2020 Zassenhaus Group Theory and Friends Conference
Online conference
May 29–30 and June 5–6, 2020

PROGRAM & ABSTRACTS

Online ad-hoc Organizing Committee

Fernando Guzman, Binghamton University, Binghamton, New York
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Arturo Magidin, University of Louisiana at Lafayette, Lafayette, Louisiana

2020 Zassenhaus Group Theory and Friends Conference
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Conference Program

Friday, May 29, Morning session

TIME (EDT)

9:10–9:30 AM Noelia Rizo (Universitá degli Studi di Firenze)
On Thompson's normal p-complement theorem

9:55–9:15 AM María Dolores Pérez-Ramos (Universitat de Valencia)
Thompson-line characterization of solubility for products of groups

10:40–11:00 AM Patrizia Longobardi (Università di Salerno)
On the structure of some locally nilpotent groups without contranormal subgroups

11:25–11:45 AM Arnold Feldman (Franklin & Marshall College)
Extension of Carter subgroups and injectors in finite π-separable groups

Friday May 29, Afternoon Session

TIME (EDT)

2:10–2:30 PM Nicholas Werner (SUNY College at Old Westbury)
Covering numbers of rings, Part 1

2:55–3:15 PM Eric Swartz (William & Mary)
Covering numbers of rings, Part 2

3:40–4:00 PM Casey Donoven (Binghamton University)
Intersection numbers of semigroups

4:25–4:45 PM Aram Bingham (Tulane University)
Bruhat posets of Hermitian-type symmetric spaces

Saturday, May 30, Morning session

TIME (EDT)	
9:10–9:30 AM	Mark Sapir (Vanderbilt University) **On groups with quadratic Dehn function**
9:55–10:15 AM	Matt Zaremsky (University at Albany) **Geometric embeddings into simple groups**
10:40–11:00 AM	Rob Spahn (University at Albany) **Introduction to braided Brin-Thompson groups**
11:25–11:45 AM	Inna Sysoeva (SUNY Binghamton) **Irreducible representations of braid groups**

Saturday May 30, Afternoon session

TIME (EDT)	
2:10–2:30 PM	Anthony Evans (Wright State University) **The existence problem for strong mappings of groups**
2:55–3:15 PM	Bret Benesh (College of Saint Benedict and Saint John's University) **The spectrum of nim-values of a game on finite groups**
3:40–4:00 PM	Andrew Latham (University of Florida) **π-submaximal subgroups of finite non-abelian simple groups**
4:25–4:45 PM	Kenneth Johnson (Penn State Abington) **Issai Schur: His influence in group theory and other areas**

Friday June 5, Morning session

TIME (EDT)	
9:10–9:30 AM	Viji Thomas (Indian Institute of Science, Education and Research Thiruvananthapuram) **Schur's exponent conjecture**
9:55–1015 AM	Ammu Elizabeth Antony (Indian Institute of Science, Education and Research Thiruvananthapuram) **Toward Schur's exponent conjecture**
10:40–11:00 AM	Patali Komma (Indian Institute of Science, Education and Research Thiruvananthapuram) **Schur's exponent conjecture for p-groups of nilpotency class p**
11:25–11:45 AM	Farrokh Shirjian (Tarbiat Modares University) **The Huppert conjecture revisited**

Friday June 5, Afternoon session

TIME (EDT)	
2:10–2:30 PM	Douglas Brozovic (University of North Texas) **An introduction to sharp permutation groups**
2:55–3:15 PM	Jay Zimmerman (Towson University) **Vertex-minimal graphs with non-abelian 2-group symmetry**
3:40–4:00 PM	Moshe Cohen (SUNY New Paltz) **Using lower central series to find Zariski pairs of line arrangements**
4:25–4:45 PM	Mark Lewis (Kent State University) **On solvable groups with one vanishing class size**

Saturday June 6, Morning session

TIME (EDT)	
9:10–9:30 AM	Ramazan Ya'Ar (Hacettepe University) **On the modules in which semisimple fully invariant submodules are essential in summands**
9:55–10:15 AM	Alexandr Griskhov (University of Sao Paulo) **Burnside type problem for groups and loops**
10:40–11:00 AM	Jonathan Doane (Binghamton University) **Classifying primal algebras by subalgebra posets**
11:25–11:45 AM	Jord Feldvoss (University of South Alabama) **Leibniz central extensions of modular Lie algebras**

Saturday June 6, Afternoon session

TIME (EDT)	
2:10–2:30 PM	Mohammad Shatnawi (Western Michigan University) **The transfer homomorphism for profinite groups**
2:55–3:15 PM	Ryan McCulloch (University of Bridgeport) **Semidirect products and the Chermak-Delgado lattice**
3:40–4:00 PM	William Cocke (Army Cyber Institute at West Point) **Proof by example**
4:25–4:45 PM	Shawn Burkett (Kent State University) **A Frobenius group analog for Camina triples**

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Abstracts

In order of presentation

On Thompson's normal p-complement theorem

Noelia Rizo, Università degli Studi di Firenze

Many problems in character theory of finite groups deal with character degrees and prime numbers. For instance, the Itô-Michler theorem asserts that a prime p does not divide $\chi(1)$ for any irreducible character χ of G if and only if the group G has a normal and abelian Sylow p-subgroup. A kind of dual situation is Thompson's normal p-complement theorem, which asserts that if 1 is the only character degree in G coprime to p, then G has a normal p-complement. Simple Groups, showed that in this situation G is solvable. In this talk we present two extensions of Thompson's theorem.

First, we consider the next natural step, namely when there are just two character degrees in G coprime to p. We obtain that in this situation G is solvable and its p-length is at most 2. In a second extension we introduce the principal Brauer p-block of G. To obtain both results we make use of the Classification of Finite Simple Groups.

