. Jae Sung Lee)
- "The 9th KIAS School and Workshop on Quantum Information and Thermodynamics" (organized by Prof. Jae Sung Lee)
- "2025 KIAS QUC Workshop" (organized by Prof. Jae Sung Lee)
- "International Conference on Quantum Technologies 2025 (ICQT 2025)" (organized by Prof. Hyukjoon Kwon)

Research Activities

The Astrophysics and Cosmology group is headed by Profs. Changbom Park, Donghui Jeong, and Research Prof. Juhan Kim and Jeong-Gyu Kim. Postdocs in the group include Drs. Alexandra Dupuy, Priya Goyal, Jaewon Yoo, Preetish Mishra, Zahra Davari Dolatabadi, Jie Li, Martha Margarita Lopez Gutierrez, Da Bi, Trupti Patil, Boon Kiat Oh, and Naik Suvedha Suresh.

In 2025, Prof. Park, in collaboration with Dr. F. Dong (Yunnan University), constrained the CPL parameters of the dark energy equation of state using SDSS data and found that the equation of state is consistent with no evolution, implying no phantom divide crossing at redshifts below 0.7. He was also analyzing the Dark Energy Spectroscopic Instrument (DESI) data and 56 multiverse simulations. Using the HR5 simulation, he is involved in many scientific projects, such as finding the mechanism and epoch of emergence of the relation between galaxy properties and clustercentric radius. Prof. Park is collaborating with many astronomers in Korea to conduct multi-object spectroscopic surveys of galaxies such as A-SPEC (the All-sky Spectroscopic Survey of the nearby universe) and the KLST project, a plan for building a telescope system with an effective diameter of 9.2 m that is dedicated to spectroscopic observations.

Research Professor Juhan Kim continued the scientific analysis of the Horizon Run 5 cosmological simulation, contributing to studies on intrahalo light formation history. In parallel, he developed LagEunha, a next-generation Lagrangian hydrodynamics code based on the Laguerre tessellation. He also developed Lumina-SN, a GPU-accelerated Monte Carlo radiative transfer code for Type Ia supernova spectral modeling, achieving automated five-dimensional parameter fitting and making the code publicly available.

Prof. Donghui Jeong's research in 2025 centered on the HETDEX survey analysis, leading to the first detection of a Baryon Acoustic Oscillation (BAO) signal in the dataset. His group played a foundational role by measuring the Lyman-alpha emitter luminosity function and constructing survey-accurate random catalogs, enabling all subsequent cosmological clustering measurements. He contributed to a DESI–HETDEX cross-validation study of emission-line classification methods, and to a search for sub-solar mass compact object using LVK O4a data. On the theoretical front, he helped validate second-order, general-relativistic descriptions of large-scale observables, providing essential groundwork for precision cosmology analyses.

QUC Research Professor Jeong-Gyu Kim has been developing a new semi-analytic model of density-bounded H II regions, working with SNU graduate student Chanjin Lee to validate the model through numerical simulations. He has also mentored SNU graduate student Gain Lee in cosmological hydrodynamic simulations using an improved mesh refinement strategy. He has been working with KIAS group members to develop new cosmological simulations with the SWIFT code. In addition, he has collaborated with Lachlan Lancaster of Columbia University on interstellar bubbles driven by stellar winds and radiation; with Samuel Crowe of Oxford on strongly magnetized H II regions; and with Chang-Goo Kim of Princeton University and other researchers to quantify the role of cosmic rays in driving galactic outflows using TIGRESS++ simulations of star-forming galactic disks.

Dr. Jaewon Yoo, a QUC postdoctoral fellow (until August 31, 2025), studies intracluster light (ICL) as a probe of dark matter and the dynamical evolution of galaxy clusters. Using the Horizon Run 5 (HR5) simulation, she demonstrated that ICL effectively traces the dark matter distribution over cosmological timescales. She analyzed

galaxy clusters in the Illustris TNG300 simulation, examining virial ratios and spatial distribution similarities across radial scales. She also investigated Cluster-EAGLE simulations under different dark matter models, cold dark matter (CDM) and self-interacting dark matter (SIDM) to explore how ICL properties can constrain dark matter physics.

Dr. Alexandra Dupuy conducted research on the reconstruction of large-scale cosmic structures using deep learning techniques. She developed a convolutional neural network (CNN) framework to infer three-dimensional dark matter density, gravitational potential, and peculiar velocity fields from galaxy positions and radial peculiar velocities. The method was trained and validated on mock datasets designed to reproduce the observational geometry of Cosmicflows-4 and then applied to the actual Cosmicflows-4 data to probe structures hidden in the Zone of Avoidance. The reconstruction recovered known galaxy clusters and revealed a mass concentration consistent with the Great Attractor.

Dr. Priya Goyal continued her work on the morphology of galaxies in the Horizon Run 5 (HR5) simulations. She published a study on the redshift evolution of the Fundamental Plane of HR5 early-type galaxies and its physical origin. She is also investigating the impact of cosmological processes such as gravitational evolution, redshift-space distortions, and massive neutrinos on large-scale structure morphology using Minkowski functionals, Betti numbers, and Minkowski tensors. She contributed to a collaborative analysis of anomalies in ACT CMB lensing convergence maps and began exploring cross-correlations between CMB lensing and large-scale structure tracers to improve delensing efficiency in CMB maps.

Dr. Zahra Davari has been constraining different classes of quintessence potentials using Alcock-Paczynski test results. She published a study on the impact of a modified Compton effect on CMB anisotropies using Planck 2018 data. She is also a collaborator in the CosmoVerse working group WG2 (Data Analysis in Cosmology), which addresses observational tensions in cosmology through systematics and fundamental physics.

Dr. Preetish Mishra is studying the fundamental scaling relations of galaxies using both observational and simulation data. Using the Horizon Run 5 simulation, he investigated the origin of the critical mass scale at which many galaxy scaling relations show transitions and identified the physical processes responsible for this threshold. He also explored optimal strategies to minimize the scatter in the Tully–Fisher relation using data from the SDSS-IV MaNGA survey. He developed a pipeline to analyze galaxy structural properties using early data from Rubin LSST Data Preview 1 and contributed to the detection of a hidden dwarf galaxy embedded within a larger galaxy through its chemical signature using MUSE integral-field spectroscopic data.

Dr. Jie Li investigated the relationship between the initial conditions and the galactic properties across cosmic time in Horizon run 5, uncovering the relationship between spin vectors vs. the initial angular momentum from high redshifts to low red shifts. She is studying the spin relations between dark matter, gas, and stellar components.

Dr. Martha López joined the group in January 2025 and is working on the evolution of galaxies in galaxy clusters using the HR5 simulation and the upcoming LSST data. She joined the Korean Rubin Science Collaboration (KRSC) to use Legacy Survey of Space and Time (LSST) data to investigate galaxy distributions and the origin of the scaling relations, such as the Morphology-Star Formation Activity-Clustercentric Radius relation across different cosmic epochs. She is using HR5 lightcone data to implement a galaxy proto-cluster identification scheme based on a spherical collapse model to develop a method applicable to observational datasets such as Rubin LSST.

Dr. Da Bi joined the group in July 2025 and started the development and optimization of a high-performance cosmological hydrodynamics simulation framework for next-generation high-resolution simulations. Since joining the group, he has initiated a rigorous evaluation and selection process for an appropriate cosmological hydrodynamics code, with SWIFT currently emerging as the primary candidate. This process has involved comprehensive benchmarking focused on numerical accuracy, computational efficiency, and suitability for high-resolution applications.

Dr. Trupti Patil joined KIAS in July 2025 and initiated a theoretical investigation of quintessence dark energy perturbations with non-zero sound speed and a parameterized equation of state. Her work extends the standard clustering quintessence framework by incorporating pressure perturbations through an effective sound speed. She has developed the linear perturbation theory for a two-component cosmological fluid comprising dark matter and quintessence, deriving the full set of evolution equations for density perturbations within the Newtonian sub-horizon regime. She has extended the analysis to compute the linear growth function for the variable sound speed scenario.

Dr. Boon Kiat Oh joined the group in October 2025 and is developing the black hole physics module in Enzo. He leads two projects in the AGORA collaboration: investigating dwarf-galaxy simulations across multiple codes to address the core–cusp problem and comparing black hole physics implementations between codes. He is designing and running next-generation cosmological simulations in KIAS. He also collaborates on filament properties in CAMELS, environmental impacts on galaxy properties, high-redshift simulations, and a fully automated optimization pipeline for simulations.

Dr. Naik Suvedha Suresh joined KIAS in November 2025. She has been working on inflation and testing models using cosmological observations. She completed her work on the morphological analysis of inflationary signatures using 21 cm simulations during the epoch of reionization. At KIAS, she will focus on detailed investigations of dark energy models using the Alcock–Paczynski (AP) test in light of the latest observations from DESI.

During the year, the Statistical Physics Group held regular internal group meetings. These meetings were held every two weeks on Thursday at KIAS and provided an opportunity for in-depth discussions on current issues and recent progress in stochastic and quantum thermodynamics. The meetings were open to both KIAS members and external scholars. In addition, the Statistical Physics Group organized the 9th KIAS School and Workshop on Quantum Information and Thermodynamics (November 2–5), providing a platform for the next generation of students and researchers to understand the significant recent progress in our comprehension of nonequilibrium thermodynamics within the context of quantum information.

The Condensed-Matter Physics Group regularly holds meetings organized by Prof. Kwon Park. During these meetings, group members discuss their research progress on topics such as quantum Hall effects, topological insulators, strongly correlated superconductivity, nonequilibrium physics, and more.

In addition to group meetings, the group hosted speakers from other institutions to present their research and exchange ideas.

Quantum Gravity and Superstring & M-Theory Group has been actively engaged in research on various topics in quantum field theory, string theory, and gravitational physics, including supersymmetric field theories, scattering amplitudes, classical double copy, and the AdS/CFT correspondence.

Dr. Kanghoon Lee joined the group as a QUC Fellow in September 2025, bringing expertise in scattering amplitudes. He has been pursuing research on the classical double copy and perturbative approaches to general relativity, building on his earlier work that derived the Schwarzschild black hole metric to all orders in perturbation theory.

Dr. Minsung Kim studied codimension-2 defect partition functions and quantum Seiberg-Witten curves in 5d rank-1 supersymmetric QFTs using generalized blowup equations. He showed that these defect partition functions satisfy difference equations encoding the quantization of classical Seiberg-Witten curves, and explored novel transitions related to SL(2,Z) transformations and Hanany-Witten transitions.

Dr. Tabasum Rahnuma extended the “AdS S-matrix” formulation from massive scalars to massive vector fields on Anti-de Sitter spacetimes, recovering the flat-space S-matrix with subleading curvature corrections. She derived massive vector propagators and computed the AdS S-matrix for processes in the Abelian Higgs Model.

The Elementary Particle Physics Group at KIAS has been actively engaged in research on various topics in theoretical and computational high-energy physics during 2025.

Prof. Pyungwon Ko continued his research program on dark sector phenomenology, applying advanced machine learning techniques including Transformer architectures and deep learning-based parameter space scanning to collider searches for dark Higgs bosons and leptophobic dark photons. He also explored quantum computing algorithms for event topology analysis in high-energy collider signals and machine learning methods for efficient integration of multibody phase space in Monte Carlo simulations. Dr. Jae Hoon Jeong extended his work on electroweak precision observables, further developing the general vertex structure for HℓℓZ interactions and investigating new physics implications of the Higgs boson coupling measurements at the LHC. Dr. Raymundo Ramos continued his studies on dark matter phenomenology and Standard Model extensions with new scalar particles, addressing dark matter relic abundance calculations, baryon asymmetry, and neutrino mass generation mechanisms through coupled Boltzmann equation analyses.

Prof. Seung J. Lee pursued a broad research program spanning cosmology, particle physics, and interdisciplinary applications of quantum field theory. In collaboration with Jay Hubisz, He Li, and Bharath Sambasivam, he advanced the quasi particles and cosmological collider—modeling a strongly coupled sector with a 5D holographic (AdS/CFT) realization—developing how strongly coupled conformal fields coupled to inflaton can be probed via cosmological collider. With Thomas Flacke (also with Benjamin Fuks, Jinheung Kim, and Dongchan Kim), he developed a theoretical estimate of BSM interpretation for newly discovered toponium at LHC. The paper will be published in *Physics Letter B.* With Heejoo Kim, he has been developing an effective field theory (EFT) for cosmic axion strings based on a Kalb-Ramond formalism. In collaboration with Benjamin Fuks, Dongchan Kim, and Dongwoo Kang, he refined the ttH coupling form factor analysis bridging strongly coupled Higgs dynamics to the quantum critical Higgs framework.

Current research directions include Composite Inflaton, Dark energy phenomenology based on recent DESI data, continuum dark matter scenarios through unparticle decay mechanisms, thermal WIMP revival via dark sector phase transitions, and the development of Rydberg sensor for axion detection.

The group continued to actively organize and participate in academic events, including workshops on amplitude methods, AI applications in high energy physics, and dark matter phenomenology, fostering interdisciplinary research collaborations across these fields.

Researchers in the QUC Quantum Information Group have conducted research on various topics in quantum information theory, including quantum state discrimination, quantum nonlocality, quantum communication, and quantum metrology. The members are Hyukjoon Kwon (HK), James Moran (JM, QUC Junior Fellow), Giorgos Eftaxias (GE), Shrobona Bagchi (SB), Prabuddha Roy (PR), and Myungshik Kim (MK, QUC Distinguished Professor). In particular, two QUC Scholars, Prof. Isaac H. Kim (UC Davis) and Prof. Jong Yeon Lee (University of Illinois Urbana–Champaign), joined KIAS and conducted research on quantum information theory and quantum many-body systems.

QUC organized Quantum Resources 2025 (March 17–21, Jeju, Korea, organized by Prof. Hyukjoon Kwon). More than 100 researchers from around the world participated in the workshop, which included 10 invited presentations, 28 contributed presentations, and more than 50 poster presentations. The QUC Scholars, Prof. Jong Yeon Lee and Prof. Isaac H. Kim, organized the Quantum Information Dynamics and Non-Equilibrium Physics workshop (June 23–27, Seoul, Korea). During the workshop, 18 invited talks were presented, along with active discussions and networking.

HK and MK published a paper on experimental demonstration of quantum fluctuation theorems *[Sci. Adv. 11, eadq6014]* in collaboration with Lijian Zhang at Nanjing University.

JM became a QUC Junior Fellow this year and conducted research on coherent-state discrimination using continuously labelled non-Gaussian measurements, which was recently accepted in Quantum. Work toward a more fundamental understanding of differences between discretely labelled measurements (e.g., photon counting) and continuously labelled measurements (e.g., homodyne detection) is underway.

GE and HK have been collaborating with Roger Colbeck (King's College London, UK) and Mirjam Weilenmann (Inria Institute, France). They constructed algorithms discovering depolarization protocols for multipartite non-signaling correlations, and they developed theory- and device-independent techniques finding quantum bounds of multipartite Bell inequalities.

SB and HK have conducted research on noise-robust snapshotting for obtaining multi-time quantum correlation functions throughout quantum dynamics that can be performed under depolarizing error channels. SB, PR, GE, and HK also studied the Bell non-locality in triangle network scenario and thought of a way to derive new inequalities in this scenario. SB also finished work on the interaction of pre- and post-selected quantum systems with collaborators based at Tel Aviv University (Israel) and LMU (Germany) [arXiv:2512.18907, accepted in PRA].

PR conducted research on unitary operations certification in prepare-measure communication complexity games *[Phys. Rev. A 112, 062216]*, as well as on self-testing protocols in Bell nonlocal scenarios. PR and HK have been working on multiparameter estimation in quantum metrology using a sequential measurement framework.

Prof. Young-Woo Son of the Quantum States of Matter Group has investigated the development of first-principles computational methods aimed at understanding quantum materials in which strong local Coulomb interactions, covalent bonding, and electron–phonon interactions coexist. His group has developed a new computational framework that incorporates the ab initio determination of nonlocal Hubbard interactions together with strong electron–phonon coupling. This approach enables predictive calculations of intrinsic phonon-limited carrier mobility and phonon-assisted optical absorption without relying on empirical parameters or prior input. Furthermore, these methodological advances provide a powerful computational platform for the study of strongly correlated metal-oxide compounds.

The Computational Quantum Many-Body Theory Group led by Prof. Sangkook Choi focuses on advancing classical and quantum methodologies for quantum many-body problems. This year, our on-going achievement is the development of qSHIFT, a new sampling-based quantum simulation algorithm. Standard approaches face significant hurdles: Suzuki-Trotter formulas require deep circuits that accumulate hardware noise, while qDRIFT reduces circuit depth but suffers from fixed sampling probabilities and limited $O(t^2)$ error scaling. qSHIFT solves these issues by adaptively updating sampling probabilities at each step, achieving a superior, tunable algorithmic error scaling of $O(t^{1+r})$ while keeping gate counts independent of the number of terms in the Hamiltonian. We are finalizing numerical demonstrations to validate qSHIFT's practical advantages on near-term quantum devices.

Visiting Scientists

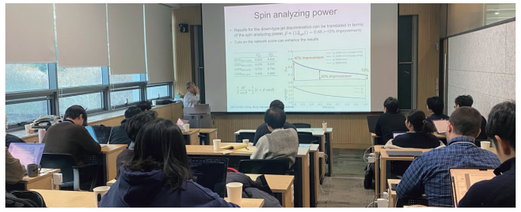
- Hong Hyunsuk / Jeonbuk National University
- Jaegon Um / POSTECH
- Minjin Kim / Kyungpook National University
- Tae-Hyon Kim / Kyungpook National University
- Lancaster, Lachlan / Columbia University
- Jihye Hwang / KASI
- Hae-Young Kee / University of Toronto
- Lake, Ethan / UC Berkeley
- Schuster, Thomas / California Institute of Technology
- Hsieh, Min-Hsiu / Foxconn Research
- Hyowon Kim / Departamento de Fisica, Universidad Tecnica Federico Santa Maria
- Mitsuru Kakizaki / Toyama University
- Hongchul Choi / MPK-POSTECH
- Dong Woo Kang / Jeonbuk National University
- Dong, Fuyu / South-Western Institute for Astronomy Research (SWIFAR), YNU
- P. Chingangbam / Indian Institute of Astrophysics

Conferences and Workshops

QUC has organized 13 conferences, and a few representative ones will be highlighted.

