

Our Team

Misao Sasaki

Research Field: **Theoretical Physics**

Kavli IPMU Deputy Director

My main research interest is in general relativity and cosmology. I am particularly interested in the theory of the inflationary universe. Thanks to rapid progress in observational cosmology, we have begun to see linear vacuum fluctuations from inflation, and we will be able to detect nonlinear, non-Gaussian fluctuations from inflation soon. However, our understanding of inflation is still very limited, and far from a quantitative level. What I am interested in now is looking for new observational signatures that can distinguish differences between different models, to identify the physics behind inflation, and to possibly find traces from physics beyond inflation. In this respect, in addition to electromagnetic waves as an observational tool, gravitational waves will certainly play a central role in cosmology, particularly in exploring early universe physics in coming years. I am currently working on gravitational wave cosmology with this expectation.



Hiraku Nakajima

Research Field: **Mathematics**

Kavli IPMU Professor

My research topic is a mathematical study of gauge theories, which have their origin in mathematical physics. In particular, I study homology groups of various moduli spaces appearing in gauge theories, using a technique called geometric representation theory. Not only can this study be considered an analysis of gauge theories, it also sheds an interesting new light on representation theory, as I obtain familiar objects like Kac-Moody Lie algebras and their quantum analogue in a very different manner than usual. Recently I give a mathematically rigorous definition of Coulomb branches of 3d supersymmetric gauge theories



using this method, and study their properties and representation theory of their noncommutative deformations (quantization).

Shin'ichiro Takeda

Research Field: **Experimental Physics**

Kavli IPMU Assistant Professor

It is very hard work to develop detectors, but it finally leads us to an exciting world. Together with a hand-picked group of colleagues, I have been working on the development of high-sensitivity hard X-ray and gamma-ray detectors for high-energy astrophysics. We also tried to apply our system to the visualization of radioactive substances and demonstrated its performance in Fukushima. For the last two years in Okinawa, I have been enjoying conducting research and development for small animal imaging with a capability of high-resolution tracking of radioactive probes. Here at Kavli IPMU, I will try to address the complexity of tumors in a living body with the power of hard X-ray and



gamma-ray imaging. The first prototype is now ready in the Kashiwa Research Complex 2 building. Welcome!

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Yutaka Yoshida

Research Field: **Theoretical Physics**

Kavli IPMU Assistant Professor

My research interests are developing exact results in quantum field theories in terms of supersymmetric localization methods and studying dualities, non-perturbative effects and mathematical aspects in supersymmetric theories. By using localization computations, I have mainly been studying non-perturbative effects in two dimensional topologically twisted sigma models such as world sheet instanton corrections and



dualities between three dimensional supersymmetric Chern-Simons-matter theories.

Metin Ata

Research Field: **Astronomy**

Postdoc

My research is dedicated to the analysis and modeling of cosmological large-scale structures, including observational data and analytical descriptions.

All the epochs our Universe has gone through offer different insights into the dynamics that led to the world we know. I want to understand structures formed at high redshifts and test against model predictions. I also like machine learning



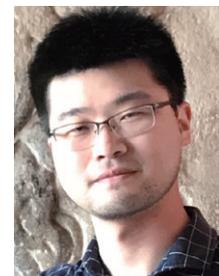
developments and try to utilize them as much as possible.

Hideaki Matsumura

Research Field: **Experimental Physics**

Postdoc

I have been working on X-ray observation of supernova remnants and development of X-ray CMOS sensors. For the former, my interest is in thermal plasma of supernova remnants, especially in recombining plasma which is caused by interaction between hot plasma and cool molecular clouds. For the latter, I have developed event-driven pixel detectors for future X-ray astronomy satellites on the basis of silicon-on-insulator technology. I will



take on observational and experimental study with radio or gamma-ray without limiting used band to X-rays.

Shi Pi

Research Field: **Astronomy**

Postdoc

My main research interests focus on the early cosmology, especially the generation and evolution of cosmological perturbations. Originating from the quantum fluctuations on very small scales, cosmological perturbations can be stretched to all the scales and then seed the macroscopic phenomena like cosmic microwave background, large scale structure, primordial black holes, and



stochastic gravitational waves. I am trying to comprehend how the largest and the smallest scales of our universe are connected by the Nature.

Yota Shamoto

Research Field: **Mathematics**

Postdoc

My mathematical research focuses on Hodge theory and mirror symmetry. In particular, I am interested in problems in which differential equations with irregular singularity naturally appear. Recently, I gave a Hodge theoretic sufficient condition and examples for the modified versions of the conjectures proposed by Katzarkov-Kontsevich-Pantev from the viewpoint of mirror symmetry between Fano manifolds and Landau-Ginzburg



models. Currently, I am trying to apply this result to construct and study the Frobenius structure on the moduli space of Landau-Ginzburg models.

Satoru Takakura

Research Field: **Astronomy, Experimental Physics**

Postdoc

I have participated in the POLARBEAR experiment, which is a cosmic microwave background (CMB) polarization measurement at the Atacama Desert in Chile. My main work is mitigation of low-frequency noise, which is very important to observe inflationary B-modes. I have developed a polarization modulator using a continuously rotating half-wave plate and started large patch observations using it.

I will continue Simons Array, an upgrade of



POLARBEAR, and also collaborate with people developing a polarization modulator for LiteBIRD at the Kavli IPMU.

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