

Conferences and Workshops

Focus Week on Non-Equilibrium Quantum Dynamics

September 30 - October 4, 2024

H. Katsura, Y. Miao, M. Oshikawa, and M. Yamazaki

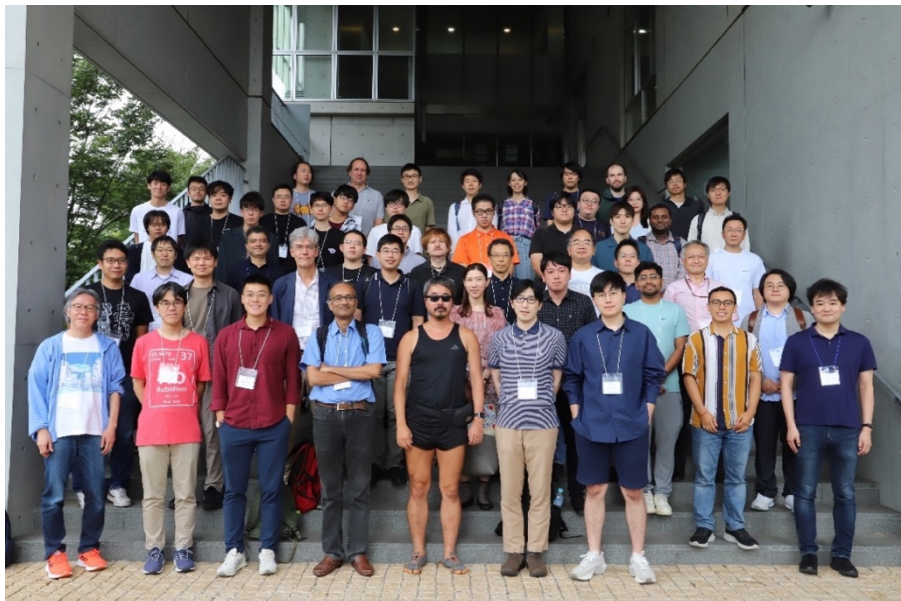
Nonequilibrium dynamics in quantum many-body systems is a fundamentally important yet notoriously difficult problem in statistical physics. Recent theoretical progress—much of it rooted in modern quantum field theory—has significantly deepened our understanding, and the subject has become central in high-energy theory as well. A characteristic example is the Sachdev–Ye–Kitaev (SYK) model. Originally conceived as a model for strongly correlated electrons, the SYK model features fermions with random, infinite-range interactions and is exactly solvable in the large- N limit. It exhibits maximally chaotic, fast-scrambling quantum dynamics saturating a bound on the Lyapunov exponent, and it connects in surprising ways to quantum gravity and gauge/gravity duality. With rapid advances in controllable quantum platforms and growing relevance to quantum devices and computation, there is a clear opportunity for breakthroughs by combining insights across disciplines.

To catalyze such cross-fertilization, we organized an international workshop bringing together leading researchers with diverse backgrounds. The meeting was held at the neighboring Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU) as a Focus Week, co-hosted by ISSP. Topics covered included non-Hermitian systems, violations and breakdown mechanisms of the Eigenstate Thermalization Hypothesis (ETH), applications of generalized symmetry concepts, and holographic approaches to quantum dynamics. We had 15 invited talks by:

Masayuki Hashisaka (ISSP, Japan), Yunfeng Jiang (Yau Center, Southeast Univ., China),
Gyu-Boong Jo (HKUST, Hong Kong), Kohei Kawabata (ISSP, Japan),
Jong Yeon Lee (UIUC, USA), Chihiro Matsui (The University of Tokyo, Japan),
Pratik Nandy (RIKEN & YITP, Japan), Takashi Oka (ISSP, Japan), Pedram Roushan (Google, USA),
Kareljan Schoutens (University of Amsterdam, the Netherlands), Krishnendu Sengupta (IACS, India),
Hal Tasaki (Gakushuin University, Japan), Takafumi Tomita (IMS, Japan),
Frank Verstraete (Cambridge & Ghent, UK/Belgium), Derek S. Wang (IBM, USA).

