Our Team

Todor Milanov

Research Area: Mathematics

IPMU Assistant Professor

The Korteweg-de Vries (KdV) equation is a mathematical model of the motion of a wave in shallow waters. It has been studied extensively from a number of different perspectives. In particular, it was discovered that KdV is a reduction of a more universal equation, known as the Kadomtsev-Petviashvili (KP) equation. It turns out that the solutions of KP can be parameterized by the points of an infinite Grassmanian. The latter is a central object in both geometry and representation theory. I am deeply impressed by the unity of seemingly different areas of mathematics on one side and nature on the other.

At the end of the 20th century it was discovered that the KdV equation governs the amplitudes of string motions in a vacuum. I have been interested in finding other equations, similar to KdV, which characterize the string amplitudes in more interesting spaces that have non-trivial topologies. More precisely, I am using complex geometry and representation theory to obtain a characterization of the string amplitudes. It seems that there are some new geometrical objects, as well as some new representation theories, that are still awaiting discovery.

Scott Carnahan

Research Area: Mathematics

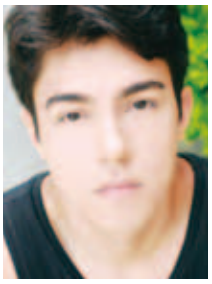
Postdoc

My research is primarily concerned with the mathematics of Monstrous Moonshine. This field of study was initiated by apparent connections between the theory of modular functions and the representation theory of the monster simple group. My recent work has concerned the construction of automorphic functions using generalized Kac-Moody Lie algebras, applications of logarithmic algebraic geometry to the theory of vertex algebras, and questions about category-theoretic structures in field theory.

Rafael Da Silva De Souza

Research Area: Astrophysics

Postdoc



I am interested in all aspects involved in the formation and evolution of structures in the universe as well as cosmic magnetic fields. I've been working with the origin of magnetic fields in the early Universe, GRBs, pulsars, galaxies and clusters of galaxies. Now I am working with the evolution of dark matter profiles in dwarf galaxies. During my stay at IPMU, I will focus on challenges related to the formation of the first stars.

Jason Evans

Research Area: Theoretical Physics

Postdoc

My research is in the area of high energy particle physics; more specifically, phenomenology and model building. I am interested in finding models that can naturally explain things such as the hierarchy problem. A great example of this is supersymmetry, which in addition to solving the hierarchy problem, also is suggestive of grand unification. I am also interested in examining possible collider signatures for these types of models. Because most models that explain the hierarchy problem are at the TeV scale, they should be testable at the LHC. Although supersymmetry is my primary focus, I am interested in any beyond the standard model physics which is testable at the LHC and/or in astrophysical observations.

Brian Feldstein

Research Area: Theoretical Physics

Postdoc

Generally my research interests have focused on particle physics beyond the standard model, with a lot of my recent work having dealt with various aspects of dark matter. I have worked on a variety of scenarios which attempt to explain a possible origin for the mysterious signature of dark matter interactions reported by the DAMA experiment. I have also studied the possibility of dark matter decaying to anti-neutrinos, as an indicator that dark matter shares in the matter/anti-matter asymmetry of ordinary baryons and leptons.

Emille Ishida

Research Area: Cosmology

Postdoc

The use of supernovae in cosmological contexts has been in the spotlight for a couple of decades now. My first interest in these objects was to investigate their ability to provide cosmological insights. Consequently, I have been working on type Ia supernovae as standard candles: their observational and statistical challenges. I am also interested in any kind of astrophysical feedback due to supernovae, such as their influence on the dark matter profile of dwarf galaxies.

Atsushi Nishizawa

Research Area: Astronomy

Postdoc

I have studied the biggest mystery in the Universe, dark energy. Recent results of cosmic microwave background radiation, or type Ia supernovae, suggest that the present Universe is expanding at an accelerating rate. The source of this expansion is thought to be the anti-gravity-like behavior of dark energy. I try to find out what dark energy is via a gravitational lens effect, which is a next-generation project using the Subaru telescope.

Yutaka Ookouchi

Research Area: Theoretical Physics

Postdoc

Supersymmetry is fascinating. Not only because it is symmetry possessed by string theory, but also because there are many phenomenologically attractive features in supersymmetric models. Discoveries are also expected at the Large Hadron Collider.

The 1990s brought a revolution, which gives us a technique to control a strongly coupled theory. In a strongly coupled region, it is believed that rich physics should exist. I am very interested in applying this progress to realistic model building and to the understanding of confinement in QCD.

Cornelius Schmidt-Colinet

Research Area: Theoretical Physics

Postdoc

To date, I have been working on topics in two-dimensional conformal field theories. These theories are covariant under local angle-preserving transformations. They play a role in statistical mechanics and in string theory. I have been interested in conformal field theories defined on a surface with a boundary; in string theory, this describes an excitation of a D-brane. There are situations in which the conformal symmetry is slightly broken, and the theory is subject to change under renormalization. The renormalization process is presumably related to time-dependent processes in string theory, such as the decay of D-branes or a change in space-time itself. Here at IPMU, I intend to study topics in this direction.

Charles Steinhardt

Research Area: Astronomy

Postdoc

My research is inspired by astrophysical phenomena whose explanation has been cast into doubt, either by new theoretical ideas or new observations. For example, my dissertation used a combination of recent large quasar catalogs and new techniques for estimating supermassive black hole masses to reveal a surprising correlation in quasar activity over cosmic distances that seems incompatible with existing models for how the black holes form. My other interests include dark matter, dark energy and astrophysical measurements of fundamental constants.

Mircea Voineagu

Research Area: Mathematics

Postdoc

My research focuses on (co)homological invariants associated with complex and real algebraic varieties, especially motivic and Lawson cohomology (with their equivariant aspects) and Semi-topological K-theory. These invariants are expected to hold a great deal of information about smooth algebraic varieties. My recent research was concerned with applications and extensions of Milnor's conjecture (proved by V. Voevodsky) with an eye toward very new and intriguing conjecture of Suslin regarding a possible partial description of morphic cohomology with integer coefficients in terms of singular cohomology.