Workshop for Young Researchers in Mathematics
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Organized by

Simion Stoilow Institute of Mathematics of the Romanian Academy

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Octav Mayer Institute of Mathematics of the Romanian Academy, Iaşi Branch

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Faculty of Mathematics of the Alexandru Ioan Cuza University

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Faculty of Mathematics and Computer Science, Ovidius University of Constanţa

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Algebra, Geometry, Number Theory & Topology
– List of abstracts –

Heat kernels of real powers of Laplacians as conformal sections in blow-up heat spaces

Cipriana Anghel-Stan

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Abstract: We study the small-time asymptotic expansion of $e^{-t\Delta^r}$, where $r \in (0,1)$ and Δ is a Laplace-type operator over a compact Riemannian manifold. More precisely, for each $r \in (0,1)$, we will give a conceptual interpretation of the heat kernel of Δ^r on a certain heat blow-up space M_{heat}. We will use Melrose's techniques of analysis on manifolds with corners, more precisely the Pull-back and Push-Forward Theorems of polyhomogeneous conformal functions.

Depth and Stanley depth of powers of the path ideal of a path graph.

Silviu Balanescu

Politehnica University of Bucharest

Abstract: Let I be the path ideal of length m associated to the path graph of length n, in the ring of polynomials $S = K[x_1, \ldots, x_n]$ over a field K. We give a precise formula for $\texttt{depth}(S/I^t)$, where $t \geq 1$ is an integer, and we prove that S/I^t and I^t satisfy the Stanley inequality.

On the monoid algebra associated to the monomial characters of a finite group

Mircea Cimpoeas

Politehnica University of Bucharest & Simion Stoilow Institute of Mathematics of the Romanian Academy

Abstract: Given a finite group G, we study the monoid algebra R_G, over a field K, generated by the monomial characters of G.

Pointed vortex loops in ideal 2D fluids

Ioana Ciuclea

West University of Timisoara

Abstract: Euler's equations for an ideal fluid are geodesic equations on the group of volume preserving diffeomorphisms. In particular, the vorticity is confined to a coadjoint orbit of this group. Besides the smooth (regular) vorticities, non-smooth (singular) vorticities have also been studied. We focus our study on the ideal 2D fluid. In terms of singular vorticities, in two dimensions one has point vortices, with zero dimensional support, and vortex loops, with one-dimensional support (i.e. vortex sheets). We study a special kind of singular vorticity in ideal 2D fluids that combines features of point vortices and vortex sheets, namely pointed vortex loops, and we focus on the coadjoint orbits of the area-preserving diffeomorphism group of $\mathbb{R}^2$ determined by them.

Some density results involving the average order of a finite group

Mihai Lazorec

Alexandru Ioan Cuza University

Abstract: Let $o(G)$ be the average of the element orders of a finite group G. A research topic concerning this quantity is understanding the relation between $o(G)$ and $o(H)$, where H is a subgroup of G. Let $\mathcal{N}$ be the class of finite nilpotent groups and let $L(G)$ be the subgroup lattice of G. We show that the set $\left\{ \frac{o(G)}{o(H)} \mid G \in \mathcal{N}, H \in L(G) \right\}$ is dense in $[0, \infty)$. Other density results are outlined throughout the talk.

Ziegler restrictions and combinatorics of line arrangements

Anca Macinic

Simion Stoilow Institute of Mathematics of the Romanian Academy

Abstract: We use Ziegler restrictions to prove some combinatorial obstructions for nearly free and plus-one generated arrangements.

Complex structures on the product of Sasakian manifolds

Vlad Marchidanu

University of Bucharest

Abstract: As a generalization of Calabi-Eckmann manifolds, we study a family of complex structures the product of two Sasakian manifolds which is indexed by a complex nonreal parameter and obtained by $\mathbb{C}$-actions on the product of the Kähler cones of the Sasakian manifolds. We show that no member of this family admits any compatible Kähler or locally conformally Kähler metric. We further characterize the complex submanifolds of the product.

Pseudovaluations on polynomial rings. A classification

Tudor Micu

Babes-Bolyai University

Abstract: Pseudovaluations on polynomial rings over a discrete valued field were described by MacLane in a series of papers in 1936. One of the main insights of these papers is an iterative process of augmentation through which one can obtain all pseudovaluations from the Gauss valuation. While purely algebraic, these pseudovaluations can be identified with bounded multiplicative seminorms, which are the points in Berkovich's theory of non-Archimedean analytic spaces. Inspired by the classification of points on the Berkovich projective line, we classify the pseudovaluations on a polynomial ring over a discrete valued field in terms of their ramification index and residue degree. This is useful, as valuations lend a scope through which we can look at models of the projective line and, perhaps, of other curves.