We reserved ample time for discussion, leading to many questions during and after the talks. Most talks were recorded and have been uploaded to YouTube (https://youtube.com/playlist?list=PLqgD11rbhHmkEyc-epjUw39g3lQuqSah&si=96m1hU_MeMlacA-p), which should be useful to colleagues who could not attend, as well as to participants for reviewing. In addition, we held poster sessions on Tuesday and Thursday with 25 contributions; the sessions were lively and continued well beyond the scheduled time. We subsidized travel for early-career participants based in Japan, which helped boost attendance among young researchers. The joint hosting by Kavli IPMU and ISSP successfully attracted participants from both the high-energy and condensed-matter communities; for many condensed-matter participants, this was their first visit to Kavli IPMU. In total, we had 82 participants, including 25 from abroad.

Overall, the workshop was a great success. We thank Kavli IPMU and ISSP for hosting, and JST for financial support (PRESTO Grant No. JPMJPR225A).



ISSP International Workshop “Materials Science of Solids and Surfaces using Radiation Field Controlled in Time and Space Domain”

October 28-31, 2024

K. Watanabe, T. Kumagai, R. Shiotari, O. Sugino,
Y. Hasegawa, I. Matsuda, R. Matsunaga, and J. Yoshinobu.

This ISSP International Workshop was held from October 28 to October 31, 2024. A total of 120 participants attended in person (including 10 international participants), and the cumulative number of participants over the four-day workshop was 293 (including 31 international participants).

In recent years, the interdisciplinary fields of radiation fields, nanoscale solid-state physics and surface science have rapidly developed. This field encompasses topics such as carrier-envelope-phase (CEP) controlled terahertz (THz) pulses using ultrashort pulse lasers, tip-enhanced Raman spectroscopy, local plasmons in metal nanoparticles, electric fields and scattered light at electrodes and interfaces, and novel optical properties of low-dimensional materials. Furthermore, experimental studies on local electronic properties and surface/interface reactions using *operando* spectroscopy with lasers and synchrotron radiation are expanding. ISSP has conducted these cutting-edge studies by the members in LASOR Center, Division of Nanoscale Science, and Division of Condensed Matter Theory. In this workshop, leading researchers were invited from the world and Japan. The workshop program consisted of one tutorial lecture, six oral presentation sessions (25 invited lectures and 4 contributed talks), and 34 poster presentations.

Researchers from different fields engaged in lively discussion. The posters mainly presented by young researchers and graduate students were of a high standard and featured active discussions. It was also impressive to see prominent overseas scientists taking notes during the lectures and asking questions. After the workshop, we received an email from an overseas invited speaker saying that “I would like to thank you from the bottom of my heart for the invitation to the workshop and the excellent organization. I learned a lot and enjoyed the talks and discussions tremendously!” Many participants were greatly inspired by learning cutting-edge research from different fields.

This workshop was supported by “ISSP International Workshop”, JST-CREST “Innovative Reactions”, and NINS “2024 Advanced Optical Science Research Project.” These supports enabled us to invite many researchers from both Japan and abroad. Finally, we would like to express our gratitude to Director Prof. Hiroi for his opening remarks and introduction of ISSP, as well as to the staffs (faculty members, administrative assistants) and graduate students of ISSP who made significant contributions to the workshop's organization.

The workshop program and abstracts can be downloaded from the following URL.
https://yoshinobu.issp.u-tokyo.ac.jp/2024Oct_ISSP_WS_Abstract_v4.pdf



Group photo at the workshop (October 30, 2024)

Correlated Quantum Materials + *beyond* (CQM+b2024)

November 18-29, 2024
H. Tsunetsugu, Y. Motome, and C. Batista

Following the tradition of the annual international theory workshops that began in 2006, this year's workshop was held over two weeks in late November with focusing on the discussion of cutting-edge theoretical research on strongly correlated systems. While the main themes centered on novel quantum magnetism and superconductivity, particular emphasis was placed on dynamics and nonequilibrium phenomena in strongly correlated quantum systems as well as the application of data science techniques such as machine learning and quantum information approaches.

Presentations about nonequilibrium and dynamical properties included topics such as the nonlinear optical response of spin liquids and the non-Hermitian Kondo effect. Regarding equilibrium properties, in-depth discussions were held on multipole degrees of freedom formed by spin and orbital moments in transition metal compounds. Topics also covered recent developments on altermagnets – a newly emerging class of antiferromagnets garnering rapid research interest – alongside kagome antiferromagnets and Kitaev materials related to spin liquids.