■ Focused Workshop on AI in High Energy Physics

The "Focused Workshop on AI in High Energy Physics" addressed the unique challenges of analyzing particle physics data, characterized by its immense size and complex quantum structure. This workshop played a role to foster the development of innovative AI techniques for future physics discoveries. It focused on surveying key questions in new physics searches, leveraging cutting-edge advancements in artificial intelligence. The workshop's structure prioritized stimulating intense discussions and collaborative efforts among participants. Ultimately, the goal was to advance the field's ability to explore new physics through the strategic application of AI.



Focused Workshop on AI in High Energy Physics (January 6–7)



Computational Quantum Many-body Theory School (January 13–17)

■ Computational Quantum Many-Body Theory School

We organized a five-day theory school with lectures by one international speaker and one domestic speaker on functional approaches to quantum many-body theory.

Approximately 70 students and early-career researchers attended, and the speakers covered topics including the fundamentals of many-body systems and computational techniques for analyzing quantum phenomena.

Informal interactions during breaks and banquets provided opportunities for the exchange of ideas and discussions on research challenges.

The event served as a venue for disseminating knowledge and fostering a community within the field of quantum many-body theory.

■ Amplitudes 2025 Summer School

This summer school is part of the Amplitudes series, which has been the biggest and best well-known conference in the field of scattering amplitudes.

As the flagship educational component of the annual Amplitudes conference, the summer school represents one of the most prestigious events for young researchers in this area. The Amplitudes



Amplitudes 2025 Summer School (June 9–13)

2025 Summer School was held at the Korea Institute for Advanced Study (KIAS) in Seoul, from June 9 to 13, 2025, just ahead of the main conference at Seoul National University (June 16–20). Approximately 120 participants, primarily PhD students and early-career postdocs from across the globe, attended the School. The event served to boost international collaboration, deepen technical expertise, and prepare attendees for cutting-edge research.

■ AstroAI Asian Network Summer School

The second A3 Net Summer School was held to educate students and researchers on artificial intelligence and machine learning (AI/ML) methods for astrophysics from August 18-22, 2025 at the Korea Institute for Advanced Study in Seoul, the Republic of Korea. About 60 undergraduate, graduate students and early-career researchers have participated from Korea, Japan, China, Taiwan, Philippines, Indonesia, Australia, India, Iran, and Cambodia. Six presenters gave lectures and hands-on training courses for five days. The school was co-hosted by KIAS and KASI in Korea.

In this one-week program, participants learned about the latest advancements in AI/ML techniques and their applications in solving complex astrophysical problems through theoretical lectures, hands-on exercises, and collaborative projects. The school is also expected to help build an AI sciences network in Asia.



AstroAI Asian Network Summer School (August 18–22)

■ The 9th KIAS School and Workshop on Quantum Information and Thermodynamics

At the 9th "KIAS School and Workshop on Quantum Information and Thermodynamics," which was held from November 2 to 5, about 40 interested students and researchers gathered to attend lectures and engage in open discussions on the latest research topics.

For this event, two tutorial lectures for students were prepared. First, Professor Gentaro Watanabe delivered a lecture titled "Theoretical Tools for Quantum Batteries: Basic Concepts and Their Applications." Professor Joonhyun Yeo gave a lecture entitled "Quantum Master Equations: Methods and Properties." In addition, seven speakers presented recent research topics on quantum machine learning, quantum error correction, quantum information theory, quantum thermodynamic inequalities, and quantum batteries, followed by active and enthusiastic discussions.



The 9th KIAS School and Workshop on Quantum Information and Thermodynamics (November 2–5)



International Conference on Quantum Technologies 2025 (ICQT 2025) (December 8–10)

In particular, many students participated in this event, making it a valuable opportunity for key research themes in this field to be introduced to the next generation of researchers.

■ International Conference on Quantum Technologies 2025 (ICQT 2025)

ICQT 2025 was hosted by Korea University from December 8 to 10. The conference invited internationally renowned researchers in the field of quantum information science, providing a platform to present cutting-edge research achievements and to foster academic exchange. In particular, the event brought together leading researchers from top universities around the world, as well as scientists from industry leaders in quantum computing such as Google, offering a valuable opportunity to examine the remarkable progress and future prospects of quantum science and technology. In addition, poster presentations by student researchers provided an opportunity to showcase domestic research achievements to international participants and to promote active scholarly interactions.

QUC Faculty and Research Fellows

Park, Hyunggyu
QUC Distinguished Professor

Kim, Jaewan
QUC Distinguished Professor

Kim, Myungshik
QUC Distinguished Professor

Kim, Isaac H.
QUC KIAS Scholar

Jong Yeon Lee
QUC KIAS Scholar

Kim, Jeong-Gyu
QUC Fellow

Lee, Kanghoon
QUC Fellow

Kim, Jinwoong
QUC Fellow

Moran, James
QUC KIAS Junior Fellow

Jeong, Jae Hoon
QUC Research Fellow

Yang, Xing-Yu
QUC Research Fellow

Ramos, Raymundo
QUC Research Fellow

Eftaxias, Nikolaos Georgios
QUC Research Fellow

Kim, Minsung
QUC Research Fellow

Oh, TaeHwan
QUC Research Fellow

Bagchi, Shrobona
QUC Research Fellow

Li, Jie
QUC Research Fellow

Roy, Prabuddha
QUC Research Fellow

Lee, Sangjin
QUC Research Fellow

Kim, Hee Seung
QUC Research Fellow

Kim, Heejoo
QUC Research Fellow

Flacke, Thomas Dieter
QUC Research Fellow

Rahnuma, Tabasum
QUC Research Fellow

Naik Suvedha Suresh
QUC Research Fellow

Publications

Paul, Rajdeep; **Roy, Prabuddha**; Pan, A. K.
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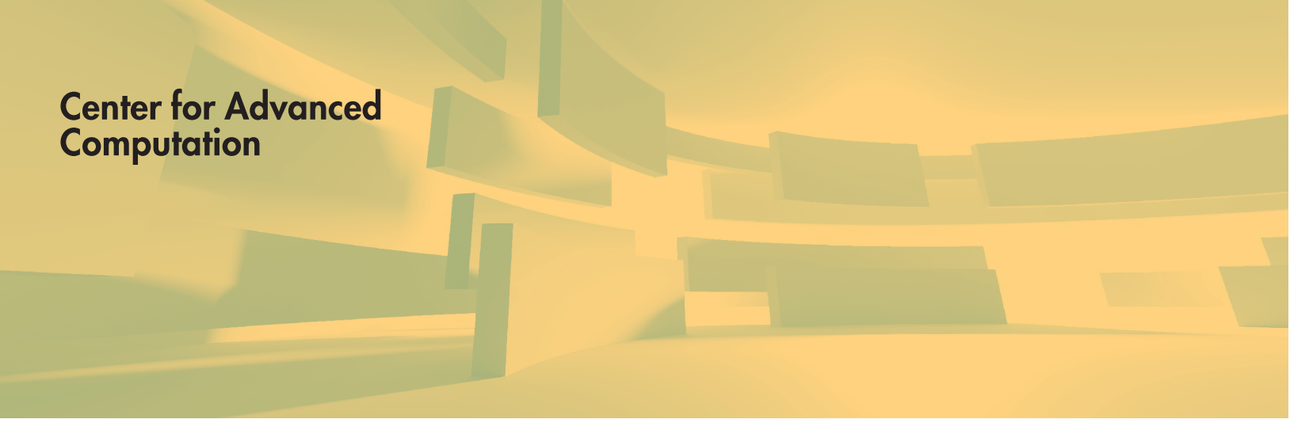
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Center for Advanced Computation

Introduction

The Center for Advanced Computation (CAC) has played a key role in providing high-performance computing resources to outstanding basic science researchers at KIAS. Since its foundation in 2010, CAC has installed eight Linux clusters (six CPU-based and two GPU-based) and massively parallel storage systems. These resources are vital to advancing research in key fields of basic sciences, including biophysics, material science, statistical physics, cosmology, and condensed matter physics.

Recognizing the crucial importance of parallel computing and supercomputing in both current and future scientific research tools, CAC annually hosts summer schools. These programs aim to inspire junior researchers by providing them with the knowledge and skills to effectively utilize significant computing power in their respective fields of research. To achieve this goal, senior researchers are invited to deliver lectures on parallel computing and machine learning. These sessions are designed for graduate students seeking to enhance their research skills with cutting-edge computational technologies.

CAC fully understands the importance of machine learning and AI in basic sciences. It therefore seeks to collaborate with AI experts outside KIAS and support related research activities, including joint workshops and training programs.

■ New Account Applications in 2025

In 2025, CAC received 43 new account applications (24 KIAS members and 19 external researchers), reflecting continued demand for high-performance computing resources across diverse scientific disciplines. Applications were submitted throughout the year, with the highest numbers in July (9) and May (7), coinciding with the start of new research projects and visiting scholar programs.

Table 1. New Account Applications by Month (2025)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Count	1	2	6	3	7	2	9	4	5	0	3	1	43

Table 2. New Account Applications by Research Field (2025)

Research Field	Count	Ratio
Condensed Matter Physics / Materials Science	13	30.2%
AI / Machine Learning / Deep Learning	10	23.3%
Astrophysics / Cosmology	8	18.6%
Mathematics / Applied Mathematics	6	14.0%
Particle Physics	2	4.7%
Quantum Computing	1	2.3%
Computational Chemistry	1	2.3%
Others	2	4.7%
Total	43	100%

Table 3. Cluster Usage Requests by New Users (2025)

Cluster	Requests	Type
Grammar	27	CPU
Syntax	26	CPU
Baekdu	18	CPU
Lexicon	18	CPU
RNA	16	GPU
DNA	6	GPU
Abacus5	6	CPU
Hyper	4	CPU
Others (e.g., Atom, Gate, Annapurna)	12	-
Total	133	

Table 4. Applicant Affiliation (2025)

Category	Count	Ratio
KIAS Members (Research Fellow, Fellow)	24	55.8%
External Researchers	19	44.2%
Total	43	100%

The research fields represented by new applicants in 2025 highlights several notable trends. Condensed matter physics and materials science remained the dominant areas, together accounting for 30.2% of all applications, consistent with KIAS's traditional strength in these fields. Notably, AI and machine learning applications rose to 23.3%, reflecting the growing importance of AI-based computational methods across basic sciences, including AI-driven approaches in mathematics, medicine, and neural network research. Astrophysics and cosmology continued to represent a significant share (18.6%), with researchers utilizing the clusters for large-scale cosmological simulations and observational data analysis. The presence of emerging fields such as quantum computing and AI safety further demonstrates the broadening scope of computational research supported by CAC.

The high proportion of external users (44.2%) underscores CAC's role as a shared national resource, attracting researchers from institutions including Konkuk University, POSTECH, Yonsei University, Sejong University, KIST, and international institutions such as Institut Teknologi Bandung (Indonesia), Sun Yat-sen University (China), and the University of Connecticut (USA).

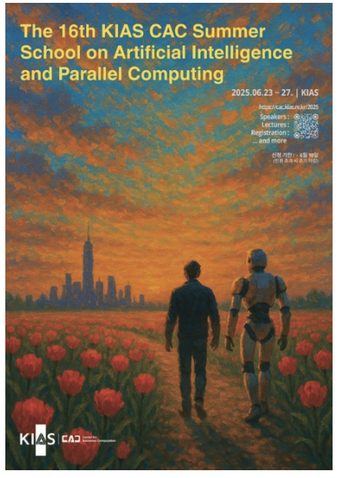
Research Activities

■ 16th CAC Summer School

The 16th KIAS CAC Summer School on Artificial Intelligence and Parallel Computing was held from June 23 to 27, 2025, in Room 1503 of the KIAS Main Building. This program was designed for graduate students and researchers in the natural sciences, providing comprehensive training on the latest developments in artificial intelligence, GPU computing, and parallel computing, along with their practical applications in scientific research.

Approximately 120 graduate students and researchers from diverse fields participated in the program. The summer school featured a structured curriculum combining theoretical lectures and hands-on training. Participants were given direct access to cluster computing systems and GPU resources via network connections, allowing them to execute their own programs in a practical environment. Through these sessions, attendees gained practical insights into how advanced computational techniques, including AI-driven methods and parallel computing, can be effectively applied to their research problems.

The lecture program covered a wide range of topics, including Neural ordinary differential equation (ODEs) and physics-informed neural networks, natural language processing and its applications, CUDA programming with Python, diffusion and flow matching models, MPI-based parallel programming for scientific computing, and foundational concepts in artificial intelligence, such as Bayesian methods and information theory. In addition, sessions on parallel GPU-based AI training provided more advanced instruction in high-performance AI workflows.



The 16th CAC Summer School

Complementing the lectures, invited talks addressed applied research topics such as AI-driven high-speed scanning, protein-ligand interaction prediction using vision transformers and graph neural networks, and challenges in plasma chemistry modeling. Participants also engaged in group projects that promoted collaboration and practical problem-solving skills. Outstanding teams were recognized through an awards program.

Overall, the summer school provided a rigorous and immersive learning experience, equipping participants with both theoretical knowledge and hands-on expertise necessary to advance their research using modern computational and AI techniques.

■ **Deployment and Expansion of the Multiverse Storage System for Cosmological Simulation Data**

A high-capacity storage system, named Multiverse, was procured and deployed in January 2025 to support large-scale cosmological simulations, particularly those related to accelerating universe expansion. The system was designed to handle the increasing volume of simulation data generated by high-resolution computational models.

In September 2025, the storage infrastructure was further expanded to accommodate growing data demands. The Multiverse system consists of a total of 60+48 drive bays, providing an overall storage capacity of approximately 1.6 PB.

This enhanced storage capability enables more efficient management, storage, and analysis of large-scale cosmological simulation datasets. It supports high-throughput data workflows, allowing researchers to store massive outputs from accelerating universe expansion simulations and perform subsequent analysis with improved performance and scalability.

■ **Addition of High-Performance Syn104 Node to the Syntax Cluster**

In December 2025, a new compute node, Syn104, was added to the Syntax cluster to enhance computational capabilities for both scientific simulations and AI workloads. The node is equipped with dual Intel® Xeon® 6737P processors, 4 TB of system memory, and eight NVIDIA H200 NVL GPUs, providing a highly optimized architecture for mixed HPC and AI applications.

The system delivers a theoretical peak performance of approximately 272 TFLOPS in double-precision (FP64) based on GPU computation, significantly improving capabilities for large-scale numerical simulations. In addition, it provides up to 32 PFLOPS of AI compute performance (FP8 Tensor Core), enabling high-throughput deep learning and AI-driven scientific workloads.

With its balanced architecture combining large memory capacity, high FP64 performance, and state-of-the-art AI acceleration, the Syn104 node has substantially enhanced the overall performance of the Syntax cluster. This upgrade has contributed significantly to advancing research activities at the Center for AI and Basic Science, enabling more efficient large-scale simulations and accelerating AI-based scientific discovery.

Major Achievement of the Year

■ **Redshift Evolution of the Intrinsic Alignments of Early-type Galaxies and Subhalos in the Horizon Run 5 Simulation**

- Title: Redshift Evolution of the Intrinsic Alignments of Early-type Galaxies and Subhalos in the Horizon Run 5 Simulation
- Authors: Sanghyeon Han, Motonari Tonegawa, Ho Seong Hwang, Yohan Dubois, Juhan Kim, Yonghwi Kim, Oh-Kyoung Kwon, Jaehyun Lee, Owain N. Snaith, Brad K. Gibson, Changbom Park (11 authors)
- Journal / Publication Date: The Astrophysical Journal, 990, 197 (September 2025)

1) Background and Objectives

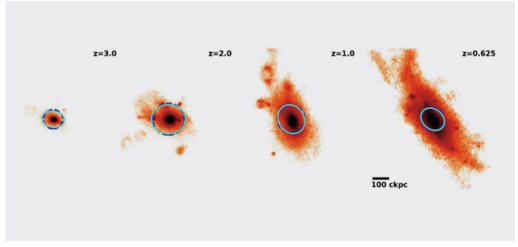
Intrinsic alignment (IA) of galaxies is a major source of systematic uncertainty in weak gravitational lensing analyses, directly impacting precise measurements of dark energy in next-generation cosmological surveys such as Euclid and the Rubin Observatory LSST. However, the redshift evolution of IA signals—particularly the evolution of misalignment between galaxy shapes and their corresponding dark matter subhalos over cosmic time—has not been fully understood.

This study aims to systematically investigate the redshift evolution of IA for early-type galaxies and their host subhalos over the range of $z = 0.625$ to $z = 2.5$, utilizing the large-scale cosmological hydrodynamical simulation Horizon Run 5 (HR5).

2) Methods

Early-type galaxies were selected from the HR5 simulation (a 717 h^{-1} cMpc box using the RAMSES adaptive mesh refinement code) based on stellar mass $M\bigstar \geq 10^{10}\,M\odot$ and a kinematic morphology criterion of $|V_r/\sigma_v| \leq 0.42$.

The shapes of galaxies and subhalos were determined by iteratively computing the mass-weighted inertia tensor until convergence of the axis ratios was achieved within 0.1%. The nonlinear alignment (NLA) model was applied to compute the galaxy–density correlation function (ξ_{g+}) over scales of $1–80\ h^{-1}\ cMpc$. The redshift dependence of the IA amplitude (A_{NLA}) was then quantified using a power-law relation.



Stellar particle distribution of the most massive galaxy $(M\bigstar = 1.436 \times 10^{12}\,M\odot)$ in the HR5 simulation. The figure illustrates its evolutionary sequence from $z = 3.0$ to $z = 0.625$. The blue dashed circles indicate the $3R_{1/2}\bigstar$ boundary, while the cyan ellipses represent the galaxy shapes measured using the inertia tensor. (Figure 5 in Han et al. 2025, *ApJ*, 990, 197)

3) Key Results

- The galaxy IA amplitude (A_{NLA}) shows little to no redshift evolution (power-law slope: 0.187 ± 0.159), whereas the subhalo IA exhibits significant redshift dependence (slope: 0.509 ± 0.127). This indicates that the alignment physics of baryonic matter and dark matter are fundamentally different.
- The positional angle misalignment between galaxies and their corresponding subhalos decreases over cosmic time, demonstrating that their shapes gradually converge at lower redshifts.
- The IA signal increases monotonically with both stellar mass and halo mass, indicating that more massive galaxies exhibit stronger alignment with the surrounding tidal field.
- The HR5 results are broadly consistent with previous observational studies (including CFHTLenS, KiDS, and six others). Discrepancies with some high-redshift observations can be explained by differences in sample mass distributions.

