# Groups, Rings & Algebras

## A Conference in Honor of

## Donald S. Passman

## The University of Wisconsin-Madison

## June 10, 11 & 12, 2005

Partially Supported by the

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&

University of Wisconsin-Madison

W. Chin, J. Osterburg & D. Quinn

The Organizing Committee

# Program

Refreshments are available during breaks in the $9^{\text{th}}$ floor lounge of Van Vleck.

**Friday, June 10, 2005**

Friday Morning: `B130` Van Vleck. Chair *Sudarshan Sehgal*.

- 8:45–9:00 Opening Remarks
- 9:00–10:00 Yuri Bahturin, *Group gradings on simple Lie and Jordan algebras*.
- 10:15–11:15 Edward Formanek, *An identity relating the Bezoutian and the Jacobian for polynomials in two variables*.
- 11:30–12:30 I. Martin Isaacs, *Character degrees*.

12:30–2:30 Lunch. Coffee will be available in the $9^{\text{th}}$ floor lounge of Van Vleck from 1:30 to 2:30.

Friday Afternoon:

*The Cardinal Session*: `B135` Van Vleck. Chair *Declan Quinn*.

- 2:30–2:50 Asma Ali, *Derivations which act both as a homomorphism and anti-homomorphism in a prime ring*.
- 2:55–3:15 Alexander J. Diesl, *Morphic rings and their generalizations*.
- 3:20–3:40 Thomas Dorsey, *Strongly clean rings over local rings*.
- 3:45–4:05 Jörg Feldvoss, *Injective modules over universal enveloping algebras*.
- 4:10–4:30 Frauke Bleher, *Galois structure of homogeneous coordinate rings*.

- 4:35–4:55 Surender K. Jain, *When essential extensions of direct sums of simple modules are direct sums of quasi-injective modules.*
- 5:00–5:20 Michael Lau, *Orbifold vertex algebras and modules for extended affine Lie algebras.*

Friday Afternoon:

*The White Session*: B115 Van Vleck. Chair *Alexander Lichtman.*

- 2:30–2:50 Margaret Beattie, *Pythagorean triples and units in integral group rings.*
- 2:55–3:15 Esther Beneish, *Lattices over group rings and rationality problems.*
- 3:20–3:40 Jeffrey Bergen, *Delta methods in group rings, enveloping algebras, and Hopf algebras.*
- 3:45–4:05 Jairo Z. Gonçalves, *Free groups in central simple algebras without Tits' Theorem.*
- 4:10–4:30 César Polcino-Milies, *Idempotents in group algebras and minimal abelian codes.*
- 5:00–5:30 George M. Bergman, *Infinite product modules: big or little, but never in between.*

Candlelight Dessert Party at Passman's house; 7:30 PM

3118 Todd Drive, Madison; (608) 271-0645

**Saturday, June 11, 2005**

Saturday Morning: B130 Van Vleck. Chair *Georgia Benkart.*

- 9:00–10:00 Martin Lorenz, *Multiplicative invariants.*
- 10:15-11:15 Susan Montgomery, *Krull relations in Hopf Galois extensions.*

- 11:30-12:30 Toby Stafford, *Cherednik algebras and Hilbert schemes of points*.

Conference Photo in Van Vleck plaza after the final morning talk.

12:30–2:30 Lunch. Coffee will be available in the $9^{\text{th}}$ floor lounge of Van Vleck from 1:30 to 2:30.

Saturday Afternoon:
*The Cardinal Session*: `B135` Van Vleck. Chair *Jim Kuzmanovich*.

- 2:30–2:50 Hamid Usefi, *The isomorphism problem for enveloping algebras of Lie algebras*.
- 2:55–3:15 Miguel Ferrero, *Partial skew polynomial rings*.
- 3:20–3:40 Eric Jespers, *Quadratic algebras and groups of $I$-type*.
- 3:45–4:05 Peter Pappas, *Cyclic structures with lag-time generators*.
- 4:10–4:30 Chris Bendel, *Cohomology of Lie algebras and Frobenius kernels*.
- 4:35–4:55 Alexandr Zubkov, *Schur superalgebras in characteristic $p$*.
- 5:00–5:20 Pramod Kanwar, *Nonsingular CS-rings coincide with tight PP rings*.

Saturday Afternoon:
*The White Session*: `B115` Van Vleck. Chair *Gail Letzter*.

- 2:30–2:50 Miriam Cohen, *Fourier transforms for Hopf algebras*.
- 2:55–3:15 Earl Taft, *A left quantum group*.
- 3:20–3:40 Stefan Catoiu, *Generalized trigonometry, coalgebras, and the zeta function*.
- 3:45–4:05 Leonid Krop, *A generalization of the Curtis-Lusztig Theorem*.
- 4:10–4:30 Ken Price, *Generic Lie color algebras*.

