ALGEBRAIC GEOMETRY SYMPOSIUM

RMS 2023

Titles and abstracts

Friday, 22 December 2023

ST1: Omprokash Das

Title: *Contraction Problem and Minimal Model Program (MMP) of Kähler Varieties*

Abstract: Given a smooth projective variety X, if its canonical bundle K_X is not nef, i.e. K_X has negative degree on some curve C, then a famous theorem of Kawamata and Shokurov, called the Base-point Free Theorem, says that there is a contraction $f : X \to Y$ of a K_X negative ray of the Mori cone of X. This theorem is the cornerstone of the minimal model program for projective varieties in higher dimensions. Now if we replace 'smooth projective' by 'compact Kähler manifold', then this theorem no longer makes sense, more specifically, if a compact Kähler manifold satisfies the hypothesis of the Base-point free theorem, then it is necessarily projective. This creates a major hurdle on developing the minimal model program (MMP) for compact Kähler manifolds which are not necessarily projective. In this talk I will explain how to overcome this obstacle in dimension 3 and in general a conjectural resolution in higher dimensions through induction on dimension. These are all parts of joint work with Christopher Hacon.

ST2: Buddhadev Hajra

Title: *Eilenberg-MacLane Spaces in Algebraic Surface Theory*

Abstract: In algebraic topology, an Eilenberg-MacLane space is a path-connected topological space with possibly a single non-trivial homotopy group. Classifying all smooth complex algebraic Eilenberg-MacLane varieties is an interesting yet seemingly a challenging question. Recently, in collaboration with R.V. Gurjar and S.R. Gurjar, we prove a classification theorem for smooth non-contractible complex affine Eilenberg-MacLane surfaces of non-general type. We also prove a result about the universal cover of smooth complex projective Eilenberg-MacLane surfaces assuming an affirmative answer to an old conjecture of Igor R. Shafarevich. I will display these results in my talk. A classification theorem for smooth complex projective Eilenberg-MacLane surfaces of non-general type is recently found by S.R. Gurjar and P. Pokale which I will state if time permits.

ST3: Tanya Kaushal Srivastava

Title: *Derived vs K- vs L-equivalences*

Abstract: In this talk I will discuss the connection between various equivalences (namely derived, K-equivalence, L-equivalence) for smooth projective varieties. I will present some old and some new examples about Kawamata conjecture (relating K-equivalence with derived) and Shinder-Kuznetsov Conjecture (relating derived with L-equivalence).

ST4: Sanjay Amrutiya

Title: *Otabe's fundamental group scheme*

Abstract: In this talk, we will begin with reviewing the definitions and basic properties of some fundamental group schemes, which are Tannaka dual to certain types of vector bundles. The main focus would be on an extension of the Nori fundamental group scheme given by S. Otabe.

Saturday, 23 December 2023

ST5: Neena Gupta

Title: *The Abhyankar-Sathaye Epimorphism Conjecture*

Abstract: In this talk we shall discuss the Abhyankar-Sathaye Epimorphism Conjecture and present a few examples of linear hyperplanes where this conjecture holds. These are based on joint works with Parnashree Ghosh.

ST6: Rahul Gupta

Title: *Kernel of the cycle class map*

Abstract: In 1960, Serre proved that for a commutative ring R of dimension d, every projective R-module of rank $> d$ has a free direct summand, and in 1994, Murthy studied this question for projective modules of rank equal to d, when R is a smooth affine algebra over an algebraically closed field k. In the talk, we recall the definition of a projective module and the main statement of Murthy. We discuss the main idea of Murthy's proof and a generalization of his result for a singular affine algebra R over k. In particular, we define the group of 0-cycles $CH_0(R)$ and the Grothendieck group $K_0(R)$ associated to R, and construct a cycle class map $\rho_R : CH_0(R) \to K_0(R)$. One of the steps in Murthy's proof is that the kernel of ρ_R is divisible by $n!$ for smooth affine algebras over k. We prove a similar result for singular rings over k. The talk is based on a joint work with Prof. A. Krishna.

