Our Team

Takeo Higuchi

Research Area: Experimental Physics

Kavli IPMU Associate Professor

I have been involved in a high-energy experiment "Belle", and have proved the Kobayashi-Maskawa theory, which is one of the pillars of the Standard Model (SM). Most behaviors of the elementary particles are known to match well to the SM. On the other hand, our Universe comprises yet-unanswered mysteries by the SM, like grand unification, dark matter, and the like. Most physicists believe that the SM is a low-temperature approximation and the mysteries may be answered by a new physics beyond the SM applicable to a much higher-temperature Universe. To elucidate the structure of the new physics, we upgrade our accelerator luminosity by a factor of 40 than Belle, because we expect new-physics signatures should be very faint. In Kavli IPMU, we also contribute to the experiment through technical works by establishing an assembly procedure of a "silicon vertex detector", which determines particle decay positions in O(10μm) accuracy, together with relevant software development.

Tanmay Deshpande

Research Area: Mathematics

Postdoc

My current research interests are in the study of the structure of certain tensor/fusion categories and the theory of character sheaves on unipotent groups. Let G be an algebraic group over a field of positive characteristic. We consider the family of finite groups formed by taking points of G with values in various finite fields. The goal of the theory of character sheaves is to understand the representation theory of these finite groups in terms of the geometry of G (in terms of l-adic sheaves). Character sheaves for reductive groups were studied by G. Lusztig, and inspired by this work, V. Drinfeld initiated the study of character sheaves on unipotent groups. My work focuses on this theory and the study of various fusion and modular categories that arise naturally in this theory.

Satyanarayan Mukhopadhyay

Research Area: Theoretical Physics

Postdoc

My research focuses on the physics we can explore with the Large Hadron Collider. This includes both standard model physics like different aspects of QCD jet physics and also new physics that might be around the corner at the TeV energy scale. After the recent discovery of a Higgs-like particle, I am very much interested in the determination of its properties, which can serve as a window to TeV-scale physics. In addition, I am interested in pursuing the cosmology and particle physics interface, in particular, the mechanism behind the matter-antimatter asymmetry in the universe and the nature of dark matter.

Daniel Pomerleano

Research Area: Mathematics

Postdoc

My research centers around algebraic structures in two-dimensional topological quantum field theory, and in particular the deformation theory of dg-categories. This interest has led me in a couple of seemingly unrelated directions including the study of matrix factorization categories and curved algebras and the deformation theory of non-compact Fukaya categories. Most recently, I have been thinking about specific cases of homological mirror symmetry.

Kai Schmitz

Research Area: Theoretical Physics

Postdoc

As a particle cosmologist, I aim at constructing a consistent history of the early universe based on possible extensions of the two standard models of particle physics and cosmology. To this end, I build new physics models, explore their phenomenology and point out eventual signatures in the sky as well as in laboratory and collider experiments. Open questions that I am particularly intrigued by concern, i.a., inflation, preheating, reheating, the production of gravitational waves during cosmological phase transitions, baryogenesis via leptogenesis, the phenomenology of the neutrino sector at low energies as well as elusive particle candidates for dark matter.

Benedetta Vulcani

Research Area: Astrophysics

Postdoc

My major research interest is to understand the most important factors that drive galaxy evolution through cosmic time, trying to disentangle and quantify the importance of galaxy mass, redshift and environment. I have been focused on characterizing the history of stellar evolution and structure development of galaxies in different environments, by tracing the star formation rate, morphology and total stellar mass of galaxies at different redshifts. In addition, I am particularly interested in understanding how the galaxy stellar mass distribution can be affected by the environment in which galaxies reside, contrasting the role of the global and local environments.