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Thompson-like characterization of solubility for products of groups

María Dolores Pérez-Ramos, Universitat de Valencia

A remarkable result of Thompson states that a finite group is soluble if and only if its two-generated subgroups are soluble. This result has been sharply generalized, and it is in the core of a wide area of study in the theory of groups, aiming for global properties of groups from local properties of two-generated (or more generally, n-generated) subgroups. We report about an extension of Thompson's theorem from the perspective of factorized groups. We prove that for a finite group $G = AB$, with A, B subgroups of G, if $\langle a, b\rangle$ is soluble for all $a \in A$ and all $b \in B$, then $[A, B]$ is soluble. In that case, the group G is said to be an $\mathcal{S}$-*connected product* of the subgroups A and B, for the class $\mathcal{S}$ of all finite soluble groups. As an application, deep results about connected products of finite soluble groups, for other relevant classes of groups, are extended to the finite universe. *Collaboration with M. P. Gállego (U. Zaragoza, Spain), P. Hauck (U. Tübingen, Germany), L. Kazarin (U. Yaroslavl, Russia), A. Martínez-Pastor (U. Politècnica de València, Spain).*

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On the structure of some locally nilpotent groups without contranormal subgroups

PATRIZIA LONGOBARDI, Università di Salerno - Italy

A subgroup H of a group G is **contranormal in** G if $H^G = G$, where $H^G = \langle x^{-1}hx \mid h \in H,\ x \in G \rangle$ is the normal closure of H in G. For example G is contranormal in G. Moreover, every subgroup of a finite group G is a contranormal subgroup of a subnormal subgroup of G. The concept of contranormal subgroup has been introduced by J.S. Rose in the paper [3]. Contranormal subgroups have been studied for example in the paper [2]. Obviously a contranormal subgroup H of a group G is normal or subnormal in G if and only if $H = G$. It follows that groups whose subgroups are all subnormal, in particular nilpotent groups, do not contain proper contranormal subgroups. The converse is also true for finite groups. The aim of this talk is to present some results obtained in the locally nilpotent case in the paper [1]. We first notice that locally nilpotent groups can have proper contranormal subgroups. We show that nilpotent-by-finite groups which do not contain proper contranormal subgroups are necessarily nilpotent. Moreover we describe locally nilpotent groups having a proper finite contranormal subgroup.

KLM L.A. Kurdachenko, P. Longobardi, M. Maj, On the structure of some locally nilpotent groups without contranormal subgroups, to appear.

KOS L.A. Kurdachenko, J. Otal, I.Ya. Subbotin, Abnormal, pronormal, contranormal and Carter subgroups in some generalized minimax groups, *Comm. Algebra*, **33** No.12, (2005) 4595-4616.

R J.S Rose, Nilpotent Subgroups of Finite Soluble Groups, *Math. Z.*, **106** (1968), 97-112.

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Extension of Carter subgroups and injectors in finite π-separable groups

ARNOLD FELDMAN, Franklin & Marshall College

This is joint work with M. Arroyo-Jordá, P. Arroyo-Jordá, R. Dark, and M.D. Pŕez-Ramos. All groups are finite here. Let $\mathcal{N}$ denote the class of nilpotent groups. A Carter subgroup of a solvable group is a self-normalizing nilpotent subgroup. The Carter subgroups also turn out to be the $\mathcal{N}$-projectors of a solvable group. These subgroups were crucial in Fischer, Gaschütz, and Hartley's proof that for any Fitting set or Fitting class a finite solvable group has a non-empty set of injectors that forms a conjugacy class in that group. In order to generalize these results to π-separable groups for a set of primes π, we introduce the class $\mathcal{N}^\pi$, whose members are direct products of π-groups and nilpotent π'-groups; thus $\mathcal{N}^\pi = \mathcal{N}$ if π has at most one member. We prove that for π'-solvable groups (which are just π-separable groups if π contains the prime 2 or π' has at most two members) the $\mathcal{N}^\pi$-projectors form a single non-empty conjugacy class, thus generalizing the $\mathcal{N}$-projectors of solvable groups. We define a particular type of Fitting set, an $\mathcal{N}^\pi$-Fitting set, which is just an ordinary Fitting set when $\mathcal{N}^\pi = \mathcal{N}$, and similarly define $\mathcal{N}^\pi$-Fitting classes. We then use the results on $\mathcal{N}^\pi$-projectors to prove that every π'-solvable group possesses a single non-empty conjugacy class of $\mathcal{F}$-injectors for any $\mathcal{N}^\pi$-Fitting set or $\mathcal{N}^\pi$-Fitting class $\mathcal{F}$, thereby generalizing the Fischer, Gaschütz, and Hartley result.

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Covering numbers of rings, Part 1

Nicholas Werner, SUNY College at Old Westbury

A cover of a ring R is a collection of proper subrings whose set theoretic union is all of R, and the covering number of R is the smallest size of such a cover (assuming one exists). The analogous concept of covering numbers of groups has been extensively studied, but much less is known in the case of rings. There are parallels between the group setting and the ring setting, but there are some subtleties that are present only in the ring setting. In particular, the presence or lack of a multiplicative identity in a ring or in subrings can affect the existence of a cover or the value of a covering number. In this talk, we will discuss these issues and summarize the known results about covering numbers of rings. As we will demonstrate, many questions about rings that have a finite covering number can be reduced to the case of finite rings of characteristic p. This is joint work with Eric Swartz.

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Covering numbers of rings, Part 2

Eric Swartz, William & Mary

A cover of a ring R is a collection of proper subrings whose set theoretic union is all of R, and the covering number of R is the smallest size of such a cover (assuming one exists). In this talk, we will discuss recent progress toward determining the cover number of a finite ring with unity. This is joint work with Nicholas Werner.

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Intersection numbers of semigroups

CASEY DONOVEN, Binghamton University

The intersection of all maximal subgroups of a group G is the Frattini subgroup of G. The intersection number of G is the minimum number of maximal subgroups of G whose intersection is the Frattini subgroup. This concept was introduced very recently by Archer et al. This talk will explore the analogous question for semigroups, describing some very basic results and differences with intersection numbers of groups.