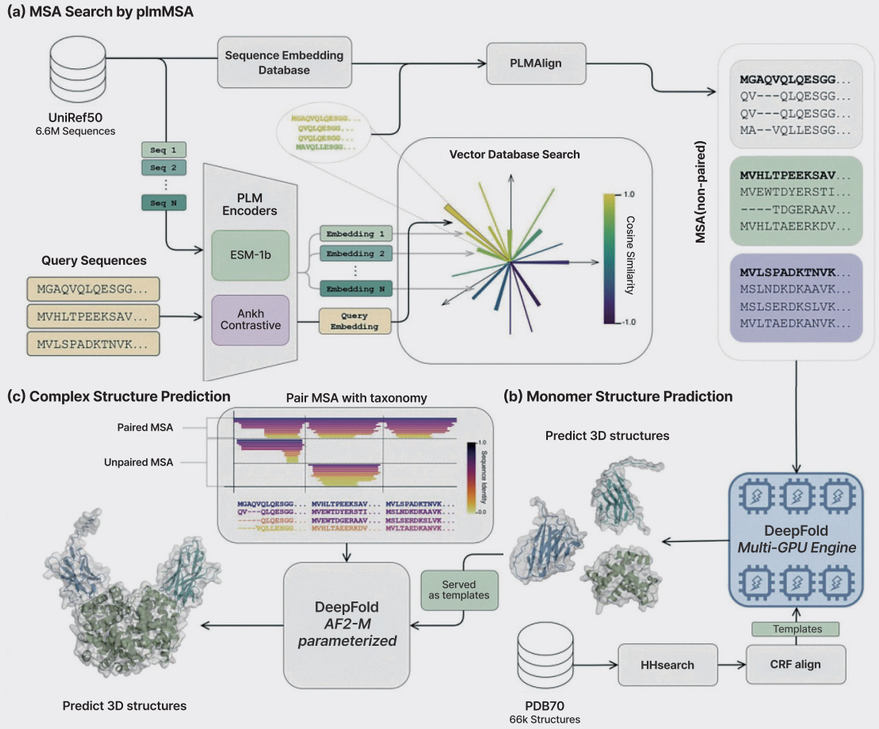
4) Significance of the Achievement

This study represents the first systematic investigation, based on a large-scale cosmological hydrodynamical simulation, demonstrating that intrinsic alignments of early-type galaxies and dark matter sub halos evolve differently with redshift. The finding that galaxy IA shows weak redshift dependence while sub halo IA exhibits strong evolution provides critical theoretical constraints for modeling IA-related systematic uncertainties in next-generation weak lensing surveys.

In particular, these results can directly contribute to improving the accuracy of IA correction models in upcoming large-scale cosmological surveys such as *Euclid*, the Rubin Observatory LSST, and the *Roman Space Telescope*. This work was published in *The Astrophysical Journal*, one of the leading journals in astrophysics.

■ **DeepFold-PLM: Development of an Efficient Protein Structure Prediction Framework Using Protein Language Models**

The AI-based Computational Biophysics Research Team at KIAS developed *DeepFold-PLM*, a protein structure prediction framework that leverages protein language models (PLMs) to overcome the bottleneck of traditional multiple sequence alignment (MSA)-based



DeepFold-PLM: High-Efficiency Protein Structure Prediction Pipeline

homology search and significantly accelerate GPU-based computations. Conventional structure prediction pipelines require extensive computational resources and time to search for homologous sequences within massive sequence databases. In contrast, this study introduces large-scale PLM embedding techniques to dramatically improve the efficiency of remote homology detection.

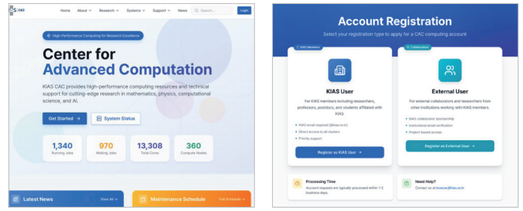
Through this approach, the framework maintains a level of structural prediction accuracy comparable to state-of-the-art models while substantially reducing computational costs by optimizing the search process. By flexibly integrating PLM-based modules into existing structure prediction pipelines, this work demonstrates the feasibility of processing large-scale protein datasets and performing structure prediction even at the level of individual research labs.

This study establishes a hybrid AI-based protein structure prediction methodology that simultaneously considers computational efficiency and predictive performance. It is expected to serve as a core technology in data-intensive fields such as drug target discovery and protein design. The work was published in *Bioinformatics* in 2025, and further details can be found at the following link: https://doi.org/10.1093/bioinformatics/btaf579

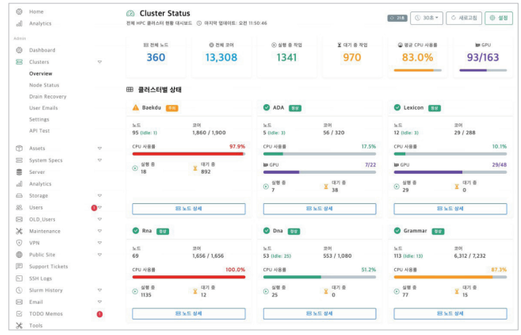
■ Launch of the New CAC Website and Management System

In 2025, the Center for Advanced Computation (CAC) at KIAS launched a newly redesigned website (https://cac.kias.re.kr) to enhance user experience and promote research outcomes.

The new website was developed with a strong focus on usability, accessibility, and effective dissemination of research achievements. It provides intuitive access to high-performance computing (HPC) resources, system status, user guides, and administrative services, enabling researchers to utilize computational resources more efficiently.



Screenshot of the redesigned CAC homepage



Dashboard displaying real-time CAC cluster utilization

■ Key Improvements

1. Unified Cluster Account System

The cluster account management system has been consolidated into a unified framework, allowing users to access multiple computing resources through a single account. This integration improves both user convenience and administrative efficiency.

2. Support for Collaborative Research

The new platform facilitates collaborative research by enabling external collaborators to obtain project-based access to CAC resources. This enhancement promotes inter-institutional collaboration and expands research opportunities.

3. Enhanced VPN and Security Infrastructure

To ensure secure and stable access, CAC has strengthened its VPN-based access system and overall security policies. Users can now access cluster resources safely from external environments while maintaining high security standards.

4. Improved Research Output Visibility

The website now includes dedicated sections for showcasing research outcomes achieved using CAC resources, increasing the visibility and impact of computational research.

■ Development of an In-house Cluster Management System

In addition, CAC has developed a proprietary management system to improve operational efficiency and monitoring capabilities.

This management platform enables centralized control and real-time monitoring of cluster resources, including:

- Integrated cluster account management
- Real-time system and node status monitoring
- Resource utilization tracking
- Operational visibility for administrators

The system significantly enhances the ability to manage large-scale HPC infrastructure, ensuring stability, efficiency, and rapid response to system events.

■ **List of Papers Utilizing CAC Computing Resources**

No.	Title	Journal
1	An efficient forgetting-aware fine-tuning framework for pretrained universal machine-learning interatomic potentials	npj Computational Materials
2	Atomistic Insights into Cu/Amorphous-Ta x N Interfacial Adhesion via Machine Learning Interatomic Potentials: Effects of Stoichiometry and Interface Construction	ACS Applied Electronic Materials
3	Benchmarking First-Principles Approaches for the Band Gap Prediction of Nanoporous Materials	Journal of Chemical Theory and Computation
4	Controlling 2D Nanoparticle Self-Assembly Mesophases via Symmetry Breaking Driven by Single Bottlebrush Polymer Conjugation	Langmuir
5	DeepFold-PLM: accelerating protein structure prediction via efficient homology search using protein language models	Bioinformatics
6	Depletion Interaction between Cylindrical Inclusions in Polymer Brushes	Macromolecules
7	Dynamic Programming for Chain Propagator Computation of Branched Block Copolymers in Polymer Field Theory Simulations	Journal of Chemical Theory and Computation
8	Effects of structural distortions and charge transfers on the ferroelectric and ferromagnetic In2Se3/CrBr3 twisted moiré heterobilayer	Physical Review B
9	Electronic structures of crystalline and amorphous GeSe and GeSbTe compounds using machine learning empirical pseudopotentials	APL Machine Learning
10	Emergence of metachronal waves in a chain of symmetrically beating filaments	Physical Review Research
11	Evolution of phonon, magnetism, and electronic excitations across the insulator-to-metal transition in Ru(Br1−xIx)3	Physical Review B
12	Exploring the Reaction Network of Acetic Acid in Supercritical Water via Machine Learning Interatomic Potential	Journal of Chemical Information and Modeling
13	First principles study of dielectric properties of ferroelectric perovskite oxides with extended Hubbard interactions	npj Computational Materials
14	First-principles electron-phonon interactions with self-consistent Hubbard interaction: Application to transparent conducting oxides	Physical Review B
15	Fluctuation-Response Inequalities for Kinetic and Entropic Perturbations	Physical Review Letters
16	Hidden Effects of Anharmonic Bath on the Excitation Energy Transfer in the Light Harvesting 2 Complex of Purple Bacteria	The Journal of Physical Chemistry Letters
17	Homotopy reservoir computing: Harnessing chaos for computation	Chaos: An Interdisciplinary Journal of Nonlinear Science
18	How Dust Models Shape High-z Galaxy Morphology: Insights from the NewCluster Simulation	The Astrophysical Journal
19	Interplay between intraspecific suppression and environment in shaping biodiversity	Physical Review E
20	Iterative annealing mechanism for protein and RNA chaperones	Biophysical Journal
21	Layer-controlled orbital-selective Mott transition in monolayer nickelate	Physical Review Research
22	Light-Wave Engineering for Selective Polarization of a Single Q Valley in Transition Metal Dichalcogenides	Nano Letters
23	Microscopic origin of the spin-splitting in altermagnets	Current Applied Physics
24	Multi-Class Support Vector Machine with Differential Privacy	Advances in Neural Information Processing Systems (NeurIPS)
25	Nonlocal Coulomb Interaction in Mixed-Valence Material LiCu2O2	Nano Letters
26	On the CP Nature of the ‘95 GeV’ Anomalies	Physics Letters B
27	On the Information Processing of One-Dimensional Wasserstein Distances with Finite Samples	arXiv:2511.12881
28	Polymer Field Theory for Multimonomer Incompressible Models: Symmetric Formulation and ABC Systems	Macromolecules
29	Probing intrinsic elastic properties of multilayer graphene – a new mechanical constant	Materials & Design
30	Quantum Zeno Monte Carlo for computing observables	npj Quantum Information
31	RAMSES-yOMP: Performance Optimizations for the Astrophysical Hydrodynamic Simulation Code RAMSES	The Astrophysical Journal
32	Redshift evolution of the fundamental plane up to z ~6	Astronomy & Astrophysics
33	Redshift Evolution of the Intrinsic Alignments of Early-type Galaxies and Subhalos in the Horizon Run 5 Simulation	The Astrophysical Journal
34	Safeguarding Privacy of Retrieval Data against Membership Inference Attacks: Is This Query Too Close to Home?	Findings of the Association for Computational Linguistics: EMNLP
35	Self-consistent tight-binding calculations with extended Hubbard interactions in rhombohedral multilayer graphene	Physical Review B
36	Signal–noise separation using unsupervised reservoir computing	Chaos: An Interdisciplinary Journal of Nonlinear Science
37	Strain engineering of van Hove singularity and coupled itinerant ferromagnetism in quasi-2D oxide superlattices	Applied Physics Reviews
38	Thermodynamic uncertainty relation of a quantum mechanically coupled two-qubit system	Physical Review Research
39	Tracing the Formation History of Intrahalo Light with Horizon Run 5	The Astrophysical Journal
40	Unconventional domain tessellations in moiré-of-moiré lattices	Nature
41	Unsupervised reservoir computing for multivariate denoising of severely contaminated signals	Knowledge-Based Systems
42	Unveiling Defect Motifs in Amorphous GeSe Using Machine Learning Interatomic Potentials	ACS Applied Materials & Interfaces
43	Variations of the Depletion Zones around Inclusions Explain the Complexity of Brush-Induced Depletion Interactions	Journal of Chemical Theory and Computation

CAC Faculty and Research Fellows

Kim, Juhan
Research Professor

Joo, Keehyoung
Research Professor

Publications

Goyal, Priya; **Park, Changbom**; Lee, Jaehyun; Hong, Sungwook E.; Gibson, Brad K.; Pichon, Christophe; **Kim, Juhan**
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Kim, Minsoo; Bae, Hanjin; Jo, Gyeongpil; Kim, Kunwoo; Lee, Sung Jong; **Yoo, Jejoong**; **Joo, Keehyoung**
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Garg, Vrinda; Mathew, Rejoy; Rai, Kunal; **Shin, Jaeoh**; Ghosh, Surya K.
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Byun, Gyeong-Hwan; Jang, J. K.; Scofield, Zachary P.; Ahn, Eunmo; Baes, Maarten; Dubois, Yohan; Han, San; Jeon, Seyoung; **Kim, Juhan**; Pichon, Christophe; Rhee, Jinsu; Rodriguez Montero, Francisco; Yi, Sukyoung K.
How Dust Models Shape High-z Galaxy Morphology: Insights from the NewCluster Simulation • ASTROPHYSICAL JOURNAL

Joo, Hyungjin; Jee, M. James; **Kim, Juhan**; Lee, Jaehyun; Ko, Jongwan; **Park, Changbom**; Shin, Jihye; Snaith, Owain; **Pichon, Christophe**; Gibson, Brad; Kim, Yonghwi
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Han, Sanghyeon; Tonegawa, Motonari; Hwang, Ho Seong; Dubois, Yohan; **Kim, Juhan**; Kim, Yonghwi; Kwon, Oh-Kyoung; Lee, Jaehyun; Snaith, Owain N.; Gibson, Brad K.; **Park, Changbom**
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Han, San; Dubois, Yohan; Lee, Jaehyun; **Kim, Juhan**; Cadiou, Corentin; Yi, Sukyoung K.
RAMSES-yOMP: Performance Optimizations for the Astrophysical Hydrodynamic Simulation Code RAMSES • ASTROPHYSICAL JOURNAL



Center for AI and Natural Sciences

Introduction

Intelligence is a phenomenon that emerges from the activity of the neural networks that make up the brains of living organisms. Founded in 2021, the Center for Artificial Intelligence and Natural Sciences (CAINS) at the Korea Institute for Advanced Study aims to develop and utilize AI algorithms based on a fundamental understanding of mathematics and physics. The two primary objectives of this research are understanding the emergence of intelligence and AI's application in individual fields of basic science.

The main focus of artificial intelligence (AI) research, largely driven by computer scientists and engineers, is currently on its application in industry. However, it is equally important to explore a new class of AI by asking fundamental questions about its mathematical foundations and physical principles. Basic sciences have advanced AI, and AI has in turn provided new insights into challenging problems in materials science, biology, and cosmology. This symbiotic relationship between AI and fundamental sciences promotes progress and the exchange of ideas across science disciplines. Based on an array of ideas and tools developed in advanced mathematics, theoretical physics, and computational sciences, CAINS aims to develop an interpretable and controllable AI. As an AI hub where experts from diverse backgrounds engage in interdisciplinary discussions, the center is laying the foundation for pioneering AI innovation.

Conferences and Workshops

■ 2025 KIAS Center for AI and Natural Sciences Workshop

The 2025 KIAS CAINS Workshop was held at the Park Roche Resort in Jeongseon from May 28 to 30, 2025. In this three-day workshop, 18 seminars were held with keynote presentations by members of CAINS and external institutes.

The aim of the workshop was to learn the latest research topics of AI and its application to basic sciences. Speakers invited from external institutes delivered in-depth lectures, which offered a forum for the development of the center and promoted communication among the participants.



2025 KIAS Center for AI and Natural Sciences Workshop (May 28–30)

■ Machine Learning and Mathematics

The Machine Learning and Mathematics workshop was held from July 7 to 11, 2025, at the Korea Institute for Advanced Study (KIAS), highlighting the rapid emergence of AI as a transformative tool in mathematical research. The program showcased significant scientific advancements, including data-driven approaches to knot theory and representation theory, the discovery of the murmuration phenomenon in arithmetic, and the construction of new singular solutions to the Euler equations. By bringing together world-class experts from institutions such as Caltech, Princeton University, and Meta, the event provided a comprehensive overview of how leading research groups around the world are using machine learning to tackle complex problems in mathematics.

The weeklong workshop was strategically designed to offer mathematics researchers practical, actionable insights through tailored hands-on tutorials and problem-solving sessions. Beyond the technical exchange, the event successfully catalyzed the formation of a robust domestic research community and laid the groundwork for future international collaborations. This initiative culminated in the establishment of a dedicated online collaboration platform, ensuring that the insights gained during the sessions translate into sustained joint research efforts and long-term academic growth in the field of AI-integrated mathematics.



Machine Learning and Mathematics (July 7–11)

■ KIAS Lecture Series on Computational Neuroscience and AI

The KIAS Lecture Series on Computational Neuroscience and AI was held from August 4 to 6, 2025, at the Korea Institute for Advanced Study (KIAS). Organized by Distinguished Prof. Daniel D. Lee (of Cornell Tech and KIAS) and Prof. Changbong Hyeon (KIAS), this lecture series provided a premier platform for exploring the transformative intersection of biological intelligence and artificial neural networks. The program featured distinguished experts, including Prof. SueYeon Chung (Harvard University), who discussed neural representation; Prof. Hannah Choi (Georgia Tech), who presented on neural dynamics and networks; and Dr. Kisuk Lee and Dr. Alexander Bae (Zetta AI), who shared insights into building the connectome. The lectures examined how the brain processes sensory information through predictive coding across excitatory and inhibitory neuron subtypes, and explored how biologically plausible models could help bridge the gap between natural and artificial systems.

Throughout the three-day event, the lectures showcased how deep learning can analyze large-scale electron microscopy data to reconstruct neural circuits, revealing how structural connectivity dictates functional outcomes. The speakers also examined how neural manifold structures relate to the efficiency of information representation and task performance. By comparing the representational geometry of the brain with that of artificial neural networks, the series established a rigorous framework for designing next-generation AI models. This event promoted a deeper understanding of biological intelligence through the lens of predictive encoding mechanisms and structural-functional mapping, fostering a new level of dialogue between computational neuroscience and AI research.



