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**Practical Information:**

*Registration:* Sunday 17:00 – 19:00 and Monday 07:30 – 08:45.

A full-board reservation at Sol Cress includes the following:

*Breakfast:* 07:30 – 08:45
*Lunch:* 12:30 (except Wednesday: 12:10)
*Dinner:* 19:00 (except Wednesday: 20:00).

On Thursday the [Conference Dinner](#) will take place at 19:00.

**Excursion:** On Wednesday afternoon there are no lectures. We organize a trip to the city of Liège (about 40km). The price is 20 Euro to be payed cash during the registration. This includes a bus trip to Liège and back, a guided city tour and tasting of Belgian beers (there will also be non-alcoholic alternatives).
Let $Q[G]$ be the rational group algebra of the finite group $G$. Since $Q$ is a perfect field, every element $x$ of $Q[G]$ has a unique additive Jordan decomposition $x = x_s + x_n$, where $x_s$ is semisimple and where $x_n$ commutes with $x_s$ and is nilpotent. If $x$ is a unit, then $x_s$ is also invertible and $x = x_s(1 + x_n)$ is a product of a semisimple unit $x_s$ and a commuting unipotent unit $x_n = 1 + x_n^2x_n$. This is the unique multiplicative Jordan decomposition of $x$. Following Hales and Passi, we say that $G$ has the multiplicative Jordan decomposition property (MJD) if for every unit $a$ of $Z[G]$, its semisimple and unipotent parts are both contained in $Z[G]$. It is an interesting and quite difficult problem to determine which groups have MJD. In this talk, I will discuss the results of Hales and Passi, as well as my results with Liu.

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On finite dimensional $G$-graded division algebras

Eli Aljadeff, Technion Institute of Technology, Israel

Two central simple algebras, $A_1$ with center $k_1$ and $A_2$ with center $k_2$, are said to be forms of each other if they become isomorphic after extensions of scalars, that is there exists a field $K$ which extends $k_1$ and $k_2$ and $A_1 \otimes_{k_1} K \cong A_2 \otimes_{k_2} K$ as $K$ algebras. Using this terminology, one knows that any $k$-central simple algebra and in particular $M_n(k)$ admits a division algebra form.

Let $G$ be any finite group. We apply tools from PI theory (and in particular generic constructions) in order to characterize the finite dimensional $G$-simple algebras over an algebraically closed field of characteristic zero which admit a $G$-graded division algebra form. Joint work with Yaakov Karasik.

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Almost Engel finite, profinite, and compact groups

Evgeny Khukhro, University of Lincoln, UK & Sobolev Institute of Mathematics, Novosibirsk, Russia

Recall the notation for left-normed simple commutators:

$$[a_1, a_2, a_3, ..., a_r] = [...[[a_1, a_2], a_3], ..., a_r].$$

A group $G$ is called an Engel group if for every $x, g \in G$ we have $[x, g, g, ..., g] = 1$, where $g$ is repeated sufficiently many times depending on $x$ and $g$.


We say that a group $G$ is almost Engel if for every $g \in G$ there is a finite set $E(g)$ such that for every $x \in G$,

$$[x, g, g, ..., g] \in E(g) \quad \text{for all } n \geq n(x, g).$$

We prove that if $G$ is an almost Engel compact Hausdorff group, then $G$ has a finite normal subgroup $N$ such that $G/N$ is locally nilpotent. The proof consists of three parts. First, a quantitative version is proved for finite groups: if $G$ is a finite group and there is a positive integer $m$ such that $|E(g)| \leq m$ for every $g \in G$, then $G$ has a normal subgroup $N$ of order bounded in terms of $m$ such that $G/N$ is nilpotent. Then the result is proved for profinite groups using the finite case and the Wilson-Zelmanov theorem. Finally, the proof for compact groups is achieved by reduction to profinite case using structure theorems for compact groups.

Joint work with Pavel Shumyatsky.
Matched products of left braces and simplicity
Ferran Cedó, Universitat Autònoma de Barcelona, Spain

Braces were introduced by Rump to study non-degenerate involutive set-theoretic solutions of the Yang-Baxter equation. It has been recently proved that, given a left brace $B$, one can construct explicitly all the non-degenerate involutive set-theoretic solutions of the Yang-Baxter equation such that the associated permutation group is isomorphic, as a left brace, to $B$. It is hence of fundamental importance to describe all simple objects in the class of finite left braces. A left brace $B$ is simple if it is nonzero and $\{0\}$ and $B$ are the only ideals of $B$. In this talk I will explain the matched product decompositions of an arbitrary finite left brace and how to construct new families of finite simple left braces using external matched products of left braces, corresponding to its internal matched product decomposition.

(Joint work with David Bachiller, Eric Jespers, and Jan Okniński.)

Degree bounds and rationality of Hilbert series in noncommutative invariant theory
Matyás Domokos, MTA Alfred Rényi Institute of Mathematics, Hungary

The main object of study in commutative invariant theory is the subalgebra of fixed elements of a group $G$ of linear transformations of a finite dimensional vector space $V$ acting on the symmetric tensor algebra of $V$. A natural way to develop noncommutative invariant theory is to replace the symmetric tensor algebra (i.e. a commutative polynomial algebra) by the factor of the tensor algebra of $V$ (i.e. a free associative algebra) modulo a $T$-ideal (i.e. an ideal stable under all algebra endomorphisms – a central notion in the theory of algebras satisfying a polynomial identity). In the talk we shall discuss recent joint results with Vesselin Drensky on the extension to this context of the following two topics:

- Noether’s degree bound for generators of rings of polynomial invariants of finite groups.
- Rationality of the Hilbert series of the algebras of invariants for a large class of groups (including reductive groups).

References:

Classification of real graded division algebras
Yuri Bakhturin, Memorial University of Newfoundland, Canada

An algebra $A$ over a field of real numbers graded by a group $G$ is called graded division if all nonzero homogeneous elements of $A$ are invertible. Two gradings on $A$ are called equivalent if there is an automorphism of $A$ which maps homogeneous components of one of the grading to those of the other. In this joint work with Professor Mikhail Zaicev, we completely classify all finite-dimensional associative real graded division algebras, up to equivalence, in the case where $G$ is abelian. In applications to Lie algebras, $G$ we can always be assumed abelian.

Combinatorial rank of quantum groups of infinite series
Vladislav Kharchenko, UNAM, Mexico

In general, an intersection of two Hopf ideals of a Hopf algebra is not a Hopf ideal. By this reason, one may not define a Hopf ideal generated by a set of elements, and the Hopf algebras do not admit a usual combinatorial representation by generators and relations. Nevertheless, Heyneman–Radford theorem implies that each nonzero Hopf ideal of a pointed Hopf algebra has a nonzero skew primitive element. Each ideal generated by skew primitive elements is a Hopf ideal. Therefore, the Heyneman–Radford theorem allows one to define a combinatorial representation step-by-step by means of skew primitive relations. By definition the combinatorial rank is the minimal number of steps in that representation. We find the combinatorial ranks of the multiparameter versions of the small Lusztig quantum groups (Frobenius–Lusztig kernels) of infinite series $A_n, B_n, C_n, D_n$. This is a joint work with M.L. Díaz Sosa (Universidad Nacional Autónoma de México, FESC-Acatlán).
Bovdi units and free products in integral group rings of finite groups

DOHYAN TEMMERMAN, Vrije Universiteit Brussel, Belgium

In the study of the Isomorphism Problem and the Zassenhaus Conjecture, one often seeks specific subgroups of the unit group of an integral group ring.

