Groups St Andrews 2022 in Newcastle
Booklet of Abstracts

30th July – 7th August 2022

(Version as of August 4, 2022)

Disclaimer: The times and rooms listed in this document are *provisional*.

Please consult **The Daily Group Theorist** for the definitive talk times.

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Principal Speakers

Michel Brion (Institut Fourier, Université Grenoble Alpes)
Finite group schemes
Time/Room: Sunday 2.30pm, Tuesday 9.30am, Friday 9.30am & Saturday 4pm; Lecture Theatre 2, Herschel Building

ABSTRACT: Finite group schemes are generalizations of finite groups in an algebro-geometric setting. They occur naturally in algebraic geometry and algebraic groups in positive characteristics (for example, as Frobenius kernels) and they are closely related to restricted Lie algebras. The lectures will first give an introduction to the general theory of finite group schemes over an algebraically closed field, with few prerequisites. Then we will discuss actions on algebraic curves and a partial solution to the inverse Galois problem for infinitesimal group schemes.

Fanny Kassel (Institut des Hautes Études Scientifiques)
Discrete subgroups of higher-rank semisimple Lie groups
Time/Room: Monday 9.30am, Tuesday 1.30pm, Thursday 9.30am & Friday 2.30pm; Lecture Theatre 2, Herschel Building

ABSTRACT: Discrete subgroups of $\mathrm{SL}(2,\mathbb{R})$ are well understood, and classified by the geometry of the corresponding hyperbolic surfaces. On the other hand, discrete subgroups of higher-rank semisimple Lie groups, such as $\mathrm{SL}(n,\mathbb{R})$ for $n \geqslant 2$, remain more mysterious. While lattices in this setting are rigid, there also exist more flexible "thinner" discrete subgroups, which may have large and interesting deformation spaces, giving rise in particular to so-called higher Teichmüller theory. We will survey recent progress in constructing and understanding such discrete subgroups from a geometric and dynamical viewpoint.

Denis Osin (Vanderbilt University)
Applications of descriptive methods in geometric group theory
Time/Room: Sunday 9.30am, Tuesday 4pm, Wednesday 9.30am & Saturday 2.30pm; Lecture Theatre 2, Herschel Building

ABSTRACT: The goal of this series of lectures is to discuss the interplay between descriptive set theory and the study of geometric and model-theoretic properties of groups. We will begin by covering the necessary background from topology and logic. After that, we will focus on applications of descriptive methods to the study of first-order rigidity, asymptotic invariants, and quasi-isometric diversity of finitely generated groups.

Pham Huu Tiep (Rutgers University)
Character bounds for finite simple groups and applications
Time/Room: Monday 4pm, Wednesday 11am, Thursday 4pm & Friday 1.30pm; Lecture Theatre 2, Herschel Building

ABSTRACT: Given the current knowledge of complex representations of finite (quasi)simple groups, obtaining good upper bounds for their characters values still remains a difficult problem, a satisfactory solution of which would have significant implications in a number of applications. We will report on recent results that produce such character bounds, and discuss some such applications, in and outside of group theory.

One-Hour Speakers

Miklos Abert (Alfréd Rényi Institute of Mathematics)
Groups and graph limits
Time/Room: Tuesday 2.30pm, Lecture Theatre 2, Herschel Building

ABSTRACT: The rank gradient problem asks whether the growth of rank of a residually finite group over a chain of normal subgroups with trivial intersection depends only on the group. The problem is related to a lot of other solved and unsolved problems. I will discuss how to relate it to the cost of point processes on locally symmetric spaces. This is joint work with Samuel Mellick.

Bettina Eick (Technische Universität Braunschweig)
Computational group theory and polycyclic groups
Time/Room: Saturday 1.30pm, Lecture Theatre 2, Herschel Building

ABSTRACT: What do polycyclic groups look like and how can one compute with such groups? The first part of this talk contains a survey of well-known algorithms for this purpose. Then the talk discusses some open problems in this research area and recent advances towards them. In particular, a new algorithm to determine the Frattini subgroup of a polycyclic group is exhibited (joint work with Matthias Neumann-Brosig).

Scott Harper (University of Bristol)
Generating finite and infinite simple groups
Time/Room: Sunday 1.30pm, Lecture Theatre 2, Herschel Building

ABSTRACT: Finite simple groups can be generated by two elements in many spectacular ways. This talk will begin with a review of recent work in this area. For instance, every finite simple group has the property that every nontrivial element is contained in a generating pair, and I'll discuss the recent classification of all finite groups with this property (joint with Burness & Guralnick). I will then turn to infinite simple groups. Much less is known here, but there are some fascinating parallels with finite simple groups. In particular, I will report on recent work establishing that for the infinite simple groups V and T of Thompson (and infinite families of related groups) every nontrivial element is contained in a generating pair (joint with Donoven for V and Bleak & Skipper for T).

Julia Pevtsova (University of Washington)
Tensor triangular geometry in representation theory
Time/Room: Thursday 11am, Lecture Theatre 2, Herschel Building

ABSTRACT: Tensor triangular geometry is the study of tensor triangulated categories via geometric methods. I'll give a brief (and partial!) introduction to its axiomatics and then focus on the applications to finite tensor categories arising from modular representations. While classifying indecomposable modules in these categories is often an insurmountable task, tensor triangular geometry allows to bring some order and structure into this wild territory, particularly via the geometric classification of tensor ideals.