KIAS Lecture Series on Computational Neuroscience and AI (Aug 4–6)

■ **Seminars**

The main purpose of the seminar program was to identify the outstanding issues in AI-related research and to engage with new researchers exploring emerging areas. CAINS aims to develop a research network through in-depth discussions with experts from a wide range of disciplines on current research topics.

On average, 3–4 seminars and special gatherings were held each month. In 2025, CAINS organized 37 seminars presented by its members and invited speakers, as well as one colloquium, to encourage discussions on topics related to the principles and applications of AI.

Visiting Program

KIAS Scholars

- Lee, Daniel D. / Cornell University
- Lee, Kyu-Hwan / University of Connecticut
- Hayat, Amaury / Ecole des Ponts

Affiliated Professors

- Han, Seungwu / Seoul National University
- Kwon, Dohyun / University of Seoul
- Noh, Yung-kyun / Hanyang University
- Yoon, Hongkee / Kangwon National University
- Hong, Youngjoon / Seoul National University

Visiting Professors

- Yun, Gunsu / Pohang University of Science and Technology

CAINS Faculty and Research Fellows

Hyeon, Changbong
Director / Professor

Choi, Kyeongsu
Professor

Choi, Sangkook
Professor

Kang, Nam-Gyu
Professor

Kiem, Young-Hoon
Professor

Kim, Jeong Han
Professor

Kim, Sang-hyun
Professor

Ko, Pyungwon
Professor

La, Joonhyun
Professor

Lee, Deok-Sun
Professor

Lee, Jae Sung
Professor

Lee, Sungjay
Professor

Park, Changbom
Professor

Son, Young-Woo
Professor

Yoo, Jejoong
Professor

Lee, Daniel D.
Professor

Choi, Jaesung
AI KIAS Junior Fellow

Yu, Ji woong
AI KIAS Junior Fellow

Cho, Kwang Hyun
AI Research Fellow

Choi, Jaewoong
AI Research Fellow

Chung, Jaehoon
AI Research Fellow

Flacke, Thomas Dieter
AI Research Fellow

Hwang, Geonho
AI Research Fellow

Kim, Jinsook
AI Research Fellow

Kim, Sejin
AI Research Fellow

Kim, Dongwon
AI Research Fellow

Ko, Joon-Hyuk
AI Research Fellow

Lee, Hyunwoo
AI Research Fellow

Lee, Yonghyeon
AI Research Fellow

Park, Jinseong
AI Research Fellow

Park, Jun Sur
AI Research Fellow

Park, Yeachan
AI Research Fellow

Yoon, Sangwoong
AI Research Fellow

Choi, Jaewoong
Project Research Fellow

Yong, Daeseong
Project Research Fellow

Publications

Lee, Yeon-Hee; Jeon, Seonggwang; Kim, Tae-Seok; Kim, Hee-Sung; Auh, Q-Schick; **Noh, Yung-Kyun**
Clinical features and subgroup patterns in elderly and super-elderly TMD patients • SCIENTIFIC REPORTS

Kim, Jisu; Lee, Jiho; Oh, Sangmin; Park, Yutack; Hwang, Seungwoo; **Han, Seungwu**; Kang, Sungwoo; Kang, Youngho
An efficient forgetting-aware fine-tuning framework for pretrained universal machine-learning interatomic potentials • NPJ COMPUTATIONAL MATERIALS

Choi, Jeong Min; Kim, Jaehoon; Lee, Ji-Hwan; Son, Won-Joon; **Han, Seungwu**
Atomistic Insights into Cu/Amorphous-TaxN Interfacial Adhesion via Machine Learning Interatomic Potentials: Effects of Stoichiometry and Interface Construction • ACS APPLIED ELECTRONIC MATERIALS

Lee, Yeon-Hee; Kim, Hee-Sung; Jeon, Seonggwang; Auh, Q-Schick; Hong, Il Ki; Choi, Sunju; Guastaldi, Fernando; Im, Hyungsoon; **Noh, Yung-Kyun**; Chaurasia, Akhilanand
Deep learning-based diagnosis of temporomandibular joint osteoarthritis using whole-body bone scans • ISCIENCE

Park, Seokju; Park, Seong-Ho; Oh, Jin-Seon; Hong, Sumin; Been, Kyung Wook; **Noh, Yung-Kyun**; Hur, Junho K.; Nam, Jin-Wu
shRNAI: A deep neural network for the design of highly potent shRNAs • MOLECULAR THERAPY NUCLEIC ACIDS

Choi, Jaesung; Kim, Pilwon
Unsupervised reservoir computing for multivariate denoising of severely contaminated signals • KNOWLEDGE-BASED SYSTEMS

Kim, Purun-hanul; Choi, Jeong Min; **Han, Seungwu**; Kang, Youngho
Neural network-driven molecular insights into alkaline wet etching of GaN: toward atomistic precision in nanostructure fabrication • NPJ COMPUTATIONAL MATERIALS

Cho, Kwang Hyun; **Jang, Seogjoo J.**; Rhee, Young Min
Hidden Effects of Anharmonic Bath on the Excitation Energy Transfer in the Light Harvesting 2 Complex of Purple Bacteria • JOURNAL OF PHYSICAL CHEMISTRY LETTERS

Moon, Minseok; Hwang, Seungwoo; Kim, Jaesun; Park, Yutack; Hong, Changho; **Han, Seungwu**
Unveiling Defect Motifs in Amorphous GeSe Using Machine Learning Interatomic Potentials • ACS APPLIED MATERIALS & INTERFACES

Choi, Jaesung; Kim, Pilwon
Homotopy reservoir computing: Harnessing chaos for computation • CHAOS

Lee, Yeon-Hee; Jeon, Seonggwang; Jung, Junho; Auh, Q. Schick; Lee, Jae Seo; Chaurasia, Akhilanand; **Noh, Yung Kyun**
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Signal-noise separation using unsupervised reservoir computing • CHAOS

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Exploring the Reaction Network of Acetic Acid in Supercritical Water via Machine Learning Interatomic Potential • JOURNAL OF CHEMICAL INFORMATION AND MODELING

Kim, Purun-hanul; **Han, Seungwu**; Kang, Youngho
BaGe2P2 and BaGe2As2 pnictides as promising ferroelectric semiconductors for thin film solar cell • PHYSICAL CHEMISTRY CHEMICAL PHYSICS

Yu, Ji Woong; **Yong, Daeseong**; Ha, Bae-Yeun; **Hyeon, Changbong**
Depletion Interaction between Cylindrical Inclusions in Polymer Brushes • MACROMOLECULES

Lim, Dae Hyun; **Noh, Yung-Kyun**; Son, Byoung Kwan; Kim, Dong-Hoon; Min, Kyueng-Whan; Chae, Seoung Wan; Kim, Hyung Suk; Kwon, Mi Jung; Pyo, Jung Soo; Byun, Yoonhyeong
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Kim, Seoyeun; Seo, Myungeun; **Yu, Ji Woong**; Kim, Yongjoo
Controlling 2D Nanoparticle Self-Assembly Mesophases via Symmetry Breaking Driven by Single Bottlebrush Polymer Conjugation • LANGMUIR

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Hur, Joon Young; Min, Kyueng-Whan; **Noh, Yung-Kyun**; Won, Young-Woong; Yeo, Yoomi; Kim, Dong-Hoon; Son, Byoung Kwan; Kwon, Mi Jung; Pyo, Jung Soo
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Park, Hyun-Su; Park, In Woo; Kim, Dowoo; Nah, Ha-Yoon; Yang, Junho; Yeo, Jisoo; **Choi, Jaesung**; Choi, Jungsik; Park, Hyung-Ho; Choi, Heon-Jin
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Elasticity of Swollen and Folded Polyacrylamide Hydrogel Using the MARTINI Coarse-Grained Model • ACS APPLIED MATERIALS & INTERFACES

Morse, David; **Yong, Daeseong**; Chen, Kexin
Polymer Field Theory for Multimonomer Incompressible Models: Symmetric Formulation and ABC Systems • MACROMOLECULES

Lee, Kyu-Hwan; Oliver, Thomas; Pozdnyakov, Alexey
Murmurations of Dirichlet Characters • INTERNATIONAL MATHEMATICS RESEARCH NOTICES

Choi, Jaewoong; **Hwang, Geonho**; Cho, Hyunsoo; Kang, Myungjoo
Analyzing the latent space of GAN through local dimension estimation for disentanglement evaluation • PATTERN RECOGNITION

Yi, Woobin; Kim, Dae Yeon; Jin, Howon; **Yoon, Sangwoong**; Ahn, Kyung Hyun
Early detection of pore clogging in microfluidic systems with 3D convolutional neural network • SEPARATION AND PURIFICATION TECHNOLOGY



Open KIAS Center

Outreach Program

■ Overview of the Outreach Program

The Korea Institute for Advanced Study (KIAS) is dedicated to achieving excellence in fundamental and theoretical scientific research while also engaging in public outreach to enhance the awareness of foundational science. As part of this commitment, KIAS organizes various programs aimed at bridging the gap between the scientific community and the public. These initiatives provide opportunities for people to explore cutting-edge scientific discoveries and understand their societal impact.

The KIAS Outreach Program has been designed to achieve a number of goals:

- Promote scientific literacy and curiosity among the general public
- Provide in-depth explanations of groundbreaking research and its implications
- Foster engagement between researchers and the community
- Inspire young students and aspiring scientists by introducing them to leading experts in various fields.

■ 2025 Nobel Prize Commentary Lecture

KIAS and the Chaos Foundation jointly hosted the 2025 Nobel Prize Commentary Lecture on November 1 in the Auditorium of the KIAS Main Building 1. The lecture was organized for students and members of the general public interested in the Nobel Prizes and contemporary scientific research. In addition to the in-person event, the lecture was livestreamed online to broaden public accessibility and participation.

The 2025 Nobel Prize Commentary Lecture featured three sessions covering the Nobel Prize-winning achievements in Physiology or Medicine, Physics, and Chemistry. Each session was presented by distinguished scholars who explained the scientific background and significance of the awarded research in a clear and accessible manner.





Nobel Prize Commentary Lecture (November 1, 2025)

Professor Kwon Park (KIAS School of Physics) presented the session on the Nobel Prize in Physics, focusing on macroscopic quantum phenomena observed in superconducting circuits. His lecture explored how superconducting electronic circuits with zero electrical resistance can behave like giant atoms that are observable and even tangible at the macroscopic scale. He further explained how these discoveries have expanded the principles of quantum mechanics into the field of quantum computing.

Professor Eui-Cheol Shin (KAIST Graduate School of Medical Science and Engineering) delivered the session on the Nobel Prize in Physiology or Medicine. His lecture focused on the mechanisms that regulate and suppress immune responses, emphasizing the discovery and medical significance of regulatory T cells. He explained why immune suppression is essential for preventing excessive immune reactions and autoimmune diseases, while also discussing future therapeutic applications.

Professor Hoiri Moon (Ewha Womans University) led the session on the Nobel Prize in Chemistry, discussing the structural characteristics and applications of metal-organic frameworks (MOFs). Her lecture highlighted how MOFs can be designed to store gases and separate molecules, while also exploring their potential contributions to future energy and environmental technologies.

The event contributed to enhancing public interest in basic science, expanding scientific culture, and strengthening the public role and visibility of KIAS. In addition, lecture recordings and secondary digital content produced from the event achieved strong public engagement on social media platforms, accumulating over 100,000 views. Building on these results, KIAS plans to continue expanding public outreach by developing accessible science communication content based on its unique research strengths.

■ 2025 Summer Science Academy with Dongdaemun-gu

KIAS hosted the 2025 Summer Science Academy with Dongdaemun-gu Office on August 13 at the KIAS Main Building 1. Designed for upper-grade elementary school students and their parents, the program provided opportunities to explore mathematics and artificial intelligence (AI) through lectures, hands-on activities, and a guided visit to one of Korea's leading institutes for basic science research.

Organized in collaboration with the Dongdaemun-gu Office, the academy aimed to inspire young students to develop an interest in basic science and to encourage future scientific talent development. The program also sought to expand public awareness of KIAS and contribute to the spread of scientific culture within the local community.

The academy featured lectures and activities led by researchers and professors from KIAS and Seoul National University. Researcher Joon-Hyuk Ko (KIAS Center for AI and Natural Sciences) delivered two sessions introducing the principles behind AI and its practical applications in everyday life. Through interactive examples and activities, participants learned how AI systems classify information, generate responses, and assist in real-world situations.

Professor Gye-seon Lee (Seoul National University) presented a lecture on tiling and mathematics, introducing students to mathematical patterns and geometric structures found in everyday environments. Participants explored how mathematical ideas emerge through repeated shapes and tessellation, gaining insight into the creative aspects of mathematics.

The program concluded with a hands-on spatial reasoning workshop led by Researchers Carl-Fredrik Nyberg Brodda (KIAS June E Huh Center for Mathematical Challenges) and David Xu (KIAS School of Mathematics). Using geometric puzzles and tiling activities, students engaged in collaborative problem-solving exercises involving symmetry, rotation, and pattern construction, including Penrose tiling and Einstein tile puzzle.

Through this event, KIAS strengthened its mission of fostering future talent in basic science and technology while expanding opportunities





2025 Summer Science Academy with Dongdaemun-gu (August 13, 2025)

for public engagement with mathematics and AI research. The academy also demonstrated the value of collaboration between research institutions and local communities in promoting science education and outreach.

■ Science with Citizens

The Open KIAS Center initiated the Science with Citizens program in March 2023, providing opportunities for citizens to actively engage in scientific research. This initiative allows participants to contribute to data generation and analysis, fostering scientific thinking and cultural benefits while advancing scientific development through the collection of fundamental research data.

Growing public interest in science has led to increased demand for platforms offering hands-on scientific experiences, high-level lectures, and direct participation in research. The Science with Citizens program aligns with these trends, moving beyond passive knowledge consumption to enable active engagement in the research process. Participants benefit from a deeper understanding of science, an appreciation for the creation of new knowledge, and enhanced critical thinking skills.

■ Mission Galaxy

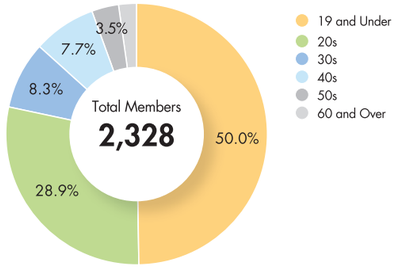
The Mission Galaxy project is a citizen science initiative that invites the public to classify galaxy morphologies and contribute to astronomical research. The project aims to classify approximately 800,000 galaxies, generating research-ready datasets while promoting public engagement in science.

Launched in 2023, the project developed its galaxy classification website in December 2023, and the platform officially opened on February 5, 2024. The operational goal is to obtain at least nine classifications for each of 310,000 galaxies.

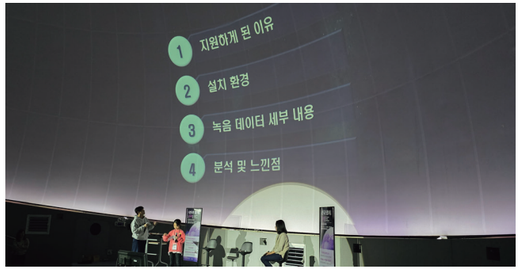
As of December 14, 2025, 2,328 citizens have participated in the project. About 265,085 galaxies (75%) have been classified at least once, while approximately 8% of the nine-classification target has been achieved.

To broaden participation, the project organized educational programs with the Gwacheon National Science Museum, introduced the activity in university astronomy courses, and promoted the project through public lectures and the science YouTube channel Science with People.

Research using the collected data has also begun, including a study published in the Publications of the Korean Astronomical Society examining the educational impact of citizen science participation.



Participation statistics and galaxy classification progress of Everyone's Galaxy Lab (as of December 14, 2025).



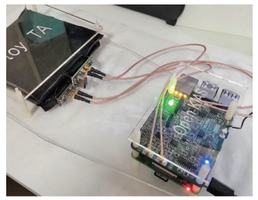
Exhibition-linked educational program at the Gwacheon National Science Museum: The Mission Galaxy project

■ Me Too, Searching for Cosmic Particles

The project "Me Too, Searching for Cosmic Particles" aims to manufacture and distribute muon detectors to citizens and utilize the collected data for science education and research. In 2025, the project focused on establishing a stable detector manufacturing process and data management system prior to large-scale public distribution.



Operational status of detectors on the map



MuonPi detection device

Prototype detectors were produced and tested to ensure reliability. Previous tests revealed that the detector circuit (HAT) is highly sensitive to electromagnetic noise, heat, and electrostatic discharge, which can cause malfunction. Accordingly, the project prioritized improving the detector case design rather than mass production. Tests with an acrylic case confirmed the need for a hybrid structure combining internal visibility and metal shielding to ensure operational stability.

In addition, a map-based visualization system for real-time detector data was developed, and a standardized installation guide for participants was prepared. Future plans include mass-producing hybrid-shielded detectors and distributing them to universities and research institutions while gradually expanding citizen participation.

■ Sori Explorer

Sori Explorer is a citizen-science project of the Korea Institute for Advanced Study (KIAS) that investigates the relationship between urban landscape features and biodiversity using ecoacoustic data. Citizens install automatic sound-recording devices in residential areas and upload recordings to the Sori Explorer web platform, enabling long-term monitoring of urban soundscapes and biodiversity.

Since its launch in July 2024, the project has established an operational framework including participant recruitment, equipment deployment, and website development. Approximately 60 citizen-scientist teams have participated in recording activities, with 37 teams regularly uploading data. To date, about 380,000 audio files (2.1 TB) have been collected.

To support participation and learning, the project organized field-based programs such as the Sori Explorer Camp and Sori Explorer Workshop, where participants received training in recording techniques and sound analysis.

The project has also developed a web platform for data upload and crowdsourced species classification, while initiating AI-based noise filtering and automated analysis systems. These efforts establish a foundation for long-term research on urban biodiversity and ecoacoustic monitoring, with plans to expand the platform and integrate automated analysis in 2026.



Citizen scientists participating in Sori Explorer field activities.