During the eight non-symposium days of the workshop, a total of 23 oral presentations were delivered, including 10 by invited speakers from overseas and 7 by invited speakers from Japan. Over the two-day symposium, there were 28 oral presentations (7 international invited speakers and 15 domestic invited speakers) and 52 poster presentations, of which 9 were from general international participants. In total, the workshop – including the symposium – had 151 registered participants, 33 of whom were from overseas. The total number of individual entries (i.e., attendance counts) was 178 during the two-day symposium and 224 during the remaining eight days, reaching an impressive total of 402.

To promote future international collaboration and joint research, we made a special effort to invite early-career researchers. In addition, 15 general participants from abroad – including graduate students and postdocs affiliated with the invited speakers – joined and actively interacted with domestic researchers, especially during and after the presentations. We believe that this workshop has laid the groundwork for multiple future collaborations.



11th Annual Ambient Pressure X-ray Photoelectron Spectroscopy Workshop(APXPS 2024)

December 3-6, 2024

I. Matsuda

This workshop was held as the international conference 11th Annual Ambient Pressure X-ray Photoelectron Spectroscopy Workshop (APXPS 2024) from December 3rd to 6th, 2024. This international workshop (APXPS Workshop), which specializes in the technology and application research of this method, has been held every year since 2014, but this was the first time it was held in Japan. The workshop was held face-to-face at Katahira Sakura Hall in the Tohoku University campus, where the University of Tokyo's Sendai office is located, and those affiliated with the Institute for Solid State Physics could also join online. Speakers and participants came from all over the world, with a total of 123 participants from 19 countries, including Japan.

Recently, *operando* measurements that directly observe actual materials in their operating environment have become indispensable. Our institute has been developing and jointly using the ambient pressure X-ray photoelectron spectroscopy (APXPS) system, which allows for real-time tracking of chemical reaction processes, at the SPring-8 synchrotron radiation facility. On the occasion of the construction of a new synchrotron radiation facility, NanoTerasu, our institute has updated a cutting-edge APXPS instrument at the soft X-ray beamline. The facility began the user operation in April of the year the symposium is held (2024). Thus, the institute took this opportunity to introduce our APXPS instrument to overseas experts, to become an international hub in the *operando* measurement research community, and to build a network of researchers.

The workshop program consisted of two keynote lectures, 13 oral presentation sessions (invited and general presentations), and a poster presentation session. The sessions were "Technical Innovations in *Operando* Spectroscopy", "Technical Update Session I", "Technical Update Session II", "*In Situ* Observations at Gas- Solid Interfaces I", "*In Situ* Observations at Gas- Solid Interfaces II", "*In Situ* Observations on Metals and Alloys", "*In Situ* Observations on Functional Materials", "*In Situ* Observations at Liquid- Solid Interfaces", "*In Situ* Observations on Electrocatalyst Surfaces and Interfaces", "*In Situ* Observations during Reactions with Oxygen", "*In Situ* Observations on Catalysts and Electrodes", "Real Applications in Environmental Science", and "*In Situ* Observations on Metal Oxides".

The technology of APXPS equipments has progressed rapidly with the development of synchrotron radiation, and many presentations on technological developments at the frontiers were given at the workshop. There were also many presentations on research into its use in the fields of catalytic chemistry, electrochemistry, and atmospheric chemistry. It was apparent that the APXPS method is being used around the world and is making a significant contribution to the development of science and technology in each country.

After the workshop, on December 9th, we invited one of the invited speakers to the University of Tokyo Kashiwa Campus to hold a face-to-face seminar. The seminar room was packed with an audience of nearly 30 participants. Lively discussions were held, making it a very successful event.

Finally, I would like to express our deep gratitude to the organizing members, Dr. S. Yamamoto, Dr. T. Abukawa, Dr. H. Kondoh, Dr. Y. Takagi, Dr. T. Koitaya, Dr. R. Yukawa, Dr. R. Toyoshima, and Dr. M. Horio. I am also thankful to the administrative staff at the Institute for Solid State Physics and the graduate students who supported the workshop.