Simon Smith (University of Lincoln)
Local-to-global behaviour of groups acting on trees
Time/Room: Saturday 9.30am, Lecture Theatre 2, Herschel Building

Abstract: Bass-Serre Theory is a powerful tool for decomposing groups acting on trees, but its usefulness for constructing non-discrete groups acting on trees is severely limited. Such groups play an important role in the theory of locally compact groups, as they are a rich source of examples of nonlinear simple groups. An alternative 'local-to-global' approach to the study of groups acting on trees has recently emerged based on groups that are 'universal' with respect to some specified 'local' action (i.e., the action of a vertex stabiliser on neighbouring vertices).

In this talk I will discuss some prominent local-to-global constructions for groups acting on trees. I will then introduce some joint work with Colin Reid, in which we aim to advance the local-to-global theory of groups acting on trees by developing a 'local action' complement to classical Bass-Serre theory. We call this the theory of local action diagrams. The theory is powerful enough to completely describe all closed groups of automorphisms of trees that enjoy Tits' Independence Property (P).

Contributed Talks

Henry Bradford (University of Cambridge)
Local permutation stability
Provisional Time/Room: Monday 13.30, 4th Floor Herschel, Teaching Room 2

ABSTRACT: A group Γ is *sofic* if elements of Γ can be distinguished by *almost-actions* on finite sets. It is a major unsolved problem to determine whether all groups are sofic. One approach to this problem which has gained much recent attention is that of "permutation stability", that is, showing that almost-actions of a group are controlled by its actions. We introduce a "local" generalization of permutation stability, under which actions are replaced by partial actions. We exhibit an uncountable family of groups which are locally permutation stable but not permutation stable, coming from topological dynamics. The proof is based on a criterion for local stability of amenable groups, in terms of invariant random subgroups.

Sofia Brenner (Friedrich Schiller University Jena)
The socle of the center of a group algebra
Provisional Time/Room: Friday 12.00, 4th Floor Herschel, Teaching Room 2

ABSTRACT: Let F be a field and let G be a finite group. We consider the socle $\mathrm{soc}(ZFG)$ of the center ZFG of FG, which is known to be an ideal in ZFG, and address the question for which groups it is even an ideal in FG. In my talk, I will describe the structure of the finite groups whose group algebras have this property and present some classification results.

Mattia Brescia (Dipartimento di Matematica e Applicazioni "Renato Caccioppoli", Università degli Studi di Napoli Federico II)
On the absolute centre of a group
Provisional Time/Room: Thursday 13.30, 4th Floor Herschel, Teaching Room 4

ABSTRACT: Let G be a group. The *absolute centre* or *autocentre* of G is the the subgroup of all elements of G which are fixed by every automorphism of G. Although in the literature there are many results on the absolute centre and on several types of "autocentral" series, no systematic approach to the problem has been carried out so far. In this talk we present the development of some homological tools which are particularly suitable for solving some known problems on the subject and to construct example showing that in fact the structure of the absolute centre of a group can be pretty varied and interesting. After having pointed out that there exists a group G such that its absolute centre A has finite index in G and such that $AutA$ has the cardinality of $2^{2^{\aleph_0}}$, we will construct "small" groups with "large" absolute centres and vice versa.

Thomas Breuer (RWTH Aachen University)
Finite groups can be generated by a π-subgroup and a π'-subgroup
Provisional Time/Room: Saturday 11.00, 4th Floor Herschel, Teaching Room 4

ABSTRACT: Given a set of primes π, any finite group can be generated by a π-subgroup and a π'-subgroup. The proof is based on the Classification of Finite Simple Groups. This is joint work with Robert M. Guralnick.

David Cushing (Newcastle University)
The curvature of Cayley graphs
Provisional Time/Room: Monday 14.00, 4th Floor Herschel, Teaching Room 2

ABSTRACT: In recent years, the discrete Bakry-Émery theory on graphs has become an active emerging research field. Fan Chung and S. T. Yau showed that all abelian Cayley graphs are non-negatively curved. However apart from some special families, such as Coxeter groups, the curvature properties of non-abelian Cayley graphs are not known. In this talk we reformulate the Bakry-Émery curvature on a graph in terms of the smallest eigenvalue of a rank one perturbation of the so-called curvature matrix using Schur complement. We view this curvature matrix as the discrete Ricci curvature tensor. Using this reformulation we will calculate the curvature of various classes of Cayley graphs including hybrids of Coxeter and Artin groups. We end by showing that adding a relation to a Cayley graph does not decrease curvature.

Luca Di Gravina (Heinrich-Heine-Universität Düsseldorf)
The Möbius function of finite classical groups
Provisional Time/Room: Friday 11.00, 4th Floor Herschel, Teaching Room 2

ABSTRACT: The Möbius function of locally finite posets is a classical tool in enumerative combinatorics. It is a generalization of the number-theoretic Möbius function and it has several applications in group theory, from the Euler characteristic of subgroup complexes to algebraic aspects of cellular automata.

If G is a finitely generated profinite group, there is a connection between the probabilistic zeta function of G and the Möbius function μ_G defined on the lattice of the open subgroups of G. In particular, if G is positively finitely generated, some questions arise about the growth of the absolute value of μ_G and the growth of the number of subgroups of G with non-zero value for this function. Let $b_n(G)$ be the number of open subgroups $H \leq_o G$ such that the index $|G : H| = n$ and $\mu_G(H) \neq 0$. It was conjectured by Avinoam Mann that $b_n(G)$ grows polynomially with respect to n and that $|\mu_G(H)| \leq |G : H|^c$ for some constant c independent of $H \leq_o G$. In this way, we would have that the Dirichlet series

$$P_G(s) = \sum_{H \leq_o G} \frac{\mu_G(H)}{|G : H|^s}$$

is absolutely convergent in some right half-plane of the complex plane and $P_G(k)$ represents, for enough large $k \in \mathbb{N}$, the probability that k random elements of G generate the whole group. This problem remains open in its general setting for all positively finitely generated profinite groups. But it can be reduced to a similar one involving only finite almost simple groups.