Sori Explorer AI-Based Sound Analysis Platform

Transdisciplinary Research Program

■ Overview of KIAS Transdisciplinary Research Program

The KIAS Transdisciplinary Research (TDR) Program, which has been running since 2012, aims to broaden the horizons of knowledge by fostering dynamic interactions among scholars in several disciplines related to the sciences, arts, and humanities. The TDR program consists of the Annual Theme Research Program and the Independent Research Group Program, which aim to help diverse groups of scholars gain new insights into nature and the essence of life. It is hoped that the science community can gain new perspectives from these interactions.

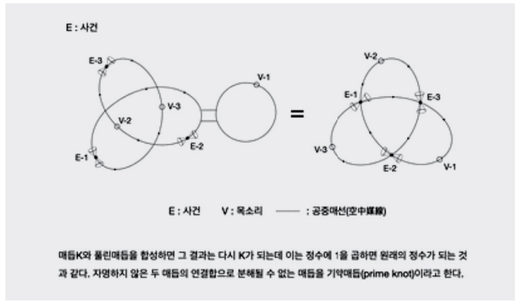
As of 2025, there are four research groups in operation.

■ **Slow Science, Low Technology, and Inverted Art**

The research group Slow Science, Low Technology, and Inverted Art is a transdisciplinary program at the Korea Institute for Advanced Study (KIAS). The group aims to explore new possibilities of thought at the intersection of science, technology, and art. It seeks points of convergence where these three domains may co-evolve, and investigates the problem of "the real" and its latent possibilities within this shared terrain.

In 2024, the group's discussions focused on the concept of "potential reality." In 2025, the research was further developed by approaching "the real" from the perspective of materiality. To pursue this inquiry, the group organized seminars in which each researcher presented an object carrying personal meaning. These objects functioned as mediating elements that revealed fragments of potential reality, allowing the group to expand its reflections on the real through the concepts of potentiality and possibility.

A small radio introduced by researcher Byungjun Kwon, together with the work of the Swedish artist Friedrich Jürgenson (1903–1987), became an important catalyst for the group's discussions. Jürgenson's recordings—capturing faint sounds through radio frequencies and recording devices—raised the question of what constitutes "noise," offering a new perspective on the material nature of sound and voice. Based on this discussion, the research group formulated the concept of "voice-ness," which approaches the voice as a material phenomenon separated from linguistic meaning or social context. In this process, the group also revisited philosophical discussions such as Aristotle's distinction between phone (sound) and logos (speech), as well as later reflections by Jacques Derrida and Nick Couldry, while examining the historical and cultural meanings of voice across literature, philosophy, and the arts.



A conceptual model of "voice-ness" as a relational, material entanglement of events (E) and voices (V).



The Performance
"What Flower Did the Cheshire Cat Bite?"

Based on the outcomes of this research, the group organized a performance program in December 2025 at the Seoul Museum of Art Archive Multipurpose Hall. The performances were held twice—on December 24 and 25—with approximately 70 attendees per session. The program presented the concept of "voice-ness" as an artistic practice, sharing with the audience an exploration of the materiality of sound and the latent possibilities of the voice.

■ **The Nonhuman: Exploring Technological Beings Beyond Humanity**

The KIAS Transdisciplinary Research Program "The Nonhuman: Exploring Technological Beings Beyond Humanity" continued its research activities through the latter half of its first year and the first half of its second year in 2025. While the first year explored diverse interdisciplinary approaches to the concept of the nonhuman, the second year focused on examining nonhuman beings from the perspectives of art, technology, and their convergence, exploring how nonhumans form cooperative relationships with humans in reality.

In February, the Research and Planning Committee held a workshop at the Busan Museum of Contemporary Art to plan activities for 2025 and explore possibilities for collaboration with external institutions. The workshop included meetings with museum curators, viewing related exhibitions, and research presentations by committee members.

Throughout the year, the group continued its public seminar series. Presentations addressed topics such as nonhuman representations in film and literature, the history of life through concepts like symbiotic evolution and entanglement, nonhuman characters in science fiction, and the role of artistic practice in responding to environmental crises.

Two symposia were also held. The first, The Age of Entanglement: Symbiosis with the Non-Human, brought together researchers from various fields to discuss human–nonhuman entanglement. The second, Aesthetics of the Nonhuman: Nonhuman Senses and Art Beyond the Human, focused on artistic and technological practices that attempt to extend human sensory limits and explore connections with nonhuman perception.

Finally, the group's research outcomes were compiled and published in the book Nonhuman: Thinking with Objects, Life, Machines, and Planets, the 12th volume of the Transdisciplinary Research Series. The collected essays emphasize that human existence itself is constituted through entanglements with numerous nonhuman entities.

■ **In the Age of AI, Focus on Humans Again: A Transdisciplinary Approach to Human Motivation and Desire**

The Motivation and Desire Research Group examines how rapidly evolving technological and sociocultural environments—particularly the emergence of generative AI—are reshaping contemporary human behavior. As human emotions, decision-making, and actions become increasingly intertwined with technological infrastructures, the group seeks to explore what remains uniquely human and how motivation and desire are constructed, expressed, and transformed within these changing contexts. As an Independent Research Group within the KIAS Transdisciplinary Research Program, the team conducts integrated discussions across disciplines including neuroscience, psychology, philosophy, computational science, the social sciences, and the arts in order to develop a broader understanding of human behavior beyond narrowly defined instinctual or psychological explanations.

Throughout 2025, the group held monthly online seminars that provided a forum for researchers to present ongoing work, exchange disciplinary perspectives, and foster interdisciplinary collaboration. In addition to these regular meetings, the group organized internal seminars, invited lectures, a public seminar, and a research workshop, further strengthening collaboration within the research team and expanding its academic network.



The First Symposium <The Age of Entanglement: Symbiosis with the Non-Human> May 24, 2025.



The 12th Transdisciplinary Research Series <Non-Human: Thinking with Objects, Life, Machines, and Planets> Published. December 31, 2025.

Alongside its academic activities, the group has also sought to communicate its research outcomes to the public by producing YouTube content that presents complex academic ideas in an accessible and engaging format. Five videos have been released on the official KIAS YouTube channel, and two additional videos are currently in post-production for release in January 2026. By translating interdisciplinary research concepts into visual narratives, these videos help broaden public understanding while increasing awareness of the group's research mission.

The research project will continue through April 2026. Based on the insights gained over the past two years, the group plans to develop a more comprehensive interdisciplinary research proposal to be submitted to organizations that support convergence-oriented research. During the early months of 2026, the team will refine its research framework through internal discussions and consultations with external experts. The group also plans to organize offline colloquia at KIAS to share research outcomes and encourage in-depth discussions, while continuing to produce additional YouTube content to present the group's research achievements to a wider public audience.

■ **Old Yet New Gugak Reimagined**

The KIAS Transdisciplinary Research Group "Old Yet New Gugak Reimagined" was launched on July 1, 2025, to explore new perspectives and research directions in Gugak. Building on earlier initiatives such as "Scientific Understanding of Gugak and AI Gugak" and "Large-Scale Gugak Data," the group continues to expand previous research while developing interdisciplinary approaches to the study of traditional Korean music.



Public Seminar on "Applications of Motivation," January 16, 2025



YouTube Content Series by the Motivation and Desire Research Group

In November 2025, the group published the paper "Persistent Homology of Music Networks with Three Different Distances" in the Journal of Mathematics and Music. The study applies persistent homology to music graphs to examine how different definitions of distance influence topological characteristics in musical data. Using Yeongsanhoesang performed on geomungo and haegeum as case studies, the research demonstrates that certain distance orderings produce an injection relationship in first-dimensional homology, showing that such topological structures also appear in Gugak data and providing a foundation for further mathematical analysis of Gugak.

On November 15, the group held a workshop titled "Gugak in the Era of Data & Computation I," focusing on the relationship between Gugak, technology, and education. About 70 participants attended, reflecting strong academic interest in scientific approaches to Gugak. The workshop included lectures on information theory in music and music cognition experiments using EEG measurements, as well as discussions on the scientific study of historical Korean musical notation.

The group also plans to release a music album featuring recordings from the KIAS Transdisciplinary AI Gugak Concert held on December 18, 2024. The album will include six works and serve both as a musical release and as an archive of research-related performance data.

In addition, the group is currently conducting research on large-scale Gugak datasets developed in earlier projects. By applying the Zipf–Mandelbrot law to the analysis of Jeong-ak, the researchers aim to identify structural and semantic patterns within Gugak music. Building on these efforts, the group is preparing future research plans for 2026, including studies using information theory, EEG-based investigations of musical perception, and AI-based research on Sanjo.

■ **Advancing Transdisciplinary Research at KIAS: Highlights of the 2025 Transdisciplinary Research Program**

Throughout 2025, researchers participating in the KIAS Transdisciplinary Research Program actively pursued its mission through a wide range of seminars, workshops, symposia, collaborative research projects, and public engagement initiatives. Several research groups explored diverse and timely themes, including the relationship between humans and nonhumans, interdisciplinary investigations of motivation and desire in the age of generative AI, and the scientific and computational analysis of Gugak (traditional Korean music).

These activities produced a variety of meaningful outcomes, ranging from academic publications, workshops, and public seminars to creative outputs such as concerts and album releases, as well as widely accessible YouTube content designed to communicate research to broader audiences. Through these dynamic efforts, the KIAS Transdisciplinary Research Program not only advanced cutting-edge interdisciplinary scholarship but also strengthened its role as a vibrant platform for intellectual exchange, expanding both the academic impact and the public visibility of its research.



Album Release – KIAS Transdisciplinary AI Gugak Concert Recordings (December 2025)



KIAS Workshop on Gugak in the Era of Data & Computation I, November 15, 2025.

Partnership

International

1999	International Society for Mathematical Sciences (ISMS., Former Japan Association for Mathematical Sciences)	Japan
	Mathematical Sciences Research Institute (MSRI), Berkeley	USA
	Institute for Advanced Study (IAS), Princeton	USA
	Institute of Particle and Nuclear Studies (IPNS/KEK)	Japan
2000	Research Institute for Mathematical Sciences (RIMS)	Japan
	National Center for Theoretical Sciences (NCTS)	Taiwan
2002	Pacific Institute for the Mathematical Sciences (PIMS)	Canada
	Mongolian Academy of Sciences (MAS)	Mongolia
2004	Nagoya University	Japan
	Yukawa Institute for Theoretical Physics (YITP)	Japan
2005	Graduate School of Mathematical Sciences, University of Tokyo	Japan
	Kavli Institute for Theoretical Physics (KITP)	USA
2007	Graduate School of Mathematics, Kyushu University	Japan
2008	Vietnamese Academy of Science and Technology (VAST)	Vietnam
	Institute of Physics Albert-Ludwigs-university of Freiburg	Germany
2009	Feza Gürsey Center for Physics and Mathematics	Türkiye
2010	Institute of Advanced Studies (IAS), Nanyang Technological University	Singapore
2011	Waseda Institute for Advanced Study (WIAS)	Japan
2013	Centre of excellence for Cosmology and Particle Physics Phenomenology, The Danish Institute for Advanced Study (CP^3-Origins DIAS)	Denmark
2014	University of Gdańsk	Poland
	Institute of Theoretical Physics, Chinese Academy of Sciences (ITP, CAS)	China
	Academy of Mathematics and Systems Science, Chinese Academy of Sciences (AMSS, CAS)	China
	Future Circular Collider Study hosted by European Organization for Nuclear Research (CERN FCC Study)	Switzerland
2015	Interdisciplinay Theoretical Science Research Group, Rikagaku Kenkyusho (RIKEN iTHES Group)	Japan
	Vietnam Institute for Advanced Study in Mathematics (VIASM)	Vietnam
2016	Italian Mathematica Union (UMI, Unione Matematica Italiana)	Italy
2019	Purdue University, Dept of Physics and Astronomy	USA
2023	University of Arizona	USA
2026	The University of Naples, Federico II, Department of Physics E. Pancini	Italy

Domestic

1999	Korea University	Seoul
	Ewha Womans University	Seoul
2000	Information Center for Mathematical Science, KAIST	Daejeon
	Information Center for Physics Research, SNU	Seoul
2001	Yonsei University	Seoul
	Sogang University	Seoul
	Korea Institute of Science and Technology Information (KISTI)	Daejeon
2002	Sungkyunkwan University	Seoul
2003	Kyung Hee University	Seoul
2004	Korea Academy of Science and Technology (KAST)	Gyeonggi
	Korea Research Institute of Standards and Science (KRISS)	Daejeon
	Hanyang University	Seoul
	Korea Atomic Energy Research Institute (KAERI)	Daejeon
	Korea Institute of Science and Technology (KIST)	Seoul
2007	Korea Foundation for the Advancement of Science & Creativity (KOFAC)	Seoul
2008	Ajou University	Gyeonggi
2009	Korean Women in Mathematical Sciences (KWMS)	Seoul
2010	Dongdaemun-gu Office	Seoul
	Korean Foundation for the Advancement of Science and Creativity (KOFAC)	Seoul
2012	Youngju City	Youngju
	Korea Institute of Science and Technology Information (KISTI)	Seoul
2013	Gwacheon National Science Museum	Gwacheon
	Seoul Metropolitan Office of Education	Seoul
	KAIST Department of Mathematical Sciences	Daejeon
2016	Institute for Basic Science (IBS)	Daejeon
	Kyung Hee University Healthcare System	Seoul
	College of Natural Sciences, Seoul National University	Seoul
2018	The Hong-Reung Forum/Seoul Housing and Communities Corporation	Seoul
2021	Sungkyunkwan University, Quantum Information	Seoul
	Korea Astronomy & Space Science Institute (KAIS)	Daejeon
	SNU R&DB Foundation, Seoul National University	Seoul
2022	University of Seoul, Dept of AI	Seoul
2023	Soorim Cultural Center	Seoul
2025	Donga Science	Seoul
	The Korean Physical Society (KPS)	Seoul
	The Korean Mathematical Society (KMS)	Seoul
	Ajou University G-LAMP Project	Gyeonggi
	College of Natural Sciences, KAIST	Daejeon
	The Korean Physical Society IYQ 2025	Seoul
	Institute of Mathematical Sciences, Kangwon National University	Gangwon
	You&Me Psychological Counseling Research Institute	Seoul

Alumni

School of Mathematics

2025

Yun, Hyungsung
Changwon Nat'l Univ.

Wen, Yaoxiong
Yonsei Univ.

Lee, Youngmin
Kyonggi Univ.

Chen, Hsin-Ku
Nat'l Chung Cheng Univ.

Lee, Sanghoon
CUHK

Genz, Volker
New Uzbekistan Univ.

Kim, Taehyeong
Brandeis Univ.

Han, Jiyoung
Pusan Nat'l Univ.

Moon, Hyunsuk
Sungshin Women's Univ

Nyberg Brodda, Carl-Fredrik
KIAS

2024

Campo, Livia
Univ. of Vienna

Choa, Dongwook
IBS

Jung, Mingu
Hanyang Univ.

Kang, Myeongju
Gachon Univ.

Kim, Daejun
Korea Univ.

Kim, Jeong-Seop
Suncheon Nat'l Univ.

Kim, Junha
Ajou Univ.

Kim, Seongyeon
Jeonju Univ.

Kim, Seonwoo
Yonsei Univ.

Lee, Jaehun
KAIST

Lee, Jung-Kyoung
Inha Univ.

Park, Jaehui
Chonnam Nat'l Univ.

Ryu, Jaehyeon
Ewha Womans Univ.

Schippa, Robert
UC Berkeley

Suen, Yat-Hin
Nat'l Cheng Kung Univ.

2023

Choi, Youn-Seo
KIAS

Kim, Hyun Kyu
KIAS

Chai, Xiaoxiang
POSTECH

De la Nuez Gonzalez, Javier
KIAS

Lee, Taehun
KIAS

Oh, Sewook
KIAS

Park, Hyeonjun
KIAS

Park, Sung Chul
Univ. of Michigan

2022

Cho, Yonghwa
IBS

Choi, Hakho
Seoul Nat'l Univ.

Choi, Junhwa

He, Weikun
Chinese Academy of Sciences

Hwang, Sukjung
Chungbuk Nat'l Univ.

Keum, JongHae
KIAS

Kim, Doheon
Hanyang Univ.

Kim, Seongchan
Kongju Nat'l Univ.

Krylov, Igor
Center for Geometry and Physics, IBS

Kwon, Yehyun
Changwon Nat'l Univ.

Lee, Cheolgyu

Lee, Jungin
Ajou Univ.

Lee, Sanghyeon
Shanghai Center for Mathematical Science

Meng, Sheng
East China Normal Univ.

Park, Bae Jun
Sungkyunkwan Univ.

Park, Jung-Tae
Korea Univ. of Technology and Education

Park, Kiho
IMC Financial Market

Shin, Jinwoo
Sookmyung Women's Univ.

Song, Jongbaek
Pusan Nat'l Univ.

Zhang, Yeping

2021

Bhamidi, S.S Sreedhar
Harish Chandra Research Institute

Hu, Yong
Shanghai Jiaotong Univ.

Hwang, WonTae
Chonbuk Nat'l Univ.

Jeong, Eunhee
Chonbuk Nat'l Univ.

Jeong, In-Jee
Seoul Nat'l Univ.

Kim, Bumsig

Kim, Joontae
Sogang Univ.

Lee, Chul-hee
KIAS

Nam, Hayan
Duksung Women's Univ.

Oh, Jeongseok
Seoul Nat'l Univ.

Seo, Seong-Mi
Chungnam Nat'l Univ.

Wan, Xueyuan
Chongqing Univ. of Technology

Yoon, Seokbeom
Barcelona Autonoma Univ.

2020

Bae, Youngjin
Incheon Nat'l Univ.

Hwang, Jun-Muk
Center for Complex Geometry, IBS

Jung, Joeun

Kim, Daehwan
Daegu Univ.

Kwak, Chulkwang
Ewha Womans Univ.

Lee, Sangwook
Soongsil Univ.

Li, Qifeng
Center for Complex Geometry, IBS

Liao, Hsuan-Yi
Nat'l Tsing Hua Univ.

Miura, Makoto
RIMS, Kyoto Univ.

P. Murillo, Plinio G.
Federal Fluminense Univ.

2019

Choi, Jongkeun
Pusan Nat'l Univ.

Goller, Thomas
Temple Univ.