- 4:35–4:55 Ian Musson, *Some noncommutative deformations of type A Kleinian singularities and Hilbert schemes.*
- 5:00–5:30 David E. Radford, *Representations parameterized by a pair of characters.*

Banquet; 6:00 PM

$9^{\text{th}}$ floor lounge of Van Vleck

**Sunday, June 12, 2005**

Sunday Morning: `B130` Van Vleck. Chair *Daniel Farkas.*

- 9:00–10:00 Lance Small, *Nil subrings of endomorphism rings.*
- 10:15–11:15 Alexander Zalesskiĭ, *On Passman's adjoint representation problem.*
- 11:30–12:30 Efim Zelmanov, *On free pro-p groups, polynomial identites and root graded algebras.*

End of Conference

# Talks

1. Asma Ali, *Derivations which act both as a homomorphism and anti-homomorphism in a prime ring*, Aligarh Muslim University, Aligarh, India.

2. Yuri Bahturin, *Group gradings on simple Lie and Jordan algebras*, Memorial University, St. John's, Newfoundland, Canada.

3. Margaret Beattie, *Pythagorean triples and units in integral group rings*, Mount Allison University, Sackville, New Brunswick, Canada.

4. Chris Bendel, *Cohomology of Lie algebras and Frobenius kernels*, University of Wisconsin-Stout, Stout, Wisconsin.

5. Esther Beneish, *Lattices over group rings and rationality problems*, Central Michigan University, Mt. Pleasant, Michigan.

6. Jeffrey Bergen, *Delta methods in group rings, enveloping algebras, and Hopf algebras*, DePaul University, Chicago, Illinois.

7. George M. Bergman, *Infinite product modules: big or little, but never in between*, University of California-Berkeley, Berkeley, California.

8. Frauke Bleher, *Galois structure of homogeneous coordinate rings*, University of Iowa, Iowa City, Iowa.

9. Stefan Catoiu, *Generalized trigonometry, coalgebras, and the zeta function*, DePaul University, Chicago, Illinois.

10. Miriam Cohen, *Fourier transforms for Hopf algebras*, Ben Gurion University of the Negev, Beer Sheva, Israel.

11. Alexander J. Diesl, *Morphic rings and their generalizations*, University of California-Berkeley, Berkeley, California.

12. Thomas Dorsey, *Strongly clean rings over local rings*, University of California-Berkeley, Berkeley, California.

13. Jörg Feldvoss, *Injective modules over universal enveloping algebras*, University of South Alabama, Mobile, Alabama.

14. Miguel Ferrero, *Partial skew polynomial rings*, Instituto de Matemática Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil.

15. Edward Formanek, *An identity relating the Bezoutian and the Jacobian for polynomials in two variables*, Pennsylvania State University, University Park, Pennsylvania.

16. Jairo Z. Gonçalves, *Free groups in central simple algebras without Tits' Theorem,* Universidade de São Paulo, São Paulo, Brazil.

17. I. Martin Isaacs, *Character degrees*, University of Wisconsin-Madison, Madison, Wisconsin.

18. Surender K. Jain, *When essential extensions of direct sums of simple modules are direct sums of quasi-injective modules*, Ohio University, Athens, Ohio.

19. Eric Jespers, *Quadratic algebras and groups of $I$-type*, Vrije Universiteit, Brussel, Belgium.

20. Pramod Kanwar, *Nonsingular CS-rings coincide with tight PP rings*, Ohio University-Zanesville, Zanesville, Ohio.

21. Leonid Krop, *A Generalization of the Curtis-Lusztig Theorem*, DePaul Univerisity, Chicago, Illinois.

22. Michael Lau, *Orbifold vertex algebras and modules for extended affine Lie algebras*, University of Ottawa, Ottawa, Ontario, Canada.

23. Martin Lorenz, *Multiplicative invariants*, Temple University, Philadelphia, Pennsylvania.

24. Susan Montgomery, *Krull relations in Hopf Galois extensions*, University of Southern California, Los Angles, California.

25. Ian Musson, *Some noncommutative deformations of type A Kleinian singularities and Hilbert schemes*, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin.

26. Peter Pappas, *Cyclic structures with lag-time generators,* Vassar College, Poughkeepsie, New York.

27. César Polcino-Milies, *Idempotents in group algebras and minimal abelian codes*, Universidade de São Paulo, São Paulo, Brazil.

28. Ken Price, *Generic Lie color algebras*, University of Wisconsin-Oskosh, Oskosh, Wisconsin.

29. David E. Radford, *Representations parameterized by a pair of characters*, University of Illinois at Chicago, Chicago, Illinois.