So, I will report on some known results for symmetric and alternating groups on finite sets, and I will introduce some methods and new results for finite classical groups. In particular there is a nice formula that allows us to express $\mu_G(H)$ for each subgroup H of a finite classical group G by using only the Möbius function of some order ideals of reducible subgroups of G and the values $\mu_G(K)$, where K ranges over the irreducible subgroups of G. By focussing on $\mathrm{PGL}(n, q)$, I will also show some links between this problem and other interesting questions in algebraic combinatorics.

Casey Donoven (Montana State University Northern)
Inverse Graphs of Semigroups
Provisional Time/Room: Sunday 16.30, 4th Floor Herschel, Teaching Room 2

ABSTRACT: A semigroup S is a set with an associative binary operation and an element $a \in S$ has inverse $b \in S$ if $aba = a$ and $bab = b$. The inverse graph of S is the graph whose vertices are elements of S and two vertices are connected by an edge when they are inverses of one another. In this talk, I will introduce this construction, along with examples, and characterise semigroups with connected inverse graphs. Specifically, connected inverse graphs arise from Rees matrix semigroups, which are unions of groups.

Florian Eisele (University of Manchester)
On Donovan's conjecture and Picard groups
Provisional Time/Room: Sunday 11.30, 4th Floor Herschel, Teaching Room 4

ABSTRACT: One of the major open questions in the representation theory of finite groups over a field k of characteristic $p > 0$ is Donovan's conjecture, which constrains the module category of kG in terms of the Sylow p-subgroups of G. I will talk about some recent results on this conjecture and the closely related Picard groups of group algebras.

Alex Evetts (University of Manchester)
Formal language descriptions of algebraic and definable sets in finitely generated groups
Provisional Time/Room: Sunday 11.00, 4th Floor Herschel, Teaching Room 4

ABSTRACT: The set of solutions to a system of equations over a group is known as an algebraic set, which is an example of a definable set (a set of tuples satisfying some formula in the first-order language of the group). The study of algebraic sets goes back to the 1970s and 1980s and work of Makanin and Razborov on finitely generated free groups. More recently, there has been a significant amount of effort to describe algebraic sets using formal languages, and in particular the class of EDT0L languages. I will introduce this class of languages and survey some recent results, including a description of algebraic sets in virtually abelian groups (joint with A. Levine) which generalises to all definable sets (joint with L. Ciobanu).

María José Felipe (Instituto Universitario de Matemática Pura y Aplicada. Universitat Politècnica de València, Spain.)
Structure of a normal subgroup from its G-character tables
Provisional Time/Room: Thursday 14.00, 4th Floor Herschel, Teaching Room 4

ABSTRACT: Let N be a normal subgroup of a finite group G. The character table of G contains square submatrices, called G-character tables of N, and which are induced by the G-conjugacy classes of elements in N and the G-orbits of irreducible characters of N. We provide this fact in a module theoretic setting, analysing the structure of the subalgebra $\mathbf{Z}(\mathbb{K}[G]) \cap \mathbb{K}[N]$ of the group algebra $\mathbb{K}[G]$ over a splitting field $\mathbb{K}$ for G (in particular, if $\mathbb{K}$ is algebraically closed) with characteristic not dividing the order of G. These submatrices are non-singular and become a useful tool to obtain information of N from the character table of G.
Joint work with M.D. Pérez-Ramos and V. Sotomayor

Maria Ferrara (University of Campania *Luigi Vanvitelli*)
On Groups Factorized by Mutually Permutable Subgroups
Provisional Time/Room: Saturday 11.30, 4th Floor Herschel, Teaching Room 4

ABSTRACT: Two subgroups A and B of a group G are said to be *mutually permutable* if $AY = YA$ and $XB = BX$ for all subgroups X of A and Y of B. Of course, any two normal subgroups are examples of mutually permutable subgroups. Groups which are products of two mutually permutable subgroups have been recently investigated by several authors and in particular, it has been proved [1] that if $G = AB$ is a finite group which is factorized by two mutually permutable subgroups, then $A \cap B$, A' and B' are subnormal subgroups of G. It follows that if any of those subgroups is locally nilpotent, then its normal closure in G is locally nilpotent as well. This conclusion has been generalized to infinite groups [2] under some additional hypotheses: the whole group must be soluble-by-finite with finite abelian section rank, and the two subgroups A and B must be finite-by-nilpotent. In a joint work with Marco Trombetti, we prove that the assumptions on A and B can be omitted, while that on the rank can be weakened.

[1] J.C. Beidleman and H. Heineken: *Mutually permutable subgroups and group classes*, Arch. Math. (Basel) 85 (2005), 18–30.

[2] F. de Giovanni and R. Ialenti: *Groups with finite abelian section rank factorized by mutually permutable subgroups*, Comm. Algebra 44 (2016), 118–124.

Saul D. Freedman (University of St Andrews)
The intersection graph of a finite simple group
Provisional Time/Room: Monday 11.00, 4th Floor Herschel, Teaching Room 4

ABSTRACT: Given a binary relation on the subgroups or elements of a group G, it is natural to study the properties of the graph encoding this relation. One example is the intersection graph, whose vertices are the proper nontrivial subgroups of G, with two distinct subgroups joined by an edge if and only if their intersection is nontrivial. There has been particular interest in the intersection graph of a non-abelian finite simple group since 2010, when Shen proved that such a graph is connected and posed questions about its diameter. In this talk, we will show that this diameter has a tight upper bound of 5, achieved only by the graphs of the baby monster group and certain unitary groups. We will also discuss applications of this result to related graphs defined on the elements of a group.