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Bruhat posets of Hermitian-type symmetric spaces

ARAM BINGHAM, Tulane University

Borel orbits in symmetric spaces have a rich combinatorics, generalizing the Bruhat decomposition for algebraic groups. In Hermitian-type, we have an affine bundle over a Grassmannian $i\colon G/L \to G/P$, and the projection map determines much about the Bruhat poset of containments of Borel orbit closures in the symmetric space G/L. We will give a concrete combinatorial description of these posets based on the parameterization of orbits by "clans."

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On groups with quadratic Dehn function

MARK SAPIR, Vanderbilt University

This is joint work with A.Yu. Olshanskii. We prove that there exists a finitely presented group with quadratic Dehn function and undecidable conjugacy problem, solving a problem due to Rips, 1992. In addition we prove that our group has solvable power conjugacy problem. So this is the first example of a finitely presented group with solvable word and power conjugacy problem and unsolvable conjugacy problem. The proof uses S-machines and the technique introduced in our previous papers.

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Geometric embeddings into simple groups

Matt Zaremsky, University at Albany

In joint work with Jim Belk, we prove that every finitely generated group admits a quasi-isometric embedding as a subgroup of a finitely generated simple group. This means the group embeds into the simple group not only as an algebraic sub-object but also as a geometric sub-object. The simple groups we use are "twisted" versions of Brin-Thompson groups. We also use twisted Brin-Thompson groups to find examples of new simple groups with arbitrary finiteness length, and typeF_∞ simple groups containing every virtually special group (no previous knowledge of what these things mean will be assumed of the audience).

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Introduction to braided Brin-Thompson groups

Rob Spahn, University at Albany

The class of "Thompson-like" groups includes the well known Thompson's group V, and many more recent variations. I will introduce the important "Brin-Thompson groups", also known as higher dimensional Thompson groups, denoted sV. An element of sV is described by taking s-dimensional cubes and cutting them into halves in certain ways, similar to the $s = 1$ case of V, and then given two ways of halving, pairing up cubes with the same number of cuts, numbering their parts, and representing the pair by a paired tree diagram and a permutation. Next we discuss the formation of "braided V", which generalizes V by replacing permutations with braids. Finally, I will discuss my recent construction of the "Braided Brin-Thompson groups", which generalize all the sV at once by replacing permutations with braids. If time permits I will discuss some interesting properties of these groups.

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Irreducible represntations of braid groups

Inna Sysoeva, SUNY Binghamton

In this talk I will discuss the classification of the irreducible representations of Artin braid group B_n on n strings. All irreducible representations of B_n of dimension less than or equal to $n-1$ were classified by Ed Formanek in 1996; the irreducible representations of B_n dimension n for $n \geq 9$ were classified by the speaker in 1999, and for $n \leq 8$ they were classified by Formanek, Lee, Vazirani and the speaker in 2003. I will talk about my new result that states that the braid group B_n has no irreducible representations of dimension $n+1$ for $n \geq 10$. I am going to go over some new ideas and methods that were used in this work.

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The existence problem for strong mapping groups

Anthony Evans, Wright State University

A *complete mapping* of a group G is a bijection $\theta\colon G \to G$ for which the mapping $x \mapsto x\theta(x)$ is also a bijection: it is a *strong complete mapping* if, in addition, the mapping $x \mapsto x^{-1}\theta(x)$ is a bijection. While the existence problem for complete mappings has been solved, the corresponding problem for strong complete mappings is very much open. We will discuss work that has been done on this problem.

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The spectrum of nim-values of a game on finite groups

Bret Benesh, College of St. Benedict & St. John's University

We study an impartial achievement game introduced by Anderson and Harary. The game is played by two players who alternately select previously unselected elements of a finite group. The game ends when the jointly selected elements generate the group. The last player able to make a move is the winner of the game. We prove that the spectrum of nim-values of these games is $\{0, 1, 2, 3, 4\}$, which positively answers two previous conjectures about the nim-numbers of the game.

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π-submaximal subgroups of finite non-abelian simple groups

Andrew Latham, University of Florida

Let π be a set of primes. A subgroup H of a finite group X is called a *π-submaximal subgroup* if there is a monomorphism $\varphi : X \to Y$ into a finite group Y such that $\varphi(X)$ is subnormal in Y and $\varphi(H) = K \cap \varphi(X)$ for some π-maximal subgroup K of Y. We say that a subgroup is proper π-submaximal if it is π-submaximal but not π-maximal. In this paper, we derive properties of π-submaximal subgroups of simple groups, in addition to classifying the complete collection of π-submaximal subgroups for various families of simple groups.

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Issai Schur: his influence in group theory and other areas

Kenneth Johnson, Penn State Abington

Issai Schur: his influence in group theory and other areas. This talk will be a semi-historical account of how the works of Schur remain important not only in group theory and combinatorics but significant parts of number theory and analysis. There is a 545 page volume Studies in Memory of Issai Schur. From the introduction ...modern day algebraists know Schur obtained fundamental results in algebra but are unaware of his great contributions to analysis, while for analysts the opposite is true. It seems that there are many places where it would be fruitful to reexamine Schur's work, and that this should lead to a greater connection between the somewhat insulated world of pure group theory and the outside world of mathematics (and physics etc.) His choice of techniques and and directions of research are usually immaculate and his papers have been compared to polished diamonds. In algebra he used old-fashioned methods and avoided the abstractions invented by Emmy Noether and her followers. This means that there are many places in his work which seem obscure on first reading, but these can lead down unexpected paths. I will try to indicate some of these.

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Schur's exponent conjecture

Viji Thomas, Indian Institute of Science, Education and Research
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We will first briefly review the history of Schurs Exponent Conjecture. Then state our main Theorems towards the validity of the Conjecture for various classes of groups.

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Toward Schur's exponent conjecture

Ammu Elizabeth Antony, Indian Institute of Science, Education and Research, Thiruvananthapuram

The Schur Multiplier of a group G, is the second homology group of G with coefficients in the set of integers. A longstanding conjecture attributed to I. Schur says that the exponent of the Schur Multiplier of a group divides the exponent of the group. In this talk, we will go through the history and mainly prove the conjecture for all odd order groups of nilpotency class 5.