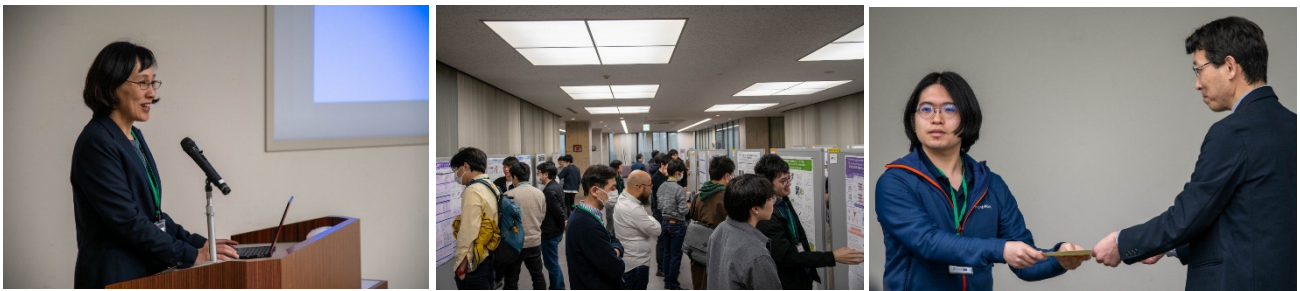
The group photo of APXPS 2024 (Dec. 4, 2024)

Annual Meeting of MDCL Supercomputer Center and CCMS – The Present and Future of Computational Materials Science –

April 3-4, 2024

T. Ozaki, N. Kawashima, O. Sugino, H. Noguchi, T. Misawa,
K. Ido, H. Nakano, J. Haruyama, M. Fukuda, and K. Yoshimi

This annual meeting brings together ISSP joint-use supercomputer users and CCMS members to share research progress. Organized in rotation by ISSP's computer-related staff, the event reflects advances in both supercomputing such as “Fugaku” and simulation methods, which have enabled more precise and large-scale studies. These developments support fundamental understanding of physical phenomena and collaborative work with experiments. The rise of machine learning and AI has further expanded computational materials science. Since FY2022, ISSP's system “kugui” (8 PF performance) has served as a national platform for simulation-based research. Held fully on-site, the workshop had 66 registrants, with 53 and 52 attendees on April 3rd and 4th, respectively. It featured 16 invited talks, including two by Yasuhiro Hatsugai (University of Tsukuba) and Masaaki Kondo (Keio University), and 31 poster presentations. Speakers from OIST, Hiroshima University, Ehime University, and NAIST were invited to enhance regional exchange. Topics ranged from strongly correlated systems and first-principles calculations to machine learning and soft matter simulations. The workshop highlighted emerging perspectives through data-driven approaches and provided insight into the future of the field. Kondo's special lecture introduced prospects for next-generation supercomputing and software development over the coming five years. Two posters, by Yasumasa Arakawa (Yamagata University) and Tetsuya Yamamoto (Keio University), were selected for the Excellent Poster Award by participant vote. Throughout the sessions, active discussion, particularly among students and early-career researchers, fostered community engagement and exchange.



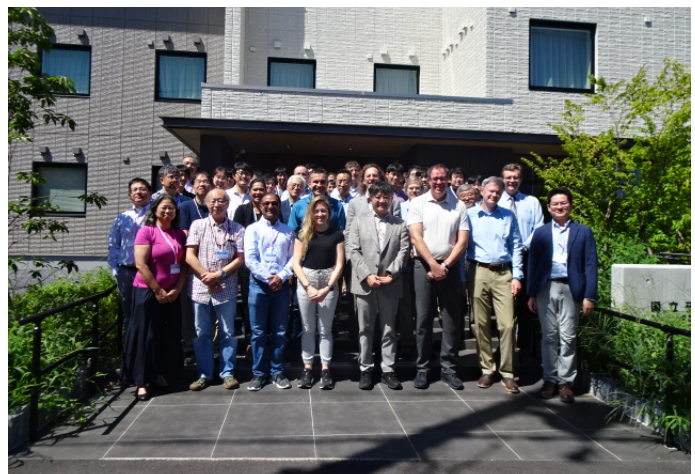
Frontier of Neutron Science in Research Reactor ～Future Perspective of US-Japan Cooperative Program on Neutron Scattering～

September 4-5, 2024

T. Masuda, T.J. Sato, K. Kaneko, A. Aczel, and M. Frontzek

Three years have passed since the research reactor JRR-3 resumed operation, resulting in numerous scientific achievements and significant advancements in the development and upgrade of instrumentation. For example, the cold-neutron multiplex triple-axis spectrometer HODACA, constructed under the US-Japan Cooperative Program on Neutron Scattering, completed its commissioning phase last year and became available for user experiments this year. Meanwhile, Oak Ridge National Laboratory is planning the construction of the next-generation triple-axis spectrometer MANTA and rearranging existing instruments, timed with the replacement of the beryllium reflector. Additionally, in western Japan, construction plans for a new research reactor, led by JAEA, Kyoto University, and Fukui University, are advancing steadily. Given this rapidly evolving environment in neutron research, sharing expertise and know-how regarding instrument development is increasingly important.