Hong, Kyusik
KAIST

Kim, Chan-Ho
Chonbuk Nat'l Univ.

Kim, Eunmi
Ewha Womans Univ.

Kim, Min Hoon
POSTECH

Kim, Soojung
Soongsil Univ.

Kim, Wansu
KAIST

Nie, Xin
Tsinghua Univ.

Park, Byungdo
Chungbuk Nat'l Univ.

Seo, Aeryeong
Kyungpook Nat'l Univ.

Shin, Hyung-Seok

Shin, Jiyong

2018

Ahn, Taeyong
Inha Univ.

Cho, Yumi
Seoul Nat'l Univ.

Ha, Junsoo
Incheon Nat'l Univ.

Ham, Seheon
Seoul Nat'l Univ.

Jang, Donghoon
Pusan Nat'l Univ.

Jung, Seung-Jo
Chonbuk Nat'l Univ.

Kim, Hwa Kil
Hannam Univ.

Kim, Kwang-Seob
Chosun Univ.

Kim, Seungki
Univ. of Cincinnati

Kim, Youchan
Univ. of Seoul

Park, Hanchul
Seoul Science High School

Park, Kyungbae
Seoul Nat'l Univ.

Paun, Mihai
Univ. of Bayreuth

Vu, Duc Viet
Univ. of Cologne

2017

Choi, Woocheol
Incheon Nat'l Univ.

Hwang, Taekgyu
KAIST

Jin, Seok-Ho
Chung-Ang Univ.

Kang, Moon-Jin
Sookmyung Women's Univ.

Kim, Hyun Kyu
Ewha Womans Univ.

Kim, Seunghyeok
Hanyang Univ.

Koh, Youngwoo
Kongju Nat'l Univ.

Lee, Eunjoo
Soongsil Univ.

Lee, Seungjin
Seoul Nat'l Univ.

Liao, Xia

Nisse, Mounir
Xiamen Univ. Malaysia

Ok, Jihoon
Kyung Hee Univ.

Van Garrel, Michel
Warwick Univ.

Xu, Binbin
Univ. of Luxembourg

Yang, Minsuk
Yonsei Univ.

2016

Jo, Sihun
Woosuk Univ.

Kuessner, Thilo

Lee, Hojoo
Chonbuk Nat'l Univ.

Lee, Jun Ho
Mokpo Nat'l Univ.

Lee, Kyoung-Seog
IBS

Lho, Hyenho
ETH Zurich

Zhu, Zhixian
UC Riverside

2015

Cho, Jinseok
Busan Nat'l Univ. of Education

Choi, Young-Jun
Pusan Nat'l Univ.

Chung, Kiryong
Kyungpook Nat'l Univ.

Han, Kangjin
DGIST

Hashimoto, Kenji
Univ. of Tokyo

Hyun, Yoonsuk
Samsung Advanced Institute of Technology

Kang, Hyosang
DGIST

Kim, Myungho
Kyung Hee Univ.

Lim, Subong
Sungkyunkwan Univ.

Park, Yoon Kyung
Seoul Nat'l Univ.

Rosales, Leobardo
Kyemyeong Univ.

Truong, Tuyen Trung
Univ. of Oslo

2014

Cao, Junyan
Université Pierre et Marie Curie (Paris 6)

Cho, Yunhyung
Sungkyunkwan Univ.

Jeon, Woojin

Kang, Hyunsuk
GIST

Kim, Jang Soo
Sungkyunkwan Univ.

Kim, Sun Kwang
Chungbuk Nat'l Univ.

Kolte, Sagar
Credit Suisse

Lee, Jungyun

Min, Sung-Hong
Chungnam Nat'l Univ.

Park, Heesang
Konkuk Univ.

Seo, Ihyeok
Sungkyunkwan Univ.

Seok, Jinmyoung
Kyonggi Univ.

Won, Joonyeong
KIAS

Yoo, HwanChul
World Quant

2013

Abdelgadir, Tarig
Univ. of New South Wales

An, Byung Hee
IBS

Cho, Jae-Seong

Harada, Shinya
Tokyo Institute of Technology

Jung, Uiji
Ajou Univ.

Kim, Wook
Minnesota State Univ. Mankato

Kim, Youngju
Konkuk Univ.

Lee, Hwayoung
UC Riverside

Lee, Jungjin
UNIST

Seo, Jeehyeon
Sogang Univ.

Song, Minju
NeoMath

Spaeth, Peter
GE Global Research

Yoo, Meesue
Chungbuk Nat'l Univ.

Ziltener, Fabian
Utrecht Univ.

2012

Morabito, Filippo
KAIST

Mueller, Stefan
Georgia Southern Univ.

Park, Jong-Do
Kyung Hee Univ.

2011

Guzzetti, Davide
SISSA

Huh, Sukmoon
Sungkyunkwan Univ.

Hwang, DongSeon
Ajou Univ.

Jang, Junmyeong
Univ. of Ulsan

Jun, Hyunkeun
Korea Science Academy, Busan

Kim, Dano
Seoul Nat'l Univ.

Kim, Taejung
Korea Nat'l Univ. of Education

Lee, JaeHyouk
Ewha Womans Univ.

Lee, Jeong-Yup
Catholic Kwandong Univ.

Lee, Kang-Hyurk
Gyeongsang Nat'l Univ.

Lee, Yoonbok
Incheon Nat'l Univ.

Li, Changzheng
Sun Yat-sen Univ.

Lopez, Martin Alberto

Marelli, Giovanni
Universidad de Antioquia in Medellin, Colombia

Park, Euiyong
Univ. of Seoul

Pyo, Juncheol
Pusan Nat'l Univ.

2010

Chang, TongKeun
Mokpo Nat'l Maritime Univ.

Cheong, Daewoong
Chungbuk Nat'l Univ.

Chung, Kuerak
Korea Nat'l Univ. of Education

Kim, Byungchan
Seoul Nat'l Univ. of Science and Technology

Kim, Ji Young
Seoul Nat'l Univ.

Lee, Dong Uk
Chungbuk Nat'l Univ.

Lee, Jung-Hoon
Chonbuk Nat'l Univ.

Park, Sung-ho
Hankuk Univ. of Foreign Studies

Sun, Hae-Sang
UNIST

2009

Bender, Andreas
Univ. of Pavia

Chan, Kungho
Taiwan Nat'l Cheng Kung Univ.

Chu, HahngYun
Chungnam Nat'l Univ.

Huang, Rung- Tzung
Nat'l Central Univ.

Kim, Chang-Wan
Mokpo Nat'l Maritime Univ.

Kim, Namhoon
Hongik Univ.

Nguyen, Viet-Anh
Univ. of Lille

Seo, Keomkyo
Sookmyung Women's Univ.

Yoon, Gang Joon
NIMS

Zuo, Dafeng
Univ. of Science and Technology of China

2008
Choe, Insong
Konkuk Univ.

Choi, SoYoung
Gyeongsang Nat'l Univ.

Choy, Jaeyoo
Kyungpook Nat'l Univ.

Jo, JangHyun
Sogang Univ.

Kim, Seung Won
Kyungsung Univ.

Lau, Chi Hin
The Chinese Univ. of Hong Kong (CUHK)

Lee, Nam-Hoon
Hongik Univ.

Lee, Seok-Min
Hongik Univ.

Nagai, Yasunari
Waseda Univ.

Oh, Yong-Geun
IBS

Sato, Fumitoshi
Takamatsu Nat'l College of Technology

2007
Chae, Myeongju
Hankyoung Nat'l Univ.

Choi, Dohoon
Korea Univ.

Kang, Soon-Yi
Kangwon Nat'l Univ.

Kwon, Young-Sam
Dong-A Univ.

Li, Li
Oakland Univ.

Oh, Byung-Geun
Hanyang Univ.

Wang, Sung Ho

2006
Jeon, Daeyeol
Kongju Nat'l Univ.

Jun, Byungheup
UNIST

Kim, Dong Han
Dongguk Univ.

Kim, Hyunseok
Sogang Univ.

Kim, Jeong-Ah
Univ. of Seoul

Kim, Min Kyu
Gyeongin Nat'l Univ.

Kim, Sung-Yeon
KIAS

Lee, Hyeonmi
Hanyang Univ.

Myung, Sung
Inha Univ.

Oh, Young-Tak
Sogang Univ.

Park, Euisung
Korea Univ.

Shin, Dong-Uy
Hanyang Univ.

Song, Won Taek
Seoul Science High School

Sung, Chanyoung
Korea Nat'l Univ. of Education

Yoon, Joung-Hahn
Dong-a Univ.

2005
Hong, Kuk-Jin
Hankuk Academy of Foreign Studies

Kolesnikov, Pavel
Sobolev Institute of Mathematics

Lee, Joongul
Hongik Univ.

Lee, Sangyop
Chung-Ang Univ.

Matsumi, Kazuya

Schweizer, Andreas

Seo, Soogil
Yonsei Univ.

2004
Cho, Jin-Hwan
NIMS

Joe, Dosang
NIMS

Kang, Seok-Jin
Seoul Nat'l Univ.

Kim, Chang Heon
Sungkyunkwan Univ.

Kim, Namkwon
Chosun Univ.

Lee, Junho
Univ. of Central Florida

Park, Mi Hee
Chung-Ang Univ.

2003
Choi, Yungook
Yeungnam Univ.

Hong, Jaehyun
KIAS

Kwon, Jae Hoon
Seoul Nat'l Univ.

Lee, Sang Jin
Konkuk Univ.

Ochi, Yoshihiro
Tokyo Denki Univ.

Yun, Ki-Heon
Sungshin Women's Univ.

2002
Hong, Jin
Seoul Nat'l Univ.

Kim. Min hyong
Univ. of Oxford, KIAS CMC

Kim, Seok Woo
Konkuk Univ.

Ouyang, Yong

Winkelmann, Joerg
RUHR-Univ. Bochum

Yoon, Jung-Rok
Clemson Univ.

2001
Byun, Dongho
Seoul Nat'l Univ.

Choi, Youn-Seo
KIAS

Kim, Joonil
Yonsei Univ.

Kim, Kyunghee

Ku, Hyejin
New York Univ.

Kwon, Daesung
NSR

Lee, Jaesung
Sogang Univ.

Oh, Byeong-Kweon
Seoul Nat'l Univ.

Rim, Kyung Soo
Sogang Univ.

2000
Kim, Hong-Chan
Korea Univ.

Koh, Jee-Heub
Indiana Univ.

Kwak, Si-Jong
KAIST

Lee, Yong-Hah
Ewha Womans Univ.

Oh, Jangheon
Sejong Univ.

Paeng, Seong-Hun
Konkuk Univ.

Park, Jinsung
KIAS

1999
Bae, Hyeong Ohk
Ajou Univ.

Kim, Sung Guen
Kyungpook Nat'l Univ.

Lee, Seunghun
U1 Univ.

Lee, Yongnam
KAIST

Moon, Dongho
Sejong Univ.

1998
Byeon, Jaeyoung
KAIST

Oleg, Emanouilov
Colorado State Univ.

Potemine, Igor
Universite Grenoble

1997
Kim, In Kang
KIAS

School of Physics

2025

Pal, Priyo Shankar
KIAS

Lu, Yongchao

Dutka, Tomasz P.

Yu, Bingrong

Kim, Suro
Ewha Womans Univ.

Kim, Youngjae
KIAS

Hwang, Kyusung
Kyung Hee Univ.

Lee, Sangyun
Johannes Gutenberg Univ. Mainz

2024

Ho, Shu-Yu
Academia Sinica

Singh, Ankit

Qiang, Jia
KAIST

Qin, Fei
Aix-Marseille Univ.

Lee, Kimyeong
BIMSA

Choi, Sunjin
IPMU

Sun, Rui
Univ. of Chinese Academy of Sciences

Park, Jaehong
KASA(Korea AeroSpace Administration)

Tian, Jiahua
East China Normal Univ.

2023

Duan, Zhihao
Queen Mary Univ. of London

Kang, Dong Woo
Jeonbuk Nat'l Univ.

Janagal, Lavneet
Wells Fargo, India

Kim, Jongkuk
KIAS

Dong, Fuyu
Yunnan Univ.

Gouin, Celine
Institut d'Astrophysique Spatiale

Jung, Tae Hyun
IBS

2022

Park, Jong-Min
APCTP

Okazaki, Tadashi
Southeast Univ.

Kim, Yonghwi
Yonsei Univ.

Ghim, Dongwook
Kyoto Univ.

Mukherjee, Sutirtha

Leem, Jae Hoon
Samsung Electronics Co.

Yoon, Yongmin
KASI

Kang, Byungmin
Massachusetts Institute of Technology

Su, Wei
Sun Yat-Sen Univ.

Shim, Junsup
Academia Sinica

Mondal, Tanmoy
Osaka Univ.

Hwang, Kyusung
KIAS

Lu, Chih-Ting
Nanjing Normal Univ.

Jun, Hyunsung
Seoul Nat'l Univ.

2021

Dashti-Naserabadi, Hor
KENTECH

Sarkis, Matthieu
Univ. of Luxembourg

Kaneta, Kunio
Tokyo Woman's Christian Univ.

Park, Miok
IBS

Papadimitriou, Ioannis
BIMSA

Yoon, Junggi
APCTP

Lee, Jae Hyun
KIAS

Nahmgoong, June
December & Company Inc.

Yi, Sudo
KIAS

2020

Eager, Richard

Ebrahimnazhad Rahbari S.H.
Seoul Nat'l Univ.

Han, Chengcheng
Zhongshan Univ.

Nomura, Takaaki
Sichuan Univ.

Poggi, Matteo
SISSA

Rosa, Dario
KAIST

Tonegawa, Motonari
APCTP

Yun, Seokhoon
Univ. of Padova

2019

Appleby, Stephen Andrew
KIAS QUC

Bae, Jin-Beom
Univ. of Oxford

Chen, Junmou
Jinan Univ.

Evans, Jason L.
Shanghai Jiao Tong Univ.

Hong, Sungryong
KASI

Kim, Joonho
IAS

Matsui, Toshinori
KAIST

Munir, Shoaib
ICTP-EAIFR

Noh, Changsuk
Kyungpook Nat'l Univ.

Nosaka, Tomoki
SISSA

Park, Sang-A
Yonsei Univ.

Saulder, Christoph

Sciarappa, Antonio
SISSA

Snaith, Owain Nicholas
Observatoire de Paris

Song, Jaewon
KAIST

Suzuki, Ryo
Shing-Tun Yau Center of Southeast Univ.

Winding, Jacob

Wu, Peiwen
Southeast Univ.

Zheng, Yi
Sun Yat-Sen Univ.

2018

Baek, Seungwon
Korea Univ.

Cho, Gil Young
POSTECH

Das, Arindam
Osaka U.

Hwang, Chiung
Univ. of Milano-Bicocca

Kim, Kun Woo
IBS

Lee, Sang Hoon
GNTECH

Li, Jinmian
Sichuan Univ.

Natale, Alexander

Nishiwaki, Kenji
Rudjer Boskovic Institute

2017

Biswas, Sanjoy
Ramakrishna Mission Vivekananda Univ.

Durang, Xavier
Univ. of Seoul

Gobat, Raphael
PUCV

Jain, Bithika
ICTP-SAIFR

Kang, Zhaofeng
Huazhong Science and Technology Univ.

Khalilian, Hamid Reza
Institute for Advanced Studies in Basic Sciences (IASBS)

Li, Xiao Dong
Sun Yat-Sen Univ.

Lim, Jongsoo

Park, Chan Beom
IBS

Shin, Jihye
KASI

2016

Chung, Hee Joong
Tsinghua Univ.

Ito, Yuto

Jeon, Imtak
King's College London

Jeon, Jae-Hyung
POSTECH

Lee, Seokcheon
Gyeongsang Nat'l Univ.

L'Huillier, Benjamin
KASI

Salmi, Fadia

Seong, Rak-Kyeong
Tsinghua Univ.

Tang, Yong
Univ. of Chinese Academy of Science

Yagi, Futoshi
Southwest Jiaotong Univ. (China)

Yoshida, Yutaka
IPMU

2015

Ahn, Yang Hwan
Institute of High Energy Physics, China

Cervantes Sodi, Bernardo
CR,A,UNAM

Jeong, Jae-Seung
Samsung Electronics Co.

Jung, Sunghoon
Seoul Nat'l Univ.

Kim, Sung-Soo
Univ. of Electronic Science and Technology of China (UESTC)

Okada, Hiroshi
APCTP

Qi, Wanming
China Univ. of Mining and Technology

Rhim, Jun Won
Seoul Nat'l Univ.

Wan, Luping
Institute of High Energy Physics, China

Yu, Chaehyun
Korea Univ.

2014

Gang, Dongmin
APCTP

Hou, Annie
Sandtable, London

Hwang, Jeong-Sun
Sejong Univ.

Kim, Sang-Woo
Institute of Theoretical Physics, CAS

Lahiri, Sourabh
Birla Institute of Technology, Mesra

Lee, Hyunjung
Seoul Science
High School

Lee, Seung-Joo
CERN

Lee, Woo-Ram
The Univ. of Alabama

Ogawa, Noriaki
RIKEN Mochizuki Laboratory

Park, Wanil
Chonbuk Nat'l Univ.

Sabiu, Cristiano
Yonsei Univ.

Sharma, Pankaj
The Univ. of Adelaide

Wang, Zhaolong
Northwest normal Univ.

Yoon, Yeo Woong
Konkuk Univ.

2013

Baek, Seung Ki
Pukyong Nat'l Univ.

Hayashi, Hirotaka
Tokai Univ.

Hong, Sungwook
Univ. of Seoul

Kim, Hee Cheol
POSTECH

Kim, Kwangmoo
Seoul Nat'l Univ.

Koh, Eunkyung
Samsung Display

Lee, Hyun Min
Chung-Ang Univ.

Nam, Seung-il
Pukyong Nat'l Univ.

Park, Jong-Chul
Chungnam Nat'l Univ.

Senaha, Eibun
IBS

Um, Jaegon
POSTECH

2012

Cho, Myoung Won
Sungshin Women's Univ.

Choi, Kang Sin
Ewha Womans Univ.

Kim, Chul
Seoul Nat'l Univ. of
Science and Technology

Kumar, Jaswant
Harish Chandra Research Institute

Lee, Choongki
Yonsei Univ.

Lee, Seong-Kook
Seoul Nat'l Univ.