In this talk we will discuss recent results of the construction of amalgamated products, in particular free products of finite groups, free semigroups, solvable subgroups and other subgroups with nice properties. This is done via the study of a new type of generic, non-trivial torsion unit, introduced by V. Bovdi. These so-called Bovdi units are deformations of trivial units using bicyclic units.

We will sketch how to construct free products of cyclic groups in matrix algebras and how to lift them back to the integral group ring. Interestingly, this method also yields elements that, as a semigroup, generate a free semigroup but do not generate a free group.

All this is based on joint works with A. Bächle, G. Janssens and E. Jespers.

Division Algebras with Left Algebraic Commutators

MEHDI AAGHABALI, University of Edinburgh, UK

Let $D$ be a division algebra with center $F$ and $K$ a (not necessarily central) subfield of $D$. An element $a \in D$ is called left algebraic (resp. right algebraic) over $K$, if there exists a non-zero left polynomial $a_0 + a_1 x + \cdots + a_n x^n$ (resp. right polynomial $a_0 + a_1 x + \cdots + a_n x^n$) over $K$ such that $a_0 + a_1 a + \cdots + a_n a^n = 0$ (resp. $a_0 + a a_1 + \cdots + a^n a_n = 0$). Bell et al proved that every division algebra whose elements are left (right) algebraic of bounded degree over a (not necessarily central) subfield must be centrally finite. In this paper we generalize this result and prove that every division algebra whose all multiplicative commutators are left (right) algebraic of bounded degree over a (not necessarily central) subfield must be centrally finite provided that the center of division algebra is infinite. Also, we show that every division algebra whose multiplicative group of commutators is left (right) algebraic of bounded degree over a (not necessarily central) subfield must be centrally finite. Among other results we present similar result regarding additive commutators under certain conditions.

Joint work with S. Akbari and M.H. Bien. The research was supported by ERC grant number 320974.

Twisted group ring isomorphism problem

OFIR SCHNABEL, University of Haifa, Israel

We propose a variation of the classical isomorphism problem for group rings in the context of projective representations. We formulate several weaker conditions following from our notion and give all logical connections between these condition by studying concrete examples. We introduce methods to study the problem and provide results for various classes of groups, including abelian groups, groups of central type, $p$-groups of order $p^4$ and groups of order $p^2 q^2$, where $p$ and $q$ denote different primes. Joint work with Leo Margolis.

Group identities for unitary units of group rings

ERNESTO SPINELLI, Sapienza Universita Di Roma, Italy

In the present talk we shall review some results concerning the structure of a group ring when the subgroup of its unitary units with respect to the classical involution satisfies certain group identities.

Some results on graded nil rings

JASON BELL, University of Waterloo, Canada

We describe joint work with Blake Madill and Be’eri Greenfeld and ongoing work with Be’eri Greenfeld on graded nil rings. A graded nil ring is an N-graded ring with the property that each homogeneous element is nilpotent. We show that there is an infinite-dimensional graded nil ring that is finitely generated as a Lie algebra; we show that there is such a ring that contains a free algebra. We explore connections to Koethe’s conjecture as well.
Skew braces and the Yang-Baxter equation

LEANDRO VENDRAMIN, University of Buenos Aires, Argentina

Braces were introduced by Rump to study non-degenerate involutive set-theoretic solutions of the Yang–Baxter equation. To study non-involutive solutions one needs skew braces, a non-commutative analog of braces. In this talk we discuss basic properties of skew braces and how these structures are related to the Yang-Baxter equation. We also discuss interesting connections between skew braces and several structures appearing in non-commutative ring theory. The talk will be mainly based on a joint work with A. Smoktunowicz.

An algorithmic construction of group automorphisms and the Yang-Baxter equation

FABIENNE CHOURAQUI, University of Haifa, Israel

The quantum Yang-Baxter equation is an equation in the field of mathematical physics and it lies in the foundation of the theory of quantum groups. The classification of the solutions of the quantum Yang-Baxter equation is still an open problem, and as an approach to tackle this problem V. Drinfeld suggested the study of set-theoretical solutions of this equation. If a set-theoretical solution satisfies some properties, then the induced operator $R$ is a solution of the quantum Yang-Baxter equation. To each such set-theoretical solution of the quantum Yang-Baxter equation is associated a group $G$ called the structure group. This group has a rich algebraic structure: it is a Bieberbach group and a Garside group. A particular interesting and efficient approach to understand a group is to compute and understand its automorphism group. In this talk, I will present an algorithm to compute explicitly a group of automorphisms of this group. Indeed, given an invertible integer matrix, there is a combinatorial criteria to decide whether it can induce an automorphism of the group and to compute it explicitly. Furthermore, there is a subgroup of this group of automorphisms that preserve entirely the Garside structure.

A Glimpse into the asymptotics of Polynomial identities

GEOFFREY JANSENS, Vrije Universiteit Brussel, Belgium

Given a set $A$ of algebras, a natural problem is to discover which algebras from $A$ are (not) isomorphic. A classical way to attack such ‘distinguishing problems’ is my means of invariants. In this talk we will associate to any finite dimensional algebra two invariants and be interested in the information they contain.

Actually we will do this for the more general class of algebras satisfying a polynomial identity, in short PI algebras. Therefore we will start by an introduction to polynomial identities. More precisely we will explain, for a PI algebra $A$ over a field of characteristic 0, the so called codimension sequence, denoted $(c_n(A))_n$, and some results hereof. Among other, as conjectured by Amitsur and thereafter proved by Berele and Regev [2], the sequence $c_n(A)$ grows asymptotically as the function $f(n) = cn^t d^n$ for some constants $c,t$ and $d$ depending on $A$. Surprisingly the invariant $t$ is an half-integer and the invariant $d$ even an integer. Moreover, as will be illustrated through examples, this values are computable and tightly connected with the algebraic structure of $A$ (see [3,1]). We will also point out the special role played by the representation theory of $S_n$. To finish we briefly discuss the modifications in the story if char$(F) > 0$, or if $A$ is only a $\mathbb{Z}$-algebra, in which case $S_n$-representation theoretical issues appear.

References

I will give a short overview of algorithms to compute with lattices over group rings of finite groups, the ring of coefficients being a $p$-adic ring. Originally these were intended to allow the computation of indecomposable projective lattices (and, ultimately, basic algebras), but I will also report on recent ongoing joint work with L. Margolis that aims to adapt these algorithms to prove Zassenhaus’ conjecture for various small groups.

