Generalized and Symplectic Geometry

August 14 – 18, 2023, Sunny Beach, Bulgaria

Christopher Brav, HSE University, Moscow, Russia

Title: ***The cyclic Deligne conjecture and Calabi-Yau structures***

Abstract: The Deligne conjecture, many times a theorem, states that for a dg category C, the dg endomorphisms End(Id_C) of the identity functor - that is, the Hochschild cochains - carries a natural structure of 2-algebra. When C is endowed with a Calabi-Yau structure, then Hochschild cochains and Hochschild chains are identified up to a shift, and we may transport the circle action from Hochschild chains onto Hochschild cochains. The cyclic Deligne conjecture states that the 2-algebra structure and the circle action together give a framed 2-algebra structure on Hochschild cochains. We establish the cyclic Deligne conjecture, as well as a variation that works for relative Calabi-Yau structures on dg functors D --> C, more generally for functors between stable infinity categories. We discuss examples coming from oriented manifolds with boundary, Fano varieties with anticanonical divisor, and doubled quivers with preprojective relation.

This is joint work with Nick Rozenblyum.

Daniel Pomerleano, University of Massachusetts, Boston, USA

Title: ***Singularities of the quantum connection on a Fano variety***

Abstract: The small quantum connection on a Fano variety is one of the simplest objects in enumerative geometry. Nevertheless, it is the subject of far-reaching conjectures known as the Dubrovin/Gamma conjectures. Traditionally, these conjectures are made for manifolds with semi-simple quantum cohomology or more generally for Fano manifolds whose quantum connection is of unramified exponential type at $q = \infty$.

I will explain a program, joint with Paul Seidel, to show that this unramified exponential type property holds for all Fano manifolds *M* carrying a smooth anticanonical divisor *D*. The basic idea of our argument is to view these structures through the lens of a noncommutative Landau-Ginzburg model intrinsically attached to (*M*,*D*).

Dennis Borisov, University of Windsor

Title: ***Derived Quot-schemes as dg manifolds***

Abstract: A construction of derived Quot-schemes will be presented realizing them as dg manifolds of finite type. This is used to prove that moduli stacks of sheaves on Calabi-Yau 4-folds are critical loci of globally defined shifted potentials.

Joint work with L. Katzarkov and A. Sheshmani.

Gueo Grantcharov, Florida International University, USA

Title: ***Hermitian metrics on compact complex homogeneous spaces***

Abstract: Complex manifolds which admit a transitive action by a compact group of biholomorphisms were first studied by Wang and are known to admit a canonical fibration over a rational homogeneous space. Such spaces in general are non-Kähler unless the fibration is trivial. In this talk I'll consider the existence of special Hermitian metrics on them like balanced, pluriclosed, and others.

The results are partly based on joint works with A. Fino nd L. Vezzoni.

Eder Correa, University of Campinas - UNICAMP

Title: ***t-Gauduchon Ricci-flat metrics on non-Kähler Calabi-Yau manifolds***

Abstract: In this talk, we will present recent results related to the construction of t-Gauduchon Ricci-flat metrics on non-Kähler Calabi-Yau manifolds defined by certain suspensions of Sasaki-Einstein manifolds. These include every compact Hermitian Weyl-Einstein manifold, every compact locally conformal hyperKähler manifold, certain suspensions of Brieskorn manifolds, and every generalized Hopf manifold provided by suspensions of exotic spheres. These examples generalize previous constructions known for Hopf manifolds.

Enrique Becerra, University of Miami, USA

Title: ***The stringy spectrum of orbifolds***

Abstract: In this talk I will introduce the stringy spectrum of a complex algebraic orbifolds as an invariant of motivic nature and state its basic properties.

Erik Paemurru, University of Miami, USA

Title: ***Log canonical thresholds of high multiplicity plane curves***

Abstract: We classify log canonical thresholds at points of multiplicity $d-1$ for plane curves of degree d. As a consequence, we describe all possible values of log canonical threshold that are less than $\frac{2}{d-1}$ for plane curves of degree d. In addition, we compute log canonical thresholds for all plane curves of degree less than 6.

