Titles and Abstracts for the Algebra Extravaganza

(updated July 21, 2017)

Jason Bell, Waterloo

Title: The Dixmier-Moeglin equivalence for D-groups

Abstract: The Dixmier-Moeglin equivalence is a characterization of the primitive ideals of an algebra that holds for many classes of rings, including affine PI rings, enveloping algebras of finite-dimensional Lie algebras, and many quantum algebras. For rings satisfying this equivalence, it says that the primitive ideals are precisely those prime ideals that are locally closed in the Zariski topology and are also those prime ideals that are rational. We investigate a differential-algebraic/geometric analogue of this equivalence and show that it holds for a D-groups, which we'll define in the talk. We use this to show that the classical Dixmier-Moeglin equivalence holds for Hopf Ore extensions of commutative Hopf algebras. This is joint work with Omar Leon Sanchez and Rahim Moosa.

Georgia Benkart, Wisconsin-Madison

Title: Tracing a Path - From Walks on Graphs to Invariant Theory (and Beyond)

Abstract: Molien's 1897 formula for the Poincaré series of the polynomial invariants of a finite group has given rise to results in algebraic geometry, coding theory, combinatorics, mathematical physics, and representation theory. This talk will focus on an analogue of Molien's formula for tensor invariants and various applications of it. The approach is via walking on McKay quivers. The associated McKay-Cartan matrix plays a key role and has interesting connections with chip firing and sandpile dynamics. This picture has a beautiful recent generalization to the representation theory of finite-dimensional Hopf algebras of arbitrary characteristic.

Ken Brown, Glasgow

Title: Azumaya loci and discriminant ideals

Abstract: I will discuss recent and not so recent results on the determination of the Azumaya locus of an affine PI algebra.

Andrew Conner, Saint Mary's

Title: Knörrer periodicity for noncommutative matrix factorizations

Abstract: In the representation theory of commutative local rings, Knörrer periodicity is a powerful tool for classifying complete Gorenstein local rings of finite Cohen-Macaulay (CM) type; that is, those having finitely many indecomposable maximal Cohen-Macaulay modules. By a theorem of Herzog, all such rings are hypersurface singularities. Knörrer periodicity can

be used to prove that a simple hypersurface singularity has finite CM type, and to prove that a hypersurface singularity of finite CM type is a simple (ADE) singularity. These proofs exploit the connection, due to Eisenbud, between maximal Cohen-Macaulay modules over $R/(f)$ for a regular local ring R, and matrix factorizations of f.

The study of noncommutative graded algebras of finite CM type has since emerged in the area of noncommutative algebraic geometry, where Artin-Schelter regular algebras play the role of regular local rings. With Cassidy, Kirkman, and Moore, the author established a version of Eisenbud's correspondence for rings of the form $A/(f)$ where A is an Artin-Schelter regular algebra and f is normal, regular, homogeneous element. In this talk I will give an analog of Knörrer periodicity in the noncommutative graded setting.

Simon Crawford, Edinburgh

Title: Singularity categories of some noncommutative deformations

Abstract: The Kleinian singularities make up a family of well-understood (commutative) surface singularities. In 1998, Crawley-Boevey and Holland introduced a family of algebras which may be viewed as noncommutative deformations of these singularities. Using singularity categories, I will make comparisons between the types of singularity arising in the commutative and noncommutative settings. Time permitting, I will also discuss some work-in-progress relating to deformations of algebras coming from group actions on AS-regular algebras of global dimension 2.

Jason Gaddis, Wake Forest

Title: Discriminants of Taft algebra smash products and applications

Abstract: The discriminant is an invariant that has been applied recently to the study of noncommutative algebras. It has been used to determine automorphism groups and the Azumaya locus of PI algebras. In this talk, I will discuss methods for computing the discriminant of the smash product $A\#H$, where H is a Taft algebra acting inner faithfully on an H-module algebra A. This is joint work with Robert Won and Daniel Yee.