Omura, Yuji
Nagoya Univ.

Rossi, Graziano
Sejong Univ.

Van Putten, Maurice
Sejong Univ.

2011

Bandyopadhyay, P.
Indian Institute of
Thechnology Hyderabad

Lu, Hantao
Lanzhou Univ.

Medved, A.J. M.
Rhodes Univ.

O Colgain, Eoin
APCTP

Song, Yong-Seon
KASI

2010

Chingangbam, P.
Indian Institute of
Astrophysics

Ham, Seung Woo

Huang, Qing-Guo
Institute of Theoretical Physics, CAS

Jo, Hang-Hyun
POSTECH

Kang, Hyuk
NIMS

Kim, Yeong Gyun
Gwangju Nat'l Univ. of Education

Kim, Yong Woon
KAIST

Lee, Jae Yong
Korea Univ.

Lee, Jong-Phil
Korea Univ.

Lee, Sungjay
KIAS

Wu, Jun-Bao
Institute of High Energy Physics, China

Yavartanoo, Hossein
Institute of Theoretical Physics, CAS

Zaballa, Ignacio
Lancaster Univ.

2009

Dutta, Sreedhar B.
IISER

Hibon, Pascale
European Southern Observatory

Hwang, Ho Seong
KASI

Jeong, Kwang Sik
Pusan Nat'l Univ.

Kihara, Hironobu
Seikei Univ.

Kim, Youngman
IBS

Kim, Young-Rae

Yang, Hyun Seok
Sogang Univ.

Zhou, Yufeng
Institute of Theoretical Physics, CAS

2008

Araya, P.
Jacobs Univ.

Choi, Yun-Young
Kyung Hee Univ.

Hosomichi, Kazuo
Japanese Nat'l
Defense Academy

Jia, Cheng long
Lanzhou Univ.

Kim, Juhan
KIAS

Kim, Mun Dae
Hongik Univ.

Kyae, Bumseok
Pusan Nat'l Univ.

Lee, Hyun Keun
Sungkyunkwan Univ.

Mawatari, Kentarou
Osaka Univ.

Nagar, Apoorva
Indian Institute of
Space Science and Technology

Park, Kwon
KIAS

Scopel, Stefano
Sogang Univ.

Wu, Xiaohong
ECUST (East China Univ. of
Science and Technology)

2007

Jung, Dong-Won
Korea Univ.

Kim, Ki-Seok
POSTECH

Kim, Seok
Seoul Nat'l Univ.

Lee, Ji-Woo
Myongji Univ.

Park, Chan-Gyung
Chonbuk Nat'l Univ.

Park, Tae-Sun
Sungkyunkwan Univ.

Yee, Ho-Ung
Univ. of Illinois at Chicago

2006

Ha, Meesoon
Chosun Univ.

Kimura, Tetsuji
Keio Univ.

Park, Su-Chan
The Catholic Univ. of Korea

2005

Borzumati, Francesca
Tohoku Univ.

Kang, Gung Won
KISTI

Lee, Jounghun
Seoul Nat'l Univ.

Okamura, Naotoshi
International U. of
Health and Welfare

Park, Jae-Suk
POSTECH

Park, Seong Chan
Yonsei Univ.

Raeymaekers, Joris
Czech Academy of Science

Suyama, Takao
KEK

Yi, Sang-Heon
Univ. of Seoul

2004
Ahn, Sang-Hyeon
KASI

Cornell, Alan
MITP Univ. of
the Witwatersrand

Hong, Hyunsuk
Chonbuk Nat'l Univ.

Kwon, Hwang-hyun
Korea Development Bank

Michishita, Yoji
Kagoshima Univ.

Sim, Heung-Sun
KAIST

Yee, Jung-Tay
Saxo Bank

Yi, Hangmo
Soongsil Univ.

2003
Akeroyd, Andrew
Univ. of Southampton

Chang, Heon-Young
Kyungpook Nat'l Univ.

Kim, Hyung Do
Seoul Nat'l Univ.

Lee, Kang Young
Gyeongsang Nat'l Univ.

Park, Jeong-Hyuck
Sogang Univ.

Rho, Mannque

Song, Jeong-hyeon
Konkuk Univ.

2002
Choi, Mahn-Soo
Korea Univ.

Lee, Chang-Hwan
Pusan Nat'l Univ.

Lee, Hyunwoo
POSTECH

Lee, Sang-Min
Seoul Nat'l Univ.

Liu, Qiu-Yu
Univ. of Science and Technology,
China

Park, Sung Yong
Northwestern Univ.

Shin, Hyeonjoon
POSTECH

Yi, Insu

2001
Guslienko, Kostyantyn
Universidad del
país vasco

Hyun, Seungjoon
Yonsei Univ.

Kang, Sin-Kyu
Seoul Nat'l Univ. of
Science and Technology

Kim, Chanju
Ewha Womans Univ.

Lee, In-Ho
Korea Research Institute of
Standards and Science

2000
Choi, Seong-Youl
Chonbuk Nat'l Univ.

Chun, Eung-Jin
KIAS

Kiem, Youngjai
KAIST

Kim, Jaekwon

Lee, Jaesik
Chonnam Nat'l Univ.

1999
Chen, Xiao-Shuang
Shanghai Institute of
Technical Physics

Deng, Zhen-Yan
Shanghai Univ.

Kim, Jihn-Eui
Kyung Hee Univ.

Kim, Tae Suk
Harvard Univ.

Liu, Chun
ITP, Chinese Academy of
Science

1998
Kim, Se Yong
Sejong Univ.

School of Computational Sciences

2025
Kim, Choong Hyun
Ajou Univ.

Moon, Sunyo
Kumoh Nat'l Institute of Technology

Kim, Minjae
Chonbuk Nat'l Univ.

Oh, Jaeseong
Yonsei Univ.

Ahn, Jungho
Durham Univ.

Lee, Changmin
Korea Univ.

Park, Changwon
Ewha Womans Univ.

Yi, Sudo
KENTECH

Lim, Youngrong
Chungbuk Nat'l Univ.

Goh, Segun
Sejong Univ.

Heo, Cheolwon
The State Univ. of New York, Korea

2024
Jonsson, Johan
Nicolaus Copernicus Univ.

Chae, Min-Kyung
Korea Disease Control and
Prevention Agency (KDCA)

Lee, Jeeun
AlpacaX

Kim, Won Kyu
KIAS

Yang, Seong-Gyu
Umeå Univ.

Yoo, Semin
IBS

Rondon, Irving
Pinellas County Schools

Das, Tamoghna
Kanazawa Univ.

Bae, Eunok
ETRI

2023
Choi, Kiri
Keimyung Univ.

Kim, Jaewan
KIAS

Kim, Pureun

Oh, Jaeseong
Sungkyunkwan Univ.

Kim, Minsung
Seoul Nat'l Univ of
Science and Tech.

Ha, Seungwoong
Santa Fe Institute

Kim, Rokyeon

Ko, Eunjung
Soongsil Univ.

Choi, Wonseok
Purdue Univ.

Kim, BeomHyun
Seoul Nat'l Univ.

2022
Park, Jungjun
LG Electronics

Lee, Jaehak
Seoul Nat'l Univ.

Hussain, Dildar
Sejong Univ.

Ahn, JinHoo

Sohbi, Adel
ORCA Computing

Park, Jejune
Samsung Electronics Co.

Kim, Seonghoon
MolCube

Kim, Jiseung
Jeonbuk Nat'l Univ.

2021
Baek, Kyunghyun
Yonsei Univ.

Song, Yonghyun
Harvard Univ.

Mand, Davinder Singh
Univ. of Toronto

Dutta, Arijit
Goethe-Universität Frankfurt am Main

Lee, Sanghoon
Samsung Display

Park, Jimin
DEARGEN

Kang, Seoung-Hun
Kyung Hee Univ.

Bang, Jeongho
Yonsei Univ.

2020
Huh, Jeonggyu
Sungkyunkwan Univ.

Kim, Chanul
Samsung Electronics Co.

Kosterlitz, John M.
Brown Univ.

Tom, Anvy Moly
Devaswom Board College

2019
Bak, Ji Hyun
Univ. of California, Berkeley

Chae, Kisung
UCSD

Heo, Seungryong
Ngenebio

Kim, Heejung

Kim, Hyun-Jung
LG Display

Kim, Min Hyeok
Samsung SDS

Lee, Hyungjun
Univ. of Texas, Austin

Lee, Su-Yong
Agency for Defense Development

Liu, Lei
Zhejiang Univ.

Nam, Gi-Moon

2018
Srivastava, Amit

Siti Raudah Mohamed Lazim
Ewha Womans Univ.

Nam, Sun-Young
Sogang Univ.

Lee, Yuno
Korea Research Institute of
Chemical Technology

Lee, Jun-Ho
Lawrence Berkeley Nat'l Laboratory

Lee, Chang-Woo
Aimble Inc.

Krah, Alexander

Kim, Hyunjin
Korea Univ.

Jo, Junghyo
Seoul Nat'l Univ.

Hwang, Wonseok
Univ. of Seoul

Baik, Seung Su
Yonsei Univ.

2017
Syed Islamuddin Shah
Univ. of South Florida

Park, Jongyook
Kyungpook Nat'l Univ.

Ok, Seongmin
Samsung Electronics Co.

Na, Joohan
Samsung Advanced Institute of
Technology

Joo, Jaewoo
Univ. of Oxford

Jin, Sung-Tae
Seoul Nat'l Univ.

Hong, Seung Hwan
KAIST

Flores-Canales, Jose
Aarhus Univ.

2016
Yun, Sang Jae
Lacomtech

Son, Younghwan
POSTECH

Qianyi Cheng
Univ. of Memphis

Kim, Songmi

Kim, Ho-Joon
Kyung Hee Univ.

Joung, In Suk
Sookmyung Women's Univ.

Jeong, Kabgyun
Seoul Nat'l Univ.

2015
Woo, Hyenkyun
Korea Univ. of
Technology and Education

Park, Hee Chul
IBS

Oh, Se-Jin
Ewha Womans Univ.

Danil Bukhvalov
Hanyang Univ.

Choi, Chulho
Samsung SDI

Cho, Jaeyoon
APCTP

Balachandran M.
Ajou Univ.

2014
Yoon, Jeseong
Seoul Nat'l Univ.

Park, Jung Mee

Moon, Pilkyung
NYU Shanghai

Lee, Juhui

Kim, Sejoong
Hongik Univ.

Hermant Srivastava
CSIR-Institute of
Microbial Technology

Choi, Seon-Myeong
Samsung Advanced Institute of
Technology

2013
Woo, Sungjong
Pukyong Nat'l Univ.

Sathiyamoorthy
Hanyang Univ.

Park, Kihyun
KAERI

Ji, Se-Wan
NSR

Huichung Tai
Academia Sinica

Arash Azari
Lund Univ.

2012
Yun, Sangwoon
Sungkyunkwan Univ.

Yumlembam Hemajit
Nat'l Institute of
Biomedical Innovation

Adeel Malik
Univ. Center for Bioinformatics

2011
Park, Seungkook
Sookmyung Women's Univ.

Muddassar, Muhammad
COMSATS Institute of
Information Technology,
Islamabad, Pakistan

Lee, Ki Ho
Sungkyunkwan Univ.

Kim, Jeenu
SK Hynix
Semiconductor Inc.

Bae, Joonwoo
KAIST

2010
Woo, Youngho
NIMS

Shin, Yong Hyun
Sookmyung Women's Univ.

Oh, Mina
Medical Device Information and
Technology Assistance Center

Lee, Jinhyuk
Korean Bioinformation Center

Joo, Keehyoung
KIAS

Hur, Jin
Agency for
Defense Development

Eo, Hae-Seok
LG Electronics

Baek, Chang-Ki
POSTECH

2009
Song, Daegene

Shin, Seungwoo
Soon Chun Hyang Univ.
Hospital

Park, Poo-Sung
Kyungnam Univ.

Park, Hyungju
Ajou Univ.

Lee, Jae Weon
Jungwon Univ.

Lee, Dong-il
Seoul women's Univ.

Kim, Bomsoo
Samsung Electronics Co.

2008
Podoshvedov, Sergey
Southern Ural State Univ.

Lee, Kwankyu
Chosun Univ.

Lee, Eunjeong

Chang, Jaeeon
Univ. of Seoul

2007
Tarakeshwar, P.
Arizona State Univ.

Son, Young-Woo
KIAS

Pae, Sung-il
Hongik Univ.

Nha, Hyon Cheol
Texas A&M Univ.

Lee, Jinwoo
Kwangwoon Univ.

Ahn, Jeaman
Kongju Nat'l Univ.

2006
Oh, Sangchul
Qatar Environment and Energy
Research Institute

Lee, Kyoungrim
Hanyang Univ.

Kwon, DoYong
Chonnam Nat'l Univ.

Kim, Yong-Hoon
KAIST

Kim, Hyung-Rae
Max Planck Institute

Choi, Kyoung Jin
Univ. of Calgary

2005
Song, MeeKyung
Sogang Univ.

Nguyen, Ba An
Vietnam Academy of
Science and Technology

Lee, Jawoong
ZeeAnn

Koh, Eunhee
Seoul Nat'l Univ.

Kim, Seung-Yeon
Korea Nat'l Univ. of Transportation

Katarzyna Maksimiak
Univ. College London

Choi, Sung Woo
Duksung Women's Univ.

Choi, Hyoung Joon
Yonsei Univ.

2004
Yu, Hoseog
Sejong Univ.

Quan, WuYan

Lee, Soojoon
Kyung Hee Univ.

Kim, Saejoon
Sogang Univ.

2003
Oh, Byeong-Kweon
Seoul Nat'l Univ.

Lee, Julian
Soongsil Univ.

Kwon, Sungchul

2002
Park, Kibeom
STEPI

Kim, Jaewan
KIAS

Hong, Sung-Joon
Samhwa Sukyou Co.

June E Huh Center for Mathematical Challenges

2025
Oh, Jaeseong
Sungkyunkwan Univ.

Jung, Mingu
Hanyang Univ.

Ryu, Jaehyeon
Ewha Womans Univ.

Kim, Seonwoo
Yonsei Univ.

Kwak, Sanghoon
Seoul Nat'l Univ.

2024
Kim, Chan-Ho
Jeonbuk Nat'l Univ.

Kim, Minhyong
Univ. of Edinburgh

Shin, Jinwoo
Sookmyung Women's Univ.

2023
Byun, Sung-Soo
Seoul Nat'l Univ.

Lee, Jungin
Ajou Univ.

Lee, Junguk
Changwon Univ.

Song, Jongbaek
Pusan Nat'l Univ.

2022
Kim, Jeongho
Kyung Hee Univ.

Kim, Joontae
Sogang Univ.

Won, Joonyeong
Ewha Womans Univ.

Yu, Myungjun
Yonsei Univ.

2021
Koh, Kyewon

Choi, Beomjun
POSTECH

Lodha, Yash
Univ. of Hawaii at Manoa

Haan, Jae-ho
Yonsei Univ.

2020
Hong, Jaehyun
IBS

Kim, Sung Yeon
IBS

Scarinci, Carlos
DGIST

2019
Oh, Sung-Jin
UC Berkeley

Park, Chol
UNIST

Park, Jinhyung
Sogang Univ.

2018
Kim, Ildoo
Korea Univ.

2017
Kuessner, Thilo

Kwon, Sanghoon
Catholic Kwandong Univ.

Lee, Hojoo
Jeonbuk Nat'l Univ.

Shin, YongJoo
Chungnam Nat'l Univ.

Yoon, Youngho
Chungbuk Nat'l Univ.

2016
Cho, Hyun Woong

Eum, Ick Sun
Dongguk Univ.

2015
Chan, Mario
Pusan Nat'l Univ.

Choi, Jinwon
Sookmyung Women's Univ.

Jung, Soyeun
Kongju Nat'l Univ.

Kim, Sungwoon
Jeju Nat'l Univ.

2014
Pang, Chao

Quantum Universe Center

2025
Kim, Jaewan
KRISS

Yang, Wooil
The Univ. of Texas at Austin

Yoo, Jaewon
KASI

2024
Hhan, Minki
The Univ. of Texas at Austin

Wang, Xin
Max Planck Institute

2023
Sun, Kaiwen
Max Planck Institute

2022
Choi, Ena
Univ. of Seoul

Kim, Minho
Samsung Electronics Co.

Jang, Bo Gyu
Los Alamos Nat'l Laboratory

Jueid, Adil
IBS

2021
Lee, Changhyoup
KRISS

Lee, Jae Sung
KIAS

2020
Appleby, Stephen A.
APCTP

Bourgine, Jean-Emile
Univ. of Melbourne

Kim, Hyun-Jung
Forschungszentrum Jülich

Lee, Seung-Woo
KIST

Mukherjee, Sutirtha
KIAS

2019
Gang, Dongmin
APCTP

Kwon, HyunWoong

Li, Xiaolei
Hebei Normal Univ.

Park, Jae-hyeon
KIAS

Tang, Yi-Lei
Sun Yat-Sen Univ.

Yang, Runqiu
Tianjin Univ.

2018
Aluri, Pavan Kumar
Indian Institute of Technology (BHU)

Kim, Jinsu
Georg-August Univ. Gottingen

Yokoya, Hiroshi

2017
Kang, Seoung-Hun
KIAS

Song, Hyunmi
KASI

2016
Jung, Dong-Won
Korea Univ.

Lee, Kanghoon
IBS

Lee, Woo-Ram
Univ. of Alabama

Park, Jubin
Chonnam Nat'l Univ.

Parolini, Alberto
Korea Univ.

Shimizu, Yusuke

2015
Mishima, Satoshi

Center for AI and Natural Sciences

2026
Yu, Ji Woong
Ajou Univ.

Cho, Kwang Hyun
Univ. of Rochester

2025
Yoon, Sangwoong
Univ. College London

Choi, Jaewoong
Sungkyunkwan Univ.

Park, Yeachan
Sejong Univ.

Park, Jun Sur
Korea Univ.

Lee, Yonghyeon
Massachusetts Institute of Technology

Hwang, Geonho
GIST

Flacke, Thomas Dieter
KIAS QUC

2024
Lee, Jaeyong
Chung-Ang Univ.

Koo, Eunho
Chonnam Nat'l Univ.

Choi, Jaewoong
KIAS

2023
Lee, Sungyoon
Hanyang Univ.

Lee, Jongmin
Pusan Nat'l Univ.