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Schur's exponent conjecture for p-groups of class p

Patali Komma, Indian Institute of Science, Education and Research Thiruvananthapuram

Schur multiplier of a group G denoted by $M(G)$, is the second homology group $H_2(G, \mathbb{Z})$ of G with coefficients in integers. It was conjectured that $\exp(M(G))|\exp(G)$ for every group G. In 1974 a group of exponent 4 where $M(G)$ is of exponent 8 was constructed providing a counterexample to the conjecture. However, the conjecture remains open for odd order groups to date. The conjecture was proved for several classes of groups by various authors, including the class of powerful p-groups, potent p-groups, p-groups of nilpotency class at most $p > 1$, groups of nilpotency class at most 3, finite 3-groups of class at most 5. We describe our recent work that $\exp(M(G))|\exp(G)$ for finite p-groups of nilpotency class p.

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The Huppert conjecture revisited

Farrokh Shirjian, Tarbiat Modares University

A celebrated conjecture of Huppert states that the non-abelian simple groups are determined up to an abelian direct factor by the set of their irreducible character degrees. The conjecture has been verified for simple alternating and sporadic groups, and only for few infinite families of simple Lie-type groups of low ranks. In this talk, we report our progress on establishing the conjecture for some new families of simple groups of Lie type, and also discuss our recent extension of this conjecture to the class of almost simple groups. Time permitting, we will also talk about some related questions such as the isomorphism question. This is based on joint results with A. Iranmanesh.

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An introduction to sharp permutation groups

Douglas Brozovic, University of North Texas

Let G be a finite group, χ a faithful character G, and set $L(\chi) := \{\chi(g) \mid g \in G - \{1\}\}$. A theorem of Cameron and Kiyota asserts that

$$|G| \;\Big|\; \prod_{k \in L(\chi)} (\chi(1) - k).$$

When $|G| = \prod_{k \in L(\chi)} (\chi(1) - k)$, χ is said to be a **sharp character of type** $L(\chi)$. When the sharp character χ is the permutation character associated to the permutation group (G, X), we say (G, X) is a **sharp permutation group of type** $L = L(\chi)$. In this talk, I'll give an overview of results relating to sharp permutation groups (with a focus on the case $|L| = 2$).

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Vertex-minimal graphs with non-abelian 2-group symmetry

Jay Zimmerman, Towson University

A graph whose full automorphism group is isomorphic to G is called a G-graph, and we let $\alpha(G)$ denote the minimal number of vertices among all G-graphs. We compute $\alpha(G)$ when G is isomorphic to either a quasi-dihedral group or a quasi-abelian group.

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Using lower central series to find Zariski pairs of line arrangements

Moshe Cohen, SUNY at New Paltz

A Zariski pair of complex projective line arrangements is a pair obtained from the same combinatorial intersection data but whose topological types are different. It is even more restrictive to find such a pair whose complements have different fundamental groups, which are finitely presented. Although these may be widely occurring for arrangements with larger numbers of lines, there are none for 9 or fewer lines, and only a handful of examples are currently known. Together with Baian Liu, we use lower central series to test for new Zariski pairs, drawing on candidates found in previous work with Liu and also with Amram, Teicher, and Ye.

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On solvable groups with one vanishing class size

Mark Lewis, Kent State University

This is joint work with Mariagrazia Bianchi, Rachel Camina, and Emanuele Pacifici. Let G be a finite group, and let $\mathrm{cs}(G)$ be the set of conjugacy class sizes of G. Recalling that an element g of G is called a *vanishing element* if there exists an irreducible character of G taking the value 0 on g, we consider one particular subset of $\mathrm{cs}(G)$, namely, the set $\mathrm{vcs}(G)$ whose elements are the conjugacy class sizes of the vanishing elements of G. Motivated by the results in an earlier paper by Bianchi, Lewis, and Pacifici, we describe the class of the finite groups G such that $\mathrm{vcs}(G)$ consists of a single element *under the assumption that G is supersolvable or G has a normal Sylow* 2-*subgroup* (in particular, groups of odd order are covered). As a particular case, we also get a characterization of finite groups having a single vanishing conjugacy class size *which is either a prime power or square-free.*

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On the modules in which semisimple fully invariant submodules are essential in summands

Ramazan Ya'Ar, Hacettepe University

One of the useful generalization of extending notion is FI-extending property. A module is called FI-extending if every fully invariant submodule is essential in a direct summand. In this paper, we explore Weak FI-extending concept by considering only semisimple fully invariant submodules rather than all fully invariant submodules. To this end, we call such a module Weak FI-extending. We obtain that FI-extending modules are properly contained in this new class of modules. Amongst other structural properties, we also deal with direct sums and direct summands of Weak FI-extending modules.

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Burnside type problem for groups and loops

ALEXANDR GRISHKOV, University of Sao Paulo

We understand the Burnside type problem for some variety V of loops as some question about periodic loops from V. Classical Burnside problem is : Let be G a finite generated loop from the variety V. Is it finite? We wll discussing Burnside type problem for Moufang loops, Bol loops and diassociative loops and its connection with Burnside type problems for groups.

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Classifying primal algebras by subalgebra posets

JONATHAN DOANE, Binghamton University

We prove that an algebra $\mathbf{A}$ is primal if and only if for each $n \in \mathbb{N}$, the canonical embedding of the lattice of partitions of n, $\Pi(n)$, into the lattice of subuniverses of $\mathbf{A}^n$, $\mathbf{Sub}(\mathbf{A}^n)$, is surjective onto $\mathbf{Sub}(\mathbf{A}^n) \setminus \{\emptyset\}$. As a consequence, $\mathbf{A}$ is primal iff the sequence $\mathbb{N} \to \mathbb{N} : n \mapsto |\mathbb{S}(\mathbf{A}^n)|$ is the famous sequence of Bell numbers, where $\mathbb{S}(\mathbf{A}^n)$ is the poset of subalgebras of $\mathbf{A}^n$.