Ken Goodearl, Santa Barbara

Title: Detecting uniparametricality and polynomial stability of graded algebras via cocycle twist invariants

Abstract: We will discuss how various graded algebras can and cannot be obtained from uniparameter ones by twisting, introduce some new invariants to help detect the difference, and describe additional invariants obtained from expansion of grading groups. In particular, we will show that a number of quantum algebras are "truly multiparameter", in that they cannot be written as cocycle twists of uniparameter algebras – algebras for which the scalars in the

relevant commutation relations are powers of a fixed scalar. The ideas apply to $\mathbb{Z}$-graded algebras by expanding the grading group from $\mathbb{Z}$ to the character group of a maximal torus of an appropriate automorphism group. We will also discuss settings in which our invariants are stable under passage to polynomial rings, thus allowing one to show that certain algebras cannot become isomorphic even after making polynomial extensions. This is joint work with Milen Yakimov.

Ed Green, Virginia Tech

Title: Algebras, modules, and varieties

Abstract: I will introduce affine algebraic varieties whose points are in one-to-one correspondence with certain algebras. For each such variety there is a distinguished monomial algebra, some of whose properties determine properties of the other algebras in the variety. For example, if the monomial algebra is finite dimensional of finite global dimension, then every algebra in the variety is finite dimensional of finite global dimension.

I will also describe an analogous construction of a constructible set whose points correspond to certain modules over a fixed algebra. These modules share a number of features in common. The results represent joint work with Lutz Hille and Sibylle Schroll, Eduardo Marcos and S. Schroll, and with S. Schroll.

Robert Guralnick, U. Southern California

Title: Simple Algebraic Groups and Stabilizers of Polynomials

Abstract: Let V be an irreducible module for the simple algebraic group G over a field k. Suppose f in $k[V]$ is fixed by G. We show that almost always G is the connected part of the stabilizer of f. In particular, we give a quick solution to a 125 year old question of Cartan to characterize E_8 and also show that in most cases simple algebraic groups can be described as stabilizers of quadratic or cubic polynomials. We also show that if $G < H$ are both irreducible on V, then the Krull dimensions are of the ring of invariants are almost never equal. This is joint work with Skip Garibaldi.

Birge Huisgen-Zimmermann, University of California, Santa Barbara

Title: Iterated tilting and strings of derived-equivalent algebras

Abstract: We will review work of Rickard, Keller, and others regarding the connection between derived equivalence of algebras and tilting. Then we will recall the notion of *strong* tilting, as introduced by Auslander and Reiten. Strong tilting provides particularly strong bridges among the module categories involved. We proceed to recent work of Manuel Saorin and the speaker. The main result shows that, in a broad scenario, the process of strong tilting allows

for iteration, eventually becoming stationary. The algebras in the corresponding sequences of consecutive tilts can be described with precision in terms of their predecessors.

Mee Seong Im, US Military Academy

Title: Cohomological properties of certain quiver flag varieties

Abstract: I will give the construction of quiver Springer desingularization and quiver Grothendieck-Springer resolution using quiver flag varieties, generalizing the classical construction arising from affine type A. I will then discuss higher cohomology vanishing for line bundles on these quiver Springer resolutions. If I have time, I will then discuss conjectural connections between filtered quiver varieties and certain flag Hilbert schemes, all arising as quadruples of matrices. This is joint with Brian Allen.

Ryan Kinser, University of Iowa

Title: Decomposing moduli spaces of representations of algebras

Abstract: This talk is based on joint work with Calin Chindris applying methods of Geometric Invariant Theory (GIT) to study representations of finite-dimensional algebras. I will present a Krull-Schmidt type decomposition for moduli spaces of semi-stable representations for arbitrary such algebras. If time permits, I will discuss some applications of this decomposition result.

