Abstracts for Talks

KUMUNU, October 8-9, 2022

Speaker: Dale Cutkosky, University of Missouri

Title: Anarchy in generically finite maps of positive characteristic surfaces

Abstract: Let k be an algebraically closed field of positive characteristic p and K → L be a finite extension of two-dimensional algebraic function fields over k. Let v be a valuation of L. (This is particularly interesting when v has a big value group such as the rational numbers Q.) The germs of generically finite maps of nonsingular birational models (nonsingular surfaces) of this extension of fields along v are given by extensions of regular local rings A → B such that A, B are essentially of finite type over k with respective quotient fields K and L and v dominates B, B dominates A.

We discuss what the best forms are that can be achieved by such an extension, and if a good form cannot be achieved, how chaotic can the best forms be?

We begin with a discussion over fields of characteristic zero (and all dimensions), where very good local forms can always be achieved.

Speaker: Brian Harbourne, University of Nebraska

Title: Algebraic geometric concepts motivated by inverse scattering

Abstract: Studying inverse scattering problems has led to remarkable advances in science and technology, from atomic physics to computed tomography and the determination of the double helix structure of DNA. In this talk I will discuss current research which applies this idea to classification problems in algebraic geometry.

In inverse scattering problems (ISP), one tries to discern an object's structure from structure in projected or reflected data. We carry this idea over to algebraic geometry and commutative algebra by asking to classify objects based on the structure of projected images. As a main focus, I will discuss work to classify sets of points in projective 3-space whose projection from a general point is a complete intersection in a plane.

Speaker: Craig Huneke, University of Virginia

Title: Weak and strong F-regularity

Abstract: This work is joint with Ian Aberbach and Thomas Polstra. One of the questions which remains open in the theory of tight closure is whether a ring which is weakly F-regular (meaning every ideal is tightly closed) is in fact strongly F-regular. Many special cases are known, for example if the ring is Gorenstein, or if it is graded. We extend some of the known cases by proving that if the ring is excellent, weakly F-regular and local, and if the symbolic anticanonical ring is Noetherian on the punctured spectrum of R, then R is strongly F-regular.

This talk will focus on some of the history of the problem, and what it means. Very interesting questions arise which have to do with the annihilation of local cohomology modules of symbolic powers, and the existence of special prime filtrations.

Speaker: Justin Lacini, University of Kansas

Title: Syzygies of adjoint linear series on projective varieties

Abstract: Syzygies of algebraic varieties have long been a topic of intense interest among algebraists and geometers alike. Starting with the pioneering work of Mark Green on curves, numerous attempts have been made to extend these results to higher dimensions. Ein and Lazarsfeld proved that if A is a very ample line bundle, then K_X + mA satisfies property N_p for any m>=n+1+p. It has ever since been an open question if the same holds true for A ample and basepoint free. In joint work with B. Purnaprajna we give a positive answer to this question.

Speaker: Claudia Miller, Syracuse University

Title: Differential operators of low order for an isolated hypersurface singularity

Abstract: We study the ring D differential operators of low order for an isolated singularity hypersurface ring of the form R=k[x,y,z]/(f) for a field k of characteristic zero and homogeneous polynomial f of degree at least 3 (that is, the cone of a smooth projective plane curve). This is

joint work with Rachel Diethorn, Jack Jeffries, Nick Packauskas, Josh Pollitz, Hamid Rahmati, and Sophia Vassiliadou.

In this talk, we will define differential operators and give some history of their study and their uses in the characteristic zero setting. In the smooth case, such rings of differential operators tend to have many operators of negative degree, yielding that certain important D-modules are simple. In addition, when R is a polynomial ring, for example, many important, but infinitely generated, R-modules such as local cohomology become of finite length as D-modules, which has been an important tool for studying them.

This project highlights further the contrasting and yet interactive behaviors in the smooth and non-smooth cases. For the hypersurfaces we study, it was long known that there are no negative degree operators by results of Vigué building on the work of Bernstein, Gel'fand, and Gel'fand, the proofs going via investigations of certain sheaf cohomologies, but the explicit operators were not known, as far as we know. We find the differential operators of order up to 3 by completely new, homological methods, as well as minimal resolutions of the R-module that they form.

Speaker: Lúis Nuñez Betancourt, CIMAT

Title: Rees algebras of determinantal ideals.

Abstract: In this talk we focus on Rees algebras and symbolic Rees algebras of determinantal ideals. In particular, we will show that they have mild singularities in prime characteristic. We will also discuss consequences for numerical invariants and initial ideals of the symbolic powers of these ideals. This is joint work with Alessandro De Stefani and Jonathan Montaño.