30. Lance Small, *Nil subrings of endomorphism rings*, University of California-San Diego, La Jolla, California.

31. Toby Stafford, *Cherednik algebras and Hilbert schemes of points*, University of Michigan, Ann Arbor, Michigan.

32. Earl Taft, *A left quantum group*, Rutgers University, New Brunswick, New Jersey.

33. Mihail Ursul, *Totally bounded topological rings,* University of Oradea, Romania.

34. Hamid Usefi, *The isomorphism problem for enveloping algebras of Lie algebras*, University of Western Ontario, London, Ontario, Canada.

35. Alexander Zalesskiĭ, *On Passman's adjoint representation problem*, The University of East Anglia, Norwich, United Kingdom.

36. Efim Zelmanov, *On free pro-p groups, polynomial identities and root graded algebras*, University of California-San Diego, La Jolla, California.

37. Alexandr Zubkov, *Schur superalgebras in characteristic p*, Omsk State Pedagogical University, Omsk, Russia.

# Abstracts

- Asma Ali, Aligarh Muslim University, Aligarh - 202002, India, *Derivations which act both as homomorphisms and anti-homomorphisms in a prime ring*.

  **Abstract**: Let $R$ be a prime ring and $S$ be a non-empty subset of $R$. Suppose that $\theta$ and $\phi$ are endomorphisms of $R$. An additive mapping $F : R \longrightarrow R$ is called a generalized $(\theta, \phi)$-derivation on $S$ if there exists a $(\theta, \phi)$-derivation $d : R \longrightarrow R$ such that $F(xy) = F(x)\theta(y) + \phi(x)d(y)$ holds for all $x, y \in S$. Suppose $U$ is a Lie ideal of $R$ such that $u^2 \in U$, for all $u \in U$. The main result of the present paper is that if $F$ is a generalized $(\theta, \theta)$-derivation on $U$ which acts as a homomorphism or an anti-homomorphism on $U$, then either $d = 0$ or $U \subseteq Z(R)$. The result obtained here extends the theorems due to Bell and Kappe [Acta. Math. Hung. 53 (1989), 339-346] and author [Acta. Math. Hung. 101 (2003), 79-82].

- Yuri Bahturin, Memorial University of Newfoundland, St. John's, Newfoundland, Canada, *Group gradings on simple Lie and Jordan algebras*.

  **Abstract** This talk is based on joint results with S. Sehgal, I. Shestakov and M. Zaicev. We describe the group gradings of classical simple Lie algebras and special simple Jordan algebras by arbitrary finite abelian groups over algebraically closed fields, with natural restrictions on the characteristic. The main approach is via the canonical matrix realizations of these algebras and our results describing all possible grading on matrix algebras.

- Margaret Beattie, Mount Allison Universiy, Sackville, New Brunswick, Canada, *Pythagorean triples and units in integral group rings*.

  **Abstract** In this talk, we will start with a project suitable for an undergraduate or high school student and show its relevance to the calculation of units in an integral group ring. This is joint work with Chester Weatherby.

- Chris Bendel, University of Wisconsin-Stout, Stout, Wisconsin, *Cohomology of Lie algebras and Frobenius kernels*.

  **Abstract** Let $G$ be a simple algebraic group over an algebraically closed field $k$ of characteristic $p > 0$, $B$ be a Borel subgroup, and $U$ be the the unipotent radical of $U$. A classical theorem of Kostant gives a characterization of the ordinary Lie algebra cohomology of the Lie algebra of $U$ over characteristic zero. This result has been extended to characteristic $p$ as long as $p$ is at least the Coxeter number of $G$. This talk will present recent results of D. Nakano, C. Pillen, and the speaker on first and second cohomology groups for small primes. Further, the talk will show how these results can used to obtain computations of certain cohomology groups for Frobenius kernels $B_r$ (of $B$) and $G_r$ (of $G$). In particular, an elegant formula found by Andersen and Jantzen for the $G_1$-cohomology of standard induced modules for large primes can be extended to small primes and generalized to higher Frobenius kernels in low degrees.

- Esther Beneish, Central Michigan University, Mt. Pleasant, Michigan, *Lattices over group rings and rationality problems*.

  **Abstract** Let $F$ and let $G$ be a finite group. Let $M$ be a $ZG$-lattice and let $F(M)$ be the quotient field of the group algebra $F[M]$. The study of the invariant subfield $F(M)^G$ is referred to as a lattice invariant problem. Various important problems, such as Noether's problem and Centers of generic algebras, can be described in terms of lattice invariants. We will present an overview of some of the methods used to solve such problems as well as some of the results obtained by such methods.

