Conferences and Workshops

International Conferences and Workshops

International Workshop "Theory of Correlated Topological Materials" and Symposium "Topological Phases and Functionality of Correlated Electron Systems"

Workshop: February 6 - March 3, 2017
Symposium: February 20 - 22, 2017

L. Balents, P. Gegenwart, S. Nakatsuji, M. Oshikawa, O. Tchernyand, and S. Trebst

In recent years, topology plays a key role in classifying, discovering, and even designing materials with desirable functionalities. The wide recognition of this trend manifested most notably in Nobel Prize in Physics 2016 awarded to the original works on "theoretical discoveries of topological phase transitions and topological phases of matter". Topology is a branch of mathematics, which studies classification of objects by regarding those connected by continuous deformations as equivalent. The application of topology to classification of quantum phases originated in the study of quantum Hall effects, but is recently expanded to much wider class of materials. The recent explosive growth of the field stemmed from the discovery of topological insulator, for which the classification of non-interacting electron systems developed first. Many of the theoretical predictions have been confirmed experimentally, and devices utilizing the topological properties are proposed. Recently, the focus of the fundamental research is shifting to the interplay of topological aspects and strong correlation in electron systems. Strongly correlated electron systems have been studied vigorously over several decades, but remain as a challenging problem theoretically and experimentally. However, new breakthroughs based on topological concepts are being made, and more are expected to come.

At this exciting time, this International Workshop and Symposium was organized to develop the frontier of condensed matter physics at the interface between topology and strong correlation, co-sponsored by ISSP, JSPS Program for Advancing Strategic International Networks to Accelerate the Circulation of Talented Researchers for "Leading Research Network Topological Phenomena in Novel Quantum Matter" (TopoNet), and Center for Magnetic Materials, Elements Strategy Initiative. The entire four-week program consisted of the three-day Symposium and the Workshop during the rest of the period. The Workshop part was primarily for discussion of theoretical studies. In order to facilitate collaborations, during the Workshop period, talks were limited to at most 2 hours each day, so that ample time was reserved for discussions. At the Symposium, many recent developments in experimental and theoretical studies were reported, and followed by vigorous discussions during coffee and lunch breaks, and after hours. The cumulative total of the daily attendance in the Workshop was 410 (over 17 days), while that in the Symposium was 347 (over 3 days).

The topics discussed at the Workshop/Symposium included various quantum spin liquids such as Kitaev spin liquid, Weyl semimetals and their electromagnetic responses, topological surface states, anomalous Hall effect in non-collinear antiferromagnets and its application to spintronics, and novel class of quantum criticalities. While these topics are diverse, intriguing connections among different subjects have also emerged. The lively discussions at the Workshop/Symposium suggested future directions, and have led to new collaborations.

International Workshop on Tensor Networks and Quantum Many-Body Problems (TNQMP2016)

Workshop: June 27 - July 15, 2016
Symposium: June 27, July 4, July 11, 2016

K. Harada, S. Hashimoto, N. Kawashima, T. Misawa, S. Morita, Y. Motoyama, T. Okubo, M. Oshikawa, S. Todo, J. Yamazaki, T. Yanai, and K. Yoshimi

The meeting was held as one of the annual workshop series that started in 2006. Since the event was cancelled in 2011 because of the earthquake, this was the 10th. The main theme of this year's workshop was the tensor network state. The concept of the tensor network itself is not very new. The simplest example may be the Ising model, which itself can be regarded as a tensor network --- an Ising spin corresponds to an index to be contracted, and the local Boltzmann weight defines the tensor elements. Any statistical physical model on some lattice is actually a tensor network. The concept of the tensor network became popular recently mainly due to the interpretation from the information science viewpoint and several impressive demonstrations of its effectiveness in describing quantum states. Numerical methods based on the tensor network concept are now producing high-precision results for the models otherwise intractable, such as frustrated magnets and fermion systems. On every Monday, we had a symposium in which, in 30min talks, participants present their most recent results, whereas on Tuesday through Friday, we have two lectures a day, one in the morning and another in the afternoon, each being 1h 30min. In lectures basic concepts are explained in details. Every lecture was recorded and posted on YouTube. (You can find it by the keyword TNQMP2016.) For example, Román Orús (Mainz) gave lectures on the 1-dimensional and the 2-dimensional tensor network state for beginners, Glen Evenbly (UC Irvine) explained renormalization group method based on the tensor network representation, Tadashi Takayanagi (Kyoto) discussed the relationship between the MERA representation and AdS/CFT correspondence, Frank Pollmann (MPIPKS) and Norbert Schuch (MPQ) dealt with the problem of the topological properties in terms of tensor networks, Tomotoshi Nishino (Kobe) talked about applications to classical systems, and Philippe Corboz (Amsterdam) and Tao Xiang (CAS, Beijing) presented their results of the state-of-the-art tensor network calculations. Particularly impressive was the talk by Frank Verstraete (Vienna) who gave a blackboard lecture on the matrix product states and the matrix product operators, in which he showed how the Yang-Baxter equation can appear in the language of the tensor networks. Reflecting the high expectation among young researchers, the lecture room was crowded everyday. The integrated total number of audience including the symposia was 558.