Vanthana Ganeshalingam (University of Warwick)
Subgroup Structure of the Exceptional Group of Type F_4
Provisional Time/Room: Friday 16.30, 4th Floor Herschel, Teaching Room 2

ABSTRACT: We will discuss the methodology used to classify the connected reductive subgroups X of $G = F_4$. When the underlying field has characteristic 2 or 3, non-G-completely reducibile (non G-cr) subgroups arise; the notion of completely reducible subgroups was introduced by Serre in the 90s. We will cover some interesting examples of non-G-cr reductive subgroups X in G and discuss our recent work in finding their connected centralisers.

Àngel García Blàzquez (University of Murcia)
The Isomorphism Problem for Rational Group Algebras of Metacyclic Groups
Provisional Time/Room: Friday 16.00, 4th Floor Herschel, Teaching Room 4

Abstract: The Isomorphism Problem for group rings with coefficients in a ring R asks whether the isomorphism type of a group G is determined by its group ring RG. We discuss the Isomorphism Problem for Rational group rings of metacyclic groups. We prove a positive result under the assumption that G is a p-group and we generalise it for the general case.

Diego García Lucas (Universidad de Murcia)
On the modular isomorphism problem: even versus odd characteristic
Provisional Time/Room: Sunday 16.30, 4th Floor Herschel, Teaching Room 4

Abstract: Let p be a prime, G be a finite p-group, k a field of characteristic p, and kG the group algebra of G over k. The Modular Isomorphism Problem (MIP), in its strongest version, asks whether the isomorphism type of G can be recovered from the structure of kG as k-algebra; and it can be reformulated as the more general question: what information can be recovered about the group G from kG?

It is known that MIP has a negative answer in general, as there exist non-isomorphic finite 2-groups with isomorphic group algebras over every field of characteristic 2; however, no analogous example for the case $p > 2$ is known. We analyze the possibility, for the odd case, of obtaining a naive counterexample to MIP satisfying similar properties to the even counterexample, namely the ones of being 2-generated, having cyclic commutator subgroup and other more technical conditions, pointing out the differences between the cases $p = 2$ and $p > 2$.

This talk is based on a joint work with Ángel del Río and Mima Stanojkovski

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Marcel Herzog (School of Mathematical Sciences, Tel-Aviv University, Tel-Aviv, Israel)
On $D(j)$-groups with an element of order p^{j+1}
Provisional Time/Room: Friday 11.00, 4th Floor Herschel, Teaching Room 4

ABSTRACT: Let G be a group and denote the conjugacy class of an element x of G by x^G. Clearly $\langle x\rangle \leq C_G(x)$. We shall call a non-trivial element x of G and its conjugacy class **deficient** if $\langle x\rangle < C_G(x)$. Let j denote a non-negative integer. We shall say that a group G belongs to $D(j)$ if **exactly** j of its non-trivial conjugacy classes are deficient. The results in this talk were obtained jointly with Patrizia Longobardi and Mercede Maj.

Groups belonging to $D(0)$ and $D(1)$ were investigated in our paper "On conjugacy classes in groups", to appear. In this talk we shall deal with groups G satisfying the following condition: $G \in D(j)$ for seme integer $j \geq 1$ and it contains an element x of order p^{j+1} for some prime p. The set of such groups will be denoted by M.

Suppose that $G \in M$ and let $N = \{x^p, x^{p^2}, \ldots, x^{p^j}\}$. Then the elements in N are non-trivial elements of G of distinct orders. Since $\langle x\rangle$ is a subset of their centralizers, the set of the conjugacy classes $\{(x^p)^G, (x^{p^2})^G, \ldots, (x^{p^j})^G\}$ consists of j non-trivial deficient classes of G. Therefore each deficient element of G is conjugate to one element of N. In particular G is periodic, since if $y \in G$ is of infinite order, then $\langle y^2\rangle < \langle y\rangle \leq C_G(y^2)$ and hence y^2 is a deficient element of G, a contradiction. Finally, it is easy to see that the order of each element g of G is either $p^i \leq p^{j+1}$ or q, where q is a prime different from p.

In our paper "On $D(j)$-groups with an element of order p^{j+1} for some prime p", to appear, we determined all finite groups G in M. They consist of some solvable groups divisible by at most two primes and one simple group $PSL(2,7)$ of order 168, corresponding to $p = 2$ and $j = 1$. In the infinite case, we obtained two results. Recall that a group G is locally graded if every non-trivial finitely generated subgroup of G has a proper normal subgroup of finite index. We proved: Theorem 1. If $G \in M$ is locally finite, then it is finite. and Theorem 2: If $G \in M$ is locally graded, then G is finite.

Hongyi Huang (University of Bristol)
Base-two primitive permutation groups
Provisional Time/Room: Thursday 14.00, 4th Floor Herschel, Teaching Room 2

ABSTRACT: Let $G \leqslant \mathrm{Sym}(\Omega)$ be a permutation group and recall that a base for G is a subset of Ω with trivial pointwise stabiliser. Bases have been studied for many decades and an ambitious project initiated by Jan Saxl in the 1990s seeks to determine the primitive groups with a base of size 2. In recent years, there has been significant progress towards this goal and I will review some of the latest developments. I will also report on recent work concerning the Saxl graph of a base-two permutation group, which was recently introduced by Burness and Giudici. Some of the new results are based on recent joint work with Tim Burness.