- Jeffrey Bergen, DePaul University, Chicago, Illinois, *Delta methods in group rings, enveloping algebras, and Hopf algebras*.

  **Abstract** Given a group $G$, the delta subgroup $\Delta(G)$ was introduced by Passman to study group algebras $K[G]$. $\Delta(G)$ was then used by Passman and many others to also examine skew group rings and crossed products. Several years later, for a Lie algebra $L$, Bahturin introduced delta subsets to examine the polynomial identities of enveloping algebras $U(L)$. Bergen and Passman defined a second type of delta ideal $\Delta_L$ in order to examine additional algebraic properties of $U(L)$. Recently

delta methods have been used to study properties of cocommutative Hopf algebras. In this talk we look back at various applications of delta methods and look forward to possible future applications.

- George M. Bergman, University of California-Berkeley, Berkeley, California, *Infinite product modules: big or little, but never in between.*

  **Abstract** I will begin with the following easily proved result: A countable product of copies of a nontrivial module, though it can be noncountably generated (clear) or finitely generated (also known) can never have generating number $\aleph_0$ (new?). I will then discuss some related results with the theme "It is hard to map infinite direct products onto infinite direct sums".

- Frauke Bleher, University of Iowa, Iowa City, Iowa, *Galois structure of homogeneous coordinate rings.*

  **Abstract** This is joint work with T. Chinburg. We consider the $RG$-module structure of the homogeneous coordinate ring $S(X)$ of a projective scheme $X$ over a commutative Noetherian ring $R$ on which a finite group $G$ acts. We study whether $S(X)$ has a polynomial description in the sense that the $n^{\text{th}}$ graded piece of $S(X)$ is isomorphic to a direct sum of indecomposable $RG$-modules lying in a finite set, independent of $n$, whose multiplicities grow as polynomial functions of $n$. We show that under suitable conditions, a variant of this statement holds in the Grothendieck group $G_0(RG)$. If the action of $G$ on $X$ is generically free and $R$ is a field, we show $S(X)$ has a polynomial description for some $X$ of low dimension.

- Stefan Catoiu, DePaul University, Chicago, Illinois, *Generalized trigonometry, coalgebras, and the zeta function.*

  **Abstract** We generalize the coalgebra of trigometric functions, $\sin x$ and $\cos x$, and the basic trigonometry involving them, and use these to compute values of the zeta function.

- Miriam Cohen, Ben Gurion University of the Negev, Beer Sheva, Israel, *Fourier transforms for Hopf algebras.*

  **Abstract** Usual Fourier transforms for groups are related to integrals. All finite-dimensional and some infinite-dimensional Hopf algebras give rise to integrals, which define in turn Fourier transforms for these Hopf

algebras. We first study these Fourier transforms $\Psi$, and the convolution product induced by them. "Quantum Fourier transforms" $F$ are defined by Lyubashenko and Majid [LM] as an application of categorical Fourier transforms. We study $F$ in terms of $\Psi$ and in addition to proving new properties of $F$ we give self-contained algebraic proofs of results in [LM].

We also apply the theory to give a short algebraic proof of the Verlinde formula for semisimple factorizable Hopf algebras.

- Alexander J. Diesl, University of California-Berkeley, Berkeley, California, *Morphic rings and their generalizations*.

  **Abstract** Following Nicholson and Sánchez Campos, we define a ring $R$ to be left morphic if, for every $a$ in $R$, there is a $b$ in $R$ such that the left annihilator of $a$ is $Rb$ and the left annihilator of $b$ is $Ra$. Such rings are a generalization of unit regular rings. In this talk, we will investigate some examples and generalizations of left morphic rings. We will also discuss some of the open problems in the theory of left morphic rings.

- Thomas Dorsey, University of California-Berkeley, Berkeley, California, *Strongly clean rings over local rings*.

  **Abstract** The work discussed here is joint with Alex Diesl and Gautam Borooah. An element of a ring is said to be clean if it is the sum of a unit and an idempotent, strongly clean if it is the sum of a unit and an idempotent which commute. We will characterize the commutative local rings $R$ for which $M_n(R)$ is strongly clean, and we will also discuss cleanness properties of incidence rings over clean rings.

- Jörg Feldvoss, University of South Alabama, Mobile, Alabama, *Injective modules over universal enveloping algebras*.

  **Abstract** In this talk, we will consider injective modules over universal enveloping algebras of finite-dimensional Lie algebras which either are solvable over a field of characteristic zero or arbitrary over a field of prime characteristic. It turns out that in both cases the injective hulls of locally finite modules are always locally finite. This enables us to develop a unified approach for several results on locally finite submodules of the coregular module of universal enveloping algebras.

