Further Connections Between Algebra and Geometry – Talk Abstracts
February 2-3, 2013

Speaker: Kristen Beck, University of Arizona

Title: Two Notions of Krull Dimension for Differential Graded Algebras

Abstract: We will compare two different notions of a system of parameters for a homologically finite complex over a commutative noetherian local ring. In particular, we will demonstrate that, while these notions differ in general, they agree when the complex admits a DG algebra structure. We will also show that the corresponding notions of Krull dimension agree in the DG case. This is joint work with Sean Sather-Wagstaff.

Speaker: Jim Coykendall, North Dakota State University

Title: A Geometric and Homological Look at Factorization

Abstract: In the spirit of connections between algebra and geometry, this talk will attempt to give a visual/geometric approach to factorization in integral domains.

We say that the integral domain, R, is atomic if every nonzero nonunit of R can be expressed as a product of irreducible elements (or atoms). In the study of factorization, the field of play is usually the class of domains that are atomic, but there is a richer, more general theory if one allows factorization in a more general setting (and indeed, this is necessary if one wants to study divisibility behavior in domains like $\overline{\mathbb{Z}}$ where there are no irreducibles to work with at all!).

In this talk we will discuss some recent work that highlights some situations where properties more general than atomic are necessary (and even desirable). In particular, we will look at divisibility conditions from a graphical point of view by defining a graph that measures some types of factorization behaviors. Additionally, we will discuss how, in this setting, one can define interesting cochain complexes (and corresponding cohomology groups) that measure some of these behaviors.

Speaker: Chris Francisco, Oklahoma State University

Title: Generalizing the Framework of Borel Ideals

Abstract: In my talk in Regina, I discussed new perspectives on Borel ideals, doing computations with Borel generators rather than ordinary minimal monomial generators. This leads to a surprising connection to a counting problem in discrete geometry. In this talk, I will explain how to loosen the restrictive Borel condition in such a way that one can study more general monomial ideals with similar techniques, recovering results for Borel ideals as a special case. This is joint work with Jeff Mermin and Jay Schweig.

Speaker: Tài Huy Hà, Tulane University

Title: Powers of Square-free Monomial Ideals and Combinatorics

Abstract: We shall give a survey on recent results that show how powers of square-free monomial ideals appear naturally in combinatorics. In particular, we shall discuss how investigating algebraic properties of powers of square-free monomial ideals may shed new lights on problems and questions in graph theory and integer linear programming.

Speaker: Brian Harbourne, University of Nebraska - Lincoln

Title: Question, Conjectures and Counterexamples about Ideal Containment Problems

Abstract: I will speak about recent joint work with Craig Huneke, Cristiano Bocci and Susan Cooper regarding when symbolic powers of a homogeneous ideal I are contained in products of powers of the irrelevant ideal with powers of I.

Speaker: Augustine O'Keefe, University of Kentucky

Title: Cohen-Macaulay Toric Rings Arising from Finite Graphs

Abstract: Given a finite simple graph G one can construct its associated toric ring, $k[G]$. In this talk we will show how the structure of G affects invariants related to the minimal free resolution of $k[G]$. In particular, using homological methods and the Auslander-Buchsbaum formula, we will determine a sufficient condition on G so that $k[G]$ is Cohen-Macaulay.

Speaker: Jared Painter, Houston Baptist University

Title: Planar Graphs, Bass Numbers and the Koszul Algebra Structure for Trivariate Monomial Ideals

Abstract: We will explore the Koszul algebra structure for $R = S/I$, where $S = \Bbbk[x, y, z]$ and I is a monomial ideal primary to the homogeneous maximal ideal $\mathfrak{m}$ of R such that $I \subseteq \mathfrak{m}^2$. Miller and Sturmfels showed that the minimal free resolution of any trivariate monomial ideal can be represented by some planar graph. We will discuss how we can relate the minimal free resolution of R and a corresponding planar map to the Koszul algebra structure of R. Our classification is based off of recent work by L. Avramov where he classified the behavior of the Bass numbers of embedding codepth 3 commutative local rings. His classification relied on a corresponding classification of their respective Koszul algebras, which is comprised of five categories. We find that this perspective also yields some interesting results/questions about which lower Bass numbers and Koszul algebra structures we can achieve from trivariate monomial ideals.

Speaker: Branden Stone, Bard College/Bard Prison Initiative

Title: Super-Stretched and Graded Countable Cohen-Macaulay Type

Abstract: This work was motivated by a question of Huneke and Leuschke; let R be a complete local Cohen-Macaulay ring of countable Cohen-Macaulay type, and assume that R has an isolated singularity. Is R then necessarily of finite Cohen-Macaulay type? We show that such a ring is super-stretched. We also give a partial result to a the following folklore conjecture: A Gorenstein ring of countable Cohen-Macaulay type is a hypersurface. In particular, we show this conjecture is true in the one dimensional graded case.

Speaker: Mark Walker, University of Nebraska - Lincoln

Title: Chern Characters for DG Modules and Curved Modules

Abstract: In their original setting, Chern classes refer to invariants of vector bundles on a space, taking values in the singular cohomology groups of the space. The Chern character is a ring homomorphism defined in term of these classes, going from the Grothendieck ring of vector bundles to the cohomology ring. The notion of a Chern character has expanded over the years from its original context to include any sort of invariant of bundles on a space or variety, or of modules over a ring, that leads to a ring homomorphism from a Grothendieck ring to a cohomology ring.

In this talk, I describe a Chern character map that is defined for maximal Cohen-Macaulay (MCM) modules over a complete intersection ring. The target of this map is the Hochschild homology groups, suitably defined, of the stable category of MCM modules. The construction builds on the case of Chern characters and Hochschild homology for the stable category of modules over a hypersurface, which has been studied by many authors of late (including Carqueville-Murfet, Dyckerhoff, Platt, Polishchuck-Vaintrob, Yu) in the setting of matrix factorizations. I will explain how such a Chern character map is of value to prove results in commutative algebra.