References

References


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The cut-groups: Groups with all central units of integral group rings trivial

**Sugandha Maheshwary**, Indian Institute of Science Education and Research Mohali, India

Given a finite group $G$, the group $\mathbb{Z}(U(ZG))$ of central units of the integral group ring $ZG$ always contains the so-called trivial central units $\pm g$, $g \in \mathbb{Z}(G)$, the centre of $G$. Naturally, there arises the problem of characterizing the groups $G$ having the property that all central units of $ZG$ are trivial, namely the cut-groups or groups with the cut-property. In this talk, I shall present results on the classification of various classes of finite groups with the cut-property and its impact in better understanding of upper central series of $U(ZG)$. A survey of recent advancements in this direction, shall be given, followed by some natural questions, which may be of interest to people working in groups, rings and group rings.

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Algebras of linear growth and the dynamical Mordell-Lang conjecture

**Dmitri Piontkovski**, NRU HSE, Russia

Ufnarovski remarked in 1990 that it is unknown whether any finitely presented associative algebra of linear growth is automaton, that is, whether the set of normal words in the algebra form a regular language. In the case when the algebra is graded, the rationality of the Hilbert series of the algebra follows from the affirmative answer. Assuming that the ground field has a positive characteristic, we show that the answer to Ufnarovskii’s question is positive if and only if the basic field is an algebraic extension of its prime subfield. Moreover, in the “only if” part we show that there exist a finitely presented graded algebras of linear growth with irrational Hilbert series. In addition, we show that over an arbitrary infinite basic field the set of Hilbert series of the quadratic algebras of linear growth with 5 generators is infinite.

Our approach is based on a connection with the dynamical Mordell-Lang conjecture. This conjecture describes the intersections of orbits of an algebraic variety endomorphism with a subvariety. We show that the positive answer to the Ufnarovski problem implies some (known) cases of the dynamical Mordell-Lang conjecture. In particular, the positive answer for a class of algebras is equivalent to the Skolem-Mahler-Lech theorem which says that the set of the zero elements of any linear recurrent sequence over a zero characteristic field is the finite union of some arithmetic progressions. In particular, the counter-examples to this theorem in the finite characteristic case give examples of algebras with irrational Hilbert series.

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Structure groups of YBE solutions: new properties, and cohomological applications

**Victoria Lebed**, Trinity College Dublin, Ireland

To any solution to the Yang-Baxter equation, one can associate its structure group or algebra. On the one hand, this is a rich source of groups and algebras with nice properties. On the other hand, structure groups bring group-theoretic tools into the study of the YBE. In this talk we will outline a third application of this construction: computation of the Hochschild cohomology of certain algebras using the braided cohomology of the corresponding solutions. Plactic algebras are our main example.
A general algebraic structure theory for tropical mathematics
LOUIS ROWEN, Bar-Ilan University, Israel

Many algebraic theories involve the study of a set $T$ with fragmented structure which can be understood better by embedding $T$ in a larger set $A$ endowed with more structure. Classical examples include the homogeneous components of a graded algebra. In the direction of tropical mathematics, the max-plus algebra and related tropical structures were embedded by Izhakian into semirings which are more manageable, and the same can be said for hypergroups and fuzzy rings.

On the other hand, in mathematical theories involving semirings, one often is challenged by the lack of negation when trying to formulate the tropical versions of classical algebraic concepts for which the negative is a crucial ingredient. Developing an idea of Gaubert in his doctoral dissertation and brought to fruition by Akian, Gaubert, and Guterman, we study triples $(A, T, (-))$ with negation maps, in the context of universal algebra, showing how these unify the more viable (super)tropical versions, as well as hypergroup theory and fuzzy rings, thereby “explaining” similarities in the various theories. Special attention is paid to meta-tangible triples, defined by the property that $a + b \in T$ for all $a, b \in T$ for which $b \neq (-)a$.

Furthermore, equality on $T$ generalizes to a relation $\preceq$ on $A$ which plays a key structural role, yielding a system. Their algebraic theory includes all the main tropical examples and many others, but is rich enough to facilitate computations and provide a host of structural results. Systems can be “fundamental,” insofar as they provide the underlying structure, which then is studied via classical structure theory, as well as linear algebra (in ongoing research with Akian and Gaubert) and through representation theory via “module” systems (in ongoing work with Jun, paralleling research of Connes and Constandan).

This approach enables one to view the tropicalization functor as a morphism, thereby indicating tropical analogs of such classical algebraic structures as Grassmann algebras, Lie algebras, Lie superalgebras, Poisson algebras, and Hopf algebras.
**Wednesday, June 21, 2017**

**Characters of odd degree**

*Gunter Malle*, TU Kaiserslautern, Germany

The McKay conjecture predicted the number of odd degree complex irreducible character of a finite group in terms of the same quantity for the normaliser of a Sylow 2-subgroup. This has become the prototype of a whole series of similar local-global conjectures relating properties of the representation theory of a group $G$ to data encoded in $p$-local subgroups. We report on some recent progress in this area.

**Strong Lie derived length of group algebras vs. derived length of their group of units**

*Tibor Juhász*, Eszterházy Károly University, Hungary

Let $R$ be an associative ring with unity, and denote by $U(R)$ its group of units. Set $\delta^{(0)}(R) = R$, and for $n \geq 1$, let $\delta^{(n)}(R)$ be the associative ideal generated by all Lie commutators $[x,y] = xy - yx$ with $x,y \in \delta^{(n-1)}(R)$. The ring $R$ is said to be strongly Lie solvable, if there exists $n$, such that $\delta^{(n)}(R) = 0$, and the least such $n$ is called the strong Lie derived length of $R$, and denoted by $dl^L(R)$. It is easy to see that if $R$ is strongly Lie solvable, then $U(R)$ is solvable with derived length $dl(U(R)) \leq dl^L(R)$.

Denote by $FG$ the group algebra of a group $G$ over a field $F$. Although we have criteria for $FG$ to be strongly Lie solvable, as well as for $U(FG)$ to be solvable, we still know little about the strong Lie derived length of $FG$, even less about the derived length of its group of units.

Assume that $FG$ is strongly Lie solvable. Then, in the few cases where the exact value of $dl(U(FG))$ is known, it is equal to $dl^L(FG)$. In this contribution, we are going to impose some conditions for $F$ and $G$, under which $dl(U(FG))$ does not attain $dl^L(FG)$. This enables us to construct some examples for strongly Lie solvable group algebra $FG$, such that $U(FG)$ is metabelian, but $FG$ is not strongly Lie metabelian. Furthermore, we will provide the exact lower bound on $dl(U(FG))$, for the case when $G$ is nilpotent and nonabelian.

This research was supported by the European Union and the State of Hungary, co-financed by the European Social Fund in the framework of TÁMOP 4.2.4. A/2-11-1-2012-0001 ‘National Excellence Program’

**Quantized coordinate rings and universal bialgebras**

*Szabolcs Mészáros*, Central European University, Hungary

The quantized coordinate ring of $n$-by-$n$ matrices was discovered in connection with the first non-trivial solutions of the quantum Yang-Baxter equation. Though the corepresentation theory of this bialgebra is well understood and analogous to the classical case, several questions about its ring theoretical structure remained unanswered or got solved only recently (see for example [2] for automorphisms or prime spectrum).

A result of this type is discussed about the representation ring (realized as the set of cocommutative elements) being a maximal commutative subalgebra of the algebra in question (see [1]). Additionally, a correspondence between the presence of an R-matrix in related algebras and the existence of a standard monomial basis is shown.

