

Mirror Symmetry, Calabi-Yau Threefolds, and Connections to Physics

Poster Session Abstracts

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Geometric realisation of an Appell hypergeometric function

Thais Gomes Ribeiro, University of Birmingham

In this poster, I would like to present a geometric model for the Appell hypergeometric function F_3 . It consists of (a family of) algebraic varieties (over a finite field) whose number of points can be described in terms of finite-field Appell hypergeometric functions and other simpler terms such as finite-field Gaussian hypergeometric functions and Jacobi sums. A similar result previously known in the literature had some restrictive assumptions in order to guarantee that no degenerate hypergeometric parameters would appear in the point counts. We eliminate some of these assumptions and, using a reduction formula, prove a more general result that, in particular, recovers the previous one.

On automorphisms of hypersurfaces

Ana Quedo, University of Ferrara

Let F be a projective variety, let H be a normally generated line bundle on F , and let $X \in |H^{\otimes d}|$ be a general member. We establish a uniform criterion, formulated in terms of the graded Betti numbers of the section ring $R(F, H)$, that provides sufficient conditions for every automorphism of X to extend to an automorphism of F . This extends the classical results of Matsumura-Monsky on automorphisms of hypersurfaces in projective space to a broad class of polarized varieties (F, H) , including rational homogeneous varieties of Picard number one, smooth Fano threefolds with their anticanonical polarization, and examples of hyperkähler and Calabi-Yau varieties.

Gluing abelian categories and stability conditions

Charalampos Evangelatos, Syddansk Universitet

We study the support property for stability conditions obtained by gluing along semiorthogonal decompositions. Our main tool is a new gluing construction for abelian categories along a bimodule: under natural exactness assumptions the glued category is abelian, and it recovers the heart obtained by gluing t-structures. This gives a concrete description of objects in the glued heart which we use to prove the support property given a phase gap for glued semistable objects. In particular, we prove the support property assuming Collins–Polishchuk phase bounds. As applications, we construct stability conditions on dg-comma categories, including examples related to augmented curves in the sense of Alexeev and Kuznetsov, and analyze the behavior of the construction under mutations of semiorthogonal decompositions.

Kähler Cone Volumes

Aaron Mutchler, Northeastern University

We investigate the distribution of volume throughout the extended Kähler cone of Calabi-Yau (CY) 3-folds with $h^{1,1} = 1$ and 2. In compactifications of $\mathcal{N} = 2$, type IIA/B to 4D the total volume of the IIA moduli space is divided disproportionately among the perturbative and non-perturbative chambers of the Gauged Linear Sigma Model (GLSM). Via mirror symmetry, we compute the complex structure moduli space of the mirror CY giving the quantum corrected volume of the IIA Kähler moduli space. Along with the 14 1-parameter families, we also compute the volume of a large class of CY moduli with no known geometric origin from the AESZ database. For $h^{1,1} = 2$, the K3-fibered models $\mathbb{P}^4_{11226}[12]$ and $\mathbb{P}^4_{11222}[8]$ are studied. We find that the large volume phase of the GLSM dominates the contribution to the extended Kähler cone and conjecture a formula for the total volume generalizing the proven $h^{1,1} = 1$ case, supported by our numerical results.

The Tate conjecture for abelian fourfolds over finite fields

Matt Broe, Boston University

We prove the Tate conjecture for abelian fourfolds over finite fields. This is the first resolution of the conjecture for all abelian varieties of a fixed dimension over finite fields since the work of Tate in the 1960s. The proof relies on techniques from Ancona's proof of the standard conjecture of Hodge type for abelian fourfolds, and ultimately reduces to Markman's results on the algebraicity of Weil classes on complex abelian varieties.

Combining the above case of the Tate conjecture with theorems of Ancona and Kahn, we deduce that the standard conjecture on homological versus numerical equivalence holds for abelian fourfolds over arbitrary fields. This completes the proof of the standard conjectures for abelian fourfolds.

Mirror to the Logarithmic Hilbert scheme of points

Sayan Chattopadhyay, University of Georgia

The Gross-Siebert program gives a recipe to construct mirrors to log Calabi-Yau varieties. We apply their program to the Logarithmic Hilbert Scheme of two points on $\mathbb{P}^2$ and explicitly describe the canonical scattering diagram. We also identify a specific family in this mirror which is isomorphic upto a double cover to the spherical part of the GL_2 DAHA. This is joint work with Pierrick Bousseau.