Our Team

Toshiyuki Kobayashi
Research Area: Mathematics

Principal Investigator

My research interests focus on the analysis of "symmetries" in mathematics. Currently I am working on representation theory and a theory of discontinuous groups including the following topics:
① Analysis of minimal representations:
Minimal representations are special irreducible representations, which are a building block of linear symmetries. My guiding hypothesis

minimal representations (algebra)

= maximal symmetries (function spaces)

is a driving force for a new theory of global analysis based on non-commutative symmetries of minimal representations.
② Spectral analysis on locally symmetric spaces:
For spaces of indefinite metric, intrinsic differential operators (*e.g.*, Laplacian) are not necessarily elliptic. As a first step of spectral theory in this new general setting, I am working on the construction of discrete spectrum of such operators, and studying its stability under the deformation of geometric structure.

My research achievements include
③ pioneering works on the theory of discontinuous groups for homogeneous spaces beyond the classical Riemannian setting,
④ pioneering works on the theory of discretely decomposable restrictions of representations (discrete symmetry breaking), and
⑤ an original theory of visible actions on complex manifolds, and its systematic and synthetic application to multiplicity-free theorems on both finite and infinite dimensional representations.

Jyotirmoy Bhattacharya

Postdoc

Research Area: Theoretical Physics

I am broadly interested in quantum field theories, super-conformal field theories and string theory. I have primarily focused on the understanding and applications of the AdS/CFT correspondence, which is one of the outstanding theoretical insights that has emerged out the study of string theory. In my research, I have tried to exploit this correspondence to study exotic and new phenomenon in fluid dynamics, condensed matter systems and gravity.

Valentin Tonita

Postdoc

Research Area: Mathematics

My interests lie in Gromov-Witten theory, in particular in its K-theoretic version which associates invariants to a complex projective manifold X by taking Euler holomorphic characteristics of certain (orbi)bundles on the moduli spaces of stable maps to X. Among the interesting problems in the field are: the computation of these invariants (which turns out to be more difficult than in cohomological theories), the study of the structures arising (*e.g.*, quantum K-theoretic product) and the connections with mirror symmetry.

Marcus Werner

Postdoc

Research Area: Astrophysics and Mathematics

Our Team

Understanding the dark sector of the universe is one of the most challenging problems in current cosmology, and gravitational lensing is among the principal tools to investigate it. I am a theoretical astrophysicist interested in the mathematical theory of lensing, as well as in general relativity and its modifications. Recently, I studied the origin of certain magnification invariants underlying the flux-ratio anomaly with Lefschetz fixed point theory, and the Randers-Finsler structure of the Kerr optical geometry. Joining IPMU from the Mathematics Department of Duke University, I hope to create some more links between the mathematics and astronomy communities here.