The 17th International Conference on High Pressure in Semiconductor Physics (HPSP-17) & Workshop on High-Pressure Study on Superconducting (WHS)

August 7 - 11, 2016
K. Takarabe and Y. Uwatoko

The 17th International Conference on High Pressure in Semiconductor Physics (HPSP17) and the Workshop on High-pressure on Superconductors (WHS) was held at the Sanjo Conference Hall (Hongo, Univ. Tokyo, Japan) in the schedule of August 7th - 11th 2016. The aim of this first joint conference was to allow young and experienced researchers from different fields to meet together during a single-session conference to present and discuss their latest results in the field of application of high pressure and other forms of stress to the study of both semiconductors and superconductors. The idea of joint conference was to give an opportunity to the participants to have a bird-eye crossing two fields, bridging over towering two fields, and thus a new stimulus in both fields. A total of 110 people participated in the conference. This number means the acceptance of the new idea of organizing the high-pressure conference. We are deeply indebted to the International Advisory Committee for recommending the invited speakers for this new conference. We would like to thank for all participants from 14 countries: Canada, China, Estonian, France, Germany, Israel, Korea, Mexico, Poland, Russia, Spain, the United Kingdom, the United States, and Japan, having had brought their latest high-pressure studies. We sincerely thank to the Institute for Solid State Physics of the University of Tokyo for jointly hosting the WHS and JSPS KAKENHI the Grant-in-Aid for Specially Promoted Research, Megar Chemistry for jointly hosting the megabar chemistry session in the conference. We thank to all companies donated to the conference for running the conference smoothly. We finally thank to all steering and editorial member for running the conference successfully.

We look forward seeing you all in the next conference.

A list of companies donating to HPSP & WHS.

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Computational Materials Science —Now and the Future—

April 4 - 5, 2016
N. Kawashima, H. Noguchi, O. Sugino, H. Watanabe, S. Kasamatsu, Y. Noguchi, S. Morita, Y. Yoshimoto, S. Motome, T. Oda, H. Kawamura, Y. Okamoto, and Y. Kawakami

This workshop was organized for the computational condensed matter research community, especially for the users of the ISSP supercomputers, to exchange the most recent information on the computational condensed matter research and on the high-performance computation of related research areas. This was held as a series of annual workshop of ISSP supercomputer that has so far been held at around the year-end or the fiscal year-end, but was held this time at the start of the fiscal year for the first time. Because of the shifting of the time, participants were slightly increased in number. The selected topics include the target of the post-K supercomputer project, the progress made in the elements strategy projects, the emergent data-driven material research, and "the Project for advancement of software usability in materials science" that started by ISSP in 2015. In addition to seventeen invited talks and twenty-two poster presentations, panel discussion (by four panelists) was held to deepen understanding on that architectures that may be adopted for the next generation ISSP supercomputer. Many of the presentations contained new results obtained by performing larger scale calculations enabled by the new system B, which was introduced in July 2015.

First Workshop of the Solid State Chemistry Forum: Present and Future of Solid Materials

June 14 - 15, 2016
S. Shimakawa, H. Miyasaka, H. Kageyama, H. Kitagawa, R. Kanno, M. Takano, and Z. Hiroi

The workshop was planned as an opportunity for researchers working in various fields of solid state chemistry and materials science to get together and discuss the recent progress of solid state chemistry. It was the first meeting of the solid state chemistry forum founded in 2015. 62 presentations including 6 reviews, 11 invited and 45 poster talks were given. Approximately 100 people joined the meeting everyday. Intensively discussed were novel methods for inorganic and organic compounds, the chemical properties of catalyses, ionic conductors and materials for ion batteries, and the physical properties of quantum magnets, dielectrics and superconductors. The workshop gave a wonderful opportunity for attendees to understand the present status and to imagine the future prospect of materials research. Moreover, it was helpful in building a community for solid state chemists.

