# Moduli of K3 surfaces

## Poster Session Abstracts

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### Automorphisms on HK varieties via Kuznetsov components

Lucas Li Bassi, ICERM, Brown University

The relation between cubic fourfolds and hyperkähler varieties can be studied through moduli spaces of stable objects in their Kuznetsov components. Starting with automorphisms of cubic fourfolds, we construct induced automorphisms on hyperkähler manifolds of (K3^{[n]})-type and OG10-type, and study how their properties are related to those of the original automorphisms. We also investigate their fixed loci through moduli spaces of stable objects in the corresponding equivariant categories. This is joint work with Hannah Dell and Augustinas Jacovskis.

### Viehweg hyperbolicity and moduli spaces

Shend Zhjeqi, University of Michigan - Ann Arbor

Viehweg hyperbolicity, roughly speaking, shows that for families of varieties that are truly varying and for which the varieties have some sort of positivity, then the base acquires certain type of positivity as well. We will discuss the history, motivation, examples, and my joint results with Sebastian Casalaina-Martin on the topic.

### Cone Conjecture and Constructibility

Daniil Serebrennikov, Johns Hopkins University

Grothendieck’s foundational work [EGA IV] shows that many geometric properties of fibers in a projective family, for example smoothness, define constructible subsets of the base. However, one natural property is absent from this list: given a fiber, is the locus of points whose fibers are isomorphic to it constructible? Surprisingly, this question is closely related to the Minimal Model Program and the Kawamata-Morrison cone conjecture. This poster explains the relationship between the conjecture and the constructibility problem and shows how it leads to finiteness results for Calabi-Yau varieties in a fixed birational class.

**Hodge numbers and deformations of singular Calabi–Yau varieties**

Haoming Ning, Georgia Institute of Technology

Hodge numbers are locally constant in smooth proper families of complex varieties, and smooth projective Calabi–Yau varieties have unobstructed deformations. Using the theory of higher Du Bois singularities, one can extend these two classical results to the singular setting. I will present on a cohomology and base change theorem for families with strict higher Du Bois fibers, and explain how it underpins and connects the two results. These generalize work of Friedman—Laza beyond the local complete intersection setting.

**Kappa Classes on the KSBA Space of Stable Toric Pairs**

Byeol Han, University of Georgia

We study kappa classes on the Kollár--Shepherd-Barron--Alexeev (KSBA) moduli space of stable toric pairs. Using a lattice modified toric model, we compute all kappa classes on the moduli space by giving an explicit combinatorial formula for their intersection numbers with all torus-invariant cycles. In particular, we identify the first normalized kappa class with the GKZ polarization of the toric variety corresponding to the secondary polytope. For interval configurations, we obtain closed formulas for all top-degree products of kappa classes.

**Families of Morin configurations**

Elena Sammarco, ICERM, Brown University

A Morin configuration is a set of pairwise intersecting planes in P^5. In 1930, Morin classified all infinite configurations and raised the problem of classifying the finite ones. In this poster, we construct families of Morin configurations of cardinality k≥10 via moduli spaces of Hyperkähler fourfolds and Verra threefolds, and we describe their birational type. This is a joint work with Grzegorz Kapustka and Alessandro Verra.

**Effective Torelli for K3 Surfaces**

Tobias Schnieders, Saarland University

According to Torelli's theorem, a K3 surface is defined by its period — a point in the module space of all polarized, marked K3 surfaces — up to isomorphism. Given a quartic K3 surface by its period, can its equation as a quartic surface in $P^3$ be obtained? We present our recent work on K3 surfaces with additional structure, specifically Kummer surfaces, and discuss the path forward for general K3 surfaces. This topic originates in algebraic geometry, but it also draws on complex geometry, Hodge theory, lattice theory, algebraic number theory, and numerical methods.

**Moduli of Wehler K3 Surfaces**

Jon Kim, University of Colorado Boulder

Wehler K3 surfaces arise as smooth hypersurfaces of multidegree (2,2,2) in (P^1)^3 and carry a natural lattice polarization induced by the three projections. In this poster, we will present preliminary results on their moduli and degenerations through GIT. Using the Hilbert--Mumford criterion for the action of (SL_2)^3 \rtimes S_3, we obtain geometric descriptions of the stable and polystable loci. These results form a starting point for comparisons with compactifications arising from Hodge theory and K-stability. This is joint work with Haoming Ning and Tomoki Oda.