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Leibniz central extensions of modular Lie algebras

JORG FELDVOSS, University of South Alabama

Leibniz algebras and their cohomology were introduced by Blo(c)h as well as Loday and Pirashvili as a natural framework for a non-commutative analog of Lie algebra cohomology. In this talk we will discuss central extensions of modular Lie algebras when the latter are considered as Leibniz algebras. These are given by the second Leibniz cohomology space with trivial coefficients.

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The transfer homomorphism for profinite groups

Mohammad Shatnawi, Western Michigan University

Let G be a finite group, and H be a subgroup of G of finite index. The transfer homomorphism emerges from the natural action of G on the cosets of H. It is a valuable tool to study unsolvable groups and the characterization of groups.

In an effort to define the transfer homomorphism for profinite groups, Oliver Schirokauer published a paper in 1997 titled "A Cohomological Transfer Map for Profinite Groups". In which he presented a new definition for the standard cohomological transfer as an integral. In this talk I will give an analog definition of the transfer homomorphism for profinite groups, that depends on the group action and structure using the permanent map and transfinite recursion.

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Semidirect products and the Chermak-Delgado lattice

Ryan McCulloch, University of Bridgeport

The Chermak-Delgado lattice of a finite group is a modular, self-dual sublattice of the lattice of subgroups of G. We study a class of semidirect products and their Cheramak-Delgado lattices. We construct examples of semidirect products, and we answer questions regarding the Chermak-Delgado lattice.

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Proof by example

William Cocke, Army Cyber Institute at West Point

We present a humorous example of applied group theory. We show that every n-sided polygon has the same interior-angle sum. [We are aware that there is an easy way to do this without invoking group theory.] We do this by showing that any nondegenerate triangle can be transformed into any other nondegenerate triangle in such a way that preserves the angle-sum. Hence any triangle is actually the result of a group action on any selected triangle. If one triangle has a certain angle-sum, then all triangles do. Hence, all n-sided polygons have the same angle-sum.

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A Frobenius group analog for Camina triples

Shawn Burkett, Kent State University

Frobenius groups are objects of fundamental importance in finite group theory. As such, several generalizations of these groups have been considered. Some examples include: A Frobenius–Wielandt group is a triple (G, H, L) where H/L is *almost* a Frobenius complement for G; A Camina pair is a pair (G, N) where N is *almost* a Frobenius kernel for G; A Camina triple is a triple (G, N, M) where (G, N) and (G, M) are *almost* Camina pairs. In this talk, we discuss triples (G, N, M) where (G, N) and (G, M) are *almost* Frobenius groups.

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Abstracts

Alphabetical by Speaker

Toward Schur's exponent conjecture

AMMU ELIZABETH ANTONY, Indian Institute of Science, Education and Research, Thiruvananthapuram

The Schur Multiplier of a group G, is the second homology group of G with coefficients in the set of integers. A longstanding conjecture attributed to I. Schur says that the exponent of the Schur Multiplier of a group divides the exponent of the group. In this talk, we will go through the history and mainly prove the conjecture for all odd order groups of nilpotency class 5.

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The spectrum of nim-values of a game on finite groups

BRET BENESH, College of St. Benedict & St. John's University

We study an impartial achievement game introduced by Anderson and Harary. The game is played by two players who alternately select previously unselected elements of a finite group. The game ends when the jointly selected elements generate the group. The last player able to make a move is the winner of the game. We prove that the spectrum of nim-values of these games is $\{0, 1, 2, 3, 4\}$, which positively answers two previous conjectures about the nim-numbers of the game.

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Bruhat posets of Hermitian-type symmetric spaces

ARAM BINGHAM, Tulane University

Borel orbits in symmetric spaces have a rich combinatorics, generalizing the Bruhat decomposition for algebraic groups. In Hermitian-type, we have an affine bundle over a Grassmannian $i\colon G/L \to G/P$, and the projection map determines much about the Bruhat poset of containments of Borel orbit closures in the symmetric space G/L. We will give a concrete combinatorial description of these posets based on the parameterization of orbits by "clans."

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An introduction to sharp permutation groups

DOUGLAS BROZOVIC, University of North Texas

Let G be a finite group, χ a faithful character G, and set $L(\chi) := \{\chi(g) \mid g \in G - \{1\}\}$. A theorem of Cameron and Kiyota asserts that

$$|G| \;\Big|\; \prod_{k \in L(\chi)} (\chi(1) - k).$$

When $|G| = \prod_{k \in L(\chi)} (\chi(1) - k)$, χ is said to be a **sharp character of type** $L(\chi)$. When the sharp character χ is the permutation character associated to the permutation group (G, X), we say (G, X) is a **sharp permutation group of type** $L = L(\chi)$. In this talk, I'll give an overview of results relating to sharp permutation groups (with a focus on the case $|L| = 2$).

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A Frobenius group analog for Camina triples

SHAWN BURKETT, Kent State University

Frobenius groups are objects of fundamental importance in finite group theory. As such, several generalizations of these groups have been considered. Some examples include: A Frobenius–Wielandt group is a triple (G, H, L) where H/L is *almost* a Frobenius complement for G; A Camina pair is a pair (G, N) where N is *almost* a Frobenius kernel for G; A Camina triple is a triple (G, N, M) where (G, N) and (G, M) are *almost* Camina pairs. In this talk, we discuss triples (G, N, M) where (G, N) and (G, M) are *almost* Frobenius groups.

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Proof by example

William Cocke, Army Cyber Institute at West Point

We present a humorous example of applied group theory. We show that every n-sided polygon has the same interior-angle sum. [We are aware that there is an easy way to do this without invoking group theory.] We do this by showing that any nondegenerate triangle can be transformed into any other nondegenerate triangle in such a way that preserves the angle-sum. Hence any triangle is actually the result of a group action on any selected triangle. If one triangle has a certain angle-sum, then all triangles do. Hence, all n-sided polygons have the same angle-sum.

