

# Our Team

## Chiaki Hikage

Research Field: **Cosmology**

Kavli IPMU Assistant Professor

My research area is observational cosmology. I have used the observational data of cosmic microwave background and galaxy distribution to address fundamental questions of the universe such as How did the universe begin? What is the origin of the accelerated expansion in the universe? I have applied different statistics such as Minkowski Functionals, which probe morphology and topology, to the cosmological data to get new insight into structure formation in the universe. I am particularly interested in the SuMIRe project, galaxy imaging and redshift surveys using the Subaru 8-m telescope to



perform precision cosmology. The Kavli IPMU is a unique place in which researchers in mathematics, particle physics, and astronomy gather from around the world. I am very excited to work with many researchers in different backgrounds.

## Sho Saito

Research Field: **Mathematics**

Postdoc (Kavli Fellow)

I am studying algebraic K-theory, currently focusing on its applications to the geometry of formal loop spaces. A certain class of infinite dimensional vector bundles, called Tate vector bundles, plays a crucial role in this context. I showed in my Ph.D. thesis that there is a natural connection between Tate vector bundles and a certain kind of principal bundles, called torsors over the K-theory sheaf. To formulate and prove this connection I used the recently developed



theory of infinity topoi, which provides a higher categorical framework with a very wide and flexible geometric scope.

## Kohei Hayashi

Research Field: **Astronomy**

Postdoc

My research interest is dark halo structures of dwarf galaxies in the Local Group. These galaxies are ideal sites for studying the fundamental properties of dark matter, because such satellites are the most dark-matter-dominated systems. In order to gain useful insight into dark halo structures on small-mass scales, I am studying the stellar dynamics of their member stars, mainly by using our constructed mass models. Using a number of the kinematical data



measured by Prime Focus Spectrograph attached to the Subaru Telescope, I hope to obtain stronger limits on dark halo structures and their dynamical evolutions.

## Akishi Ikeda

Research Field: **Mathematics**

Postdoc

My research interests are describing the spaces of Bridgeland stability conditions on the derived categories of Calabi-Yau algebras and to study the relationships between these spaces and Frobenius manifolds. In my recent work, I determined the spaces of stability conditions for two dimensional Calabi-Yau algebras associated with quivers by using the theory of root systems. And for higher dimensional Calabi-Yau algebras of type A, I made



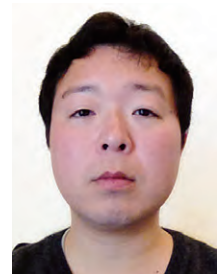
clear the relationship between the spaces of stability conditions and Frobenius manifolds.

## Tadashi Ishibe

Research Field: **Mathematics**

Postdoc

My research interests are in the study of the topology of the complement of the discriminant divisor of a semi-universal deformation of an isolated hypersurface singularity, of which homotopy groups are believed to have nice properties. For rational double points, the homotopy groups are fully understood. In other words, the fundamental group is an Artin group and the higher homotopy groups vanish. For the simply elliptic singularities,



very little is currently known. I attempt to understand the fundamental groups for these cases through a generalization of the theory of Artin groups.

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## David McGady

Research Field: **Theoretical Physics (String Theory)**

Postdoc

My current research is in two directions. I study the interplay between on-shell and off-shell formulations of observables in quantum field theories, in particular the massless  $S$ -matrix. Additionally, I am interested in novel symmetries present in exactly solvable limits of physically interesting theories. Specifically, I am working on both elucidating the fundamental cause of, and the consequences derived from, a recently discovered temperature-reflection symmetry in



large- $N$  gauge theories on compact four-dimensional manifolds—such as hidden modular invariance and vanishing Casimir energies.

## Yuki Moritani

Research Field: **Astronomy**

Postdoc

I am a new postdoc from Hiroshima University. I was a development member of optical and near-infrared astronomical instruments such as Subaru/FMOS, the Kyoto University 3.8m Telescope, and the Hiroshima 1.5m Kanata telescope/HONIR. Now I am in charge of the PFS project, mainly planning the commission of the instrument. My research interests also lie in high-energy binaries (X-ray binaries and gamma-ray binaries), which are comprised of a compact object and a star. By monitoring the optical



counterpart, the star, in these binaries, I probe the nature of the interactions and the relationship between the stellar activity and high-energy phenomena.

## Kyohei Mukaida

Research Field: **Theoretical Physics**

Postdoc

My interests lie in the strong connection between particle physics and cosmology in the early universe. In particular, I have been focusing on its dynamical aspects from the viewpoint of quantum fields under extreme conditions. This is partly because the early universe was filled with very hot plasma as strongly suggested by the observations of CMB and the success of BBN. I try to refine understanding of various phenomena in the early universe, like



preheating/reheating, baryo/leptogenesis, dark matter production, and cosmological phase transition, which are closely tied with new physics.

## Maresuke Shiraishi

Research Field: **Cosmology**

Postdoc

Higher spin fields have a great variety of impacts on our universe. For example, magnetic fields (spin 1) are deeply associated with structure formations of varied sizes, and gravitational waves (spin 2) generate distinctive signatures in CMB. A main goal of my research is to understand the origins of these cosmic spin dependencies, through phenomenological studies and parameter estimations based on observational data. My recent/ongoing activities are to find new observables for symmetry breakings



(non-Gaussianity, broken rotational invariance, parity violation) motivated by higher spin fields, to build these estimators, and to constrain these observables from new CMB temperature and polarization data in the ESA Planck collaboration.

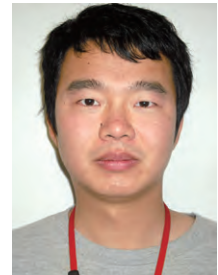
## Benda Xu

Research Field: **Experimental Physics**

Postdoc

I set out to search for the particle side of dark matter, one of the most important open questions in modern physics.

My work is carried out with the world's largest single-phase scintillation liquid Xenon dark matter detector, named XMASS, located in Kamioka in Japan. If it exists, the dark matter signature from the detector will be extremely rare. At the heart of this experiment is the production of a supreme low radiation environment to a level not found anywhere



in nature.

I am also enthusiastic about free and open source software and hardware, together with their applications in physics experiments and the real world.

## Kiyoto Yabe

Research Field: **Astronomy**

Postdoc

My research interests revolve around the formation and evolution of galaxies. I have tackled this topic from observational aspects. I am particularly interested in various properties of star-forming galaxies at redshift around 2, where star-formation in galaxies is in the most active phase. Near-infrared (NIR) spectroscopy is necessary to examine detailed properties of galaxies at this redshift. I have been involved with the FMOS project, which is a fiber multi-object spectrograph of the Subaru Telescope,



and NIR spectroscopic surveys by using FMOS. With this experience, now I am working on the PFS project, which is a new instrument of the Subaru Telescope and led by the Kavli IPMU.

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