For instance, the continuous dual of a universal enveloping algebra of a finite-dimensional Lie algebra over a field of prime characteristic is always injective and the same holds in characteristic zero if and only if the Lie algebra is solvable. Moreover, we also discuss the cohomology of certain locally finite submodules of the coregular module and a recent result of Hans-Jürgen Schneider which is important in the extension theory of Lie bialgebras. Finally, we also describe the minimal resolution of the regular module of a universal enveloping algebra of a finite-dimensional Lie algebra over a field of prime characteristic.

- Miguel Ferrero, Instituto de Matemática Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil, *Partial skew polynomial rings*.

  **Abstract** Partial skew group rings have been recently defined by M. Dokuchaev and R. Exel, using partial actions. In this lecture we define partial skew polynomial rings. A partial skew polynomial ring can be considered as a subring of a skew polynomial ring $T[x, \sigma]$ defined by a direct summand of $T$. Complete description of prime and maximal ideals are given.

  The results of this lecture are contained in a joint work with Wagner Cortes.

- Edward Formanek, Pennsylvania State University, University Park, Pennsylvania. *An identity relating the Bezoutian and the Jacobian for polynomials in two variables*.

  **Abstract** Associated with any pair of polynomials $f(y), g(y)$ of degree $\leq n$ over a commutative ring is an $n \times n$ matrix $\mathcal{B}_y(f, g)$, the *Bezoutian* of $f$ and $g$ with respect to $y$. If $f(x, y)$ and $g(x, y)$ are polynomials in two variables over a field $K$ of degree $n$ in $y$ and $u, v$ are two new variables, then the determinant of $\mathcal{B}_y(f - u, g - v)$ is a polynomial $\Phi(u, v, x) \in K[u, v, x]$, which for general polynomials is the minimal polynomial of $f$ and $g$ over $K(x)$.

  **Theorem.** *$J(f, g)b_0(f, g, x) = \Phi_x(f, g, x)$, where $J(f, g)$ is the Jacobian of $f$ and $g$, $b_0(u, v, x)$ is the $(1, 1)$-cofactor of $\mathcal{B}_y(f-u, g-v)$, and $\Phi_x(f, g, x)$ is the derivative of $\Phi(f, g, x)$ with respect to $x$.*

- Jairo Z. Gonçalves, Universidade de São Paulo, São Paulo, Brazil, *Free groups in central simple algebras without Tits' Theorem.*

**Abstract** This is a joint work with Professor Mazi Shirvani, from the University of Alberta. Let $R$ be a noncommutative central simple algebra, the centre $k$ of which is not absolutely algebraic, and consider units $a, b \in R$ such that $\langle a, a^b \rangle$ freely generate a free group. It is shown that such $b$ can be chosen from suitable Zariski dense open subsets of $R$, while the $a$ can be chosen from a set of cardinality $|k|$ which need not to be open.

- I. Martin Isaacs, University of Wisconsin-Madison, Madison, Wisconsin, *Character degrees.*

  **Abstract** How much information about a finite group can be recovered from a knowledge of the isomorphism type of its complex group algebra? This algebra is a direct sum of full matrix algebras, and so it is determined by a list of integers: the sizes of the matrices, or in group-theoretic language, the degrees of the irreducible characters. In fact, a great deal of information about a group can be recovered from a knowledge of the set of degrees, even without knowing how many of each there are. (In fact, a knowledge of just the cardinality of the set of degrees gives significant information.)

- Surender K. Jain, Ohio University, Athens, Ohio, *When essential extensions of direct sums of simple modules are direct sums of quasi-injective modules.*

  **Abstract** Bass-Papp showed that $R$ is right noetherian if and only if every direct sum of injective modules is injective. Later Kurshan proved that $R$ is right noetherian if and only if every countable direct sum of injective hulls of simple right $R$-modules is injective. Beidar-Ke showed that $R$ is right noetherian if and only if every essential extension of a direct sum of injective modules (or injective hulls of simple modules) is a direct sum of injective modules. We show that any finitely generated module $M$ is right noetherian if and only if $M$ is right $q.f.d.$ and every essential extension of a direct sum of injective hulls of simple modules is a direct sum of quasi-injectives. In case $R$ is a von-Neumann regular ring, it can be shown that $R$ is artinian if and only if every essential extension of a direct sum of simple modules is a direct sum of quasi-injective modules. (Joint work with the late Kostia Beidar and Ashish Srivastava)

- Eric Jespers, Vrije Universiteit, Brussel, Belgium, *Quadratic algebras and groups of $I$-type.*

  **Abstract** In joint work with J. Okninski, the problem of characterizing Noetherian semigroup algebras $K[S]$ is investigated. In this talk we present recent results when $S$ has a presentation with $n$ generators $x_1, \ldots, x_n$ and $\binom{n}{2}$ quadratic homogeneous equations so that each pair $x_i x_j$ appears in at most one defining relation. These monoids first appeared in the work of Gateva-Ivanova and Van den Bergh (inspired by earlier work of Tate and Van den Bergh) and Etingof, Schedler and Soloviev. There are connections with various other mathematical notions, such as set theoretic solutions of the Yang-Baxter equation, Bieberbach groups and rings and groups of $I$-type.