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Using lower central series to find Zariski pairs of line arrangements

Moshe Cohen, SUNY at New Paltz

A Zariski pair of complex projective line arrangements is a pair obtained from the same combinatorial intersection data but whose topological types are different. It is even more restrictive to find such a pair whose complements have different fundamental groups, which are finitely presented. Although these may be widely occurring for arrangements with larger numbers of lines, there are none for 9 or fewer lines, and only a handful of examples are currently known. Together with Baian Liu, we use lower central series to test for new Zariski pairs, drawing on candidates found in previous work with Liu and also with Amram, Teicher, and Ye.

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Classifying primal algebras by subalgebra posets

Jonathan Doane, Binghamton University

We prove that an algebra $\mathbf{A}$ is primal if and only if for each $n \in \mathbb{N}$, the canonical embedding of the lattice of partitions of n, $\Pi(n)$, into the lattice of subuniverses of $\mathbf{A}^n$, $\mathbf{Sub}(\mathbf{A}^n)$, is surjective onto $\mathbf{Sub}(\mathbf{A}^n) \setminus \{\emptyset\}$. As a consequence, $\mathbf{A}$ is primal iff the sequence $\mathbb{N} \to \mathbb{N} : n \mapsto |\mathbb{S}(\mathbf{A}^n)|$ is the famous sequence of Bell numbers, where $\mathbb{S}(\mathbf{A}^n)$ is the poset of subalgebras of $\mathbf{A}^n$.

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Intersection numbers of semigroups

Casey Donoven, Binghamton University

The intersection of all maximal subgroups of a group G is the Frattini subgroup of G. The intersection number of G is the minimum number of maximal subgroups of G whose intersection is the Frattini subgroup. This concept was introduced very recently by Archer et al. This talk will explore the analogous question for semigroups, describing some very basic results and differences with intersection numbers of groups.

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The existence problem for strong mapping groups

Anthony Evans, Wright State University

A *complete mapping* of a group G is a bijection $\theta\colon G \to G$ for which the mapping $x \mapsto x\theta(x)$ is also a bijection: it is a *strong complete mapping* if, in addition, the mapping $x \mapsto x^{-1}\theta(x)$ is a bijection. While the existence problem for complete mappings has been solved, the corresponding problem for strong complete mappings is very much open. We will discuss work that has been done on this problem.

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Extension of Carter subgroups and injectors in finite π-separable groups

Arnold Feldman, Franklin & Marshall College

This is joint work with M. Arroyo-Jordá, P. Arroyo-Jordá, R. Dark, and M.D. Pŕez-Ramos. All groups are finite here. Let $\mathcal{N}$ denote the class of nilpotent groups. A Carter subgroup of a solvable group is a self-normalizing nilpotent subgroup. The Carter subgroups also turn out to be the $\mathcal{N}$-projectors of a solvable group. These subgroups were crucial in Fischer, Gaschütz, and Hartley's proof that for any Fitting set or Fitting class a finite solvable group has a non-empty set of injectors that forms a conjugacy class in that group. In order to generalize these results to π-separable groups for a set of primes π, we introduce the class $\mathcal{N}^\pi$, whose members are direct products of π-groups and nilpotent π'-groups; thus $\mathcal{N}^\pi = \mathcal{N}$ if π has at most one member. We prove that for π'-solvable groups (which are just π-separable groups if π contains the prime 2 or π' has at most two members) the $\mathcal{N}^\pi$-projectors form a single non-empty conjugacy class, thus generalizing the $\mathcal{N}$-projectors of solvable groups. We define a particular type of Fitting set, an $\mathcal{N}^\pi$-Fitting set, which is just an ordinary Fitting set when $\mathcal{N}^\pi = \mathcal{N}$, and similarly define $\mathcal{N}^\pi$-Fitting classes. We then use the results on $\mathcal{N}^\pi$-projectors to prove that every π'-solvable group possesses a single non-empty conjugacy class of $\mathcal{F}$-injectors for any $\mathcal{N}^\pi$-Fitting set or $\mathcal{N}^\pi$-Fitting class $\mathcal{F}$, thereby generalizing the Fischer, Gaschütz, and Hartley result.

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Leibniz central extensions of modular Lie algebras

Jorg Feldvoss, University of South Alabama

Leibniz algebras and their cohomology were introduced by Blo(c)h as well as Loday and Pirashvili as a natural framework for a non-commutative analog of Lie algebra cohomology. In this talk we will discuss central extensions of modular Lie algebras when the latter are considered as Leibniz algebras. These are given by the second Leibniz cohomology space with trivial coefficients.

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Burnside type problem for groups and loops

ALEXANDR GRISHKOV, University of Sao Paulo

We understand the Burnside type problem for some variety V of loops as some question about periodic loops from V. Classical Burnside problem is : Let be G a finite generated loop from the variety V. Is it finite? We wll discussing Burnside type problem for Moufang loops, Bol loops and diassociative loops and its connection with Burnside type problems for groups.

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Issai Schur: his influence in group theory and other areas

KENNETH JOHNSON, Penn State Abington

Issai Schur: his influence in group theory and other areas. This talk will be a semi-historical account of how the works of Schur remain important not only in group theory and combinatorics but significant parts of number theory and analysis. There is a 545 page volume Studies in Memory of Issai Schur. From the introduction ...modern day algebraists know Schur obtained fundamental results in algebra but are unaware of his great contributions to analysis, while for analysts the opposite is true. It seems that there are many places where it would be fruitful to reexamine Schur's work, and that this should lead to a greater connection between the somewhat insulated world of pure group theory and the outside world of mathematics (and physics etc.) His choice of techniques and and directions of research are usually immaculate and his papers have been compared to polished diamonds. In algebra he used old-fashioned methods and avoided the abstractions invented by Emmy Noether and her followers. This means that there are many places in his work which seem obscure on first reading, but these can lead down unexpected paths. I will try to indicate some of these.

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Schur's exponent conjecture for p-groups of class p

PATALI KOMMA, Indian Institute of Science, Education and Research Thiruvananthapuram

Schur multiplier of a group G denoted by $M(G)$, is the second homology group $H_2(G, \mathbb{Z})$ of G with coefficients in integers. It was conjectured that $\exp(M(G))|\exp(G)$ for every group G. In 1974 a group of exponent 4 where $M(G)$ is of exponent 8 was constructed providing a counterexample to the conjecture. However, the conjecture remains open for odd order groups to date. The conjecture was proved for several classes of groups by various authors, including the class of powerful p-groups, potent p-groups, p-groups of nilpotency class at most $p > 1$, groups of nilpotency class at most 3, finite 3-groups of class at most 5. We describe our recent work that $\exp(M(G))|\exp(G)$ for finite p-groups of nilpotency class p.

