Our Team

Yukari Ito

Research Field: Mathematics

Kavli IPMU Professor

My original research area is algebraic geometry and I have studied quotient singularities and the resolution. When I started to learn algebraic geometry, I came across an amazing problem on singularities from superstring theory. It implies a generalization of two-dimensional McKay correspondence. I studied several ways to construct crepant resolutions of quotient singularities for three-dimensional McKay correspondence. The McKay correspondence is now generalized to a higher dimensional case in terms of derived categories. However, there are two problems: most results hold only for abelian finite subgroups. Moreover, they need a crepant resolution. To show the existence of a crepant resolution is difficult in general, but I believe there is a way, and non-abelian cases may bring us new mathematics. I would like to expand my mathematical world at the Kavli IPMU with many other mathematicians and physicists.

Tom Melia

Research Field: Theoretical Physics

Kavli IPMU Assistant Professor

I am currently interested in exploring particle phenomenology in two main areas. The first is in devising novel analyses at the LHC or future colliders to search for beyond the (or interesting 'within the') standard model physics. The second is the effort to directly detect dark matter, where in particular I have been thinking about designing new small-scale experiments with low energy thresholds.

I am also interested in uncovering – and putting to use – new mathematical structures in quantum field theory. Conformal representation theory, commutative algebra, and cohomology have proven important in organizing the way we think about real-world effective QFTs. Standard model scattering amplitudes harbour hidden symmetries. I am interested in developing these ideas further.

Hillary Child

Research Field: Astronomy

Postdoc

Much of my research focuses on the shape and evolution of dark matter halos. I measure the concentrations of simulated halos to better determine the redshift dependence of the concentration-mass relation, which is sensitive to cosmological parameters, and to better understand how the shapes of halos change as they grow. During my six months at Kavli IPMU, I will also be working on using the bispectrum to improve measurements of the baryon acoustic oscillation length scale.

Chang-Tse Hsieh

Research Field: Theoretical Physics

Postdoc

I am broadly interested in theoretical physics. Specifically, my research interests lie on high energy and condensed matter theories, and in particular, the interplay between them. My past research has been devoted to the classification of topological phases of matter, wherein I applied some theoretical tools, such as K-theory in algebraic topology and anomalies in quantum field theory and string theory, to study the universal properties of these exotic states when considering symmetry and interaction effects. Currently, I would like to have more understanding about topological phenomena and entanglement in quantum systems and also explore the fundamental physics behind them.

Frederick Takayuki Matsuda

Research Field: Cosmology

Postdoc

My research interest is Cosmic Microwave Background (CMB) polarization observation experimentation. The CMB polarization B-mode signal contains rich information related to the mechanism of inflation and massive neutrinos in the early universe. I primarily work on instrumentation for CMB ground-based experiments such as the Simons Array and the Simons Observatory. I research telescope optical design and optical simulation analysis. I optimize the optics of these telescopes in order to obtain high sensitivity and throughput across all observation frequencies of interest.

Benjamin Quilain

Research Field: Experimental physics

Postdoc

The matter and antimatter asymmetry observed so far in the baryon sector is too small to explain coherently the predominance of matter in our universe with a realistic inflation scenario. I have focused on searching this asymmetry in the lepton sector, through neutrino oscillation at the T2K and Super-Kamiokande experiments. After having observed the appearance of electron neutrinos in a muon neutrino beam, we have recently shown hints that antineutrino may oscillate differently. Through the construction of a new detector to decrease systematic uncertainty and T2K-Super-Kamiokande combined analysis, I aim to provide evidence of this asymmetry.