Our Team

Tomotake Matsumura

Research Field: Cosmology

Kavli IPMU Associate Professor

I have been pursuing the research on the physics of early universe using the measurement of the cosmic microwave background (CMB) polarization. Currently, the measurement of the CMB polarization is known as a powerful tool to test inflationary models. While working on a CMB experiment is fascinating in terms of the scientific goal itself it is also exciting in terms of the nature of the experiment. A CMB experiment requires using broad areas of physics. It starts from relativistic cosmology to astronomy, thermal statistics, optics, superconductivity, mechanics, electromagnetism, and so on. Also the experimental techniques come with as simple as soldering wires (not actually simple!) to cryogenics, mechanical design and machining, parallel computing, and more. This makes me feel a tight connection between daily activities and an event at the early universe, which may always look as if it is unreachable. The Kavli IPMU is a hub for scientists who are inspired by the fundamental questions and I look forward to working with you at the Kavli IPMU.

Satoshi Shirai

Research Field: Theoretical Physics

Kavli IPMU Assistant Professor

The framework of the standard model and cosmology is demonstrating notable success in explaining nature. It is, however, clear that this is not the ultimate theory to explain everything. An obvious reason is this framework fails to explain the origin of the (dark) matter in the Universe.

My research aim is investigating the ultimate theory by studying closely the nature of the (dark) matter. In particular, I am now intensively studying the collider physics for efficient discovery/measurement of dark matter. I am also very interested in cosmic-ray signatures as a probe of dark matter. We will be getting deeper insights into dark matter for the next ten years, thanks to these observations.

I am excited that I will be working together with Kavli IPMUers at this crucial time.

Anne Ducout

Research Field: Cosmology

Postdoc

My research focuses on the Cosmic Microwave Background (CMB) analysis, mainly to constrain fundamental theories such as Inflation, and looking for primordial B-modes (primordial gravitational waves seen in polarization).

I previously worked on measuring the primordial non-Gaussianities, especially on Planck data.

More recently, I also worked on the instrumental analysis, for Planck but also for the POLARBEAR telescope, and here I will focus on LiteBIRD, a Japanese-led satellite mission to detect primordial B-modes, particularly on methods to separate Galactic from primordial signals.

Fabian Köhlinger

Research Field: Astronomy

Postdoc

Shedding light on the physical nature of dark matter and dark energy, but also investigating the cosmological effects of massive neutrinos is the major motivation for my current research.

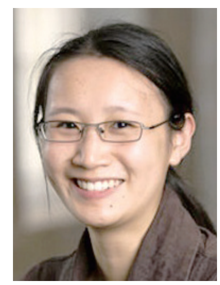
The weak gravitational lensing effect of the cosmic large-scale structure is very sensitive to the growth of structure in the Universe and hence to the evolution of these dark species.

Those kinds of weak lensing observations require increasingly larger surveys and I have been working with data from two such surveys, i.e., CFHTLS and KiDS. Here at the Kavli IPMU I am especially looking forward to exploiting the statistical power of HSC.

Juliana Kwan

Research Field: Astronomy

Postdoc



I am a postdoctoral researcher interested in cosmology with large scale structure. I joined the Kavli IPMU in October 2016 from The University of Pennsylvania, where I worked on weak lensing within the Dark Energy Survey. I am particularly interested in using weak lensing as a probe for nature of cosmic acceleration, one of the most fundamental questions that plague modern physics. I am also interested in constraining the growth of large scale structure, as measured by redshift space distortions. While at the Kavli IPMU, I will be working on a joint approach using both weak lensing and redshift space distortions as measured by the Hyper Suprime-Cam survey to address this problem.

Matthew Murdoch

Research Field: Experimental Physics

Postdoc

The EGADS (Evaluating Gadolinium's Action on Detector Systems) detector was originally constructed as part of an R&D program for the gadolinium doping of the Super-Kamiokande detector. With its R&D mission largely completed, EGADS (re-branded Employing Gadolinium to Autonomously Detect Supernovas) will become a dedicated supernova detector capable of autonomously announcing a galactic supernova burst within one second of first neutrino arrival and providing a valuable warning for the astronomy community. My research is focused on maximizing the sensitivity of EGADS through neutron tagging, simulation development, and analysis of cosmic-ray induced backgrounds.

Francesco Sala

Research Field: Mathematics

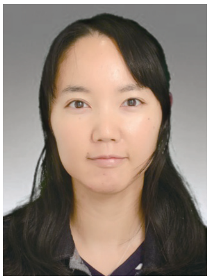
Postdoc

My research interests are algebraic geometry, geometric representation theory, and mathematical physics. At the moment I study different realizations of Hall algebras and their refined versions (K-theoretical/cohomological) by using (Higgs) sheaves on curves. One can construct geometric representations of these algebras by using the K-theory/cohomology of moduli spaces of torsion-free sheaves on resolutions of A-type toric singulaties and Nakajima cyclic quiver varieties. This yields to applications in physics, most notably in four-dimensional supersymmetric gauge theories on A-type ALE spaces and the AGT conjecture for these theories.

Tomomi Sunayama

Research Field: Astronomy

Postdoc



My research interests lie between theory and observation related to cosmology. In particular, I am interested in how we can use galaxies to explore dark energy, dark matter, and early universe physics. During my Ph.D., I studied how to construct galaxy mock catalogs using large N-body simulations as well as some cosmological probes using galaxies such as the baryon acoustic oscillations (known as a "standard ruler") and redshift-space distortions. These research projects provided me with appreciation for the interplay between theory and observation. Increased survey volumes in upcoming galaxy surveys such as PFS (using the Subaru telescope) will enable us to measure cosmological parameters with much better precision and I think that this is a really interesting time for cosmologists.

Gabi Zafrir

Research Field: Theoretical Physics

Postdoc

My research focuses mostly on supersymmetric higher dimensional quantum field theories. These are interesting both from the study of quantum field theory in general and due to their connection with string theory on one hand and theories in lower dimensions on the other. The last connection is given by compactifying the higher dimensional theory to lower dimensions, and has proved insightful, for example, in the study of four dimensional theories with 8 supercharges. I study all these aspects to better understand quantum field theories, in both lower and higher dimensions, and string theory.