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現在の研究概要

The main focus of my work is in singularity theory and Gromov—Witten (GW) theory of compact Kähler orbifolds with semi-simple quantum cohomology. Singularity theory can be viewed as an application of algebraic/complex geometry and topology to the study of isolated critical points of holomorphic functions, while GW theory is intersection theory on the moduli space of holomorphic stable maps. One of the important recent discoveries is what is now called a *mirror symmetry phenomenon*: GW invariants can be described via the asymptotic expansions of oscillatory integrals. Using the period integrals in singularity theory and the mirror symmetry phenomenon, I am working on problems related to two very interesting features of GW theory: integrability and modularity. Namely, if the quantum cohomology is semi-simple then GW theory is a source of a certain class of integrable hierarchies that generalize the famous KdV hierarchy. In the other extreme, if the target manifold is a Calabi-Yau (CY), then the quantum cohomology is never semi-simple and it is expected that the GW invariants are organized in Fourier series that resemble and generalize the Fourier series of a modular form. Surprisingly, the finite group quotients of CY manifolds often have semi-simple quantum cohomology and modularity can be studied via mirror symmetry with the methods of singularity theory.

学生への要望. I am expecting that students wishing to work with me will have some basic knowledge of algebraic geometry, such as schemes and sheaf cohomology (Chapters I, II and III in Hartshorne, "Algebraic Geometry"), complex geometry (Chapter 0 in Griffiths and Harris, "Principles of algebraic geometry"), representation theory of simple Lie algebras (Fulton and Harris, "Representation theory").