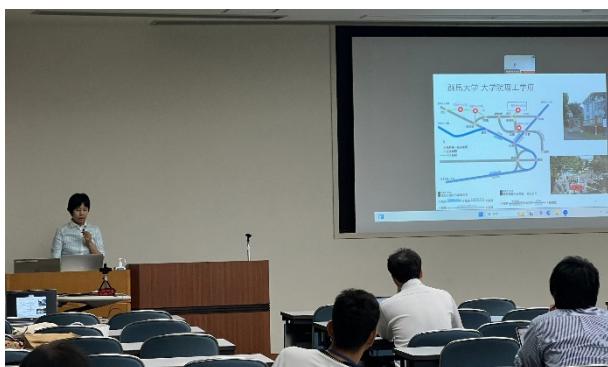
Against this background, this workshop invited 21 speakers (11 from the US and 10 from Japan) to discuss solid-state physics and soft matter research using neutron scattering, as well as neutron instrumentation development. The presentations covered cutting-edge topics from each field and stimulated active discussion. A poster session was also held, featuring 33 presentations primarily by early-career researchers (9 from the US and 24 from Japan).



ISSP Joint Research Results Presentation Meeting 2024

September 10, 2024
Joint Research Program Office (Kyodo Riyou Gakari)

The Joint Research Program is one of the most crucial functions of the Institute for Solid State Physics (ISSP). This symposium was organized to share the results obtained through the Joint Research Program at ISSP and to promote future collaborations. The program included four invited lectures: one by an external speaker and three by speakers within ISSP. From outside ISSP, Prof. Hiyama from Gunma University presented her theoretical and experimental research on the biological luminescence of firefly luciferase, conducted in collaboration with the Laser and Synchrotron Research Center (LASOR). From within ISSP, Dr. Kinoshita from the International MegaGauss Science Laboratory gave a talk on direct observation under strong magnetic fields using polarized light microscopy. Prof. Mayumi from the Neutron Science Laboratory presented recent studies on multicomponent soft matter using neutron scattering methods, while Dr. Okawa from LASOR reported on investigation of the electronic structures of thermoelectric material candidates and excitonic insulator candidates using time-resolved ARPES with high-harmonic lasers.



Frontier of New Materials and Systems Research: Physical Properties and Functionalities Based on Molecules and Atomic Clusters

October 2-4, 2024

Y. Okamoto, T. Akutagawa, T. Kusamoto, K. Takimiya, H. Yamamoto,
T. Ideue, R. Takagi, S. Miwa, H. Mori, and J. Yamaura

This workshop was organized to facilitate the exchange of recent findings on the development of new materials and systems composed of molecules and atomic clusters with a focus on their physical properties and functionalities. Recently, various physical properties and functionalities, such as non-reciprocal superconductivity, chirality-induced spin selectivity, ferroelectrics based on molecular rotators, anisotropic circularly polarized luminescence, and exotic excitonic properties, have been discovered in new molecular compounds, metal complexes, metal-organic frameworks (MOFs), and van der Waals crystals, characterized by features such as chirality, polarization, nontrivial topology, molecular mobility, and luminescence. However, it remains challenging to get comprehensive overview of which studies are driving innovation within the broad field of molecular and cluster compounds. We organized a hybrid-style workshop from October 2nd to 4th, highlighting recent developments in materials and systems composed of molecules and atomic clusters with a view to their physical properties and functionalities. The workshop attracted 110 registered participants, with more than half attending on-site. It featured 34 invited talks and 17 poster presentations, fostering lively discussions and interdisciplinary exchange among researchers from a variety of fields.