References


Free symmetric and unitary pairs in the field of fractions of free nilpotent group algebras

JAIRO Z. GONÇALVES, University of S˜ ao Paulo, Brazil

Let $G$ be a free nilpotent group, let $kG$ be the group algebra of $G$ over the field $k$ of characteristic $\neq 2$, let $D$ be its field of fractions, and let $D^\times$ be the multiplicative group of $D$. If $^*$ is an involution of $G$ extended linearly to $kG$, and to $D$, then $D^\times$ contains free pairs of $^*$-symmetric and $^*$-unitary elements. If $G \subseteq N \triangleleft D^\times$, and $N = N$, then $N$ contains free symmetric pairs. Some partial results are presented when $\text{char}(k) = 2$.

Joint work with Vitor O. Ferreira and Javier Sanchez.

Growth alternative for Hecke-Kiselman monoid algebras

ARKADIUS MĘCEL, University of Warsaw, Poland

Let $\Theta$ be an arbitrary finite simple graph with vertices from the set $\{1,\ldots,n\}$ such that two vertices can be connected either by an arrow or an unoriented edge. In [2] the following monoid $\text{HK}_\Theta$, called the Hecke-Kiselman monoid, associated to $\Theta$ has been defined, by specifying generators and the set of defining relations.

(i) $\text{HK}_\Theta$ is generated by idempotents $e_i$, where $1 \leq i \leq n$,
(ii) if the vertices $i$, $j$ are not connected in $\Theta$, then $e_ie_j = e_je_i$,
(iii) if $i$, $j$ are connected by an arrow $i \to j$ in $\Theta$, then $e_ie_je_i = e_je_ie_j = e_ie_j$,
(iv) if $i$, $j$ are connected by an unoriented edge in $\Theta$, then $e_ie_je_i = e_je_ie_j$.

If the graph $\Theta$ is unoriented (has no arrows), the monoid $\text{HK}_\Theta$ is isomorphic to the so called 0-Hecke monoid $H_0(W)$, where $W$ is the Coxeter group of the graph $\Theta$, see [1]. In case $\Theta$ is oriented (all edges are arrows) and acyclic, the monoid $\text{HK}_\Theta$ is finite and it is a homomorphic image of the so called Kiselman monoid $K_n$, see [2], [3].

We discuss the growth of Hecke-Kiselman monoids, or in other words, the Gelfand-Kirillov dimension of the semigroup algebras $A_{\Theta} := K[\text{HK}_\Theta]$ over a field $K$, in case $\Theta$ is an oriented graph. Clearly, $\text{GKdim}(A_{\Theta}) = 0$ if and only if the monoid $\text{HK}_\Theta$ is finite. This means exactly that the graph $\Theta$ is acyclic, see [3] (though, for graphs $\Theta$ that are not oriented finiteness of $\text{HK}_\Theta$ has not yet been characterized). Our main result reads as follows.

**Theorem** ([4]). Assume that $\Theta$ is a finite oriented simple graph. The following conditions are equivalent.

(1) $\Theta$ does not contain two different cycles connected by an oriented path of length $\geq 0$,
(2) $A_{\Theta}$ satisfies a polynomial identity,
(3) $\text{GKdim}(A_{\Theta}) < \infty$,
(4) the monoid $\text{HK}_\Theta$ does not contain a free submonoid of rank 2.

A similar growth alternative has been known in several other contexts. In particular, in the class of monomial algebras, that provide a rich area of examples of algebras with a particular growth behaviour and have been used to answer several questions on the Gelfand-Kirillov dimension of arbitrary algebras.

Joint work with J. Okniński.

**References**

An element of a(n associative) ring (with 1) is clean if it is the sum of a unit and an idempotent. A ring is clean if every element in it is clean. The concept of clean rings was formulated by Nicholson [8] in the course of his study of exchange rings, for both are closely related. Cleanliness in group rings has been studied from 2001 [3] and has been attracting attention ever since.

Several related concepts have been proposed. In 2010, Vaš proposed the definition of a $\ast$-clean ring ("$\ast$"-clean) [9]: a $\ast$-ring (ring with an involution $\ast$) in which every element may be written as a sum of a unit and a projection (a $\ast$-symmetric idempotent). Clearly, every $\ast$-clean ring is clean. So Vaš asked in [9]: when is a $\ast$-ring clean, but not $\ast$-clean?

Since every group $G$ is endowed with the classical involution $g \mapsto g^{-1}$, group rings $RG$ are almost always $\ast$-rings: if $R$ is a commutative rings, for instance, an involution in $RG$ is obtained from the $R$-linear extension of the classical involution in $G$ (and is also called the classical involution in $RG$). The $\ast$-cleanliness of group rings was first approached in 2011 [6]. Very little is still known about conditions under which a group ring with the classical involution is $\ast$-clean.

In this talk, we present clean rings, $\ast$-clean rings, some answers to Vaš’s question, their story in the realm of group rings, and some recent results [1, 2, 4, 5, 7].

References

Quandles decompose to orbits with respect to the action of the group generated by translations, or more specifically, by its subgroup called the displacement (or transvection) group. Quandles with a single orbit are called connected and are central objects of quandle theory.

With Hulpke and Vojtechovsky, we formulated a one-one correspondence between quandles on a set $X$, and certain configurations in transitive groups acting on $X$. The configuration consists of a pair $(G, \zeta)$ where $G$ is a transitive group and $\zeta$ a central element of the stabilizer of a point whose conjugacy class generates $G$. This allows to translate virtually any problem about connected quandles into the theory of transitive groups. We experienced a mild success with the method, for example, proving that there are no connected quandles of order $2p$, $p > 5$ prime. Is there a similar representation of connected (indecomposable) solutions of YBE?

The second line of our research is motivated by the abstract commutator theory. What is a solvable or nilpotent quandle, at least in the connected case? The Smith commutator theory of universal algebra gives one possible answer. However, it is not straightforward to adapt the general theory into the quandle setting. In our recent projects with Bonatto, Jedlicka, Pilitowska, Zamojska-Dzienio, we realized that the abstract notion of abelianness is strongly related to semiregularity of the displacement groups. Among the highlights, we can prove that a quandle is abelian if and only if it embeds into an affine quandle, if and only if its displacement group is abelian and semiregular, if and only if it can be constructed by a special kind of central extension of a projection quandle over an affine quandle. Some of these properties generalize to abelianness of congruences, leading to the notion of solvability and nilpotence. For example, for quandles that are connected in a stronger sense (no non-trivial quotient of a subquandle is a projection quandle), solvability (resp. nilpotence) of the quandle is equivalent to solvability (resp. nilpotence) of its displacement group. Does the theory extend naturally to solutions of YBE?

### GAP group rings toolkit

**Alexander Konovalov**, University of St Andrews, UK

The computational algebra system GAP ([http://www.gap-system.org](http://www.gap-system.org)) provides some functionality to study group rings, mainly spread across several packages: LAGUNA, Wedderga, UnitLib and HeLP. As a consequence, it may not be obvious for a new user how to find the necessary functionality in GAP. In a brief overview, I will describe the goals and distinctions of each of the packages, point out further sources of information about them, and explain how one could become a contributor to the development of GAP and its packages.

