MATRIX PROGRAM
"Algebraic Geometry at the interface between Mathematics and Physics"
(17-21 July 2023)

https://www.matrix-inst.org.au/events/algebraic-geometry-at-the-interface-between-mathematics-and-physics/

TALKS:

- **Jean-Emile Bourgine** (University of Melbourne)
  Title: A (q,t)-deformation of the 2d Toda integrable hierarchy
  Abstract: In this talk, I will present a deformation of the 2d Toda integrable hierarchy inspired by a connection with (refined) topological strings. It is derived by enhancing the underlying $\mathsf{gl}(\infty)$ symmetry algebra to the quantum toroidal $\mathsf{gl}(1)$ algebra. The difference-differential equations of the deformed hierarchy are obtained from the expansion of (q,t)-bilinear identities, and two equations refining the 2d Toda equation are found in this way. I will also present an interesting class solutions built from the R-matrix of the toroidal algebra.

- **Philip Candelas** (University of Oxford)
  Title: Arithmetic and geometry of Calabi-Yau manifolds
  Abstract: Introduction to number theoretic techniques in the study of Calabi-Yau manifolds and their periods.

- **Qile Chen** (Boston College)
  Title: Basics of Logarithmic Gauged Linear Sigma Models
  Abstract: I will introduce some basic properties/formulas in Logarithmic Gauged Linear Sigma Models. Then we will go through some preliminary calculations in explicit examples such as hypersurfaces in projective spaces.

- **Jock McOrist** (University of New England)
  Title: Heterotic string compactifications Part 2
  Abstract: We give a pedagogical introduction to heterotic string compactifications. These provide a fascinating link between certain geometries and physics.

- **Xenia de la Ossa** (University of Oxford)
  Title: Heterotic string compactifications Part 1
  Abstract: We give a pedagogical introduction to heterotic string compactifications. These provide a fascinating link between certain geometries and physics.

- **Emanuel Scheidegger** (Beijing International Center for Mathematical Research)
  Title: Generalizations of quantum cohomology
  Abstract: There are two generalizations of quantum cohomology that have attracted attention in physics in the past few years: FJRW theory and quantum K-theory. After a

very short orientation how these generalizations fit into a bigger picture, the audience is invited to decide which of the two shall be explained in more detail.

- **Thorsten Schimannek** (Sorbonne University)
  Title: Counting curves on non-Kähler Calabi-Yau 3-folds with Topological Strings and Hybrid GLSM
  Abstract: In general, a Kähler Calabi-Yau threefold with nodal singularities does not admit a Kähler small resolution. This happens in particular if the exceptional curves are torsion in homology. However, the presence of torsion also leads to the possibility of turning on a flat, topologically non-trivial B-field that stabilizes the singularities. Using conifold transitions, we will describe a large family of examples for this phenomenon and explain how the resulting backgrounds can be studied using hybrid phases of gauged linear sigma models. This leads us to find some old and many new GLSM. Using the sphere partition function, we can then extract periods of the mirror Calabi-Yaus, which allows us to study the topological string partition functions. We argue that the latter encode Gopakumar-Vafa invariants associated to BPS states with discrete charges and that the invariants capture the enumerative geometry of the non-Kähler small resolutions.

- **Gabriele Tartaglino-Mazzucchelli** (University of Queensland)
  Title: Higher derivative supergravity from superspace
  Abstract: In this talk, I will review key ingredients used to construct off-shell higher-derivative invariants in (gauged) supergravity theories. The construction is based on an interplay between the superconformal tensor calculus, the superform approach to construct supersymmetric invariants, and novel off-shell superspace techniques. I will discuss how to obtain curvature-squared (four-derivative) invariants for minimal supergravities in five (5D) and six (6D) dimensions, including the Gauss-Bonnet invariant, which is linked to the description of α'-corrections to the low-energy limit of compactified string theory. Time permitting, I will review how to obtain the two 6D $N = (1, 0)$ and single 6D $N = (2, 0)$ (six-derivative) conformal supergravity actions that describe type B anomalies of six-dimensional conformal field theories.