Our Team

Kevin Bundy

Research Area: Astrophysics

IPMU Assistant Professor

I am excited to be joining IPMU not only for its innovative and stimulating environment but also because of the leading role IPMU and the National Astronomical Observatory of Japan is taking in pursuing advanced new surveys of the Universe. My work focuses on the study of galaxy formation, where we seek to understand the physical processes that develop small density fluctuations in the early universe into the rich and beautiful structure of galaxies we see today. The SuMiRe survey program that IPMU is developing for the Subaru Telescope will mark a major milestone in this endeavor by charting the evolving properties of nearly 1 billion galaxies in an unprecedented volume of the Universe. With such a powerful survey, we will discover and quantify new patterns of evolution that will tell us how the complexity of galaxies today originates in their growth, interactions, and transformations over the last 12 billion years.

Biplob Bhattacherjee

Research Area: Theoretical Physics

Postdoc

I am working on the phenomenology of particle physics. My research interests are the study of the Standard Model and scenarios beyond the Standard Model physics, *e.g.*, Supersymmetry, Universal Extra Dimensions, etc. and prediction of signatures of such models in the context of high-energy colliders such as Large Hadron Collider and International Linear Collider. Apart from this, I look forward to work on the dark matter physics also.

Yu-Chieh Chung

Research Area: Theoretical Physics

Postdoc

My research interests center on flux compactifications, their mathematical structures, and their applications to string phenomenology and cosmology. A recent development in F-theory compactification opens a new window for GUT model building. In F-theory, four-dimensional physics in which we are interested is encoded by fluxes and singularities in Calabi-Yau geometries. My current research mainly focuses on F-theory model building. It is interesting to understand better the role of the fluxes as well as the relation between physics quantities and singularities in the F-theory framework.

Richard Eager

Research Area: Theoretical Physics

Postdoc

D-branes at Calabi-Yau singularities provide a bridge between algebraic geometry and quantum field theories. The Calabi-Yau geometry determines the quantum field theory on the D-brane world-volume. Many interesting properties of the quantum field theory such as anomalies and beta functions can be translated into statements about the Calabi-Yau geometry. One of my research goals is to expand this dictionary and create effective methods to determine the quantum field theory associated to a given Calabi-Yau singularity.

John Kehayias

Research Area: Theoretical Physics

Postdoc

My research interests have been diverse, and I plan to continue doing research in several different areas while at IPMU. My general research interests include aspects of quantum gravity and geometry, supersymmetric field theories (general aspects and model building), and cosmology (inflation, dark energy). My past research has included studying fuzzy geometry and holographic spacetime, discrete R-symmetries, generalized gaugino condensation, axions in string theory, gravitational waves from phase transitions in the early universe, and dark matter.

Siu-Cheong Lau

Research Area: Mathematics

Postdoc

My research interests are symplectic geometry, complex geometry and their close relations with modern Physics. More specifically, I work on mirror symmetry, which is a duality between symplectic and complex geometry discovered by string theorists. Its enumerative power astonished the mathematical society: it transforms quantum symplectic invariants, which are very difficult to compute, into certain classical integrals, which are much easier to handle. Strominger-Yau-Zaslow proposed that mirror symmetry can be understood geometrically by duality between tori. Their approach has to receive "quantum correction," which is the main subject of my study. As an application I compute open Gromov-Witten invariants of Calabi-Yau and semi-Fano toric manifolds.

Alexie Leauthaud

Research Area: Astrophysics

Postdoc

As we look towards distant galaxies, fluctuations in the intervening mass distribution cause a slight, coherent distortion of their apparent shapes. The statistical measurement of this effect, known as weak gravitational lensing, has become a fundamental tool for observational cosmology, on par with studies of the CMB and Supernovae. My work focuses on measurements of weak gravitational lensing with the aim of understanding the role that dark matter plays in shaping the large-scale structure in the Universe. I am very excited to join IPMU and in particular to be involved in the SuMiRe project which will be one of the leading surveys for weak gravitational lensing in the next decade.

Changzheng Li

Research Area: Mathematics

Postdoc

My current research interests have focused on quantum cohomology of generalized flag varieties and related topics. Most of my works have dealt with the genus zero, three-pointed Gromov-Witten invariants of flag varieties as well as certain information on the ring structure of the quantum cohomology. It is a known fact that the quantum cohomology ring of a complete flag variety is isomorphic to the homology ring of a based loop group after localization. I am also interested in finding a K-theoretic analogue.

Chunshan Lin

Research Area: Cosmology

Postdoc

Cosmology provides us a unique arena where gravitation and quantum physics meet each other. It is also a unique probe of ultra-high energy physics beyond energies which can be achieved at colliders. I have been working on several aspects of cosmology, *e.g.*, statistical non-Gaussianities of CMB primordial perturbation, calculations of loop corrections to correlation functions of inflationary perturbations, dark energy phenomenology, modifying gravity, and so on.

Yu Nakayama

Research Area: Theoretical Physics

Postdoc

Our world is replete with scale invariant phenomena, shape of the coastline, roman broccoli or fluctuation of stock price to name a few. It is believed that relativistic scale invariant quantum field theories show a stronger symmetry known as *conformal invariance*. Is this belief true? I try to attack this long-standing unsolved problem by using the holographic principle and its mathematical structure in string theory.

Robert Quimby

Research Area: Astrophysics

Postdoc

When a star explodes as a supernova, it releases energy that affects galaxy evolution, metals that alter the chemistry of future stars and their planets, and light that can be used to probe the distant universe and its cosmology. My research has uncovered new classes of superluminous supernovae, which are 100 times more luminous than typical outbursts. I am currently working to better understand these events and what they may reveal about our universe's history.

Christian Schnell

Research Area: Mathematics

Postdoc

Before joining IPMU, I was a postdoc at the University of Illinois at Chicago. My research is about two topics in complex algebraic geometry: Hodge theory and derived categories. On the one hand, I study variations of Hodge structure and normal functions; the motivation comes from families of algebraic varieties, and especially, families of hypersurfaces. On the other hand, I am interested in knowing which topological and geometric invariants of an algebraic variety are determined by its derived category. Recently, I have been thinking about Hodge modules on abelian varieties, and about a certain class of Calabi-Yau threefolds.