### Affine and quasi-affine quandles

**Anna Zamojska-Dzienio**, Warsaw University of Technology, Poland

A binary algebra $(Q, \ast)$ is called a quandle if the following conditions hold, for every $x, y, z \in Q$:

1. $x \ast (y \ast z) = (x \ast y) \ast (x \ast z)$ (we say $Q$ is left distributive),
2. the equation $x \ast u = y$ has a unique solution $u \in Q$ (we say $Q$ is a left quasigroup),
3. $x \ast x = x$ (we say $Q$ is idempotent).

As a consequence of the axioms (1)–(2), each left translation $L_a : Q \to Q, x \mapsto a \ast x$, is an automorphism of $Q$, for each $a \in Q$. The algebras which satisfy these two axioms are called racks. It is known that racks and quandles are closely related to nondegenerate set-theoretical solutions of the quantum Yang-Baxter equation (QYBE): a rack and derived solution are exactly the same, while any injective derived solution is a quandle.

A quandle $Q$ is called medial if, for every $x, y, u, v \in Q$,

$$(x \ast y) \ast (u \ast v) = (x \ast u) \ast (y \ast v).$$

A prototypic example is the class of affine (Alexander) quandles: given an abelian group $(A, +)$ with an automorphism $f$, let $\text{Aff}(A, f)$ denote the quandle over the set $A$ with the operation $x \ast y =$...
In [1] it is shown that all indecomposable, nondegenerate set-theoretical solutions to the QYBE on a set of prime order are affine (there is also a complete classification of such solutions). In the language of the quandle theory this means that any connected finite quandle of a prime order is isomorphic to an Alexander quandle.

Another important class of medial quandles consists of quasi-affine quandles: quandles that embed into affine quandles, that is, that are isomorphic to subquandles of affine quandles. This class generates the variety of all medial quandles.

We present the main result of [2]: the characterization theorems for affine quandles and for quasi-affine quandles. We consider there: group-theoretic properties of their displacement group, a clone-theoretic condition coming from universal algebra, and an explicit construction. As a consequence, we obtain efficient algorithms for recognizing affine and quasi-affine quandles, and we enumerate small quasi-affine quandles.

This is a joint work with P. Jedlička, A. Pilitowska and D. Stanovský.

References

On some connections between set-theoretic solutions of the Yang Baxter equation, matrices and noncommutative rings

**Agata Smoktunowicz**, University of Edinburgh, UK

In 2005, Wolfgang Rump discovered some connections between noncommutative ring theory and set-theoretic solutions of the Yang-Baxter equation. In this talk we explore some further connections between noncommutative rings, matrices, braces and set-theoretic solutions of the Yang-Baxter equation. We also present some new results on the prime radical and locally nilpotent ideals in noncommutative rings, and discuss their connection with the Yang-Baxter equation.

On lower bounds for the degrees of projective modules for finite simple groups

**Alexandre Zalesski**, University of East Anglia, UK

Let $G$ be a finite group and $F$ an algebraically closed field of characteristic $p > 0$, such that $|G|$, the order of $G$, is a multiple of $p$. Projective indecomposable modules are exactly the indecomposable direct summands of the regular $FG$-module. I shall report some recent results on lower bounds for the dimensions of these modules, mainly, for Chevalley groups.

The $p'$-subgraph of the Young graph

**Eugenio Giannelli**, University of Cambridge, UK

In this talk I will present some new results on the restriction of characters of $p'$-degree of the symmetric group $S_n$ to $S_{n-1}$. This is joint work with Stacey Law and Stuart Martin.

On a result of Cliff and Weiss about a strategy to attack the Zassenhaus Conjecture

**Leo Margolis**, University of Murcia, Spain

Let $G$ be a finite group and let $V(ZG)$ denote the group of units of $ZG$ with augmentation one. Hans Zassenhaus conjectured that every torsion element of $V(ZG)$ is conjugate in the rational group algebra $QG$ to an element of $G$. Though studied by many authors and proven for several series of groups, the conjecture remains open in general.

A particularly interesting case are metabelian crops. When $N$ is a normal subgroup of $G$ such that $G/N$ is abelian the Zassenhaus Conjecture are usually divided into two parts: Study the units not mapping to 1 under the natural homomorphism $ZG \to ZG/N$ separately from the units mapping to 1 under this homomorphism. A strategy to attack the latter kind of units was proposed by Marciniak, Ritter, Sehgal and Weiss. It consists in studying matrices of finite order in $GL_k(ZN)$ which map to the identity matrix under the componentwise application of the augmentation map and their conjugacy classes in $GL_k(QN)$, where $k = [G : N]$. However the strategy has been abandoned after Cliff and Weiss proved that such matrices are in general not conjugate to diagonal matrices with entries in $N$, if $N$ has more than one non-cyclic Sylow subgroup.

I will report on ongoing work with A. del Río how results of Cliff and Weiss do not invalidate completely the strategy, but rather that their ideas can be used to prove the Zassenhaus Conjecture in cases where the previously available methods have failed.
Construction of Binary Codes using Dihedral Group Algebras
LÓG CREEDON, Institute of Technology Sligo, Ireland

An \([n, k, d]\) code is a code with length \(n\), rank \(k\) and minimum distance \(d\). In [1] a new technique for constructing codes from finite group algebras and circulant matrices is given. This was applied in [2] to construct the extended binary Golay code (the unique \([24, 12, 8]\) linear block code). Subsequently, in [3] a similar technique was used to construct the self-dual, doubly-even and extremal \([48, 24, 12]\) binary linear block code. These code words can be viewed as either elements of a commutative group algebra or as elements of a dihedral group algebra. The codes are vector subspaces of the group algebra. Here these results are generalised (using a decomposition of the underlying group algebra, the Frobenius automorphism and non-classical involutions) to use unitary units to construct linear block codes of length \(n = 3(2^m)\) for positive whole numbers \(m\) which had previously been computationally prohibitive.

Joint work with Fergal Gallagher and Ian McLoughlin.

References:
References


On the Zassenhaus conjecture for direct products
Mariano Serrano, University of Murcia, Spain

H.J. Zassenhaus conjectured that any torsion unit of finite order with augmentation one in the integral group ring $\mathbb{Z}G$ of a finite group $G$ is conjugate in the rational group algebra $\mathbb{Q}G$ to an element of $G$. This conjecture found much attention and was proved for many series of groups. However, there is no so much information about the conjecture for the direct product of two groups. In this talk we present our recent results on the Zassenhaus conjecture for the direct product $G \times A$ where $G$ is a Camina finite group and $A$ is a abelian finite group.

Semi-braces and the Yang-Baxter equation
Ilaria Colazzo, Università del Salento, Italy

The Yang-Baxter equation is a basic equation of the statistical mechanics that arose from Yang’s work in 1967 and Baxter’s one in 1972. Drinfeld in [2] posed the question of classifying the solutions of the Yang-Baxter equation, in particular those called set-theoretical. This is a difficult task and many authors dealt with this problem. In particular, several algebraic structures were studied to answer this problem, such as groups, cycle sets, braces (for instance, see [3], [4], [5]).

Recently, a new generalization of braces, semi-brace, was introduced in [1].