High Magnetic Field Co-laboratory, International Collaboration and Future of the High Magnetic Field Science

June 23 - 24, 2016
H. Nojiri, T. Sasaki, S. Awaji, T. Shimizu, Y. Imanaka, H. Ota,
M. Hagiwara, K. Kindo, S. Takeyama, M. Tokunaga, and Y. Matsuda

In 2015, the Global High Magnetic Forum was founded by the world leading high field facilities and the new phase of the international high magnetic field research community has begun at 10 years after the foundation of High Magnetic Field Forum of Japan. In such occasion, the workshop aimed at the mutual exchange and discussion on the trends of science in high magnetic fields and the organization for the facility network in domestic and regional levels. Nine sessions were hold with theme of science in the interdisciplinary area, science and material design/synthesis, science studied in steady fields, development of physics in spin systems under high magnetic fields, current status and future prospects of science in mega-gauss fields, generation of steady and quasi-steady fields and their application, current status and future prospects of non-destructive pulse magnets and their application, and international collaborations. Each session consists of a few leading talks by young representatives, contributed talks and comment from experienced leaders. Students and post-doc researchers presented their recent results in the poster session. Three leaders from China and Korea were invited to report the present status of research and facility in each country. In the final session, the attendants agreed to found the Asian high magnetic field forum and accelerate the regional research collaboration.

New Frontier of Pi-Electron Based Molecular Materials Science

August 8 - 10, 2016
H. Sawa, K. Mori, M. Ogata, R. Kato, K. Kanoda, T. Sasaki,
I. Terasaki, T. Naito, H. Yamamoto, H. Mori, T. Osada, and M. Yamashita

We held a workshop by researchers dealing with experiments and theories including science of molecular π electron systems and related fields. In this workshop, we held discussions for molecular material development and condensed matter physics beyond the conventional framework. Furthermore, the role of ISSP as a hub of advanced research of material science was reconfirmed.

Molecular π-electron systems, in particular the quantum mechanical properties of crystalline materials composed of π-conjugated molecules, are studied for the development and deepening of basic physics, which is the creation of the basic principle of next-generation molecular electronics. In molecular crystals, exotic electronic states are realized by competition and cooperation of different order parameters of the energy scale and characteristic space-time scale, and insulators, semiconductors, metals, dielectrics, superconductors, etc. appear. We have the possibility to manipulate macroscopic functions due to exotic quantum properties of molecular crystals. Therefore, in this workshop, program organization was divided for each theme, and combining molecular system and inorganic system, we devised to clarify the physical aspects of various phenomena.

The number of people participating in this workshop exceeded 300 people in total, more than 120 attendees daily, which means that it became the largest in this year's ISSP workshop. Researchers in other fields interested in the molecular material science field gathered, so the academic expansion and objective consciousness became clear. Many young researchers who participated in the poster session conducted more active discussions than before.

ISSP Workshop: Frontier of Neutron Scattering Research in the Field of Magnetism and Strongly Correlated Electrons

October 6 - 7, 2016
T. Masuda, H. Yoshizawa, M. Fujita, and M. Takeda

Neutron scattering technique is a powerful probe for microscopic structure and dynamics of materials. ISSP and Japan Atomic Energy Agency (JAEA) have updated the neutron instruments and reconsidered the safety issues in the research reactor JRR3, which has been suspending its operation since the great east-Japan earthquake in March 2011, so that we will be able to resume the user program smoothly as soon as the JRR3 restarts. Recently the adaptability to new regulatory standard of the reactor's safety is being satisfied, and the director of JRR3 indicated that the reactor would restart its operation in the end of Japan fiscal year 2017. We, thus, held the ISSP workshop for the discussion of scientific research by using neutron spectrometers in JRR3. The main purpose is to fulfill the maximum scientific output after the restart. Specialists of triple axis spectrometer (TAS), outstanding users, and scientists in the facilities related to JRR3 participated in the workshop; the numbers of the participants were 64 for the first day and 49 for the second day. The importance of the TAS was reconfirmed. Furthermore settlement of working group for the future plan of JRR3 was proposed.