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π-submaximal subgroups of finite non-abelian simple groups

ANDREW LATHAM, University of Florida

Let π be a set of primes. A subgroup H of a finite group X is called a *π-submaximal subgroup* if there is a monomorphism $\varphi : X \to Y$ into a finite group Y such that $\varphi(X)$ is subnormal in Y and $\varphi(H) = K \cap \varphi(X)$ for some π-maximal subgroup K of Y. We say that a subgroup is proper π-submaximal if it is π-submaximal but not π-maximal. In this paper, we derive properties of π-submaximal subgroups of simple groups, in addition to classifying the complete collection of π-submaximal subgroups for various families of simple groups.

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On solvable groups with one vanishing class size

MARK LEWIS, Kent State University

This is joint work with Mariagrazia Bianchi, Rachel Camina, and Emanuele Pacifici. Let G be a finite group, and let $\mathrm{cs}(G)$ be the set of conjugacy class sizes of G. Recalling that an element g of G is called a *vanishing element* if there exists an irreducible character of G taking the value 0 on g, we consider one particular subset of $\mathrm{cs}(G)$, namely, the set $\mathrm{vcs}(G)$ whose elements are the conjugacy class sizes of the vanishing elements of G. Motivated by the results in an earlier paper by Bianchi, Lewis, and Pacifici, we describe the class of the finite groups G such that $\mathrm{vcs}(G)$ consists of a single element *under the assumption that G is supersolvable or G has a normal Sylow* 2-*subgroup* (in particular, groups of odd order are covered). As a particular case, we also get a characterization of finite groups having a single vanishing conjugacy class size *which is either a prime power or square-free*.

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On the structure of some locally nilpotent groups without contranormal subgroups

PATRIZIA LONGOBARDI, Università di Salerno - Italy

A subgroup H of a group G is **contranormal in** G if $H^G = G$, where $H^G = \langle x^{-1}hx \mid h \in H,\ x \in G\rangle$ is the normal closure of H in G. For example G is contranormal in G. Moreover, every subgroup of a finite group G is a contranormal subgroup of a subnormal subgroup of G. The concept of contranormal subgroup has been introduced by J.S. Rose in the paper [3]. Contranormal subgroups have been studied for example in the paper [2]. Obviously a contranormal subgroup H of a group G is normal or subnormal in G if and only if $H = G$. It follows that groups whose subgroups are all subnormal, in particular nilpotent groups, do not contain proper contranormal subgroups. The converse is also true for finite groups. The aim of this talk is to present some results obtained in the locally nilpotent case in the paper [1]. We first notice that locally nilpotent groups can have proper contranormal subgroups. We show that nilpotent-by-finite groups which do not contain proper contranormal subgroups are necessarily nilpotent. Moreover we describe locally nilpotent groups having a proper finite contranormal subgroup.

KLM L.A. Kurdachenko, P. Longobardi, M. Maj, On the structure of some locally nilpotent groups without contranormal subgroups, to appear.

KOS L.A. Kurdachenko, J. Otal, I.Ya. Subbotin, Abnormal, pronormal, contranormal and Carter subgroups in some generalized minimax groups, *Comm. Algebra*, **33** No.12, (2005) 4595-4616.

R J.S Rose, Nilpotent Subgroups of Finite Soluble Groups, *Math. Z.*, **106** (1968), 97-112.

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Semidirect products and the Chermak-Delgado lattice

Ryan McCulloch, University of Bridgeport

The Chermak-Delgado lattice of a finite group is a modular, self-dual sublattice of the lattice of subgroups of G. We study a class of semidirect products and their Cheramak-Delgado lattices. We construct examples of semidirect products, and we answer questions regarding the Chermak-Delgado lattice.

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Thompson-like characterization of solubility for products of groups

María Dolores Pérez-Ramos, Universitat de Valencia

A remarkable result of Thompson states that a finite group is soluble if and only if its two-generated subgroups are soluble. This result has been sharply generalized, and it is in the core of a wide area of study in the theory of groups, aiming for global properties of groups from local properties of two-generated (or more generally, n-generated) subgroups. We report about an extension of Thompson's theorem from the perspective of factorized groups. We prove that for a finite group $G = AB$, with A, B subgroups of G, if $\langle a, b\rangle$ is soluble for all $a \in A$ and all $b \in B$, then $[A, B]$ is soluble. In that case, the group G is said to be an $\mathcal{S}$-*connected product* of the subgroups A and B, for the class $\mathcal{S}$ of all finite soluble groups. As an application, deep results about connected products of finite soluble groups, for other relevant classes of groups, are extended to the finite universe. *Collaboration with M. P. Gállego (U. Zaragoza, Spain), P. Hauck (U. Tübingen, Germany), L. Kazarin (U. Yaroslavl, Russia), A. Martínez-Pastor (U. Politècnica de València, Spain).*

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On Thompson's normal p-complement theorem

NOELIA RIZO, Università degli Studi di Firenze

Many problems in character theory of finite groups deal with character degrees and prime numbers. For instance, the Itô-Michler theorem asserts that a prime p does not divide $\chi(1)$ for any irreducible character χ of G if and only if the group G has a normal and abelian Sylow p-subgroup. A kind of dual situation is Thompson's normal p-complement theorem, which asserts that if 1 is the only character degree in G coprime to p, then G has a normal p-complement. Simple Groups, showed that in this situation G is solvable. In this talk we present two extensions of Thompson's theorem.

First, we consider the next natural step, namely when there are just two character degrees in G coprime to p. We obtain that in this situation G is solvable and its p-length is at most 2. In a second extension we introduce the principal Brauer p-block of G. To obtain both results we make use of the Classification of Finite Simple Groups.

