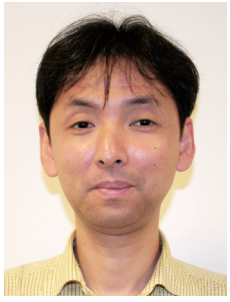
Our Team

Hajime Sugai

Research Area: Astronomy

IPMU Associate Professor

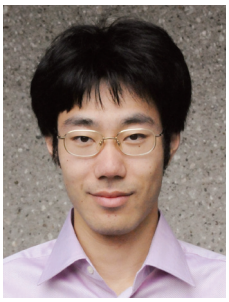


I have moved from Kyoto University, where key words on my research have basically been astronomical instrumentation and observations of active galaxies in optical/infrared wavelengths. I developed a multi-mode optical spectrograph Kyoto 3DII, which is used at the Cassegrain foci of the Subaru 8m telescope as well as of the UH 88-inch telescope. It has four observational modes, including integral field spectrograph, Fabry-Perot imaging, slit spectrograph, and filter imaging modes. The integral field spectrograph mode enables us to simultaneously obtain the spectra for more than 1000 spatial elements of a target object. I will use my experience here for the development of the Subaru Prime Focus Spectrograph, which is a project promoted by IPMU. I used Kyoto 3DII for the research of active galaxies. Examples are clarifying the morphological and kinematical structures of a young AGN outflow, and investigating a lens galaxy mass distribution and line emission region structure of a lensed quasar through observations of a lensed quasar system.

Tomoyuki Abe

Research Area: Mathematics

IPMU Assistant Professor



I am studying arithmetic geometry; especially, the theory of arithmetic D-modules. Arithmetic geometry is a subject that tries to understand arithmetic equations, or more generally arithmetic varieties, by "geometric" methods. How, for example, can we get "topological information" of a $\mathbb{Z}$ coefficient equation? A naive answer would be, by considering the equation as a complex variety and taking the cohomology. Although we can get genus information with this method, we cannot see the difference between equations defined over $\mathbb{Z}$ and $\mathbb{C}$.
In the 60's, Grothendieck defined étale cohomology on which arithmetic properties reflect. This important cohomology is an analog of singular cohomology. He also suggested more "analytic" cohomology, called crystalline cohomology, which is an analog of de Rham cohomology. I am studying a variation of crystalline cohomology called the arithmetic D-modules, and I am interested in the relationship between various cohomology theories from the viewpoint of Langlands program.

Recently, some physicists pointed out links between the geometric Langlands program and "S-duality." It is my dream to study arithmetics by using some insight from physics.

Masamune Oguri

Research Area: Cosmology

IPMU Assistant Professor

A recent development in cosmology has revealed that the universe is filled by unknown components called dark matter and dark energy. My main research interest is to explore the properties of these dark components from astronomical observations. In particular, I make use of gravitational lensing phenomena to tackle this problem. While I initially started my research career as a theoretical astrophysicist, I had the opportunity to have my theoretical prediction confirmed by my own observation, which was exciting enough for me to begin observational research using various survey data and telescopes. So far I've worked mainly on gravitational lens searches in the Sloan Digital Sky Survey data and its theoretical implications. At IPMU, I'd like to engage in the SuMIRe project, a wide-field survey using the Subaru telescope. I can't wait to see the new picture of the universe that the survey will bring us.

Mitsutoshi Fujita

Research Area: Theoretical Physics

Postdoc

My research interests are the gauge/gravity correspondence and its application for condensed matter physics. Here, the gauge/gravity correspondence is the duality between the strong-coupling gauge theory and weak-coupling gravity. In particular, we have constructed three holographic models of the fractional quantum hall effect via gauge/gravity correspondence. Here, the fractional quantum hall system is realized via d=2 strong-coupling electron systems under the strong magnetic field, and the hall conductivity in this system is quantized.

Noriaki Ogawa

Research Area: Theoretical Physics

Postdoc

One of the most important aspects in field and string theories is duality, where apparently different theories describe the same physics. We can sometimes use it to understand complicated phenomena easily using the other equivalent theory. In particular, gauge/gravity correspondence is a surprising duality between a gravitational theory and a non-gravitational one. I have been studying its applications to black holes. At IPMU I would also like to research many other aspects of this correspondence.

Malte Schramm

Research Area: Astronomy

Postdoc

My research interest as an observational astrophysicist is the evolution of active galactic nuclei (AGN) and their host galaxies. I mainly focus on quasars, the most luminous active galaxies known, which can tell us something about the growth phase of the black hole. I want to get a better understanding of the tight correlations found between the black hole and the properties of their host galaxies. Therefore I use high angular resolution multi-band imaging to study the properties of the host galaxies out to high redshifts. Lately I am also involved in observational campaigns using spatially resolved integral field spectroscopy with the aim to explain the unusual stellar population properties of AGN host galaxies and to collect evidence for AGN driven outflows and their relevance for the evolution of these galaxies.

Shunsuke Tsuchioka

Research Area: Mathematics

Postdoc

I am studying Lie theory and its applications via categorification. While Lie theory has a rich history in mathematics and physics, it became known recently that it has relations with seemingly different areas of research such as modular representation theory of Hecke algebras via categorification. I aim at both establishing such connections and studying the corresponding Lie-theoretic objects. Recently, I am interested in Lie theory associated with non-symmetric Cartan matrices, conjecturally related algebras and supermathematics.

The IPMU Berkeley Satellite, located at the University of California, Berkeley, is in close collaboration with the Department of Physics of UC Berkeley and the Berkeley Center for Theoretical Physics (BCTP). The pictures show a sign of the IPMU Satellite and theorists gathering at the BCTP's interaction area.