ST7: Archana Morye

Title: *Gröbner basis and its geometric implications*

Abstract: In this talk, we consider the question of whether there are polynomials for which the corresponding reduced Gröbner basis is double exponential in size for different monomial orderings. We will identify a sufficient criteria on the monomial ordering, that guarantees a double exponential sized reduced Gröbner basis. Using this we show that there is a family of such polynomials for which the reduced Gröbner basis under lexicographic, degree lexicographic and the weighted ordering is double exponential in size. We will also discuss how this question is related to the ideal membership problem and syzygy modules from a geometric point of view.

ST8: Sarbeswar Pal

Title: *Fano manifolds of Picard number one whose co-tangent bundle is algebraically completely integrable system and its endomorphisms*

Abstract: Let X be a projective Fano manifold of Picard number one, different from the projective space. There is a folklore conjecture that any non-constant endomorphism of X is an isomorphism. In this talk we will give a sketch of the proof of the conjecture when the co-tangent bundle of X is algebraically completely integrable system and the tangent bundle of X is not nef, and we will see some interesting examples of such Fano manifolds.

ST9: Umesh Dubey

Title: *Semi-Tannakian subcategories of loop quiver bundles*

Abstract: Nori introduced the notion of essentially finite vector bundles, giving an example of the Tannakian subcategory of (semistable) vector bundles. Using Tannaka duality it captures the finite-dimensional representations of the fundamental group of proper varieties.

We will study the examples of semi-Tannakian subcategories of loop quiver bundles w.r.t. Kronecker and Simpson tensor. We also describe some conditions to get the Tannakian structure on these semi-Tannakian subcategories. This is based on a joint work with Parul Keshari.

ST10: Gopinath Sahoo

Title: *Tensor t-structures on the derived categories of schemes*

Abstract: The localizing and smashing subcategories of the unbounded derived category of quasi-coherent sheaves over Noetherian affine schemes are well understood, and, in this case, the telescope conjecture is known to be true. In this talk, I will present our work on the classification of compactly generated tensor t-structures on the derived categories of Noetherian schemes. As an application of our main theorem, we will show that a tensor version of the telescope conjecture for t-structure is true for separated Noetherian schemes.

Sunday, 24 December 2023

ST11: V. Uma

Title: *Equivariant Grothendieck ring of flag Bott manifolds*

Abstract: We shall define cellular varieties and cellular bundles and give examples. We shall describe the equivariant Grothendieck ring of cellular bundles. We apply our results to give a presentation of the equivariant Grothendieck ring of flag Bott manifolds which are generalizations of Bott manifolds.

ST12: Jyoti Dasgupta

Title: *Logarithmic connections on toric principal bundles*

Abstract: Let X be a normal projective variety, D be a reduced Weil divisor on X, and G be a reductive linear algebraic group, defined over an algebraically closed field of characteristic zero. We introduce the notion of a logarithmic connection on a principal G-bundle over X, which is singular along D. We give necessary and sufficient conditions for the existence of such a connection in terms of connections on associated vector bundles when the logarithmic tangent sheaf of X is locally free. The existence of a logarithmic connection on a principal bundle over a projective toric variety, singular along the boundary divisor, is shown to be equivalent to the existence of a torus equivariant structure on the bundle. This is based on a joint work with Bivas Khan and Mainak Poddar.

ST13: Suratno Basu

Title: *Existence of Ulrich Bundles on some surfaces of general type*

Abstract: In recent years Ulrich bundles have received wide attention among algebraic geometers. In this talk we will discuss the existence of such bundles on some surfaces of general type. More specifically, let X be a smooth projective algebraic surface of Picard rank one with a very ample canonical bundle K_X. We further assume that $q + 1 \leq \chi(\mathcal{O}_X)$. We will discuss the existence of Ulrich bundles and its stability with respect to K_X. This is a joint work with Sarbeswar Pal.

ST14: Aditya Subramaniam

Title: *Seshadri constants and curve arrangements.*

Abstract: Seshadri constants of line bundles on projective varieties were defined by J.-P. Demailly in 1990, motivated by an ampleness criterion of C.S. Seshadri. They are a measure of local positivity of line bundles. In this talk, we will discuss some important questions that drive research on Seshadri constants. We will also discuss behaviour of multi-point Seshadri constants when the points are centered at singular loci of certain curve arrangements on surfaces and mention some recent results in this direction. This talk is based on joint work with Krishna Hanumanthu and Praveen Kumar Roy.