Polyocollection ideals and primary decomposition of polyomino ideals

Francesco Navarra

University of Messina

Abstract: In this talk we present the primary decomposition of some binomial ideals. In particular, we introduce the concept of polyocollection, a combinatorial object that generalizes the definitions of collection of cells and polyomino, which can be used to compute a primary decomposition of non-prime polyomino ideals. Furthermore, we give a description of the minimal primary decomposition of non-prime closed path polyominoes. In particular, for such a class of polyominoes, we characterize the set of all zig-zag walks and show that the minimal prime ideals have a very nice combinatorial description in terms of the attached polyomino.

The homology of big mapping class groups

Martin Palmer-Anghel

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Abstract: "Big mapping class groups" – mapping class groups of infinite-type surfaces – have recently become the subject of intensive study, having connections for example with dynamical systems and geometric group theory. However, their homology (beyond degree 1) has so far been very little understood. I will describe two results, from joint work with Xiaolei Wu, that exhibit contrasting behaviour of the homology of big mapping class groups. First, using methods of homological stability, we find an uncountable family of big mapping class groups whose integral homology vanishes in all positive degrees. Second, by entirely different methods, we find another uncountable family of big mapping class groups whose integral homology is uncountable in each positive degree.

Compact moduli spaces of sheaves

Mihai Pavel

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Abstract: We present a method to construct moduli spaces of sheaves compactifying the locus of slope-stable vector bundles over a smooth projective variety. We can think of these spaces as intermediate compactifications between the Gieseker and the Uhlenbeck compactification. The key ingredient in the construction is a Mehta-Ramanathan type restriction theorem.

Blow-ups and modifications of lcK spaces

Ovidiu Preda

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Abstract: We show that the blow-up of an lcK space X along a subspace Z which verifies certain conditions is lcK if and only if Z is induced gcK, generalizing a theorem of Ornea-Verbitsky-Vuletescu to complex spaces. We also prove that the class of quasi-lcK spaces is stable under modifications.

Non-normal edge rings satisfying (S_2)-condition

Nayana Shibu Deepthi

Osaka University

Abstract: Let G be a finite simple connected graph on the vertex set $V(G) = [d] = \{1, \ldots, d\}$, with edge set $E(G) = \{e_1, \ldots, e_n\}$. Let $K[\mathbf{t}] = K[t_1, \ldots, t_d]$ be the polynomial ring in d variables over a field K. The edge ring of G is the semigroup ring $K[G]$ generated by monomials $\mathbf{t}^e := t_i t_j$, for $e = \{i, j\} \in E(G)$. In this paper, we will prove that, given integers d and n, where $d \geq 7$ and $d + 1 \leq n \leq \frac{d^2-7d+24}{2}$, there exists a finite simple connected graph G with $|V(G)| = d$ and $|E(G)| = n$, such that $K[G]$ is non-normal and satisfies (S_2)-condition.

Graphs, Koszul modules and resonance schemes

Calin Spiridon

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Abstract: To a pair (V, K) where V is a finite dimensional vector space and K is a linear subspace in the second exterior power of V one associates a Koszul module and a resonance variety. They were introduced by S. Papadima and A. Suciu in a paper from 2015, in order to generalize some objects coming from the geometric group theory. It turned out that they also have important applications in other areas of mathematics, such as algebraic geometry, where for instance, a vanishing theorem for Koszul modules of finite length was a key ingredient for the proof of the Generic Green's Conjecture given by M. Aprodu, G. Farkas, S. Papadima, A. Suciu and J. Weyman in 2019. After briefly recalling the general theory of the Koszul modules, we will focus on a particular setup, when the subspace K admits a monomial basis. We shall see how graphs come into play, make the connection with the theory of right-angled Artin groups and present some new results obtained in this direction.

On p-isogenies of elliptic curves with multiplicative reduction

George Turcas

Babes-Bolyai University

Abstract: For a give number field K, we report on recent progresses towards the following question: For which primes p does there exist an elliptic curve an elliptic curve E, defined over K, admitting a K-rational p-isogeny and which has multiplicative reduction at the primes above some other prime q? We focus on the case when K is quadratic imaginary and, time permitting, we will explain how some results concerning non-existence of p-isogenies of elliptic curves have applications to Diophantine equations.