Gail Letzter, US Government

Title: Quantum Coideals: From Reflection Equations to Cartans

Abstract: There is renewed interest in the coideal subalgebras used to form quantum symmetric pairs because of recent discoveries showing that they play a fundamental role in the representation theory of quantized enveloping algebras. During the first part of the talk, we present highlights of this special family of quantum coideals. We start with their connection to reflection equations which parallels the relationship between quantized enveloping algebras and the Quantum Yang Baxter Equations and then illustrate how representations for these quantum coideals appear in a variety of contexts. The second half of the talk is devoted to a major step in classifying their finite-dimensional representations: identifying a Cartan subalgebra which is a polynomial ring that acts semisimply on finite-dimensional unitary modules.

Donald Passman, Wisconsin-Madison

Title: Rewritable Groups

Abstract: We consider three related types of identities satisfied by groups. First, G satisfies PI_n if the group algebra $K[G]$ satisfies a polynomial identity of degree n. Of course, this depends somewhat on the nature of the field K. Next, G satisfies the permutational property P_n if for each $x_1, x_2, \ldots, x_n \in G$ there exists a permutation $1 \neq \pi \in \mathrm{Sym}_n$, depending on these elements, with $x_1 x_2 \cdots x_n = x_{\pi(1)} x_{\pi(2)} \cdots x_{\pi(n)}$. Finally, G satisfies the rewritable property Q_n if for each sequence $x_1, x_2, \ldots, x_n \in G$ there exist distinct permutations $\sigma, \tau \in \mathrm{Sym}_n$, depending on these elements, with $x_{\sigma(1)} x_{\sigma(2)} \cdots x_{\sigma(n)} = x_{\tau(1)} x_{\tau(2)} \cdots x_{\tau(n)}$. We discuss the relationship between these properties and, in particular, results of I. M. Isaacs, M. K. Smith, D. J. S. Robinson, R. D. Blyth, M. I. Elashiry, and the speaker.

Manny Reyes, Bowdoin

Title: Toward a functorial quantum spectrum for noncommutative algebras

Abstract: What kind of "quantum space" should play the role of the spectrum of a noncommutative algebra? Potential solutions to this problem might include a topological space, a sheaf of rings, or a noncommutative algebra of "discrete" functions. I will discuss various obstructions to these approaches in both ring theory and operator algebra. Then I will report on work-in-progress toward coalgebras as a "quantum spectrum," yielding a potential solution to this problem in the restricted context of noetherian affine PI algebras.

Dan Rogalski, UC San Diego

Title: Twisted Calabi-Yau and Artin-Schelter regular conditions for locally finite graded algebras

Abstract: For connected graded algebras, the notion of a twisted (or skew) Calabi-Yau algebra is known to be equivalent to the older notion of an Artin-Schelter regular algebra. For graded locally finite but not necessarily connected algebras, several different possible definitions of Artin-Schelter regular have been proposed. We show that in most cases, these are all equivalent to the notion of twisted Calabi-Yau algebra. As an application of our methods, we show that any graded locally finite twisted Calabi-Yau algebra of global dimension 2 with finite GK-dimension is necessarily noetherian. Time permitting we also describe some general results about the GK-dimension of twisted Calabi-Yau algebras. This is joint work with Manny Reyes.

Anne Shepler, U. North Texas

Title: Noncommutative algebras arising from group actions and color Lie algebras

Abstract: We consider finite groups acting on Koszul algebras like polynomial rings and skew (quantum) polynomial rings. Deformations of a group together with an algebra upon which it acts include many noncommutative algebras important in combinatorics and representation

theory. For example, graded Hecke algebras and rational Cherednik algebras arise from the action of a reflection group on a polynomial ring (with deformation parameters supported on bireflections). We discuss connections with color Lie algebras and the differences between the modular and nonmodular settings.

Lance Small , UC San Diego

Title: Generic Matrices, Coherence and Finite Presentation

Abstract: We show that generic matrices, in general, are not coherent using remarks on finite presentations. Further observations on embedding PI algebras into matrices over commutative rings are also made. This work is joint with Efim Zelmanov.