- Pramod Kanwar, Ohio University-Zanesville, Zanesville, Ohio, *Nonsingular CS-rings coincide with tight PP rings.*

  **Abstract** This is joint work with K. I. Beidar and S. K. Jain. It is shown that a ring $R$ is a right nonsingular right CS-ring if and only if $R$ is a right $R$-tight right PP-ring. In particular, if $R$ is a right nonsingular ring such that $Q^r_{max}(R)$ is unit regular (equivalently, directly finite) then $R$ is right CS if and only if $R$ is a right weakly selfinjective and right PP-ring. As an application it is shown that for any domain $R$, $R^2_R$ is CS if and only if $R$ is right 2-hereditary two sided Ore domain, giving answer to an open question known previously in special cases. For a von Neumann regular ring $R$, it is shown that the matrix ring $M_n(R)$, $n > 1$, is right weakly selfinjective if and only if $R$ is right selfinjective.

- Leonid Krop, DePaul Univerisity, Chicago, Illinois, *A generalization of the Curtis-Lusztig Theorem.*

  **Abstract** C. Curtis' theorem on simple restricted modules for classical finite-dimensional Lie algebras $L$ states that every such module has one-dimensional socle when viewed as the module for a Borel subalgebra of $L$. G. Lusztig proved a similar statement for his deformations of the restricted enveloping algebras of $L$. Lusztig's construction is intimately connected to the Drinfel'd double construction for a finite-dimensional Hopf algebra.

  In this talk we define a class of finite-dimensional pointed Hopf algebras $H$ whose double have the property that the functor $M \mapsto \sigma(M_B)$

induces a one-to-one correspondence between the set of simple $D(H)$-modules and the set of algebra homomorphisms from $B$ to the ground field $k$. Here $B$ is a certain subHopfalgebra of $D(H)$ and $\sigma(M_B)$ denotes the socle of the $B$-module $M$.

- Michael Lau, University of Ottawa, Ottawa, Ontario, Canada, *Orbifold vertex algebras and modules for extended affine Lie algebras*.

  **Abstract** In the late 1960s, Victor Kac constructed the affine Lie algebras from fixed point subalgebras of loop algebras. Recent work on multiloop algebras has shown that almost all extended affine Lie algebras can be described in terms of fixed point subalgebras of toroidal loop algebras. In this joint work in progress with Y. Billig, I will describe a procedure to construct representations of these extended affine Lie algebras using an appropriate vertex algebra analogue of a multiloop algebra.

- Martin Lorenz, Temple University, Philadelphia, Pennsylvania, *Multiplicative invariants*.

  **Abstract** This will be a survey talk on some recent developments in multiplicative invariant theory.

- Susan Montgomery, University of Southern California, Los Angles, California, *Krull relations in Hopf Galois extensions*.

  **Abstract** I will discuss recent work with H.-J. Schneider on the Krull relations for prime ideals in a ring extension $R \subset A$, where the extension is $H$-Galois for a finite-dimensional Hopf algebra $H$. In earlier work, we studied versions of Incomparability, Lying over, and Going Up which extend the classical notions, as well as those studied by Lorenz and Passman when $H = kG$, a group algebra and $A = R * G$, a crossed product of $G$ over $R$. In newer work we consider Galois extensions for some particular Hopf algebras $H$, such as the Taft algebras, the pointed Hopf algebras described by Andruskiewitsch and Schneider, bicrossed products constructed from factorizable groups, and their Drinfel'd doubles. Our approach is to consider what happens to the Krull relations when $H$ and the algebra $A$ are twisted by a (Hopf) 2-cocycle or dual cocycle.

- Ian Musson, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin, *Some noncommutative deformations of type A Kleinian singularities and Hilbert schemes*.