**K3 tails in the KSBA moduli of Kunev surfaces**

Elisa Scattone, University of Roma Tor Vergata

The aim of this study is to investigate the boundary of the KSBA compactification of the moduli space M_K of Kunev surfaces. Our main contribution is the construction of boundary strata (some of which divisorial) parameterizing stable surfaces that exhibit an ADE K3 surface among their irreducible components. In particular, we classify all those that we will call K3 tails.

**Compactifying families via stacky modifications**

Myeong Jae Jeon, University of Maryland, College Park

A family of geometric objects over a dense open subset of a regular scheme determines a rational map to a moduli stack parametrizing these objects. Compactifying the family can therefore be approached by resolving the indeterminacy of this map. Because the target is a stack, extending the family may require a stacky modification of the base. This poster presents a strategy for constructing such modifications and extending families over them under suitable hypotheses on the target stack. The strategy combines a valuative criterion in codimension one with a Hartogs-type argument for extension in higher codimension, an extension property we call purity. I will also indicate how extending torsors under certain classes of groups provides a starting point for extending families parametrized by more general moduli stacks.

**Low Genus Curves on Compact Shimura Surfaces**

Zhehao Li, Tsinghua University

We investigate and compare the behaviors of complex curves on two major types of compact Shimura surfaces: compact variants of Picard and Hilbert modular surfaces. They are quotients of complex hyperbolic balls corresponding to moduli problems for abelian varieties with certain endomorphism types. We prove that if we fix a genus bound, then when the defining discriminant is large enough, low genus curves on the compact variant of Picard modular surfaces do not exist, while low genus curves may persist on the compact variant of Hilbert modular surfaces only if they are special curves, which parametrize those with extra endomorphisms. These results are special cases of a complex function field analogue of uniform boundedness on endomorphism types of abelian varieties. The proof requires understanding the repulsion of special subvarieties and relies on volume estimates in hyperbolic geometry.

**Reciprocal mirror map derivatives and instanton counts in local mirror symmetry via quantum Serre duality**

Michael Schultz, Virginia Tech

The non-equivariant limit of quantum Serre duality as formulated by Iritani, Mann, \& Mignon, when applied to the euler-twisted theory of the pair $(V,K_V^{-1})$ of a smooth Fano variety and its anticanonical bundle, intertwines the associated closed and local mirror maps by the generating function of ambient 2-point euler-twisted invariants, together with a cohomological shift by the first Chern class $c_1(V)$. For $V$ an almost minimal Fano, we show that the second structure connection representing the regularized small quantum $D$-module of $V$ is expressed in terms of an inhomogenous Picard-Fuchs equation whose inhomogeneity is a generating function of 3-point euler-twisted invariants. Via this form of quantum Serre duality, we prove that the inhomogeneity is naturally given by the derivative of the local mirror map with respect to the closed mirror map, and use this to prove that the generating function of 3-point local invariants of the associated local Calabi-Yau is given by the reciprocal mirror map derivative. As a corollary, this supplies from a uniform perspective a new proof of a theorem by Bloch, Kerr, \& Vanhove on instanton counts for local Calabi-Yau threefolds over toric Fano surfaces, as well as a positive resolution to a conjecture formulated by the presenter and A. Malmendier on genus zero invariants of local Calabi-Yau fourfolds over a rank-1 Fano threefold. Using euler-twisted invariants as a bridge, explicit recursive relationships between invariants of the anticanonical and local Calabi-Yau varieties are obtained, which has implications for the growth rates of the associated genus zero invariants in low dimensions. As an example, the classical instanton counts or equivalently genus zero Gopakumar-Vafa invariants for the quintic threefold are explicitly related to the 3-point invariants of local $\mathbb{P}^4$.

**Wild Brauer classes via prismatic cohomology**

Margherita Pagano, ICERM

Let K be a finite extension of Qp and X a smooth proper K-variety with good reduction. Under a mild assumption on the behaviour of Hodge numbers under reduction modulo p, we prove that the existence of a non-zero global 2-form on X implies, after a finite extension of K, the existence of p-torsion Brauer classes with surjective evaluation map. This implies that any smooth proper variety over a number field which satisfies weak approximation over all finite extensions has no non-zero global 2-form. The proof is based on a prismatic interpretation of Brauer classes with eventually constant evaluation. This is joint work with Emiliano Ambrosi and Rachel Newton.