In this talk, we describe how to obtain a solution of the Yang-Baxter equation through semi-braces. Furthermore, we show which properties satisfy this kind of solutions. Finally, we present a construction of solution of the Yang-Baxter equation that arises from the matched product of left semi-braces.

References

Application of the graded Posner theorem

Yaakov Karasik, Technion Institute of Technology, Israel

Posner’s theorem for PI algebras is an invaluable tool for generic construction related to PI theory. Nevertheless, one can see it shine when considering richer frameworks. One such is the group graded algebras satisfying an ordinary PI.

In this talk I will explain this theorem and its (non-trivial) generalization to group graded PI setting. However, the main part of the talk will be devoted to show a quick and conceptional proof to a theorem of Aljadeff and Haile which states that two \( G \)-simple f.d. algebras are graded isomorphic if and only if they have the same ideal of graded identities.

Garside germs for the structure groups of the Yang-Baxter equation

Patrick Dehornoy, University of Caen, France

We use the connection, due to W. Rump, between the structure groups attached with involutive nondegenerate set-theoretical solutions of the YBE and the right-cyclic law \( (xy)(xz) = (yx)(yz) \) to revisit the I-structure and the Garside structure of these groups, and, for each of them, we describe a finite ”torsion” quotient exactly playing the role that a Coxeter group plays for the associated Artin-Tits group.
Solvable groups and affine structures
WOLFGANG RUMP, University of Stuttgart, Germany

In 1896, Hurwitz wrote a remarkable paper on unique prime factorization in a non-commutative domain. An intriguing phenomenon he discovered is what is now called metacommutation of Hurwitz primes, which requires a “normalization” of primes.

We show that the same phenomenon arises for finite solvable groups where the “Hurwitz primes” correspond to the elements of the Sylow subgroups, and metacommutation appears in connection with mutual actions within a normalized system of Sylow subgroups. The mutual actions provide any finite solvable group with a partial binary operation: If (and only if) this operation extends to the whole group, the latter will become the adjoint group of a brace.

In other words, any finite solvable group contains the layout of a building plan for an affine structure (a brace), which has to be completed inside the Sylow subgroups. Based on this view, some applications will be given.

Braces over a field and regular subgroups of the affine group
FRANCESCO CATINO, Università del Salento, Italy

The problem of determining all regular subgroups of an affine group has been raised explicitly by Liebeck, Praeger and Saxl in [4] and it is still open. Among the results in this area, Rizzo and I [2] establish a link between regular subgroups of an affine group and braces over a field: a vector space $V$ over a field $F$ with an operation $\circ$ is called a brace over $F$ or $F$-brace if the structure $(V, +, \circ)$ is a brace and $\mu(a \circ b) = a \circ (\mu b) + (\mu - 1)b$, for all $a, b \in V$ and $\mu \in F$. Fixed a vector space $V$, there exists a bijective correspondence between the class of all $F$-braces on the underlying vector space $V$ and regular subgroups of the affine group $AGL(V)$. This result extends a previous description of all abelian regular subgroups of an affine group in terms of commutative associative radical algebras obtained by Caranti, Dalla Volta and Sala in [3]. Besides the theoretical appeal of this subject, the interest in the topic is nowadays strongly motivated by applications to Cryptography, where such objects are used to insert and detect algebraic trapdoors in block ciphers, as discussed in [1].

In the talk I will introduce the relationship between regular subgroups of an affine group and F-braces, to then move to detail the most recent constructions of the latter ones. Throughout the talk, I will also introduce and review selected open problems and challenges in the field.

References

Braces, Symmetric groups and the Yang-Baxter equation
TATIANA GATEVA-IVANOVA, Bulgarian Academy of Science, Bulgaria

We involve simultaneously the theory of matched pairs of groups and the theory of braces to study set-theoretic solutions of the Yang-Baxter equation (YBE). We show the equivalence of the two notions “a symmetric group” $(G, r)$ (an involutive braided group) and “a left brace” $(G, +, \cdot)$ and find new results on symmetric groups of finite multipermutation level and the corresponding braces. For every symmetric group $(G, r)$, we introduce an invariant series—the derived chain of ideals of $G$, which gives a precise information about the recursive process of retraction of $G$. We prove that every symmetric
group \((G,r)\) of finite multipermutation level \(m\) is a solvable group of solvable length \(\leq m\). To each set-theoretic solution \((X,r)\) of YBE we associate two invariant sequences of symmetric groups: (i) the sequence of its derived symmetric groups; (ii) the sequence of its derived permutation groups and explore these for explicit descriptions of the recursive process of retraction.

The simultaneous study of symmetric groups and their braces is particularly interesting and fruitful when we study symmetric groups and braces with special conditions on the actions such as conditions \(\text{i}r\)i and \(\text{Raut}\).

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**Hopf-Galois structures on Galois extensions of fields**  
Nigel Byott, University of Exeter, UK

Let \(L/K\) be a finite, Galois extension of fields with Galois group \(\Gamma\). Then the group algebra \(K[\Gamma]\) is a Hopf algebra acting on \(L\). There may be other Hopf algebras \(H\) acting on \(L\) and giving it a Hopf-Galois structure. Greither & Pareigis (1987) showed that the problem of finding all Hopf-Galois structures on a given extension \(L/K\) can be formulated as a combinatorial problem in group theory, which turns out to be closely related to the problem of classifying braces. In this talk, I will give a survey of results on Hopf-Galois structures, and interpret some of them in terms of braces.

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**The classification of generalized Riemann derivatives**  
Stefan Catoiu, DePaul University, USA

The following three examples of derivatives of a function \(f\) at \(x\):

- the ordinary derivative \(f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}\),
- the symmetric derivative \(f'_s(x) = \lim_{h \to 0} \frac{f(x + \frac{h}{2}) - f(x - \frac{h}{2})}{h}\), and
- the “crazy” derivative \(\tilde{f}'(x) = \lim_{h \to 0} \frac{2f(x+h) - 3f(x) + f(x-h)}{h}\).

are the first order generalized Riemann derivatives (\(A\)-derivatives) corresponding to the data vector \(A\) being \(\{1, -1; 1, 0\}\), \(\{1, -1; 1/2, -1/2\}\) or \(\{2, -3; 1, 0, -1\}\). Basic Calculus shows that the existence of the ordinary derivative implies the existence of the other two derivatives. It is also known for a long time that the symmetric derivative does not imply the ordinary derivative. Very recently, it was observed that the “crazy” derivative implies the ordinary derivative.

We characterize all pairs \((A, B)\) of generalized Riemann derivatives of any orders for which \(A\)-differentiation implies \(B\)-differentiation, and those for which \(A\)-differentiation is equivalent to \(B\)-differentiation.

The description of the equivalence class of the ordinary first derivative is based on joint work with J. Marshall Ash and Marianna Csörgő. The general case for both real and complex derivatives is joint with J. Marshall Ash and William Chin. Similar classifications hold for quantum derivatives. These classifications were obtained using a new object from algebra, a group algebra, and open up a new algebraic direction of research in analysis that is different from both functional analysis and operator algebras.

