

IMSAC Days in Sofia

August 8 – 10, 2024, Sofia, Bulgaria

IMI-BAS, Hall 403

Anna Maria Fino, University of Torino, Italy and Florida International University, USA

Title: *Strong G_2 -structures with torsion*

Abstract: A 7-manifold with a G_2 -structure φ admits a G_2 -connection with totally skew-symmetric torsion if and only if $d * \varphi = \theta \wedge * \varphi$, where θ is the Lee form of the G_2 -structure.

In the talk, I will present recent results on 7-manifolds admitting a G_2 -connection with closed totally skew-symmetric torsion. In particular, I will discuss the twisted G_2 equation, which represents the G_2 -analogue of the twisted Calabi-Yau equation for $SU(n)$ -structures introduced by Garcia-Fernández, Rubio, Shahbazi and Tipler. The talk is based on a joint work with Lucia Merchan and Alberto Raffero.

Ernesto Lupercio, Cinvestav, Mexico

Title: *Hodge Polynomials for Non-Algebraic Complex Manifolds*

Abstract: Hodge theory is pivotal in studying algebraic varieties' intricate geometry and topology, providing essential insights into their structure. The Hodge decomposition theorem establishes a profound link between the geometry of varieties and their cohomology groups, helping to understand their underlying properties. Moreover, Hodge theory was crucial at the inception of the field of mirror symmetry, revealing deep connections among seemingly disparate algebraic varieties. This talk explores Hodge polynomials and their properties, specifically focusing on non-Kähler complex manifolds. We investigate a diverse range of such manifolds, including (quasi) Hopf, (quasi) Calabi-Eckmann, and LVM manifolds, alongside a class of definable complex manifolds encompassing both algebraic varieties and the aforementioned special cases. Our research establishes the preservation of the motivic nature of Hopf polynomials within this broader context. Through explicit calculations and thorough analyses, this work contributes to a deeper understanding of complex manifold geometry beyond the realm of algebraic varieties.

Joint work with Katzarkov, Lee, and Meersseman.

Jaqueline Mesquita, Department of Mathematics at University of Brasília, Brazil

Title: *Functional differential equations with state-dependent delays: results and applications*

Abstract: In this talk, I will present the results concerning stability for functional differential equations with state-dependent delays. Also, I will explain the difficulties behind this investigation. Finally, I will present some applications.

Leonardo Francisco Cavenaghi, University of Campinas – UNICAMP, Brazil, and University of Miami, USA

Title: *Applications of the Blow-Up Formula for Chen-Ruan Cohomology in Stacks*

Abstract: This talk explores various applications of a blow-up formula for the Chen-Ruan cohomology of stacks. Our primary objective is to demonstrate how this technique can obstruct G -equivariant birationality by examining stacks. This approach enables us to address intriguing questions: Given $X(1, 1, 1, 1)$, the blow-up of $(\mathbb{P}^1)^3$ along an elliptic curve, when do group actions exist such that this blow-up is equivariantly performed? This discussion is related to the question of rationality over non-algebraically closed fields. If time permits, we will also provide a brief overview of how this framework aligns with ongoing research in collaboration with L. Grama, L. Katzarkov, and M. Kontsevich on a stack theory of atoms (grounded in the work of Katzarkov-Kontsevich-Pantev-Yu).

Lino Grama, University of Campinas – UNICAMP, Brazil

Title: *Generalized Log Transform and Its Applications*

Abstract: In this talk, we will discuss the construction of the generalized log transform and its relation to the theory of singularities. To illustrate our techniques, we will apply our constructions to the case of 8-dimensional homotopy Hopf manifolds. We will explore the parallels between the classical log transform for 4-dimensional elliptic fibrations and our new proposed construction. This is joint work with L. Cavenaghi and L. Katzarkov.