Gordana Todorov, Northeastern

Title: Tilting modules and dominant dimension

Abstract: We study tilting modules which are both generated and cogenerated by projective-injective modules. We show that the existence of such a tilting module is equivalent to the algebra having dominant dimension at least 2. We also show that existence of such a tilting module which is also cotilting is equivalent to algebra being 1-Auslander-Gorenstein.

Auslander algebras satisfy all of the above and were original motivation for this work. This is joint work with Van Nguyen, Idun Reiten, Shijie Zhu.

Michaela Vancliff, University of Texas at Arlington

Title: One-Dimensional Line Schemes

Abstract: The classification of all quadratic regular algebras of global dimension four is an open problem. Likewise, the classification of the line schemes of such algebras, even the generic classes of such, is open. In this talk, I will discuss some known examples and a recent result (joint work with A. Chirvasitu and S. P. Smith) concerning the degree of the line scheme if the line scheme has dimension one.

Xingting Wang, Temple University

Title: Calabi-Yau property under monoidal Morita-Takeuchi equivalence

Abstract: Two Hopf algebras are said to be Morita-Takeuchi equivalent if their comodule categories are tensor equivalent. In this talk, we will discuss homological properties of Hopf algebras that are invariant under Morita-Takeuchi equivalence. We will be focusing on the

AS-Gorenstein condition and Calabi-Yau property which are enjoyed by a large family of well-known Hopf algebras or quantum groups. We will study these results in the framework of cogroupoids introduced by Bichon. This is a joint work with Xiaolan Yu and Yinhuo Zhang.

Sarah Witherspoon, Texas A&M Universiry

Title: The Lie structure on Hochschild cohomology, with motivation from algebraic deformation theory

Abstract: Some questions about deformations of algebras can be answered by using Hochschild cohomology, and in particular by using its Lie/Gerstenhaber brackets. Until very recently there was no independent description of this Lie structure for an arbitrary resolution, a big disadvantage both theoretically and computationally. In this talk, we will first introduce Hochschild cohomology and explain its role in algebraic deformation theory. We will then summarize recent progress by several mathematicians, focusing on examples.

Quan-Shui Wu, Fudan

Title: Poisson Hopf algebras and co-Poisson Hopf algebras

Abstract: Co-Poisson structure (or coalgebra) is a dual concept of Poisson structure in categorial point of view. It arises also in mathematics and mathematical physics naturally.In the talk I will start from the defintions and basic properties of co-Poisson structures.The Hopf dual H° of any Poisson Hopf algebra H is proved to be a co-Poisson Hopf algebra provided H is noetherian. It is proved that there is no nontrivial Poisson Hopf structure on the universal enveloping algebra of a non-abelian Lie algebra.So the polynomial Hopf algebra, viewed as the universal enveloping algebra of a finite-dimensional abelian Lie algebra, is considered.The Poisson Hopf structures on polynomial Hopf algebras are exactly linear Poisson structures. The co-Poisson structures on polynomial Hopf algebras are characterized. Some correspondences between co-Poisson and Poisson structures are also established. This is a joint work with Lou Qi.

Milen Yakimov, Louisiana State University

Title: C-vectors of 2-Calabi-Yau categories and Borel subalgebras of $\mathfrak{sl}_\infty$

Abstract: This is a report on joint work with Peter Jorgensen. C-vectors play a major role in the theory of cluster algebras in the description of the mutation of their principal coefficients due to Fomin and Zelevinsky. We develop a general framework for c-vectors of 2-Calabi-Yau categories with respect to arbitrary cluster tilting subcategories, based on Dehy and Keller's treatment of g-vectors. This approach deals with cluster tilting subcategories which are in general unreachable from each other and have infinitely many indecomposable objects. The approach does not rely on (finite or infinite) sequences of mutations. We propose a general

program for decomposing sets of c-vectors and identifying each piece with root systems. In the case of the A_∞ cluster categories of Igusa and Todorov, we realize this in terms of the roots of the Borel subalgebras of $\mathfrak{sl}_\infty$ which are of substantial current interest because they are not conjugate to each other.