Erzsébet Horváth (Budapest University of Technology and Economics)
Constructing arbitrary depth with the help of wreath products
Provisional Time/Room: Friday 16.30, 4th Floor Herschel, Teaching Room 4

ABSTRACT: The notion of depth of a subalgebra originates from von Neumann algebras and Hopf Algebras. Later it was introduced for group algebras. The minimal depth of the group algebra of a subgroup in the group algebra of a group is called *subgroup depth*. We consider a question by Lars Kadison saying: Are there subgroups of even depth bigger than 6? We answer this question positively, moreover we produce infinitely many examples of any depth. This is joint work with Hayder Abbas Janabi and Thomas Breuer.

Alexander Hulpke (Colorado State University)
The perfect groups of order up to two million
Provisional Time/Room: Thursday 14.30, Lecture Theatre 2, Herschel Building

ABSTRACT: In 1989, Holt and Plesken classified the perfect groups of order up to 10^6 with the exception of a few orders. Despite of much progress in both software and computation, this classification had not been completed in the intervening 30 years. One reason for this has been that doing so required progress on constructing extensions with nonsolvable groups, as well as with isomorphism tests.

With such routines recently having become available in GAP, I completed the classification and extended it to perfect groups of order up to $2 \cdot 10^6$. I will describe the underlying mathematics, algorithms, and GAP routines to do such calculations.

Stephen Humphries (Brigham Young University, USA)
Weak Cayley table maps: generalized group automorphisms
Provisional Time/Room: Sunday 16.00, 4th Floor Herschel, Teaching Room 2

ABSTRACT: A *weak Cayley table map* is a bijection $\varphi : G \to G$, where G is a group, satisfying: (i) $\varphi(g^G) = \varphi(g)^G$; and (ii) $\varphi(gh) \sim \varphi(g)\varphi(h)$ for all $g, h \in G$, where $\sim$ denotes conjugacy. The set of all such φ forms a group $W(G)$ that contains $\mathrm{Aut}(G)$ and the inverse map $\iota : g \mapsto g^{-1}$. Let $W_0(G) = \langle \mathrm{Aut}(G), \iota \rangle$. Given G the main problems are to determine $W(G)$ explicitly, or just to say when $W(G) = W_0(G)$. We investigate these problems for various families of groups. For example, we can show that $W(A_4) \neq W_0(A_4)$, but that $W(A_n) = W_0(A_n)$ for all $n \neq 4$; or if $p \geq 5$ is prime and $n \geq 1$, then we can show that $W(\mathrm{PSL}(2, p^n)) = W_0(\mathrm{PSL}(2, p^n))$. We also address these problems for the following families: some sporadic simple groups, finite irreducible Coxeter groups, symmetric groups, dihedral groups, some crystallographic groups, abelian groups, free groups and more.

Gareth A. Jones (University of Southampton, UK)
Groups and the Bateman–Horn Conjecture
Provisional Time/Room: Monday 14.00, 4th Floor Herschel, Teaching Room 4

ABSTRACT: A number of problems in various areas of mathematics depend on whether or not a finite set of polynomials $f_i(t) \in \mathbb{Z}[t]$ simultaneously take prime values for infinitely many $t \in \mathbb{N}$. They include the twin primes conjecture, with $f_i(t) = t, t+2$ for $i = 1, 2$. In finite group theory, they include the classifications of permutation groups and of linear groups of prime degree, and of simple groups of order the product of six primes, where it is unknown whether certain classes of groups are finite or infinite. The Bateman–Horn Conjecture proposes a heuristic estimate for the number of $t \leq x \in \mathbb{R}$ yielding prime values $f_i(t)$. Joint work with Alexander Zvonkin gives strong experimental evidence that the Conjecture is correct, and hence that these classes of groups are all infinite.

Seungjai Lee (Seoul National University)
Higman's PORC conjecture on the p-groups of maximal class
Provisional Time/Room: Monday 11.00, 4th Floor Herschel, Teaching Room 2

ABSTRACT: In 1960, Graham Higman formulated his famous PORC conjecture on the function $f(p, n)$ counting the number of (isomorphism classes) of p-groups of order p^n. Up to the present, the complete description of $f(p, n)$ for any given prime p is only available for $n \leq 7$, and still open for $n \geq 8$.

Recently, we managed to make some progress by counting the number of groups of order p^8 which are of maximal class, which also turns out to be PORC. In fact, we proved that the function $m(p, n)$ counting the number of maximal class p-groups of order p^n is PORC for $n \leq 8$. In this talk I will introduce our result and discuss interesting observations we made from our computations. This is joint work with Michael Vaughan-Lee.

Alan Logan (University of St Andrews)
The Conjugacy Problem for Ascending HNN-extensions of Free Groups
Provisional Time/Room: Saturday 11.30, 4th Floor Herschel, Teaching Room 2

ABSTRACT: In this talk, I will explain how to solve the conjugacy problem for ascending HNN-extensions of free groups. In 2006, Bogopolski+Martino+Maslakov+Ventura solved the conjugacy problem for free-by-cyclic groups. Their proof is based on 2 key components, which are both proven using an analysis of free groups automorphisms via train-track maps. We follow this same route, and but instead use an analysis of free group endomorphisms via the "automorphic expansions" of Mutanguha to prove the analogous 2 key components.

Leo Margolis (ICMAT, Madrid)
A counterexample to the Modular Isomorphism Problem
Provisional Time/Room: Sunday 16.00, 4th Floor Herschel, Teaching Room 4

ABSTRACT: Say we are given only the R-algebra structure of a group ring RG of a finite group G over a commutative ring R. Can we then find the isomorphism type of G as a group? This so-called Isomorphism Problem has obvious negative answers, considering e.g. abelian groups over the complex numbers, but more specific formulations have led to many deep results and beautiful mathematics. The last classical open formulation was the so-called Modular Isomorphism Problem: Does the isomorphism type of kG as a k-algebra determine the isomorphism type of G as a group, if G is a p-group and k a field of characteristic p?