Misha Shkolnikov, Institute of Mathematics and Informatics, Sofia, Bulgaria

Title: *Topology of radial degenerations*

Abstract: A way to approach tropical geometry is via degenerations of amoebas of subvarieties in the algebraic torus. In the joint work with Grigory Mikhalkin, we proposed a new concept of a non-commutative amoeba by replacing the algebraic torus with a non-commutative group. In the case of families of curves in $PSL_2(C)$, we have described the corresponding tropical limits in terms of spherical floor diagrams. However, such tropical limits of surfaces have appeared to be essentially trivial. One way to overcome this and get meaningful degeneration diagrams is to apply the phase version of PSL_2 -tropicalization. In the joint work with Peter Petrov, we have realized that this procedure extends to arbitrary dimensions of the ambient projective space and is described as a degeneration in the radial direction with respect to an imaginary quadric hypersurface. In my talk, based on work in progress with Ilia Zharkov, I will address the question of understanding the topology of the corresponding degeneration diagrams.

Oscar García-Prada, Instituto de Ciencias Matemáticas— ICMAT, Madrid

Title: *Relative higher Teichmüller spaces and parabolic Higgs bundles*

Abstract: It is well-known that the Teichmüller space of a compact surface can be identified with a connected component of the moduli space of representations of the fundamental group of the surface in $PSL(2, R)$. Higher Teichmüller spaces are generalizations of this in which $PSL(2, R)$ is replaced by certain real simple non-compact Lie groups of higher rank. Recently, there has been a classification of the groups for which higher Teichmüller spaces exist, and a Higgs bundle parametrization of these components. After briefly reviewing these developments, I will consider a generalization of this theory to punctured surfaces, where one considers the moduli space of representations with fixed conjugacy classes around the punctures.

Phillip Griffiths, Institute for Advanced Study, USA

Title: *Hodge theory II: Infinitesimal Hodge theory and odd dimensional cubics*

Abstract: Algebraic geometry is the study of the solution sets of polynomial equations, which are called algebraic varieties. In an earlier talk here in Sofia, I emphasized the historical development of the subject and especially the roles of complex analysis and topology. After linear and quadratic equations (lines and conics) the next case is a cubic. This subject has

an incredibly rich history and is currently the topic of very active research. Today's talk will be centered around cubics, especially in dimension three. The focus will emphasize the algebraic role of the defining equation in the geometry and Hodge theory of cubic 3-folds, including a brief discussion of the recent categorical approach to the subject.

Rodolfo Aguilar, University of Miami, USA

Title: *On the universal cover of projective varieties*

Abstract: We will present some questions around the universal cover of projective varieties. Starting from the uniformization Theorem of Riemann-Koebe to recent advances of a question of Shafarevich regarding higher dimensional varieties. This all makes a nice interplay between algebra, analysis and topology.

Vladimir Mitankin, Institute of Mathematics and Informatics, Sofia, Bulgaria

Title: *Brauer–Manin obstruction theory for semi-integral points*

Abstract: In this talk I shall explain the notion of semi-integral points on Campana orbifold pairs and how they generalise integral and rational points on algebraic varieties. I will show how to construct a suitable adelic space for semi-integral points, which will then be used to define semi-integral local-global principles. I will define a semi-integral version of the Brauer–Manin obstruction, which interpolates between Manin's classical version for rational points and its integral counterpart developed by Colliot-Thélène and Xu. Finally, I will apply this obstruction theory to study the status of semi-integral local-global principles for quadric orbifold pairs with a linear divisor. This talk is based on a joint work with Masahiro Nakahara and Sam Streeter.

Yong-Geun Oh, IBS Center for Geometry and Physics, South Korea

Title: Strict contactomorphisms are scarce

Abstract: In this talk, we will talk about the geometry and dynamics of the contactomorphism group for a generic choice of contact forms of a given closed manifold M . We will explain our recent proof of the theorem that the only strict contactomorphisms are Reeb flows of a generic choice of contact form so that the group of strict contactomorphisms is isomorphic to the group of real numbers for such a contact form. This is based on the ongoing joint work with Y. Savelyev.

Yuri Tschinkel, Courant Institute at New York University, USA

Title: *Birational geometry of cubics*

Abstract: I will discuss recent results and constructions in the study of cubic hypersurfaces over nonclosed fields and in presence of actions of finite groups.