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On groups with quadratic Dehn function

MARK SAPIR, Vanderbilt University

This is joint work with A.Yu. Olshanskii. We prove that there exists a finitely presented group with quadratic Dehn function and undecidable conjugacy problem, solving a problem due to Rips, 1992. In addition we prove that our group has solvable power conjugacy problem. So this is the first example of a finitely presented group with solvable word and power conjugacy problem and unsolvable conjugacy problem. The proof uses S-machines and the technique introduced in our previous papers.

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The transfer homomorphism for profinite groups

Mohammad Shatnawi, Western Michigan University

Let G be a finite group, and H be a subgroup of G of finite index. The transfer homomorphism emerges from the natural action of G on the cosets of H. It is a valuable tool to study unsolvable groups and the characterization of groups.

In an effort to define the transfer homomorphism for profinite groups, Oliver Schirokauer published a paper in 1997 titled "A Cohomological Transfer Map for Profinite Groups". In which he presented a new definition for the standard cohomological transfer as an integral. In this talk I will give an analog definition of the transfer homomorphism for profinite groups, that depends on the group action and structure using the permanent map and transfinite recursion.

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The Huppert conjecture revisited

Farrokh Shirjian, Tarbiat Modares University

A celebrated conjecture of Huppert states that the non-abelian simple groups are determined up to an abelian direct factor by the set of their irreducible character degrees. The conjecture has been verified for simple alternating and sporadic groups, and only for few infinite families of simple Lie-type groups of low ranks. In this talk, we report our progress on establishing the conjecture for some new families of simple groups of Lie type, and also discuss our recent extension of this conjecture to the class of almost simple groups. Time permitting, we will also talk about some related questions such as the isomorphism question. This is based on joint results with A. Iranmanesh.

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Introduction to braided Brin-Thompson groups

Rob Spahn, University at Albany

The class of "Thompson-like" groups includes the well known Thompson's group V, and many more recent variations. I will introduce the important "Brin-Thompson groups", also known as higher dimensional Thompson groups, denoted sV. An element of sV is described by taking s-dimensional cubes and cutting them into halves in certain ways, similar to the $s = 1$ case of V, and then given two ways of halving, pairing up cubes with the same number of cuts, numbering their parts, and representing the pair by a paired tree diagram and a permutation. Next we discuss the formation of "braided V", which generalizes V by replacing permutations with braids. Finally, I will discuss my recent construction of the "Braided Brin-Thompson groups", which generalize all the sV at once by replacing permutations with braids. If time permits I will discuss some interesting properties of these groups.

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Covering numbers of rings, Part 2

Eric Swartz, William & Mary

A cover of a ring R is a collection of proper subrings whose set theoretic union is all of R, and the covering number of R is the smallest size of such a cover (assuming one exists). In this talk, we will discuss recent progress toward determining the cover number of a finite ring with unity. This is joint work with Nicholas Werner.

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Irreducible represntations of braid groups

Inna Sysoeva, SUNY Binghamton

In this talk I will discuss the classification of the irreducible representations of Artin braid group B_n on n strings. All irreducible representations of B_n of dimension less than or equal to $n-1$ were classified by Ed Formanek in 1996; the irreducible representations of B_n dimension n for $n \geq 9$ were classified by the speaker in 1999, and for $n \leq 8$ they were classified by Formanek, Lee, Vazirani and the speaker in 2003. I will talk about my new result that states that the braid group B_n has no irreducible representations of dimension $n+1$ for $n \geq 10$. I am going to go over some new ideas and methods that were used in this work.

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Schur's exponent conjecture

Viji Thomas, Indian Institute of Science, Education and Research Thiruvananthapuram

We will first briefly review the history of Schurs Exponent Conjecture. Then state our main Theorems towards the validity of the Conjecture for various classes of groups.

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Covering numbers of rings, Part 1

NICHOLAS WERNER, SUNY College at Old Westbury

A cover of a ring R is a collection of proper subrings whose set theoretic union is all of R, and the covering number of R is the smallest size of such a cover (assuming one exists). The analogous concept of covering numbers of groups has been extensively studied, but much less is known in the case of rings. There are parallels between the group setting and the ring setting, but there are some subtleties that are present only in the ring setting. In particular, the presence or lack of a multiplicative identity in a ring or in subrings can affect the existence of a cover or the value of a covering number. In this talk, we will discuss these issues and summarize the known results about covering numbers of rings. As we will demonstrate, many questions about rings that have a finite covering number can be reduced to the case of finite rings of characteristic p. This is joint work with Eric Swartz.

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On the modules in which semisimple fully invariant submodules are essential in summands

RAMAZAN YA'AR, Hacettepe University

One of the useful generalization of extending notion is FI-extending property. A module is called FI-extending if every fully invariant submodule is essential in a direct summand. In this paper, we explore Weak FI-extending concept by considering only semisimple fully invariant submodules rather than all fully invariant submodules. To this end, we call such a module Weak FI-extending. We obtain that FI-extending modules are properly contained in this new class of modules. Amongst other structural properties, we also deal with direct sums and direct summands of Weak FI-extending modules.

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Geometric embeddings into simple groups

Matt Zaremsky, University at Albany

In joint work with Jim Belk, we prove that every finitely generated group admits a quasi-isometric embedding as a subgroup of a finitely generated simple group. This means the group embeds into the simple group not only as an algebraic sub-object but also as a geometric sub-object. The simple groups we use are "twisted" versions of Brin-Thompson groups. We also use twisted Brin-Thompson groups to find examples of new simple groups with arbitrary finiteness length, and typeF_∞ simple groups containing every virtually special group (no previous knowledge of what these things mean will be assumed of the audience).

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Vertex-minimal graphs with non-abelian 2-group symmetry

Jay Zimmerman, Towson University

A graph whose full automorphism group is isomorphic to G is called a G-graph, and we let $\alpha(G)$ denote the minimal number of vertices among all G-graphs. We compute $\alpha(G)$ when G is isomorphic to either a quasi-dihedral group or a quasi-abelian group.

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