Our Team

Masahiro Kawasaki

Research Field: Theoretical Physics

Principal Investigator

I am mainly working on particle cosmology. In particular, I am interested in inflation cosmology, baryogenesis and axion cosmology. The inflationary universe can not only solve cosmological problems such as the horizon problem but also produce primordial density perturbations which are perfectly consistent with anisotropies in the cosmic microwave background radiation observed by WMAP and Planck. Now inflation is a new paradigm of cosmology. I have been studying inflation models in supergravity and obtaining constraints on the reheating temperature after inflation by considering the cosmological effects of gravitinos which are predicted in supergravity. Since inflation dilutes away pre-existing matter, the baryon number and dark matter should be produced after inflation. I am working on the Affleck-Dine baryogenesis in supersymmetric theories and Q-balls which are non-topological solitons produced in the Affleck-Dine mechanism. I am also studying the cosmological consequences of axions which are a promising dark matter candidate.

Artan Sheshmani

Research Field: Mathematics

Project Researcher (Adjunct Assistant Professor)

My research is on Gromov-Witten/Donaldson-Thomas theory, Calabi-Yau geometries and mathematical aspects of String theory. Recently, together with collaborators, I have studied and proved the modularity property of DT invariants of CY3's predicted in the famous S-duality modularity conjecture in string theory in many cases. I also work on the interaction between GW/DT theories and Homological projective duality conjecture by Kuznetsov, as well as proving the relation between geometry of Hilbert scheme of singular surfaces and quantum topology of higher dimensional knots, using representation theory and algebraic geometric techniques.

Chengcheng Han

Postdoc

Research Field: Theoretical Physics

My research interests include the following:

(1) Higgs physics. I study Higgs physics at the colliders, predicted by various new physics models like supersymmetry and little Higgs theory.

(2) Phenomenology of supersymmetry. I examine various direct and indirect experimental constraints on the new physics models, and study their phenomenology at colliders like Tevatron, LHC and ILC. I also perform MC study for searching new particles at the colliders.

(3) Dark matter, especially the dark matter physics in low energy supersymmetry. I interpret cosmic dark matter as the LSP in supersymmetry, and try to explain the Planck relic density and other detection results, then analyze the implications of the phenomenology at the colliders.

Kaori Hattori

Postdoc

Research Field: Experimental Physics

I have been working on a ground-based Cosmic Microwave Background (CMB) experiment, POLARBEAR, aiming to observe polarization with a high sensitivity. Our goal is to reveal the early history of our universe through observing polarization modes created by the inflation. The POLARBEAR telescope is currently observing in the Atacama Desert, Chile (elevation of 5,200 m). Meanwhile, we are preparing for an upgraded experiment, POLARBEAR-2 with a higher sensitivity. To achieve the required sensitivity, we will install more than 7,000 superconducting detectors at cryogenic temperature. My research focuses on how we can achieve such large detector arrays. This study aims not only to conduct a ground-based experiment, but also to perform a Japanese-led satellite experiment, LiteBIRD.

Changwoo Joo

Postdoc

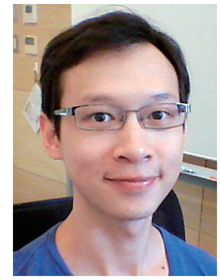
Research Field: Experimental Physics

We are developing/constructing a new Silicon Vertex Detector (SVD) for the Belle II experiment at the super KEKB collider. Because of higher luminosity, the SVD requires a new design and better performance. My topic is Electrical Quality Assurance (EQA) of the new SVD to guarantee good quality as a tracking detector. First I check the electrical functionality to confirm the connection of electronics and readout chips. Then I survey the performance of SVD modules including noise level, signal to noise ratio, time resolution and dead time. My feedback will help the SVD production force to make a better quality SVD module. In this way, we can make the highest-quality SVD possible for the Belle II experiment.

Shing Chi Leung

Research Field: Astronomy

Postdoc



I study Type-Ia supernovae, which are the explosions of carbon-oxygen white dwarfs due to thermonuclear runaways, by running computer simulations with Professor Ken'ichi Nomoto. We are interested in understanding the relations among various parameters of Type-Ia supernovae and their influences to the galactic chemical evolution. In particular, we want to derive constraints on the theoretical explosion mechanisms from observational data, from which we can refine our usage of Type-Ia supernovae in the precision measurement of dark energy.

Evangelos Routis

Research Field: Mathematics

Postdoc

My research is in the field of algebraic geometry with a focus on degenerations of algebraic objects. In particular, I study compactifications of configuration spaces of points on algebraic varieties and moduli problems associated with them. Additionally, I am interested in Gromov-Witten theory and enumerative geometry. More specifically, I study moduli spaces of stable maps from curves to Fulton-MacPherson type targets from the point of view of logarithmic geometry, as well as their connections to other curve counting theories.

Alessandro Sonnenfeld

Research Field: Astronomy

Postdoc

How do early-type galaxies form and evolve? How do the properties of these galaxies depend on their dark matter halo? I address these questions using strong gravitational lensing as my main investigation tool. I joined the Kavli IPMU, so that I could look for new strong gravitational lenses in the Hyper Suprime-Cam (HSC) survey. Thanks to its very large field of view, HSC will allow us to find more strong lenses than what has ever been possible with any other survey.

David Stark

Research Field: Astronomy

Postdoc

My research is focused around trying to understand how galaxies form and evolve, with an emphasis on the physics governing galaxy gas reservoirs, the raw fuel for star formation. Using multi-wavelength observations, I examine how galaxies acquire (or lose) their gas reservoirs, and how this gas gets converted into dense star-forming clouds. I am especially interested in how galaxy environments, from group scales up to large-scale structure, influence these processes. Some of my other research has explored the potential for star formation in high velocity clouds and the baryonic Tully-Fisher relation.

Itamar Yaakov

Research Field: Theoretical Physics

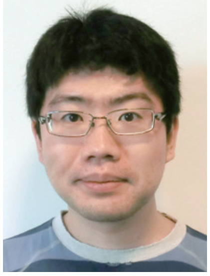
Postdoc

My research is focused on non-perturbative aspects of quantum field theory. I am especially interested in defects and their role in duality, supersymmetric gauge theory, and their mathematical applications. My recent work has centered on extracting exact results using supersymmetric localization. Some of the most challenging aspects of strongly coupled quantum field theory, for which we have few if any analytic tools, such as finding the spectrum, computing correlation functions, and figuring out the low energy behavior, can be greatly simplified using supersymmetry and localization.

Kazuya Yonekura

Research Field: Theoretical Physics

Postdoc



Quantum field theory is one of the most fundamental frameworks of physics. It explains almost all the phenomena of physics at short distances via models such as the standard model of particle physics. It also often has interesting relations with mathematics, especially in supersymmetric quantum field theories.

I am working on aspects of quantum field theory and its applications. Recently it has been understood that there are lots of things which cannot be captured by a conventional approach starting from a Lagrangian. Sometimes there are no known Langrangians for some theories which can still be constructed by string theory. In particular, there is no renormalizable Lagrangian in higher dimensions, and hence we need new methods to understand them. I am aiming to understand those new sides of quantum field theory.