Forefront Research in Glass and Related Fields

October 30-November 1, 2024

S. Tatsumi, M. Kofu, O. Yamamuro, A. Ikeda, M. Saito, T. Kawasaki, and H. Akiba

This workshop, held at the Institute for Solid State Physics, is conducted every 3 to 4 years to share cutting-edge research with glass researchers from all around Japan. Lively discussions were held throughout the workshop, focusing on researchers in experiments, theories, and numerical calculations, as well as peripheral fields such as proteins, granular materials, pharmaceuticals, and other related areas. Additionally, new trends were explored, including active glass and electronic glass. In addition to 42 oral presentations and 28 poster presentations, we have featured three special lectures by Osamu Yamamuro, Takeshi Kawasaki, and Kazushi Kanoda. Finally, we found very stimulating discussions that went beyond the boundaries of academic societies, involving participants from different academic fields who shared their daily research experiences.



Correlated Quantum Materials + *beyond*: Symposium

November 25-26, 2024

H. Tsunetsugu, Y. Motome, Y. Yanase, J. Otsuki, Y. Nomura, Y. Okamoto

This was a two-day symposium in the two-week theory workshop starting on Nov. 18 and provided a valuable platform for international participants and domestic researchers, both experimentalists and theorists, to engage in focused discussions. While the symposium's main theme centered novel quantum magnetism and superconductivity, two emerging directions were particularly emphasized.

The first was the study of dynamics and non-equilibrium phenomena. Presentations in this area featured several exciting developments, including nonlinear optics in cavity systems, spin switching in antiferromagnets using terahertz radiation, and high-harmonic spectroscopy. The second is the application of data-driven approaches, such as machine learning. The symposium also featured promising theoretical work on quantum many-body dynamics, eigenvalue optimization, and experimental data interpretation using Bayesian inference, demonstrating the growing potential of data science in condensed matter physics.



ISSP Women's Week 2024

December 3-4, 2024

T. Nakajima, T. Ideue, K. Kawabata, Y. Hasegawa, I. Matsuda, A. Miyata, J. Yamaura
A. Shirai, L. Watakabe, R. Watanabe, M. Hara, and R. Yamaoka

ISSP Women's week started from 2021 to encourage female scientists studying and working in condensed matter science. In the fiscal year of 2024, we organized "ISSP Women's Week(s) 2024" from November 22 to December 6 in 2024. During this period, regular ISSP seminars were held with female invited speakers. This period also included a talking event for female graduate students, in which female researchers working in universities, academic institutes or companies gave enlightening talks regarding their work careers. As the main event in this period, we organized ISSP women's week workshop 2024 on Dec. 3rd and 4th in the large lecture room of ISSP. We invited seven invited speakers, ranging from company researchers to university professors. In addition to their valuable talks, we held discussion sessions facilitated by graduate students of ISSP. The students brought up questions regarding gender equality, diversity in Japanese society, life-work balance etc., which leads to fruitful discussions between the students, invited speakers and the audience. There were more than 30 participants on each day. The week was supported by KIOXIA Holdings Corporation and by the MEXT Academic Transformative Research (A) project "Chemical Catastrophe in Ultra-Strong Magnetic Fields of 1000 Tesla: Science of Chemical Bonding in Non-Perturbative Magnetic Fields".



100th anniversary of pulsed magnets

December 16-18, 2024

A. Miyata, Y. Kohama, M. Tokunaga, Y. H. Matsuda, and K. Kindo

The concept of pulsed-field magnets dates back to the early 20th century. In 1924, Pyotr Kapitza first demonstrated the possibility of a pulsed magnet to generate magnetic fields up to 50 Tesla. To commemorate this milestone, we organized a workshop to review the development of pulsed magnets and to discuss recent advances and future directions in high-field research. In the workshop, a wide range of topics including quantum oscillations, topological materials, superconductors, magnetic materials, and experimental techniques under high magnetic fields were actively discussed. A total of 114 participants joined the workshop (102 onsite and 12 online). Many early-career researchers also gave oral and poster presentations, and the workshop provided a valuable opportunity for them to connect and build networks for future collaboration.