We report on some recent results on the problem including a counterexample in the class of 2-groups. This is joint work with Diego García-Lucas and Ángel del Río.

Eshita Mazumdar (Ahmedabad University)
Zero sums in restricted sequences over finite groups
Provisional Time/Room: Monday 13.30, 4th Floor Herschel, Teaching Room 4

ABSTRACT: Zero-sum problems are basically combinatorial in nature. It deals with the condition which ensures that a given sequence over a finite group has a zero-sum subsequence with some prescribed property. There are many group invariants associated with zero-sum problems. The original motivation for introducing group invariant was to study the problem of non-unique factorization domain over number fields. The precise value of these group invariants for any finite group is still unknown. In this talk I will discuss about k-restricted sequence where no element of finite group G appears more than k times in a sequence and discuss various results related to it. Also we will discuss the similar problem for random G-sequences.

Justin McInroy (University of Chester)
Split spin factor algebras
Provisional Time/Room: Sunday 11.30, 4th Floor Herschel, Teaching Room 2

ABSTRACT: Axial algebras are a new class of non-associative algebra with a strong natural link to groups. The are generated by so-called axes, which are idempotents with nice properties. Of particular interest are those of Monster type (α, β) of which the Griess algebra (with automorphism group the Monster) is a motivating example. Very recently, the 2-generated axial algebras of Monster type (α, β) have been explicitly classified by the combined work of Yabe, Franchi, Mainardis and McInroy, yet fundamental questions remain. For example, how many axes does each algebra have?

We define *split spin factor algebras* which have parallels to the spin factor Jordan algebras. We show that split spin factor algebras give one of the families of 2-generated axial algebras of Monster type (α, β). However, the structure of these algebras are much clearer from our construction. In particular, we explicitly describe how many axes an algebra has – this can be finite or infinite depending on the parameters.

This is joint work with Sergey Shpectorov (Birmingham).

Carmine Monetta (University of Salerno)
The structure of a finite group from a neighborhood's point of view
Provisional Time/Room: Friday 11.30, 4th Floor Herschel, Teaching Room 2

Abstract: The aim of this talk is to present some new directions in the study of graphs whose vertex set is a group G and where there is an edge between two vertices if they generate a subgroup of G with specific characteristics. More precisely, we will focus our attention on the set of neighbors of a vertex, trying to understand when numerical and combinatorial properties of a neighborhood may affect the structure of the finite group G.

Péter P. Pálfy (Rényi Institute, Budapest, Hungary)
Galois's theorems on $\mathrm{PSL}(2,p)$
Provisional Time/Room: Monday 14.30, Lecture Theatre 2, Herschel Building

Abstract: In his "testamentary letter" Galois claims (without proof) that $\mathrm{PSL}(2,p)$ is simple for every prime number $p \geq 5$ and it does not have a subgroup of index p whenever $p > 11$. Moreover, he gives examples that for $p = 5, 7, 11$ such subgroups do exist.

The attempt by Betti in 1853 to give a proof does not seem to be complete. Jordan's proof in his 1870 book uses methods certainly not known to Galois. Nowadays we deduce Galois's result from the complete list of subgroups of $\mathrm{PSL}(2,p)$ obtained by Gierster in 1881.

In the talk I will give a proof that might be close to Galois's own thoughts.

In October 2020 I exchanged a few e-mails on this topic with Peter M. Neumann. The talk is dedicated to his memory.

Komma Patali (IISER Thiruvananthapuram)
Bounding the exponent of a group and its commutator subgroup and Schur's exponent conjecture
Provisional Time/Room: Tuesday 11.30, 4th Floor Herschel, Teaching Room 4

Abstract: Let G be a finite p-group, and S be a Sylow p-subgroup of $\mathrm{Aut}(G)$ with $\exp(S) = q$. We prove that if the nilpotency class of G is c, then $\exp(\mathrm{Aut}(G)) \mid p^{\lceil \log_p c \rceil} q^3$, and if G is a metabelian p-group of class at most $2p-1$, then $\exp(G) \mid pq^3$. We also prove that $\exp(\gamma_2(G)) \mid p^{\lceil \log_p c \rceil - 1} \exp(G/Z(G))$ if the nilpotency class of G is at most c, and $\exp(\gamma_2(G)) \mid \exp(G/Z(G))$ if G is a metabelian p-group of class at most $2p-1$. We discuss the progress made towards the Schur's exponent conjecture in recent years, and will describe our contribution to this conjecture.

M. Dolores Pérez-Ramos (Universitat de València, Spain)
Carter and Gaschütz theories beyond soluble groups
Provisional Time/Room: Tuesday 11.30, 4th Floor Herschel, Teaching Room 2

ABSTRACT: Classical results from the theory of finite soluble groups state that Carter subgroups, i.e. self-normalizing nilpotent subgroups, coincide with nilpotent projectors and with nilpotent covering subgroups, and they form a non-empty conjugacy class of subgroups, in soluble groups. We present an extension of these facts to π-separable groups, for sets of primes π, by proving the existence of a conjugacy class of subgroups in π-separable groups, which specialize to Carter subgroups within the universe of soluble groups. The approach runs parallel to the extension of Hall theory from soluble to π-separable groups by Čunihin, regarding existence and properties of Hall subgroups. Our Carter-like subgroups enable an extension of the existence and conjugacy of injectors associated to Fitting classes to π-separable groups, in the spirit of the role of Carter subgroups in the theory of soluble groups.

