Joint ISSP-OIST Symposium:

Lighting Up New Frontiers – From Tokyo to Okinawa, From Materials to Neurons

Abstracts

**Abstracts in program order*

***ISSP = The University of Tokyo, The Institute for Solid State Physics*

****OIST = Okinawa Institute of Science and Technology Graduate University*

Yabing Qi, Energy Materials and Surface Sciences Unit, OIST

Title: Low-cost solar cells

Solar cells have been intensively investigated because of their potential in alleviating the pressing challenges associated with sustainable energy and global warming. In this presentation, I will talk about our recent research efforts related to solar cells. In particular, I will focus on new developments towards low-cost solar cells.

Hidefumi Akiyama, ISSP

Title: Nano-device physics of semiconductor lasers, solar cells, and bioluminescence

Advanced semiconductor lasers, state-of-the-art solar cells, and bioluminescence are all essentially light-emitting/absorbing nano-structures embedded in sophisticated controlling systems such as semiconductor cavity/waveguide/conductors/electrodes and protein enzyme/catalyzer. We study such systems with the help of basic physics.

Tohru Suemoto, ISSP

Title: Observation and control of spin motions by impulsive terahertz radiation

Although the laser-based time domain terahertz spectroscopy has made considerable progress in this decade, most of the activities have been restricted in the dielectric response of the materials. In this talk, I will discuss recent development in utilization of its magnetic field, that is, excitation, detection and selective control of spin precession motion.

Yohei Kobayashi, ISSP

Title: 10-MHz repetition rate, high-order harmonics generation

We are developing many laser systems such as a Yb-fiber chirped pulse amplifier system, an optical frequency comb, and an ultra-high repetition-rate, solid-state laser. The high-harmonic generation by using an enhancement cavity and its applications will be presented.

Jiro Itatani, ISSP

Title: Soft-X-ray high harmonic generation using a few-cycle intense infrared light source

Optical parametric chirped pulse amplification (OPCPA) is a new technique to produce intense ultrashort optical pulses beyond visible wavelength. We report on the current status of our OPCPA system that can produce sub-two-cycle phase-stable intense optical pulses in infrared and its application to high harmonic generation in soft X rays. This new light source will extend the energy scale of attosecond physics to a sub-keV range and open the opportunities for ultrafast soft X-ray spectroscopy.

Yoshihisa Harada, ISSP

Title: Soft X-ray emission spectroscopy

In this talk I would like to review recent developments in soft X-ray emission spectroscopy which has attracted much attention because of its high potential for probing the electronic states of a wide range of materials such as wide gap insulators, superconductors, correlated transition metal oxides, rare earth compounds, materials in gaseous and liquid states. There are two directions about the development: one is toward energy resolution, and the other is toward sample manipulation. I will talk about several breakthroughs that contributed to gain attention to this method.

Nic Shannon, Theory of Quantum Matter Unit, OIST

Title: Shedding light on frustrated magnets in high magnetic field

The search for new quantum phases and excitations is central to modern condensed matter physics. In this context, frustrated magnets have proved a particularly rich source of inspiration. Using the cubic spinel Cd2Cr2O7 as an example, we discuss some of the new types of quantum order which can arise in frustrated magnets in high magnetic field, and how optical experiments have helped inform our understanding of these systems.

Shik Shin, ISSP

Title: Study of materials science by the laser-photoemission spectroscopy

Angle resolved photoemission spectroscopy (ARPES) is very powerful to know the solid state properties, because we can know the solid state electrons directly. Recently, VUV- and SX-lasers have been developed, and it is found that they are very useful for the photoemission spectroscopy. Laser has excellent properties, such as coherence, monochromaticity, polarization, ultra-short pulse, high intensity, and so on. I would like to introduce laser-ARPES is very powerful for the materials science, such as high resolution ARPES, time-resolved ARPES, and photoemission microscopy (PEEM). For example, low-temperature high-resolution laser- ARPES system has achieved the highest energy resolution of ~ 100 μeV and the lowest sample temperature of ~ 1.0 K. High resolution ARPES is very powerful for the study of superconductors.

Sile Nic Chormaic, Light Matter Interactions Unit, OIST

Title: Manipulating and trapping particles with optical nanofiber guided light

In this talk, we will present some of our research on optical nanofibers and the role they play in trapping and manipulating particles from the atomic to the micron scale. We will also discuss their potential as tools for developing neutral atom-based quantum technologies.

Mukhles Sowwan, Nanoparticles by Design Unit, OIST

Title: Build -A –Nanoparticle

In recent years, progress in nanomaterials synthesis has made it possible to mix two or more different materials to obtain binary, ternary and multicomponent hybrid nanoparticles. Thus, different functionalities can be combined in one single nanoparticle, and enhanced properties can even be realized due to the coupling between the different components (optical, magnetic, etc.) . However, to gain control over the size, morphology and position of each component in the hybrid nanoparticles complicated multistep procedures that include nucleation and growth of a second and even a third material on a single component seed nanoparticle are usually required.

Herein, I will talk about the design and single-step synthesis of multicomponent hybrid nanoparticles for different applications.

Yoko Yazaki-Sugiyama, Neuronal Mechanism for Critical Period Unit, OIST

Title: Singing in the brain

Depending on how the brain works, we acquire information from environment, process and store this information as well as generating behavior. What is happening in the birds' brain while they are learning to sing? We are investigating which neuronal circuit in the brain and what kind of circuit functions are involved in birds' song learning by monitoring and controlling neuronal activities. We are further seeking new methods for controlling activities of specific neurons with high resolution of time and space.

Jeff Wickens, Neurobiology Research Unit, OIST

Title: Use of Optical tools in the study of memory & learning mechanisms in the brain

Optical tools are causing a revolution in neuroscience by providing radical new ways to study brain function. Real-time measurement and experimental manipulation of activity in the living brain has become possible using light. New genetic tools, which make nerve cells sensitive to light, let us experimentally investigate the role of specific neural circuits in animal behavior and learning. I will give examples of these approaches, including optogenetics to study behavioral flexibility; 2-photon microscopy to study memory and learning mechanisms in the brain; and, photolytic uncaging of neurotransmitters to study the actions of dopamine, a chemical important in reward-related learning. I will highlight the strengths and limitations of current tools and express some hopes for the future.