Ernesto Lupercio, Cinvestav-IPN

Title: TBA

Abstract:

Ivan Minchev, Sofia University, Bulgaria

Title: ***A geometry of cubic discriminants in 8 dimensions***

Abstract: We show that the formula for the discriminant of a cubic polynomial determines a special $Sp(2)Sp(1)$-orbit, $\mathcal{C}(\mathbb{R}^8)$, in the space of all 4-tensors on $\mathbb{R}^8$ that possess the algebraic properties of a hyper-Kähler curvature. In fact, we show that $\mathcal{C}(\mathbb{R}^8) \cong Sp(2)Sp(1)/SO(4)_{irr}$, where $SO(4)_{irr}$ is a copy of $SO(4)$ in $Sp(2)Sp(1)$ that corresponds to an irreducible action of $SO(4)$ on $\mathbb{R}^8$. To each almost quaternion-Hermitian manifold M, there is a canonical fiber bundle $\mathcal{C}(M) \to M$ with fibers diffeomorphic to $Sp(2)Sp(1)/SO(4)_{irr}$. The sections of $\mathcal{C}(M)$ – called cubic discriminants – determine a reductions of the structure group of M to $SO(4)_{irr}$. A non-trivial example of a cubic discriminant on a 8-manifold is provided by the Wolf space $G_2/SO(4)$. We show that locally the only integrable cubic discriminants are those of the flat space and the Wolf space. We provide also a new curvature characterization for the Riemannian metric on $G_2/SO(4)$.

Jiachang Xu, Institute of Mathematics and Informatics, Sofia

Title: ***Aspects of Mirror Symmetry for Abelian Varieties***

Abstract: In this talk, I will introduce the mirror symmetry for abelian varieties in terms of moduli spaces associated with abelian varieties. To understand the Hodge theoretical and non-Archimedean aspects of moduli spaces associated with the mirror pairs is an ongoing project joint with Muyuan Zhang.

Johann Davidov, Institute of Mathematics and Informatics, Sofia

Title: ***Generalized Metrics and Generalized Twistor Spaces***

Abstract: In the first part of this talk, basic facts about the generalized complex geometry will be recalled. Then the twistor construction for Riemannian manifolds will be extended to the case of manifolds endowed with generalized metrics. The generalized twistor space associated to such a manifold is defined as the bundle of generalized complex structures on the tangent spaces of the manifold compatible with the given generalized metric. This space admits natural generalized almost complex structures whose integrability conditions will be discussed. An interesting feature of the generalized twistor spaces, which usual twistor spaces do not admit, is the existence of intrinsic isomorphisms.

Lino Grama, University of Campinas – UNICAMP

Title: ***Kähler-like scalar curvature on homogeneous spaces***

Abstract: In this talk, we will discuss the curvature properties of invariant almost Hermitian geometry on generalized flag manifolds. Specifically, we will focus on the "Kähler-like scalar curvature metric" - that is, almost Hermitian structures (g, J) satisfying $s = 2s_C$, where s is the Riemannian scalar curvature and s_C is the Chern scalar curvature. We will provide a classification of such metrics on generalized flag manifolds whose isotropy representation decomposes into two or three irreducible components.

This is a joint work with A. Oliveira.

Mancho Manev, University of Plovdiv Paisii Hilendarski and Medical University – Plovdiv

Title: ***Some Almost Riemann Solitons on Conformal Cosymplectic Contact Complex Riemannian Manifolds***

Abstract: Almost Riemann solitons are introduced and studied on an almost contact complex Riemannian manifold, i.e. an almost contact B-metric manifold, obtained from a cosymplectic manifold of the considered type by a contact conformal transformation of the Reeb vector field, its dual contact 1-form, the B-metric, and its associated B-metric. The potential of the studied soliton is assumed to be in the vertical distribution, i.e. it is collinear to the Reeb vector field. In this way, manifolds from the four main classes of the studied manifolds are obtained. Curvature properties of the resulting manifolds are derived. An explicit example of dimension five is constructed. The Bochner curvature tensor is used (for dimension at least seven) as a conformal invariant to get properties and construct an explicit example in relation to the obtained results.

Mina Teicher, University of Miami, USA

Title: ***Numbers in the Brain- Can I read your thoughts?***

Abstract: Unlocking the mystery of the brain is one of the most intriguing challenges. Trying to reveal the real model of brain activity is a target of many mathematicians and physicists, who try to do it via one of the brain controls - either Motiric, cognitive or emotional. I took as a toy one of the highest brain functions - Numeration. With my students we proved using MEG recording that there is a theoretical concept or control of a number in the brain. More over we succeeded to build a classification metric and identify different numbers in recording of brain activity, and then guess what number one is thinking on. This was never done before!
Our next target is to differentiate between math gifted students and regular students, using recordings of brain activity. Later, to differentiate from brain recordings if one is more talented to algebra or to geometry.

