

D-modules on commutative algebra

Guanajuato, Guanajuato, Mexico
August 10-14

Abstracts Research Talks

Vladimir Bavula
University of Sheffield, UK

The algebras of polynomial integro-differential operators and their groups of automorphisms. I will talk about general properties of the polynomial integro-differential operators, classification of their ideals and groups of automorphisms.

Daniel J. Hernández
University of Utah, USA

Roots of Bernstein-Sato polynomials via positive characteristic methods. In this talk, we recall the connection between F-thresholds (numerical invariants of singularities defined in terms of the Frobenius endomorphism) and the Bernstein-Sato polynomial associated to a hypersurface over the complex numbers. In particular, we hope to illustrate how positive characteristic methods can be used to recover subtle analytic information (e.g., roots of Bernstein-Sato polynomials and certain related strata). This is joint work with Emily Witt.

Laura Matusevich
Texas A & M University, USA

A-hypergeometric functions A-hypergeometric systems were introduced by Gelfand, Graev, Kapranov and Zelevinsky, as generalizations of the classical hypergeometric differential equations, and comprise an important class of D-modules, playing a role akin to that of toric varieties in algebraic geometry. One of the features that make these D-modules interesting is that they depend on parameters, and changing the parameters can have significant effects. For instance, the holonomic rank of an A-hypergeometric D-module is not in general constant as a function of the parameters. In this talk, we explore the parametric behavior of A-hypergeometric functions, the solutions of A-hypergeometric systems; our goal is to form sheaves of solutions over the parameter space, and to explain, at the level of solutions, the mechanisms that lead to the formation of rank jumps. This is joint work (in progress) with Roberto Barrera, Christine Berkesch Zamaere and Jens Forsgaard.

Luis Narváez Macarro
Universidad de Sevilla, Spain

Differentiably admissible algebras in positive characteristic. In 1991, Mebkhout and the author proved that the theory of Bernstein-Sato polynomials could be extended to the ring of differential operators with coefficients in any algebra A over a field k of characteristic 0 satisfying some natural hypotheses, covering the extreme cases of polynomial rings and formal power series rings. One of these hypotheses asked for the existence of global “differential coordinates”. Recently, Núñez-Betancourt was able to replace this hypothesis by a more canonical one: that the localization at any maximal ideal of A of its module of k -derivations coincide with the module of k -derivations of the localization. In this talk, I will review on the notions of Hasse-Schmidt derivations, integrable derivations and some related results, and I will propose a “good” class of algebras over a field of positive characteristic with respect to the behavior of rings of differential operators.

Luis Núñez-Betancourt
University of Virginia, USA

Mixed characteristic Lyubeznik numbers. The mixed characteristic Lyubeznik numbers are invariants for local rings that do not contain a field. These invariants are inspired by the numbers that Lyubeznik defined for equal characteristic rings, which are known to have algebraic and geometric interpretations. In this talk, we will give an overview of the Lyubeznik numbers, and their relation with the theory of D-modules. We will also discuss new results on the vanishing of local cohomology over regular rings of mixed characteristic, and conclude geometric properties measured by the mixed characteristic Lyubeznik numbers. This is joint work with Daniel J. Hernández, Felipe Pérez and Emily E. Witt.

Claudiu Raicu
University of Notre Dame, USA

Characters of equivariant D-modules on spaces of matrices. I will describe the characters of the simple GL-equivariant D-modules on a complex vector space of matrices (general, symmetric, or skew-symmetric) and explain how this information can be used to compute local cohomology modules, as well as to (dis)prove some cases of a conjecture of Levasseur.

Michel Van den Bergh
Universiteit Hasselt, Belgium

To be announced.

Rafael H. Villarreal
CINVESTAV-IPN, Mexico

Hilbert Functions in Evaluation Codes. Using commutative algebra methods we study the basic parameters of projective Reed-Muller type codes over finite fields and show how to estimate the minimum distance. The methods will apply to vanishing ideals of sets parameterized by Laurent monomials or rational functions. The theory of Hilbert functions and the notion of degree play a central role in the actual computation of the algebraic invariants using Groebner basis.

Uli Walther
Purdue University, USA

Annihilators of powers of arrangements. We consider the differential operators that annihilate f^s where s is a new unknown and f the defining equation of an arrangement. An interesting question is: when is this D-ideal generated by derivations? The issue is related to depth conditions on the Jacobian, and may be equivalent. We discuss the connection, and some possible applications.

Emily E. Witt
University of Utah, USA

The injective dimension of local cohomology modules. Local cohomology modules can be used to understand properties of rings and their ideals. However, since they are typically large and sometimes unwieldy, it can be useful to find finiteness properties that these modules possess. Work of Huneke and Sharp and of Lyubeznik established that the injective dimension of local cohomology modules of regular rings of equal characteristic are bounded by the dimension of their support. In this talk, we will discuss the injective dimension of regular rings of mixed characteristic. This is joint work with Daniel Hernández, Luis Núñez-Betancourt, and Felipe Pérez.

Santiago Zarzuela
Universitat de Barcelona, Spain

Spectral sequences in local cohomology. Spectral sequences are often applied to compute local cohomology functors. In this talk I'm going to review how to use them in order to calculate local cohomology from the primary decomposition of an ideal I in a commutative Noetherian ring R . By one hand, we shall deal with the computation of several generalized local cohomology functors supported on I . On the other hand, we shall mainly be concerned with the computation of the local cohomology of R/I . The construction of these spectral sequences is done by means of the explicit computation of the left and right derived functors of the direct and inverse limits in terms of some complex constructions introduced by J. E. Roos and G. Nöbeling in the 1960's. In some cases, one can also give sufficient conditions in order to guarantee the degeneration of the corresponding spectral sequence. As a guide we will have in mind the results obtained by Àlvarez-García-Zarzuela in 2003 and G. Lyubeznik in 2007 for the local cohomology modules supported on I and the well known Hochster's decomposition formula for the local cohomology of Stanley-Reisner rings.