This is joint work with M. Arroyo-Jordá, P. Arroyo-Jordá, R. Dark and A. D. Feldman

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Kamilla Rekvényi (Imperial College London)
The Orbital Diameter of Affine and Diagonal Groups
Provisional Time/Room: Monday 11.30, 4th Floor Herschel, Teaching Room 4

ABSTRACT: Let G be a group acting transitively on a finite set Ω. Then G acts on $\Omega \times \Omega$ componentwise. Define the orbitals to be the orbits of G on $\Omega \times \Omega$. The diagonal orbital is the orbital of the form $\Delta = \{(\alpha, \alpha) | \alpha \in \Omega\}$. The others are called non-diagonal orbitals. Let Γ be a non-diagonal orbital. Define an orbital graph to be the non-directed graph with vertex set Ω and edge set $(\alpha, \beta) \in \Gamma$ with $\alpha, \beta \in \Omega$. If the action of G on Ω is primitive, then all non-diagonal orbital graphs are connected. The orbital diameter of a primitive permutation group is the supremum of the diameters of its non-diagonal orbital graphs.

There has been a lot of interest in finding bounds on the orbital diameter of primitive permutation groups. In my talk I will outline some important background information and the progress made towards finding explicit bounds on the orbital diameter. In particular, I will discuss some results on the orbital diameter of the groups of simple diagonal type and their connection to the covering number of finite simple groups. I will also discuss some results for affine groups, which provides a nice connection to the representation theory of quasisimple groups.

Renu (Indian Institute of Science Education and Research Bhopal, India)
The Schur Multiplier of finite p-groups of maximal class.
Provisional Time/Room: Tuesday 11.00, 4th Floor Herschel, Teaching Room 4

ABSTRACT: Let G be a finite p-group of maximal class of order p^n. In a research article, Primož Moravec raised the following question: if $n = p + 1$, the Schur multiplier $M(G)$ of G is always an elementary abelian p-group. Taking this into account, we showed that $M(G)$ is an elementary abelian p-group, whenever $4 \leq n \leq p + 1$. The case $n = p + 1$ settles the question raised by Primož Moravec. This is a joint work with Dr. Siddhartha Sarkar.

Aluna Rizzoli (University of Cambridge)
On the isometry group of a finite dimensional Banach space
Provisional Time/Room: Friday 16.00, 4th Floor Herschel, Teaching Room 2

ABSTRACT: For a closed subgroup H of $\mathrm{GL}_n(\mathbb{R})$, define $\hat{H}$ to be the largest subgroup of $\mathrm{GL}_n(\mathbb{R})$ that has the same orbits as H on $\mathbb{R}^n$. We prove that H is the full isometry group of a norm on $\mathbb{R}^n$ if and only if $\pm I \in H$ and $H = \hat{H}$. Using this, we show that every compact Lie group with a central involution can be realised as the isometry group of a norm. We then study the relationship between H and $\hat{H}$ for compact $H \leq \mathrm{GL}_n(\mathbb{R})$, showing that, with specified exceptions, H and $\hat{H}$ have the same connected component of the identity. This is joint work with Emmanuel Breuillard, Martin Liebeck and Assaf Naor.

Robert Shwartz (Ariel University, ISRAEL)
Sequences over finite fields defined by OGS and BN-pair decompositions of $PSL_n(q)$ connected to Dickson and Chebyshev polynomials
Provisional Time/Room: Sunday 11.00, 4th Floor Herschel, Teaching Room 2

ABSTRACT: Factorization of groups into Zappa-Szép product, or more generally into k-fold Zappa-Szép product of its subgroups, is an interesting problem, since it eases the multiplication of two elements in a group, and has recently been applied for public-key cryptography as well. We give a generalization of the k-fold Zappa-Szép product of cyclic groups, which we call OGS decomposition. It is easy to see that existence of an OGS decomposition for all the composition factors of a non-abelian group G implies the existence of an OGS for G itself. Since the composition factors of a soluble group are cyclic groups, it obviously has an OGS decomposition. Therefore, the question of the existence of an OGS decomposition is interesting for non-soluble groups. The Jordan-Hölder Theorem motivates us to consider an existence of an OGS decomposition for the finite simple groups. In 1993, Holt and Rowley showed that $PSL_2(q)$ and $PSL_3(q)$ can be expressed as a product of cyclic groups. In this talk, we consider an OGS decomposition of $PSL_n(q)$ from point of view different than that of Holt and Rowley, and for every $n \geq 2$. We look at its connection to the $BN-pair$ decomposition of the group. This connection leads to sequences over $\mathbb{F}_q$, which can be defined recursively, with very interesting properties, and which are closely connected to the Dickson and to the Chebyshev polynomials on $n-1$ variables. Since every finite simple group of Lie-type has $BN-pair$ decomposition, the ideas of the talk might be generalized to further simple groups of Lie-type.

Víctor Sotomayor (Centro Universitario EDEM - Valencia)
Finite groups and the class-size prime graph
Provisional Time/Room: Tuesday 11.00, 4th Floor Herschel, Teaching Room 2

ABSTRACT: The aim of this talk is to discuss new progress on the relationship that exists between the structure of a finite group and certain features of the prime graph built on its set of conjugacy class sizes.