  **Abstract** Let $H_{\mathbf{k}}$ be a symplectic reflection algebra corresponding to a cyclic subgroup $\Gamma \subseteq SL_2\mathbb{C}$ of order $n$, and $U_{\mathbf{k}} = eH_{\mathbf{k}}e$ the spherical subalgebra of $H_{\mathbf{k}}$. We show that for suitable $\mathbf{k}$ there is a filtered $\mathbb{Z}^{n-1}$-algebra $R$ such that

  **Theorem.** (1) *There is an equivalence of categories* $R-\mathrm{qgr} \simeq U_{\mathbf{k}}$*-mod.* (2) *There is an equivalence of categories* $grR-\mathrm{qgr} \simeq Coh(Hilb_{\Gamma}\mathbb{C}^2)$.

  Here $Coh(Hilb_{\Gamma}\mathbb{C}^2)$ is the category of coherent sheaves on the $\Gamma$-Hilbert scheme and for a graded algebra $\mathcal{R}$, we write $\mathcal{R}-\mathrm{qgr}$ for the quotient category of finitely generated graded $\mathcal{R}$-modules modulo torsion.

- Peter Pappas, Vassar College, Poughkeepsie, New York, *Cyclic structures with lag-time generators*.

  **Abstract** In work with Rachel Betz and Sandrah Eckel, we introduce the notion of algebraic structures with lag-time generators. Our main result gives necessary and sufficient arithmetic conditions for such structures to be cyclic. Applications include a a classification of lag-time torus knots as well as generalizations of classical results from algebra and number theory.

- César Polcino-Milies, Universidade de São Paulo, São Paulo, Brazil, *Idempotents in group algebras and minimal abelian codes*.

  **Abstract** For a fixed finite abelian group $G$, the minimal number of abelian codes in $\mathrm{GF}(p)[G]$ occurs when the primitive idempotents in the rational group algebra $\mathbb{Q}[G]$ remain primitive in the modular group algebra. This is equivalent to certain cyclotomic polynomials remaining irreducible over $\mathrm{GF}(p)$, and this situation is characterized.

- Ken Price, University of Wisconsin-Oskosh, Oskosh, Wisconsin, *Generic Lie color algebras*.

  **Abstract** We describe a type of Lie color algebra, which we call generic, whose universal enveloping algebra is a domain with finite global dimension. Moreover, it is an iterated Ore extension. We provide an application and show Gröbner basis methods can be used to study universal enveloping algebras of factors of generic Lie color algebras.

- David E. Radford, University of Illinois at Chicago, Chicago, Illinois, *Representations parameterized by a pair of characters*.

  **Abstract** Let $U$ and $A$ be algebras over a field $k$. We study algebra structures $H$ on the underlying tensor product $U \otimes A$ of vector spaces which satisfy $(u \otimes a)(u' \otimes a') = uu' \otimes aa'$ if $a = 1$ or $u' = 1$. For a pair of characters $\rho \in \mathrm{Alg}\,(U, k)$ and $\chi \in \mathrm{Alg}\,(A, k)$ we defined a left $H$-module $L(\rho, \chi)$. Under reasonable hypotheses the correspondence $(\rho, \chi) \mapsto L(\rho, \chi)$ determines a bijection between character pairs and the isomorphism classes of objects in a certain category ${}_H\underline{\mathcal{M}}$ of left $H$-modules. In many cases the finite-dimensional objects of ${}_H\underline{\mathcal{M}}$ are the finite-dimensional irreducible left $H$-modules. There are large families of finite-dimensional pointed Hopf algebras whose irreducible representations are parameterized by pairs of characters. This is joint work with Hans Jürgen Schneider.

- Lance Small, University of California-San Diego, La Jolla, California, *Nil subrings of endomorphism rings*.

  **Abstract** Various nil implies nilpotence theorems will be discussed. In particular, we shall show that nil subrings of endomorphism rings of finitely generated modules over affine PI rings are nilpotent. This result will be applied to show that weakly Engel Lie subalgebras of affine PI algebras are Lie nilpotent. This is joint work with R. Guralnick and E. Zelmanov.

- Toby Stafford, University of Michigan, Ann Arbor, Michigan, *Cherednik algebras and Hilbert schemes of points*.

  **Abstract** The work discussed in this lecture is joint with Iain Gordon.

  The Cherednik algebra $H_c$ of type $A_{n-1}$ is a particular deformation of the twisted group ring of a Weyl algebra by the symmetric group $S_n$. In their short history, Cherednik algebras have been influential in a surprising range of subjects: for example they have been used to answer questions in integrable systems, combinatorics and symplectic quotient singularities.

  In many ways Cherednik algebras behave rather like primitive factor rings of enveloping algebras. In this talk we will show, in a manner reminiscent of the Beilinson-Bernstein equivalence of categories, that $H_c$ can also be regarded as a noncommutative deformation of the Hilbert

scheme of points in the plane. This can be used to show the close connection between the representation theory of $H_c$ and the geometry of Hilbert schemes. In turn this allows one to use the rich theory of Hilbert schemes, notably Haiman's work on the $n!$ conjecture, to understand the representation theory of Cherednik algebras.