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**Hopf-Galois structures on Galois field extension of degree \(p^3\) and their relationship to braces**  
Kayvan Nejabati Zenouz, University of Exeter, UK

We briefly talk about Hopf-Galois structures on a Galois field extension and their relationship to braces, or more generally to skew braces in the nonabelian setting as studied recently by L. Guarnieri and L. Vendramin. Then we explain how one can, with the aid of some methods of N.P. Byott, enumerate the Hopf-Galois structures on Galois field extensions of degree \(p^3\) for a prime number \(p\); we explain how our findings can help to obtain results relating to classification of skew braces of order \(p^3\), which in the abelian setting should match those obtained by D. Bachiller.
The Algebra of Generalized Derivatives
William Chin, DePaul University, USA

Generalizations of Riemann derivatives are studied from the point of view of pointwise existence by translating the problem into the group ring of the multiplicative group over real or complex numbers. Each generalized derivative corresponds to an element of the group algebra satisfying certain normalization conditions. We show that pointwise differentiability is controlled by containment of principal ideals in the group algebra. Accordingly, the structure of the algebra as generalized polynomials in continuum-many variables, together with a torsion component, determines the equivalence classes. We are then able to use the structure theory to completely classify generalized derivatives with respect to pointwise differentiability. In the complex case, the torsion part is built out of infinite trees of idempotents and yields generalized derivatives that include ones that are important from the view of numerical approximation.

Counting Hopf-Galois Structures on Cyclic Field Extensions of Squarefree Degree
Ali Alabdali, University of Exeter

Let $L/K$ be a finite Galois extension of fields. There may be many Hopf algebras $H$ giving $L$ a Hopf-Galois structure. We count the Hopf-Galois structures on cyclic extension of squarefree degree $n$. We describe all groups $G$ of order $n$ and find the number of Hopf-Galois structures of type $G$ on a cyclic extension of degree $n$. In particular we show that Hopf-Galois structures of all possible types $G$ do occur.

On the arithmetic of integral representations
Dmitry Malinin, UWI, Kingston, Jamaica

We consider the arithmetic background of integral representations of finite groups. Some infinite series of integral pairwise inequivalent absolutely irreducible representations of finite $p$-groups over the rings of integers of number fields with the extra congruence conditions are constructed. Certain problems concerning integral irreducible two-dimensional representations over number rings are discussed. We investigate related problems concerning globally irreducible representations, primitive representations of the Galois groups of local fields, finite arithmetic groups, Galois action and Galois cohomology.

Irreducible representations of the plactic monoid of rank four
Lukasz Kubat, University of Warsaw, Poland

In this talk I will focus on results concerning irreducible representations of the plactic monoid $M$ of rank four. Comparing to previously obtained results for plactic monoids of rank not exceeding three, it turns out that the structure of irreducible representations of $M$ is much more complex. However, construction of certain concrete families of simple modules over the plactic algebra $K[M]$ over a field $K$ leads to the proof that the Jacobson radical $J(K[M])$ of $K[M]$ is nilpotent. Moreover, the congruence $\rho$ on $M$ determined by $J(K[M])$ coincides with the intersection of the congruences determined by the primitive ideals of $K[M]$ corresponding to the constructed simple modules. In particular, $M/\rho$ is a subdirect product of the images of $M$ in the corresponding endomorphism algebras.

This is a joint work with Ferran Cedó and Jan Okniński.

Group algebras satisfying a Laurent Polynomial Identity
Ángel del Río, University of Murcia, Spain

Let $K$ be a field and $A$ an associative unital $K$-algebra. We say that the units of $A$ satisfy a Laurent polinomial identity if there is non-zero Laurent polynomial $f(X_1, \ldots, X_n)$, in (non-commuting) free variables $X_1, \ldots, X_n$, if $f(u_1, \ldots, u_n) = 0$ for every list $u_1, \ldots, u_n$ of units of $A$. For example, if the units of $A$ satisfy a group identity then they satisfy a Laurent polynomial identity.
Let $KG$ be the group algebra of a torsion group $G$ over a field $K$. We show that if the units of $KG$ satisfy a Laurent polynomial identity, which is not satisfied by the units of the relative free algebra $K[\alpha, \beta : \alpha^2 = \beta^2 = 0]$, then $KG$ satisfies a polynomial identity.

This extends the Hartley Conjecture which states that if the units of $KG$ satisfy a group identity then $KG$ satisfies a polynomial identity. Special cases of the Hartley Conjecture were proved by Warhurst, Gonçalves and Mandel, Giambruno, Jespers and Valenti and Giambruno, Sehgal and Valenti proved the Hartley Conjecture for infinite fields. Finally, in 1999, Liu proved the Hartley Conjecture in full generality.

Joint with Osnel Broche, Jairo Gonçalves.

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**Matrix Wreath Products**

EFIM ZELMANOV, University of California at San Diego, USA

We will discuss a new construction of matrix wreath product of algebras and it’s applications to embedding theorems and growth functions.
Posters

Weakly reversible, indecomposable and poconnected properties in S-posets
Bana Al Subaiei, King Faisal University, Saudi Arabia

Over the last three decades an extensive literature of flatness and its related properties have been studied widely in the category of S-acts. However, few researchers have tried to generalize some of the known properties in S-acts to the category of S-posets. This has led to much information being missed for many properties in S-posets. The analogs of reversible, and indecomposable in S-acts within the category of S-posets, have only been considered in two articles, one for each concept. Connectivity has not been defined in S-posets to date. This property was found to be related to those of reversibility and flatness. Connectivity was also related to issues of amalgamations in semigroups. The primary objective of this paper is to define connectivity in the category of S-posets for both versions: ordered “poconnected” and unordered “connected”. Also, our goal is to investigate the relationship between connectivity with other properties such as reversibility, and indecomposability. This paper shows that the decomposable S-poset is not poconnected, and a poconnected S-poset is always indecomposable. Also, we find that the weakly reversible partially ordered monoid simply pomonoid is always connected and the weakly reversible pomonoid is indecomposable.

Note: S-act means action on semigroup where S-poset means action on partial ordered semigroup

Idempotent rings
Jafar A'zami, University of Mohaghegh Ardabili, Ardabil, Iran

In this paper we introduce a new class of rings that we say idempotent rings. We call a ring R is idempotent, if every ideal of R is generated by an idempotent element. In this paper we prove some properties of this rings, where one of the importent results is the following:
Let $t \geq 2$ be an integer number. Then the ring $\mathbb{Z}_t$ is an idempotent ring if and only if $t = p_1p_2\ldots p_n$, where all of the $p_i$ are distinct prime numbers.

References

Simply connected quandles
Marco Bonatto, Charles University, Prague, Czech Republic

Quandles are non associative algebraic structures that arise in different areas as knots theory, the study of braided vector spaces and the classification of pointed Hopf algebras.

This poster is about quandle coverings, defined as a special class of quandle extension and in particular about simply connected quandles, that are the class of connected quandles which admit no proper coverings.

We will give an alternative characterization of this family of quandles based on the results of the paper of Eisermann [2].