Trends and Prospects in the Condensed Matter Physics Studied by Scanning Tunneling Microscopy

October 30 - November 1, 2017
Y. Hasegawa, T. Hanaguri, T. Komeda, H. Shigekawa, F. Komori, and Y. Kim

Recent tremendous advances in scanning tunneling microscopy (STM) enable us to investigate physical properties of various materials in nanometer and atomic scale spatial resolutions that cannot be accessible by other methods. Nowadays, STM can be operated in dilution refrigerator temperature under high magnetic fields. In addition to structural and electronic properties, spin, phonon, and vibrational modes of individual atoms/molecules can be probed and their spatial mappings are visualized. Time-resolved measurements are performed in combination with laser pulses, and photon mappings showing site-dependent emission intensity within a single molecule are obtained. Throughout this workshop, we discussed various physical phenomena revealed by cutting-edge STM systems and shared their technological advances.

One of the recent hot topics we extensively discussed is surface superconductivity. It was first reported with STM by showing the superconducting gap and vortices in a single metallic layer formed on a substrate, and later confirmed by transport measurements through the monoatomic surface layer. It was found that atomic steps on the surface behave as a Josephson junction. Because of the broken space inversion symmetry, a mixture of s- and p-wave electron pairing is expected, and the detection of the unconventional pairing in tunneling spectra was discussed.

Topological insulator, Weyl semimetal, graphene etc. are also attractive subjects among STM researches because of their peculiar surface electronic states. The suppressed backscattering of the protected surface states on topological insulators was nicely demonstrated through the disappearance of the electron standing waves. On a Weyl semimetal the Fermi arc was visualized in quasiparticle interference pattern. It was also demonstrated that the Dirac cone of graphene can be well controlled through the modification in the step morphology of a SiC substrate

Time-resolved measurement was also a recent utmost achievement in STM as it realizes a microscope with both ultimate spatial and temporal resolutions. Site-dependent relaxation times of optical responses and spin precessions have been demonstrated in a pump-probe method with laser-combined STM. It was demonstrated that monocycle THz pulses work as a picosecond pulse in the bias voltage and will be used for time-resolved imaging near future.

Local Functionality of 3D Active-site on Atomic-Layer Materials

December 20 - 21, 2016
H. Daimon, R. Saito, T. Kinoshita, and T. Osada

Recent materials science is related to a development of new functional materials for realizing the energy-saving sustainable society. It is very important to understand the local 3D atomic arrangement as well as the bulk periodic arrangement to realize these functional materials. The discovery of graphene stimulated many researches on atomic layer material because of its novel electronic and optical properties. These zero- to two-dimensional local atomic structures have not been able to be studied because they have no translational symmetry which is necessary for x-ray diffraction analysis. The development of new analysis tools and theoretical studies based on experimental evidence are necessary to realize novel functional materials. Scanning probe microscope can study local atomic structure and properties, but it cannot reveal 3D atomic arrangement. Several atomic resolution holographies, which can visualize 3D atomic arrangement images around specific atoms in materials, have been developed and reached application levels in Japan recently. Two projects of Grant-in-Aid for Scientific Research on Innovative Areas by MEXT, "3D Active-site Science" and "Science of Atomic Layers", are now running and many researchers are involved. About 90 people of not only the members of these groups but also related researchers in ISSP attended this symposium, and discussed about the development of functional materials, device application, improvement of measurement method, cooperation with theory, and so on. The attendee could find some seeds of collaboration among them and could hold a possibility of new science in common.

ISSP Workshop: Origins of material functions elucidated by SPring-8 BL07LSU

March 8, 2017
H. Wadati, S. Shin, F. Komori, I. Matsuda, and Y. Harada

Synchrotron radiation laboratory has a Harima branch to maintain and develop a high-brilliance soft X-ray beamline BL07LSU at SPring-8. There we are performing time-resolved, spatial-resolved and energy-resolved soft X-ray spectroscopy to study electronic states and dynamics of new materials. In this workshop, recent research activities at our beamline were reported and we discussed our new experimental techniques which will reveal the origins of material functions. The speakers talked about their recent results from each end station (time-resolved spectroscopy, 3D nano-ESCA, emission spectroscopy, and so on). There were two invited talks; one is about soft X-ray nanofocusing with ultraprecise mirrors, and the other is about nano-metric spin textures observed by coherent soft X-ray scattering. There were a lot of discussions for each talk, and we successfully started to obtain a clear vision about how we can elucidate the origins of material functions such as magnetism, chemical reaction, and biological systems. We also encouraged the young generation in this research field by awarding the best poster prizes to two graduate students.