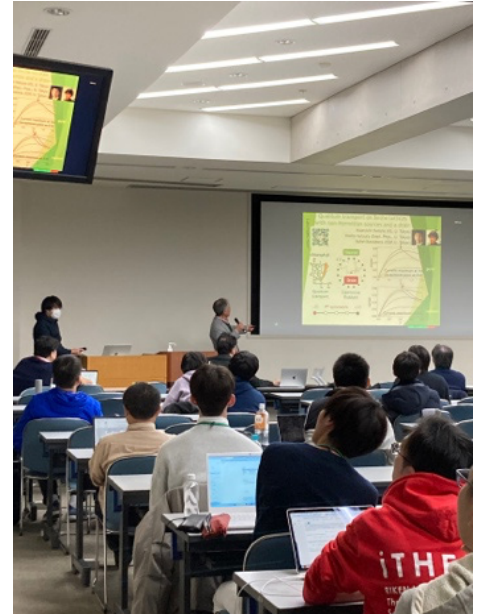
New trends in condensed matter theory 2024

December 9-11, 2024

T. Oka, T. Kato, M. Oshikawa, and K. Kawabata

The workshop New Trends in Quantum Condensed Matter Theory 2024 was held in December 2024, bringing together a wide range of topics in condensed matter physics. The field continues to evolve around quantum materials that exhibit remarkable quantum phenomena driven by strong interactions and unique electronic structures. Recent years have also seen rapid developments in nonequilibrium phenomena, active matter, artificial materials, and interdisciplinary areas involving quantum information science. Theoretical advances have been supported by progress in numerical methods and mathematical approaches.

This workshop was organized to highlight these broad and dynamic developments, with a particular focus on early-career researchers who have made notable contributions in recent years. The program featured 18 invited talks and 36 poster presentations, stimulating lively discussions across disciplines and generations.



Topological Nonlinear Optics in Quantum Materials

February 19-21, 2025

T. Oka, R. Shimano, T. Morimoto, and M. Hayashi

The ISSP workshop Topological Nonlinear Optics in Quantum Materials was held from February 19 to 21, 2025, at the Institute for Solid State Physics, University of Tokyo. The workshop brought together researchers aiming to deepen the understanding of exotic optical responses in topological materials and explore future applications in quantum devices and novel functional materials. With a strong focus on fostering early-career researchers and enhancing ISSP's international role, the event provided a valuable platform for interdisciplinary exchange.

The program featured 23 invited talks covering a wide range of topics including Floquet theory, nonlinear optics, spin control with terahertz fields, and topological phenomena in quantum materials. Both theoretical and experimental perspectives were represented, with contributions from leading researchers across Japan and abroad. Notably, themes such as Berry-phase-driven shift currents, circular photogalvanic effects, and ultrafast control of quantum states highlighted the frontier of nonlinear optical studies.

The workshop gathered approximately 85 participants, both in person and online, enabling vibrant discussions across disciplines. By bridging topics from strong correlations and spintronics to quantum information and light-matter interactions, the event offered insight into the future of topological quantum photonics and reinforced ISSP's position as a hub for cutting-edge condensed matter research.



Advances of Frustrated Magnetism in Kagome Antiferromagnets

March 10-11, 2025

Y. Okamoto, Y. Kohama, C. Hotta, H. Yoshida and M. Yamashita

In magnetic systems with geometric frustration, including a kagome lattice, a quantum spin liquid state with no long-range order may appear with elementary excitations different from those in conventional magnetic materials, such as spinon excitations and Majorana quasiparticles. Among frustrated systems, kagome materials have been extensively studied because an emergence of a quantum spin liquid state is theoretically predicted even in the simplest Heisenberg model. Recently, the successful syntheses of new kagome materials have led to new discoveries, including the $1/9$ magnetization plateau in $YCu_3(OH)_6.5Br_{2.5}$ and the $1/3$ plateau at low magnetic fields in In-kapellasite. We thus had a workshop at ISSP to share advances of these new studies, as well as to review previous experimental and theoretical studies on kagome antiferromagnets. We also had many presentations reporting progresses in research on frustrated magnetism done in frustrated magnetism not limited in kagome materials. The workshop began with review lectures on kagome materials by Prof. Yoshida from Hokkaido Univ. and Prof. Hotta from University of Tokyo focusing on the experimental and theoretical perspectives, respectively. We also had 16 oral presentations and 17 poster presentations. This meeting was found to be very successful and meaningful with nearly 60 participants for lively hot discussions that include progresses in research on magnetization plateaus in kagome lattice antiferromagnets, as well as advancements in studies of other frustrated magnets.

