Our Team

José M. Figueroa-O'Farrill

Research Area: Theoretical Physics

IPMU Professor

My research may be described as an exploration of the mathematical landscape of M-theory. Much of it deals with supersymmetry, which can be understood as adding extra quantum dimensions to spacetime. The bulk of my work touches upon the gauge/gravity correspondence, most recently on the one associated to M2-branes, whose understanding might shed light on one of the outstanding problems in string theory: to find a formulation of eleven-dimensional M-theory. Currently I am involved in a research programme based on a recent proposal for a nonabelian theory of membranes. The current view is that membranes are described by three-dimensional superconformal Chern-Simons theories, which can be formulated in terms of somewhat exotic mathematical objects known as 3-algebras. Together with my collaborators I have obtained a number of structure results about these objects and continue to apply them to the study of the superconformal theories.

Sergey Galkin

Research Area: Mathematics

Postdoc

I work with the Fano varieties and their properties prescribed by the Mirror Symmetry. In particular I do the degeneration of Fano varieties to toric ones and try to describe Fano varieties by their quantum D-module (Gromov-Witten invariants). For these I use (and sometimes justify) things like recently constructed hidden integral structures in the quantum cohomology, homological mirror symmetry and arithmetic of Landau-Ginzburg models mirror dual to Fano varieties.

Dongfeng Gao

Research Area: Theoretical Physics

Postdoc

String theory is believed to be a promising candidate for a theory of everything. There are five consistent superstring theories in 10-dimensional spacetime. To make contact with the real world particle physics, the six extra dimensions have to be so tiny that they are undetectable. This is called the string theory compactification. In the past, we have studied the structure of D9-brane Chan-Paton factors in Type II orientifold theories. This provides important information on string theory compactification. I am now working on the string theory phenomenological model building.

Tsz Yan Lam

Research Area: Astrophysics

Postdoc

My research focuses on the formation and the evolution of large scale structure. I showed how to use simplified analytical models to study the non-linear gravitational effect. It is essential to understand how gravity modifies cosmological signals in order to achieve the percent level precision constraint in the next generation of sky surveys. I am also interested in constraining primordial non-Gaussianity using large scale structure. Such detections will have big implications for discriminating inflation models.

Rajat Mani Thomas

Research Area: Cosmology

Postdoc

Detailed observations in multi-wavelengths of our Universe up to a redshift of 6 and precise measurements & analysis of the cosmic microwave background (CMB) has left us with only a small fraction of the visible Universe that is not observed. This is the so called "dark ages" and the "Epoch of Reionization" (EoR). My interests are, on the astrophysical side, in efficient modeling of the 21(1+z)-cm from this epoch and on the technical aspect, signal processing techniques for the extraction of these signals from the much higher galactic & extragalactic foreground contamination. On a completely different note, I also work on theoretical neuroscience & neuroimaging.

An image of the completed IPMU Research Building (center) superimposed on the present campus view.
Right: Building of the Institute for Cosmic Ray Research. Left: Building of the Institute for Solid State Physics.