YOUNG RESEARCHERS MEETING IN ALGEBRA AND GEOMETRY 2022

TITLES AND ABSTRACTS

MICHELE ANCONA

Existence of real algebraic hypersurfaces with large Betti numbers. In this talk, we will show that any real algebraic variety contains real algebraic hypersurfaces of degree d whose Betti numbers grow by the maximal order, when the degree d tends to infinity. The existence of such hypersurfaces is obtained using probabilistic techniques.

FRANCESCA ARICI

A class of noncommutative varieties with spherical symmetry and their K-theory. In the spirit of noncommutative topology, in this talk we compute topological invariants, in the form of topological K-theory groups, for the $\mathbb{C}^*$-algebraic completion of a class of quadratic algebras. These algebras are constructed from the input of an irreducible unitary representation of the group SU(2) and can be thought of as noncommutative varieties defined by a single quadratic polynomial, in the spirit of the noncommutative Nullstellensatz by Shalit and Solel. We will see that the K-theory groups of these algebras fit into an exact sequence in K-theory that resembles the Gysin exact sequence for sphere bundles of Hermitian vector bundles.

FEDERICA FANONI

Generating (big) mapping class groups. To a surface (a manifold of real dimension two) we can associate its mapping class group, which is the group of homeomorphisms of the surface up to homotopy. This group is very important in low-dimensional topology: it is for instance the orbifold fundamental group of the moduli space of Riemann surfaces. For compact surfaces, or more generally for surfaces of finite type (whose fundamental group is finitely generated), the mapping class group is very well studied. In particular, a very nice set of generators is known. If the surface is of infinite type (e.g. it has infinite genus), much less is known.

The goal of the talk is to introduce these groups, explain how tools from geometric group theory (in particular, actions on "nice" spaces) can be used to describe their generating sets in the finite-type case and discuss joint work with Sebastian Hensel about how (not) to generate mapping class groups of infinite-type surfaces.

SARA FILIPPINI

Free resolutions from opposite Schubert varieties in minuscule homogeneous spaces. Free resolutions $F_\bullet$ of Cohen-Macaulay and Gorenstein ideals have been investigated for a long time. An important task is to determine generic resolutions for a given format $\mathrm{rk}(F_i)$. Starting from the Kac-Moody Lie algebra associated to a T-shaped graph $T_{p,q,r}$, Weyman constructed generic rings for every format of resolutions of length 3. When the graph $T_{p,q,r}$ is Dynkin, these generic rings are Noetherian. Sam and Weyman showed that for all Dynkin types the ideals of the intersections of certain Schubert varieties of codimension 3 with the opposite big cell of the homogeneous spaces $G(T_{p,q,r})/P$, where P is a specified maximal parabolic subgroup, have resolutions of the given format. In joint work with J. Torres and J. Weyman we study the case of Schubert varieties in minuscule homogeneous spaces and find resolutions of some well-known Cohen-Macaulay and Gorenstein ideals of higher codimension.

GIULIA GUGIATTI

Homological mirror symmetry for the Johnson-Kollár surfaces. In this talk I will discuss homological mirror symmetry for certain log del Pezzo surfaces, known as Johnson-Kollár surfaces, and their Hodge-theoretic mirrors. These surfaces fall out of the standard mirror constructions since they have empty anticanonical linear system. I will build full exceptional collections for the stacks associated to the surfaces, and suitable Lefschetz fibrations arising from the Hodge theoretic mirrors. This is work in progress with Franco Rota and Matthew Habermann.

MARGHERITA LELLI CHIESA

Irreducibility of Severi varieties on K3 surfaces. Let (S, L) be a general K3 surface of genus g. I will prove that the closure in $|L|$ of the Severi variety parametrizing curves in $|L|$ of geometric genus h is connected for $h \geq 1$ and irreducible for $h \geq 4$, as predicted by a well known conjecture. This is joint work with Andrea Bruno.

MAURO PORTA

Topological exodromy with coefficients. In this talk I will survey joint work with Peter Haine and Jean-Baptiste Teyssier on the Exodromy equivalence of MacPherson, Treumann and Lurie. I will recall the classical statement, its relation with the monodromy correspondence, and explain how our approach can be used to remove many of the original assumptions. I will later sketch some applications to the construction of a moduli space of perverse sheaves.

ANDREA RICOLFI

A tale of two d-critical structures. D-critical schemes and Artin stacks were introduced by Joyce in 2015, and play a central role in Donaldson-Thomas theory. They typically occur as truncations of (-1)-shifted symplectic derived schemes, but the problem of constructing the d-critical structure on a "DT moduli space" without passing through derived geometry (which is hard) is wide open. We discuss this problem, and new results in this direction, when the moduli space is the Hilbert (or Quot) scheme of points on a Calabi-Yau 3-fold. Joint work with Michail Savvas.

ALBERTO VEZZANI

Homotopy theory of adic spaces and applications. In this talk we will discuss some recent advances in the theory of motivic rigid analytic geometry. In particular, we show how to define and study a relative de Rham cohomology for adic spaces in mixed characteristic and how to extend this construction to the equi-characteristic p case (taking values on the relative Fargues-Fontaine curve). Finiteness results, the relation to "tilting" and to classical cohomology theories are also discussed. As an application, we give a proof of the p-adic weight-monodromy conjecture for smooth projective hypersurfaces. These results are part of joint works with J. Ayoub and M. Gallauer, with A.-C. Le Bras and with F. Binda and H. Kato.

DANIELE ZUDDAS

Branched covering simply-connected 4-manifolds by a surface product. We will show that every closed simply-connected smooth 4-manifold is branched covered by the product of an orientable surface with the torus. The proof is based on an almost explicit construction in four steps, which moreover turns out to be natural with respect to spin structures. This solves a problem in Kirby's list and it is related with a conjecture by Eliashberg about branched covering 4-manifolds by symplectic manifolds. This is a joint work with David Auckly, Inanç Baykur, Roger Casals, Sudipta Kolay and Tye Lidman.