Given a quandle $X$ its coverings can be parametrized by the second Non-Abelian cohomology set of $X$ (denoted by $H^2(X, \text{Sym}_n)$), that is the set of equivalence classes of maps $\beta$

$$\beta : X \times X \to \text{Sym}_n$$

satisfying some further conditions under a suitable equivalence (see [1]). Using a combinatorial approach that can be carried out for latin quandles in general, we extend the result given by Granañ in [3]:

**Theorem.** Let $X = Q(\mathbb{Z}_p, \alpha)$. Then $X$ is simply connected.

to some classes of affine latin quandles.
References


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**Counterexamples to the Isomorphism Problem in Finite Group Algebras**

*Fergal Gallagher*, Institute of Technology Sligo, Ireland

Techniques by Perlis-Walker [3] and more recently by Broche and Del Rio [1] are used to find the Wedderburn decomposition of group algebras. These methods are used and adapted to give new results for semisimple finite abelian group algebras. In doing so, we get a further insight into the isomorphism problem for group algebras, which asks, given two groups $G$ and $H$ and a field $F$, is it true that if $FG$ and $FH$ are isomorphic, then $G$ and $H$ are isomorphic? The answer to this question is no. For example, the minimum counterexample to this problem is given in [2]. Here we show that this is a specific case of a general class of counterexamples. We construct another class of isomorphic group algebras and give examples.

Joint with Leo Creedon.

References:


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**Differential calculus on h-deformed spaces**

*Basile Herlemont*, Aix Marseille Univ, Université de Toulon, CNRS, CPT, Marseille, France

The ring $\text{Diff}_h(n)$ of $h$-deformed differential operators of type A appears in the theory of reduction algebras. A reduction algebra provides a tool to study decompositions of representations of an associative algebra $A$ with respect to a subalgebra $B$ in the situation when $B$ is the universal enveloping algebra of a reductive Lie algebra. The ring $\text{Diff}_h(n)$ is the reduction algebra of $\text{Diff}(n) \otimes U(\mathfrak{gl}_n)$. The ring $\text{Diff}_h(n)$ can be described in the R-matrix formalism. The needed R-matrix is a solution of the so-called dynamical Yang–Baxter equation. We show that the center of $\text{Diff}_h(n)$ is a polynomial ring in $n$ variables. We construct an isomorphism between certain localizations of $\text{Diff}_h(n)$ and $W_n \otimes \mathbb{C}[a_1, \ldots , a_n]$ where $W_n$ is the Weyl algebra and $a_1, \ldots , a_n$ are commuting variables.

Joint with O. Ogievetsky.

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**Computer Algebra meets Ring Theory**

*Viktor Levandovskyy*, RWTH Aachen University, Germany

Since the very beginning of Computer Algebra more than 50 years ago, there has been an exchange of ideas and techniques between Computer Algebra and Ring Theory. In this poster I’d like to tell, how ring theorists can profit from recent achievements in Computer Algebra, in particular from implemented algorithms in computer algebra systems. For instance I will address factorization over noncommutative domains and its applications (a joint work with A. Heinle and J. Bell).
Hopf-Galois structures on Galois filed extension of degree $p^3$ and their relationship to braces

KAYVAN NEJABATI ZENOZ, University of Exeter, UK

For an abstract see the talk with the same title on page 21.

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Orbit decomposition for medial quandles

AGATA PILITOWSKA, Warsaw University of Technology, Poland

An algebraic structure $(Q, \cdot)$ is called a quandle if

- $Q$ is idempotent (for every $x \in Q$, $xx = x$),
- $Q$ is left distributive (for every $x, y, z \in Q$, $x(yz) = (xy)(xz)$),
- $Q$ is a left quasigroup (for every $x, y \in Q$ the equation $xu = y$ has a unique solution $u \in Q$).

In particular, the conditions say that all left translations $L_a : Q \to Q$, $x \mapsto ax$ form a subgroup of the automorphism group of $(Q, \cdot)$.

Among the many motivations behind quandles, perhaps the most striking is the one coming from knot theory: the three axioms of quandles correspond to the three Reidemeister moves. It is also well known that quandles provide set-theoretical solutions of the braid equation.

A quandle $(Q, \cdot)$ is called medial if, for every $x, y, u, v \in Q$,

$$(xy)(uv) = (xu)(yv).$$

Important examples of medial quandles are Alexander (affine) quandles $(A, \ast) = \text{Aff}(A, f)$ constructed over any abelian group $(A, +)$ with an automorphism $f$ by taking the operation $x \ast y = (id - f)(x) + f(y)$.

Medial quandles were investigated by Joyce [2] and Romanowska and Smith [3, Section 8.6]. From their results we can conclude that a quandle $(Q, \cdot)$ is medial if and only if the displacement group $\text{Dis}(Q)$, the subgroup of the group of left translations generated by all compositions $L_a L_b^{-1}$, with $a, b \in Q$, is abelian. But for medial quandles one can obtain a better description based on a derived construction, in this case, using an appropriate sum.

For a medial quandle $(Q, \cdot)$, on each orbit of the natural action of the displacements group $\text{Dis}(Q)$ on $Q$, one can define the structure of an abelian group. Moreover, each orbit, as a subquandle, is an Alexander quandle.

We present the main result of [1] which states that all medial quandles can be represented as certain sums of some affine pieces, called affine meshes. The Isomorphism Theorem determines when two meshes represent isomorphic quandles.

The concept of affine meshes turns out to be a powerful tool. As an application, we show several structural results about medial quandles and enumerate isomorphism classes of medial quandles up to size 13.

This is a joint work with P. Jedlička, D. Stanovský and A. Zamojska-Dzienio.

References

The Jacobian and Dixmier Conjectures
Ann E. Rogers, DePaul University, USA

One of the most tantalizing open problems in mathematics is the Jacobian (Keller) Conjecture, a version of which posits that any locally injective polynomial map of two-dimensional complex affine space is globally invertible. Although the conjecture is commonly stated in terms of algebraic geometry, the strategies aimed at proving it have varied widely. These efforts have included approaches from analysis, algebra, combinatorics, and birational geometry, to name a few. We focus on summarizing the history of the algebraic approach; specifically, the precise conditions under which the Jacobian Conjecture can be shown to be a consequence of the generalized form of Dixmier’s conjecture, which claims that in characteristic zero, any endomorphism of the Weyl algebra $A_n(k)$ must be an automorphism.

The Dimension Problem for Groups and Lie Rings
Thomas Sicking, Georg-August-Universität Göttingen, Germany

The dimension subgroup problem can be stated as follows: Take a group $G$ and its integral group ring $\mathbb{Z}G$. Let $\epsilon: \mathbb{Z}G \to \mathbb{Z}$ be the augmentation map, i.e. the linear extension of the map $g \mapsto 1$ to $\mathbb{Z}G$ and set $\Delta(G) = \ker(\epsilon)$. Then the group $D_n(G) := (1 + \Delta(G)^n) \cap G$ is a normal subgroup of $G$, and one easily sees that $\gamma_n(G)$ is always contained in $D_n(G)$. However, for $n \geq 4$, there are groups with $\gamma_n(G) \neq D_n(G)$.

For Lie rings, an analogous study has been initiated in [1], where similar results to those known in group rings were found. Furthermore, in [2] it is shown, that for a metabelian Lie ring $L$ we have $2D_n(L) \subseteq \gamma_n(L)$, which is stronger than any result known for metabelian groups so far.

References
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