2022
Jeong, Wooseok
KIER

Kim, Eugenia H.
Samsung Electronics Co.

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Song, Taegeun
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Associate Members

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KAIST

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Kwak, Si-Jong
KAIST

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Kwon, Yehyun
Korea Nat'l Univ. of Education

Kim, Kunwoo
POSTECH

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Chosun Univ.

Kim, Namkwon
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Kim, Daehwan
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Kim, Doheon
Hanyang univ.

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Kim, Byungchan
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Kim, Sangjib
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Kim, Sungwoon
Jeju Nat'l Univ.

Kim, Seongchan
Kongju Nat'l Univ.

Kim, Seongtag
Inha Univ.

Kim, Seonghak
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Kim, Se-Goo
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Kim, Seung Won
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Sungkyunkwan Univ.

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Kim, Yeansu
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Kim, Youchan
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Kim, Ildoo
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Kim, Jeongah
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Kim, Jeongho
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Kim, Joontae
Sogang Univ.

Kim, Junha
Ajou Univ.

Kim, Chan-Ho
Jeonbuk Nat'l Univ.

Kim, Chang Heon
Hanyang Univ.

Kim, Taehee
Konkuk Univ.

Kim, Panki
Seoul Nat'l Univ.

Kim, Hwa Kil
Hannam Univ.

Kim, Hoonjoo
Sehan Univ.

Nam, Kyeongsik
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Nam, Hayan
Duksung Women's Univ.

Lho, Hyenho
Chungnam Nat'l Univ.

Yoo, Meesue
Chungbuk Nat'l Univ.

Moon, Hyunsuk
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Park, Kyeong-Dong
Gyeongsang Nat'l Univ.

Park, Bae Jun
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Park, Jung-Tae
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Park, Jong-Do
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Park, Jiewon
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Park, Jinhyung
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Park, Heesang
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Sohn, Sung-Ik
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Sohn, Jaebum
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Shin, Dongsoo
Chungnam Nat'l Univ.

Shin, Donguy
Hanyang univ.

Ahn, Tae yong
Inha Univ.

Yang, Minsuk
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Oh, Jeongseok
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Yun, Gab-Jin
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Lee, Ki-Ahm
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Lee, Sanghyeon
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U1 Univ.

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Ewha Womans Univ.

Lee, Junguk
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Lee, Jungin
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Lee, Chong Gyu
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Lee, Junho
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Choi, Dohoon
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Choi, Youngook
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Choe, Insong
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Choi, Jongkeun
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Choi, Jinwon
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Scarinci, Carlos
DGIST

Pyo, Juncheol
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Han, Kangjin
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Han, Jiyoung
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Huh, Suk Moon
Sungkyunkwan Univ.

Heo, Jaeseong
Hanyang Univ.

Hong, Kyusik
Jeonju Univ.

Hong, Jaehyun
IBS-CCG

Hwang, Dongseon
IBS-CCG

Hwang, Sukjung
Chungbuk Nat'l Univ.

Hwang, WonTae
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Hwang, Jun-Muk
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Shafieloo, Arman
KASI

Scopel, Stefano
Sogang Univ.

Kang, Gung Won
Chung-ang Univ.

Dongmin Gang
Seoul Nat'l Univ.

Kang, Sin Kyu
Seoul Nat'l Univ. of Science and Technology

Kyae, Bumseok
Pusan Nat'l Univ.

Gong, Jinn-Ouk
Ewha Womans Univ.

Kwon, Chul-An
Myongji Univ.

Kim, Kun Woo
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Keun-Young Kim
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Kim, Kihong
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Kim, Nak Woo
Kyunghee Univ.

Kim, Dong-Hee
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Kim, Beom Jun
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Kim, Seok
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Kim, Se Yong
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Kim, Aaram J.
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Gwangu Nat'l Univ. of Education

Kim, Yong Woon
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Kim, Yoonbai
Sungkyunkwan Univ.

Kim, Jeong Han
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Kim, Jin Min
Soongsil Univ.

Kim, Chanju
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Kim, Chul
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Kim, Hang Bae
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Kim, Hyun-Chul
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Kim, Heeyeon
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Kim, Hee-Cheol
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David Parkinson
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Moon, Eun-Gook
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Bak, Dongsu
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Park, Myeong-Gu
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Park, Myeonghun
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Park, Sung-Chan
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Park, Soo Chan
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Park, Wan Il
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Park, Jae-mo
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Park, Jeong-Hyuck
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Park, Jong-Min
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Bae, Kyu Jung
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Baek, Seung Ki
Pukyong Nat'l Univ.

Baek, Yongjoo
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Van Putten, Maurice
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Son, Minho
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Jaewon Song
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Song, Jung-hyeon
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Stephen Appleby
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Sin, Sang-Jin
Hanyang Univ.

Shin, Jihye
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Shin, Chang Sub
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Sim, Heong-Sun
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Ahn, Kang-Hun
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Ahn, Changrim
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Yeo, Joonhyun
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Yu, Jaejun
Seoul Nat'l Univ.

Lee, Nam-Kyung
Sejong Univ.

Lee, Minchul
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Lee, Bum Hoon
Sogang Univ.

Lee, Sangmin
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Lee, Sang Hoon
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Lee, SungBin
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Lee, Su Houng
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Seung-Joo Lee
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Lee, Jae Sik
Chonnam Nat'l Univ.

Lee, Jungil
Korea Univ.

Lee, Jung Jai
Daejin Univ.

Yi, Juyeon
Pusan Nat'l Univ.

Lee, Changhoan
Pusan Nat'l Univ.

Lee, Taekoon
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Lee, Hyun Min
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Lee, Hyun Cheol
Sogang Univ.

Lee, Hyung Mok
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Lee, Hye-Sung
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Im, Myungshin
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Chang, Sanghyeon
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Jeon, Gun Sang
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Jeon, Jae-Hyung
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Jeong, Kwang Sik
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Chung, Myung-Hoon
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Chung, Suk Bum
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Jung, Sunghoon
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Jeong, Hawoong
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Jeong, Hyeong-Chai
Sejong Univ.

Cho, Gil Young
POSTECH

Cho, Young Sul
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Cha, Min-Chul
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Choi, Ki Woon
IBS-CTPU

Choi, Mahn-Soo
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Choi, Seong-Youl
Chonbuk Nat'l Univ.

Choi, Yun-Young
Kyung Hee Univ.

Choi, Junegone
Korea Univ.

Choi, Han Yong
Sungkyunkwan Univ.

Cristiano Sabiu
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Ha, Meesoon
Chosun Univ.

Hyun, Seungjoon
Yonsei Univ.

Hong, Sungwoo
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Hong, Sungwook
KASI

Hong, Hyun Suk
Chonbuk Nat'l Univ.

Hwang, Jai-chan
Kyungpook Nat'l Univ.

Hwang, Ho Seong
Seoul Nat'l Univ.

Rhim, Junwon
Ajou Univ.

Kim, Yonghwi
KISTI

Kim, Junhan
KAIST

Ghim, Cheol-Min
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Seong, Rak-Kyeong
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Sohn, Jubee
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Um, Jaegon
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Yoon, Junggi
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Lee, Kanghoon
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Jeon, Imtak
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Chung, Hee-Joong
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Cho, Hyun Woo
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Cho, Jaeyoon
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Choi, Hyoung Joon
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Choi, Sun
Ewha Womans Univ.

Choi, Taeseung
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Eom, Young-Ho
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Goh, Gwang-Il
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Hong, Suklyun
Sejong Univ.

Huh, Joonsuk
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Hwang, Won-Young
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Jeong, Kabgyun
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Jhi, Seung-Hoon
POSTECH

Jin, Hosub
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Jo, Hang-Hyun
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Jo, Junghyo
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Kahng, Byungnam
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Kim, Je-Hyung
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Kim, Mun Dae
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Kim, Sejoong
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Kim, Wonkyu
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Kim, Yong-Hoon
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Kim, Yoon-Ho
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Kown, Young-Kyun
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Lee, Changhyoup
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Lee, Hai-Woong
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Lee, Hyang-Sook
Ewha Womans Univ.

Lee, Hyeokjae
Kookmin Univ.

Lee, Jae Woo
Inha Univ.

Lee, Jae-Weon
Jungwon Univ.

Lee, Jaeyong
Chung-Ang Univ.

Lee, Jinhyoung
Hanyang Univ.

Lee, Jinwoo
Kwangwoon Univ.

Lee, Ji-Woo
Myongji Univ.

Lee, Sangjoon
Kyung Hee Univ.

Lee, Seung-Woo
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Lee, Soojoon
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Lee, Sung Jong
Changwon Nat'l Univ.

Lee, Sungyoon
Hanyang Univ.

Lee, Su-Yong
ADD

Lie, Seok Hyung
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Oh, Byungdu
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Pae, Sung-il
Hongik Univ.

Park, Hee Chul
Pukyong Nat'l Univ.

Park, Hye Jin
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Park, Jiyong
Hanbat Nat'l Univ.

Park, Juyong
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Park, Poo-Sung
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Park, Seungkook
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Park, Se Young
Soongsil Univ.

Seo, Joohyun
Kookmin Univ.

Seok, Chaok
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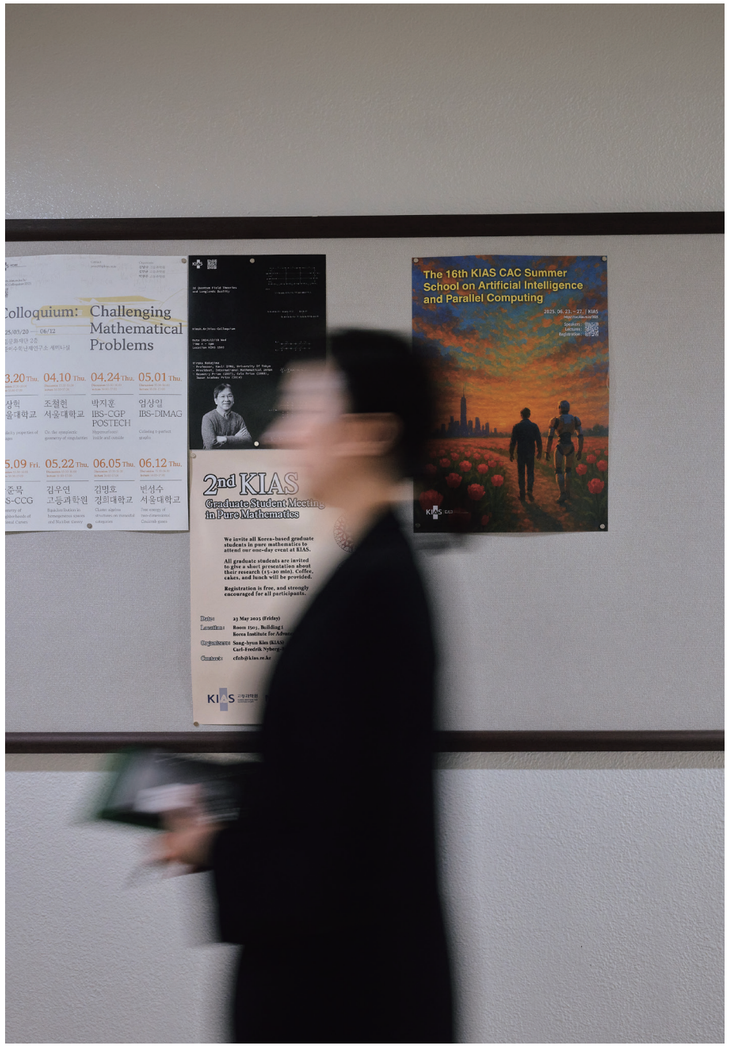
Son, Seung-Woo
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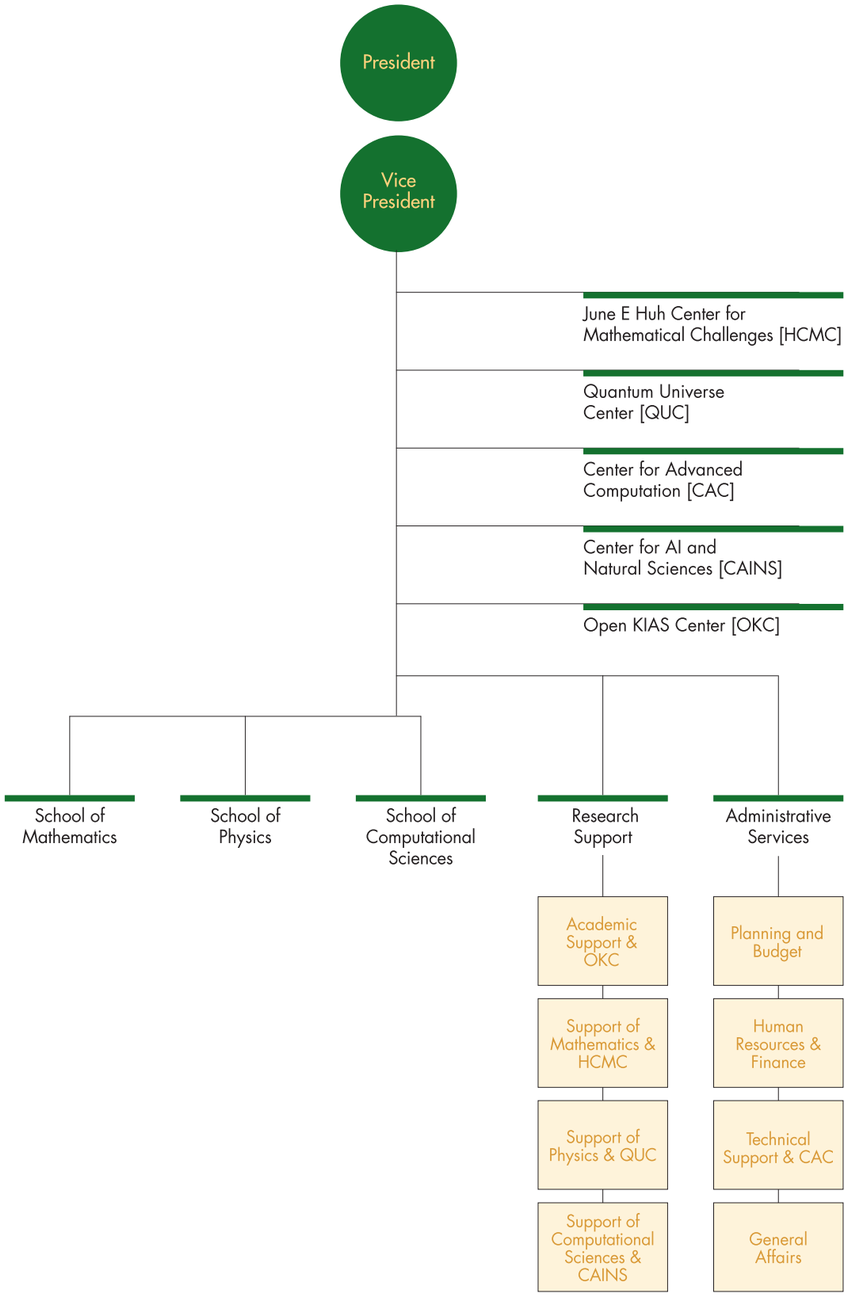
Yook, Soon-Hyung
Kyung Hee Univ.

Yu, Byung Deok
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Yun, Sangwoon
Sungkyunkwan Univ.



Organization



Administrative Division

	Noh, Tae won	President
	Kim, Jeong Han	Vice President
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	Lee, Sungjay	Chair, School of Physics
	Lee, Deok-Sun	Chair, School of Computational Sciences

Research Support

	Oh, Si-Hyoung	General Manager
	Park, Choul Kyu	Support for Research Performance Evaluation
Academic Support & OKC	Lee, Hyung-Soon	Head
	Kwak, Seong-Cheol	External grants
	Kwon, Brad	Academic Affairs (Transdisciplinary Research Program)
	Lee, Seohyun	Public Relations
	Park, Sumin	Personnel Affairs for Researchers
	Kim, Jaeyoung	Public Relations
Support of Mathematics & HCMC	Park, Sujin	Head
	Han, Susie	School Affairs
	Park, Yoojin	Academic Events
	Bae, Sojung	School Affairs (HCMC)
	Na, Boyeon	Academic Events (HCMC)
	Lee, Jisu	Librarian
	Han, Young Goo	IT Supporting
Support of Physics & QUC	Yang, Minwoo	Head
	Shin, Ingyeong	School Affairs
	Wee, Sunmi	Academic Events
	Yoon, Hyejoon	Center Affairs (QUC)
	Park, Juhye	Academic Events (QUC)
	Choi, ByungHo	IT Supporting
Support of Computational Sciences & CAC & CAINS	Yun, Suk Min	Head
	Park, Deure	School Affairs
	Ryu, Aeri	Academic Events
	Nam, Kisun	Center Affairs (CAINS)
	Lee, Kangwon	Academic Events (CAINS)
	Kim, Hoyoung	Center for Advanced Computation

Administrative Services

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	Chae, Heejin	Evaluation
	Seo, Hyunjun	Budget Management
	Kim, Rian Kim, Young Eun	Planning
Human Resources & Finance	Kim, Seyoung	Head
	Kim, Si-jae	Payroll
	Lee, Junseong	Human Resources
	Kwon, Beom Jun	Accounting & Expenditure
	Son, Sungwoo	Accounting & Assets
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	Lee, Seong Hwan	Computing Support
	Lee, Young Jin	Server Administration
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	Lee, Minsung	General Affairs & Purchasing
	Gan, Jerry E.	Accommodations
	Kim, Doha	Secretary
	Kim, Jongcheol	Driver

Former Presidents

8th

Dr. Choe, Jaigyoung

Jan. 1, 2020 – May 28, 2024

7th

Dr. Lee, Yong-Hee

Nov. 9, 2016 – Nov. 7, 2019

6th

Dr. Keum, JongHae

Sep. 2, 2013 – Sep. 1, 2016

5th

Dr. Kim, Doochul

Jul. 1, 2010 – Jun. 30, 2013

4th

Late Dr. Myung, Hyo Chul

Jul. 1, 2007 – Feb. 11, 2010

3rd

Dr. Kim, Mahn Won

Jul. 1, 2004 – Jun. 30, 2007

1st
2nd

Dr. Kim, Chung Wook

Dec. 22, 1997 – Jun. 30, 2004

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