James Zhang, Washington-Seattle

Title: ADE Dynkin diagrams in algebra, geometry and beyond

Abstract: ADE Dynkin diagrams play an important role in many subjects such as representation theory of quivers, (super)conformal field theories, spectral radius of graphs, classification of semisimple Lie algebras and finite simple groups, surface singularities and the McKay correspondence. In this talk we survey recent work related to the ADE diagrams in noncommutative algebraic geometry and noncommutative invariant theory and provide new connections between the ADE diagrams and some recently developed subjects in Mathematics.

Titles and Abstracts for the Poster Session.

July 25 (Tuesday) 5:15pm – ...

Ana Berrizbeitia, University of Iowa

Title: Invariant rings of Taft algebras acting on path algebras

Abstract: The Taft Algebras $T(n)$ are a family of finite-dimensional Hopf algebras which are neither commutative nor cocommutative. Given an action of a Taft algebra on the path algebra of a quiver, we investigate whether the ring of invariants is finitely generated as an algebra. In the case of the Sweedler algebra, $T(2)$, acting on quivers with 2 vertices, we present a family of invariants for such an action, and conjecture that these generate the full ring of invariants. We furthermore conjecture that these results naturally extend to all actions of $T(n)$, and that the invariant ring is not finitely generated in general.

Zachary Cline, Temple University

Title: Extending actions to the Drinfel'd double of various Hopf algebras "close" to Taft algebras

Abstract: Susan Montgomery and Hans-Jürgen Schneider classified all non-trivial n-dimensional module algebras A over the Taft algebras H of dimension n^2, $n > 2$. They further showed that each such module structure extends uniquely to make A a module algebra over the Drinfel'd double of H. We explore what it is about the Taft algebras that leads to this uniqueness, by examining Hopf algebras "close" to the Taft algebras in various directions, and their module algebras.

Elizabeth Drellich, Swarthmore College

Title: Algebraic Splines: from engineering to cohomology

Abstract: Historically the word splines refers to pieces of bendable wood used to design the hulls of ships so that they were smooth and hydrodynamic. In modern engineering a spline is a collection of curves or surfaces that meet sufficiently smoothly. Dual to this idea of curve matching is the algebraic spline: given a graph with edges labeled by ideals of a given ring, a spline on that graph is a vertex labeling such that adjacent vertices are labeled by ring elements whose difference is in the edge's ideal. The set of all splines on a given edge-labeled graph is both a ring and a module, and is a useful tool for studying the (equivariant) cohomology of GKM spaces. This poster will walk through the construction of algebraic splines and present an application to Schubert calculus.

Dominic Hipwood, University of Manchester

Title: Maximal Orders in the Sklyanin Algebra

Abstract: Let S denote the 3-dimensional Sklyanin algebra over an algebraically closed field and assume that S is not a finite module over its centre. In this poster we summarize results completing the classification of maximal orders inside S. In previous work, Rogalski, Sierra and Stafford classify the maximal orders of the 3-veronese subring $S^{(3)}$ of S. These are built out of geometric data coming from the associated elliptic curve E to S. More specifically, the maximal orders can be considered as blowups at (possibly non-effective) divisors on E. We are able to obtain similar results in the whole of S.

Mee Seong Im, US Military Academy

Title: On the category of finite-dimensional representations of periplectic Lie superalgebras

Abstract: We study the category $\mathcal{F}_n$ of finite-dimensional integrable representations of the periplectic Lie superalgebra $\mathfrak{p}(n)$ by defining an action of the Temperley-Lieb algebra attached to the infinite symmetric group on the category $\mathcal{F}_n$. Combinatorial tools known as weight and arrow diagrams for $\mathfrak{p}(n)$ are used to calculate the multiplicities of standard and costandard modules in indecomposable projective modules and to classify the blocks of $\mathcal{F}_n$. This is joint with M. Balagovic, Z. Daugherty, I. Entova-Aizenbud, I. Halacheva, J. Hennig, G. Letzter, E. Norton, V. Serganova, and C. Stroppel.

