

Workshop on Birational Geometry, Moduli, and Syzygy

March 10 – March 13, 2026
B109, IBS, Daejeon, Republic of Korea

Lecture Series

Speaker: **Dawei Chen** (Boston College)

Title: Moduli of Differentials

Abstract: Differentials on complex algebraic curves induce translation structures on the underlying Riemann surfaces, and affine transformations acting on them preserve the zero orders of the differentials. This makes the study of moduli spaces of differentials with prescribed zero orders a central topic in moduli theory and surface dynamics. In this lecture series, I will explain the rich geometry of moduli spaces of differentials, with a focus on their birational geometry, compactification, and the singularities arising from degenerations of differentials.

Speaker: **Gavril Farkas** (Humboldt University of Berlin)

Title: Koszul modules in geometry

Abstract: Koszul modules and their associated resonance varieties are objects originating in topology, which turned out however to recently have major applications to algebro-geometric problems. I will present an introduction to this general circle of ideas, focusing on developments connected to (i) syzygies of algebraic curves, (ii) fundamental groups of projective varieties and (iii) Chen ranks of groups of geometric origin.

Speaker: **Francesco Russo** (University of Catania)

Title: On the tangent degree and the degree of the tangent variety of a projective variety

Abstract: The tangent degree $\tau(X)$ of a projective variety $X^n \subset \mathbb{P}^N$ is the number of tangent spaces to X at smooth points passing through a general point of the tangent variety $\text{Tan}(X) \subseteq \mathbb{P}^N$, if positive and finite; it is equal to zero if $\dim(\text{Tan}(X)) < 2n$.

We shall focus on general properties of $\tau(X)$ and of $\deg(\text{Tan}(X))$. For example $\tau(X) \neq 1$ if $N = 2n$ and, as soon as $\text{Tan}(X)$ does not coincide with the secant variety, we prove a linear lower bound for the degree of $\text{Tan}(X)$ in terms of its codimension in the spirit of the lower bound for higher-secant varieties found by Ciliberto and myself many years ago. This sharp lower

bound leads to the notion of projective variety of *minimal tangent degree* and poses the problem of understanding the defining equations and syzygies of the corresponding tangent varieties, a problem which has been addressed in several contexts, classically and also recently.

Then we consider the cases in which the previous two invariants attain the lower bounds found here, either in small dimension/codimension and/or under the smoothness assumption. Finally for $N \geq 2n + 1$ we consider varieties $X^n \subset \mathbb{P}^N$ having $\tau(X) > 1$ and provide their classification in small dimension, pointing out a new perspective on the characterizations of *Roth varieties*.

The lectures are based on joint work with Jordi Hernandez Gomez.

One-hour presentation

Speaker: **Minyoung Jeon** (IBS-CCG)

Title: Cohomological rank functions and syzygies of projective bundles on abelian varieties

Abstract: Tracing back to Hilbert's foundational work on polynomial relations, the study of syzygies has evolved into a central tool for understanding the geometry of embeddings. We study the syzygies of projective bundles over abelian varieties using Jiang-Pareschi's cohomological rank functions and techniques from Caucci and Ito. These methods allow us to generalize and refine Chiantapalli's results on property N_p . We present these improvements and discuss an application of our results for Jacobians. This is joint work with Sofia Tirabassi.

Speaker: **Donggun Lee** (KIAS)

Title: Cohomology of the Hacking moduli space of quartic plane curves

Abstract: In the early 2000s, Hacking introduced a compact moduli space of plane curves of fixed degree. This construction provided one of the first examples of compact moduli spaces of higher-dimensional pairs, generalizing the moduli spaces of pointed (rational) curves. Despite its significance, the cohomology of this space has remained largely unexplored.

Recent developments in moduli theory provide a way to relate the Hacking moduli space to its GIT model via wall crossings of stability conditions. Building on these ideas, we compute the cohomology of the moduli space in the case of plane quartics. This is joint work in progress with Kenneth Ascher.

Speaker: **Li Li** (IBS-CCG)

Title: Syzygies of generic projections of generic canonical curves

Abstract: Syzygy resolutions of varieties embedded via the complete linear systems have been discussed since 1980s by M. Green, R. Lazarsfeld, F.-O. Schreyer and so on and it turns out that some geometric invariants can be read off from the resolutions. In recent decades, syzygies of non-complete linear system also draw attentions by J. Ahn, S. Kwak, E. Park and so on. Geometrically a non-complete linear system defines the projection of the variety away from a linear subspace. In this talk, I will show that for the generic canonical curve, its isomorphic projection away from a generic point is cut out by quadrics as long as the genus is at least 8. I will also give the predictions of the Betti diagrams of the projected canonical curves with the help of Macaulay2.

	Mar 10 (Tue)	Mar 11 (Wed)	Mar 12 (Thu)	Mar 13 (Fri)
10:00–11:00		Russo , Lec 1	Russo , Lec 2	Russo , Lec 3
11:30–12:30		Chen , Lec 1	Chen , Lec 2	Chen , Lec 3
12:30–14:30	Registration (begins at 14:00)	Lunch & Discussion	Lunch & Discussion	Lunch & Discussion
14:30–15:30	Farkas , Lec 1	Farkas , Lec 2	Farkas , Lec 3	
16:00–17:00	Li	Jeon	Lee	
17:30–19:30	Dinner for Speakers	Banquet	Dinner for Speakers	