- Earl Taft, Rutgers University, New Brunswick, New Jersey, *A left quantum group.*

  **Abstract** We describe our recent construction of a variation of quantum SL(2), which results in a bialgebra with a left antipode but no right antipode (J. Algebra **286** (2005) 154–160). There are four relations on the comatrix generators $X_{ij}$, $i, j = 1, 2$ which involve reducing the four quadratic monomials $X_{2i} \cdot X_{1j}$ for $i, j = 1, 2$. There is a basis of irreducible monomials with the feature that the comultiplication of an irreducible monomial (before any reduction) has the set of left tensor factors also irreducible. The left antipode constructed is not an algebra antihomomorphism, although it does reverse order on irreducible monomials. We will describe our current efforts to extend our construction to variations of quantum SL($n$), for $n > 2$. (Joint with Suemi Rodriguez-Romo, UNAM. Mexico.)

- Mihail Ursul, University of Oradea, Romania, *Totally bounded topological rings.*

  **Abstract** Recall that a Hausdorff topological ring is called *totally bounded* provided its completion is a compact ring. We will present new theorems concerning rings of endomorphisms of abelian groups admitting a compact ring topologies, compact right topological rings and dense free boolean subrings of compact boolean rings.

- Hamid Usefi, University of Western Ontario, London, Ontario, Canada, *The isomorphism problem for enveloping algebras of Lie algebras.*

  **Abstract** This is joint work with David Riley. Let $L$ be a Lie algebra with universal enveloping algebra $U(L)$. The isomorphism problem asks whether or not (the isomorphism type of) every Lie algebra $L$ is determined by the algebra structure of $U(L)$. In this talk we shall show that if $H$ is another Lie algebra with the property that $U(L) \cong U(H)$ then certain invariants of $L$ are inherited by $H$. For example, we show that if $L$ is nilpotent then $H$ is nilpotent with the same class as $L$.

We also prove that if $L$ is nilpotent of class at most two then $L$ is isomorphic to $H$. Meanwhile, we provide examples showing that the isomorphism problem has a negative solution in its general form.

- Alexander Zalesskiĭ, University of East Anglia, Norwich, United Kingdom, *On Passman's Adjoint Representation Problem.*

  **Abstract** In 1992, D. S. Passman published a paper where he studied adjoint group representations. These are permutation representations associated with the action of a group $G$ on itself by conjugation. More precisely, if $F$ is a field, $M$ is the $FG$-module of the adjoint representation then the problem is to determine the kernel of the mapping from the group algebra $FG$ to End$M$. He clarified the problem for infinite groups, but the finite group case remains rather mysterious. For $F$ of characteristic 0 the problem is equivalent to determining the irreducible $FG$-modules that are not constituents of $M$. Passman specified the problem by asking for which groups $G$ is every irreducible $FG$-module a constituent of $M$. Obviously, such $G$ are centerless, but I assume $G$ to be simple. The main result to be reported says that for a finite simple classical group $G$ the answer is negative if and only if $G = \mathrm{SU}(n, q)$ for $n$ coprime to $2(q + 1)$. In this case there is exactly one irreducible $FG$-module which is not a constituent of $M$. The answer is observed to be positive also for all sporadic simple groups. These results have been obtained jointly with G. Heide.

- Efim Zelmanov, University of California-San Diego, La Jolla, California, *On free pro-p groups, polynomial identities and root graded algebras.*

  **Abstract** It is an old problem whether the free pro-p group is linear. I will discuss the connections of this problem with the theory of algebras satisfying a polynomial identity and, what is more surprising, with Lie algebras graded by root systems.

- Alexandr Zubkov, Omsk State Pedagogical University, Omsk, Russia, *Schur superalgebras in characteristic p.*

  **Abstract** This is joint work with Frantisek Marko. We define upper and lower Borel subalgebras that play a crucial role in the representation theory of Schur superalgebras. Simulating the approach from the representation theory of algebraic groups based on properties of

(co)induced functors, we derive that all simple modules over a Schur superalgebra are uniquely defined by their highest weights with respect to the dominance order. This is a generalization of a recent result of Donkin. Our proof is more elementary and does not use the representation theory of symmetric groups. Further we discuss Kempf vanishing theorem, Donkin-Mathieu's theorem and Schur superalgebras that are quasi-hereditary, cellular or stratified (in the sense of Dlab-Agoston-Lukacs). The last three properties for non-classical Schur superalgebras are equivalent to semisimplicity.

# Participants

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