Maitreyee Kulkarni, Louisiana State University

Title: Dimer models on cylinders over Dynkin diagrams

Abstract: Let G be a Lie group of type ADE and P be a parabolic subgroup. It is known that there exists a cluster structure on the coordinate ring of the partial flag variety G/P (see the work of Geiss, Leclerc, and Schroer). Since then there has been a great deal of activity towards categorifying these cluster algebras. Jensen, King, and Su gave a direct categorification of the cluster structure on the homogeneous coordinate ring for Grassmannians (that is, when G is of type A and P is a maximal parabolic subgroup). In this setting, Baur, King, and Marsh gave an interpretation of this categorification in terms of dimer models. In this talk, I will give an analog of dimer models for groups in other types by introducing a technique called "constructing cylinders over Dynkin diagrams", which can (conjecturally) be used to generalize the result of Baur, King, and Marsh.

Bach Nguyen, Louisiana State University

Title: Quantum folding and quantum cluster algebra

Abstract: We explore the connections between quantum foldings and quantum cluster algebras using results of Ken Goodearl and Milen Yakimov on quantum nilpotent algebras.

Jessica Prince, Tennessee Technological University

Title: μ-rank of Noncommutative Quadratic Forms

Abstract:

In 2010, Cassidy and Vancliff extended the notion of commutative quadratic forms to the noncommutative setting. This led to a definition of a notion of rank, referred to as μ-rank, for quadratic forms on two and three generators. For quadratic forms on four generators, a definition for μ-rank was developed by Frauendienst and Veerapen. In this poster, we examine this further. We take the field k to be an algebraically closed field such that $\text{char}(k) \neq 2$.

Daniel Smertnig, University of Graz

Title: Non-unique factorizations in some noncommutative rings

Abstract: In a Noetherian ring every non-zero-divisor can be written as a product of atoms (irreducible elements). However, usually, such a representation is far from being unique. Arithmetical invariants can be used to describe, quantify, and study this non-uniqueness.

Studying non-unique factorizations has its origin in rings of algebraic integers, and a machinery has been developed for more general commutative domains and monoids (Dedekind domains and more generally Krull monoids). Recently, this approach has been extended to some noncommutative setting. We present results on bounded HNP rings and local quaternion orders.

Trey Trampel, Louisiana State University

Title: Noncommutative Discriminants and Poisson Primes

Abstract: We will present a general method for computing discriminants of noncommutative algebras obtained from specialization at roots of unity. This method builds a connection with Poisson geometry and will express the discriminants as products of Poisson primes. We will examine the method by computing the discriminants of specializations at roots of unity of algebras of quantum square matrices and the more general case of specialization of any quantum Schubert cell algebra.

Charlotte Ure, Michigan State University

Title: The generic Clifford algebra

Abstract: Let V be an n-dimensional vector space over a field k, and let TV be its tensor algebra over k. The generic Clifford algebra of degree d in n variables is the quotient of TV by the ideal generated by commutators $[X, Y^n]$ with X and Y in V. Note that for any homogeneous form of degree d in n variables, the Clifford algebra C_f associated to f is a homomorphic image of the generic Clifford algebra of degree d in n variables. My poster will be concerned with the case $n = 2, d = 3$. This is joint work in progress with Rajesh Kulkarni.

Kent Vashaw, Louisiana State University

Title: The Prime Spectra of 2-Categories

Abstract: We describe a general theory of prime, completely prime, semiprime, and primitive ideals of (abelian) 2-categories and the positive parts of $\mathbb{Z}_+$-rings. On the one hand, these notions provide a bridge between prime spectra of noncommutative rings and total positivity. On the other hand, they lead to a natural set of integrality conditions under which a quotient algebra by a prime ideal is categorifiable. As an application of the general theory we obtain monoidal categorifications of the quantization of coordinate rings of Richardson varieties for arbitrary symmetric Kac-Moody algebras. This is a joint work with Milen Yakimov.