Morgan Brown, University of Miami, USA

Title: ***Birational, Berkovich, and Tropical Geometry***

Abstract: I will give an overview of the relationship between constructions of dual complexes in birational geometry, skeletons in Berkovich geometry, and the tropicalization map.

Phillip Griifiths, Institute for Advanced Study, USA

Title: ***Atypical Hodge Loci****

Abstract: Recent work by a number of people has shown that for a general family of smooth varieties of dimension at least 3 the non-trivial Hodge loci have strictly bigger dimension than expected. This talk will sketch the proof of their result and explain why it is true.

*Talk based on the paper [BKU] and related works given in the references in that work, and on extensive discussions with Mark Green and Colleen Robles.

Rodolfo Aguilar, University of Miami, USA

Title: ***Around homology planes: old and new***

Abstract: We will present a survey about old and new results on affine acyclic complex algebraic surfaces, sometimes called homology planes. Relations with topology, symplectic and algebraic geometry will be discussed.

Sebastian Torres, University of Miami, USA

Title: ***Windows and moduli of bundles on a curve***

Abstract: We survey some results regarding semi-orthogonal decompositions on moduli spaces of vector bundles on a curve, with an emphasis on those that use the machinery of windows.

Stefan Ivanov, Sofia University and Institute of Mathematics and Informatics, Sofia

Title: ***Solutions to the quaternionic contact Yamabe equation on the 3-Sasakian spaces and the qc Yamabe problem***

Abstract: All solutions to the qc-Yamabe equation on the quaternionic sphere and on the compact 3-Sasakian spaces are found. Consequently, all positive extremals and the best constant in the Sobolev-Folland-Stein inequality on the quaternionic Heisenberg group are presented explicitly. It is shown that the qc Yamabe problem on locally non-spherical compact qc manifolds always has a solution.

Tony Pantev, University of Pennsylvania, USA

Title: ***Derived moduli of D-branes and superpotentials***

Abstract: Moduli of D-branes in Calabi-Yau manifolds are naturally equipped with enhanced geometric structures which play important role in classical field theory and are an essential input for the quantization problem. I will explain how one can recognize when such enhanced structures arise from a local or global superpotential and how Gromov-Witten invariants introduce derived and non-commutative corrections to the geometry of moduli spaces of branes. I will discuss applications to higher dimensional Chern-Simons functionals.

The talk is based on joint works with Calaque, Katzarkov, Kontsevich, Toen, Vaquie, and Vezzosi.

Vestislav Apostolov, Université du Québec à Montréal, Canada and Institute of Mathematics and Informatics, Sofia

Title: ***The generalized Calabi problem***

Abstract: The notion of a generalized Kähler (GK) structure was introduced in the early 2000's by Hitchin and Gualtieri in order to provide a mathematically rigorous framework of certain nonlinear sigma model theories in physics. Since then, the subject has developed rapidly. It is now realized,

thanks to more recent works of Hitchin, Goto, Gualtieri, Bischoff and Zabzine, that GK structures are naturally attached to Kähler manifolds endowed with a holomorphic Poisson structure. Inspired by Calabi's program in Kähler geometry, which aims at finding a "canonical" Kähler metric in a fixed deRham class, I will present in this talk an approach towards a "generalized Kähler" version of Calabi's problem motivated by an infinite dimensional moment map formalism. As an application, we give an essentially complete resolution of the problem in the case of a toric complex Poisson variety.

Based on a joint works with J. Streets and Y. Ustinovskiy.

Yingdi Qin, Institute of Mathematics and Informatics, Sofia

Title: ***Polydifferential operators, shifted symplectic geometry and Generalized complex branes***

Abstract: Generalized complex geometry was introduced by N. Hitchin partly motivated by Mirror Symmetry. It is an interpolation between complex geometry and symplectic geometry. A new approach to generalized complex geometry was introduced based on Tony Pantev's idea from (shifted) Poisson geometry and motivated by my thesis on Coisotropic Branes. This approach utilizes shifted symplectic geometry and a new theory of homotopy complex structures on derived differential stacks. The theory of homotopy complex structure is built on a strict model of differential forms on formal differential stacks based on polydifferential operators. I will also explain the corresponding results for generalized complex branes which are geared towards a construction of a category of generalized complex branes.