Rick Thomas (University of Leicester / University of St Andrews)
Word problems and formal language theory
Provisional Time/Room: Friday 12.00, 4th Floor Herschel, Teaching Room 4

Abstract: The word problem of a finitely generated group is a fundamental notion in group theory; we choose a finite generating set for our group G and then define the word problem of G to be the set of all the words in the generators of the group that represent the identity element of G. This formulation allows us to consider the word problem of a group as a formal language and there has been considerable research concerning the connections between the complexity of this set of words as a formal language and the algebraic structure of the corresponding group.

One interesting question is that of asking, given a particular family $\mathcal{F}$ of formal languages, which groups G have a word problem lying in $\mathcal{F}$. It would appear that whether or not the word problem of a group G lies in the family $\mathcal{F}$ should depend on the choice of generating set for G, but it is well known that this is not the case for some natural families of languages.

Another interesting question is that of characterizing which languages are word problems of groups, asking, in particular, what sets of conditions on languages are necessary and sufficient for that language to be a word problem of a finitely generated group. A related question is that of the decidability of such conditions for certain natural families $\mathcal{F}$ of languages.

The purpose of this talk is to survey some of what is known about these problems.

Mathew Timm (Bradley University)
GBS Groups: A topological approach
Provisional Time/Room: Saturday 11.00, 4th Floor Herschel, Teaching Room 2

Abstract: The generalized Baumslag-Solitar groups are groups which have a graph of groups description in which all vertex and edge groups are copies of $\mathbb{Z}$. The group theory of these groups is intimately connected to the topology of a class of Seifert fibered spaces. This talk explores some of those connections.

Marco Trombetti (Università degli Studi di Napoli Federico II)
Uncountable Groups and Abstract Group Properties
Provisional Time/Room: Friday 11.30, 4th Floor Herschel, Teaching Room 4

Abstract: How strong is the influence of proper uncountable subgroups on the structure of an uncountable group? What if all proper uncountable subgroups are nilpotent, or even abelian? What if all proper uncountable subgroups are normal (subnormal) in the whole group? It turns out that the former kind of questions has a stronger impact than the latter kind of questions, and the aim of the talk is to discuss these problems and related ones.

Martin van Beek (University of Birmingham)
Exotic Fusion Systems Related to Sporadic Simple Groups
Provisional Time/Room: Monday 11.30, 4th Floor Herschel, Teaching Room 2

Abstract: We describe several exotic fusion systems related to the Sporadic simple groups at odd primes. More generally, we classify saturated fusion systems supported on Sylow 3-subgroups of the Conway group Co_1 and the Thompson group F_3, and a Sylow 5-subgroup of the Monster M, as well as a particular maximal subgroup of the latter two p-groups. This work is supported by computations in MAGMA.

Peiran Wu (University of St Andrews)
Irredundant bases for the primitive actions of the symmetric and the alternating groups
Provisional Time/Room: Thursday 13.30, 4th Floor Herschel, Teaching Room 2

Abstract: A finite transitive permutation group G on a set Ω is primitive if and only if any point stabiliser is a maximal subgroup of G. The maximum irredundant base size of G, denoted by $\mathrm{I}(G)$, is equal to the maximum length of a subgroup chain in G consisting of pointwise stabilisers of subsets of Ω. We examine upper and lower bounds on $\mathrm{I}(G)$ when G is primitive and isomorphic to the symmetric or the alternating group of some finite degree n, using the classification of the maximal subgroups of such groups. We also discuss related statistics of G such as the base size and the height.

Schedule of Talks

Sunday 31st July

9.30am **Denis Osin**, Applications of descriptive methods in geometric group theory, 1 (Lecture Theatre 2, Herschel Building)

10.30am Tea/coffee

11.00am Contributed talks

	4th Floor Herschel, Teaching Room 4	4th Floor Herschel, Teaching Room 2
11.00am	Alex Evetts, Formal language descriptions of algebraic and definable sets in finitely generated groups	Robert Shwartz, Sequences over finite fields defined by OGS and BN-pair decompositions of $PSL_n(q)$ connected to Dickson and Chebyshev polynomials
11.30am	Florian Eisele, On Donovan's conjecture and Picard groups	Justin M^{c}Inroy, Split spin factor algebras

12.00pm Lunch (provided)

1.30pm **Scott Harper**, Generating finite and infinite simple groups (Lecture Theatre 2, Herschel Building)

2.30pm **Michel Brion**, Finite group schemes, 1 (Lecture Theatre 2, Herschel Building)

3.30pm Tea/coffee

4.00pm Contributed talks

	4th Floor Herschel, Teaching Room 4	4th Floor Herschel, Teaching Room 2
4.00pm	Leo Margolis, A counterexample to the Modular Isomorphism Problem	Stephen Humphries, Weak Cayley table maps: generalized group automorphisms
4.30pm	Diego García Lucas, On the modular isomorphism problem: even versus odd characteristic	Casey Donoven, Inverse Graphs of Semigroups

Monday 1st August

9.30am **Fanny Kassel**, Discrete subgroups of higher-rank semisimple Lie groups, 1
(Lecture Theatre 2, Herschel Building)

10.30am Tea/coffee

11.00am Contributed talks

	4th Floor Herschel, Teaching Room 4	4th Floor Herschel, Teaching Room 2
11.00am	Saul D. Freedman, The intersection graph of a finite simple group	Seungjai Lee, Higman's PORC conjecture on the p-groups of maximal class
11.30am	Kamilla Rekvényi, The Orbital Diameter of Affine and Diagonal Groups	Martin van Beek, Exotic Fusion Systems Related to Sporadic Simple Groups

12.00pm Lunch break

1.30pm Contributed talks

	4th Floor Herschel, Teaching Room 4	4th Floor Herschel, Teaching Room 2
1.30pm	Eshita Mazumdar, Zero sums in restricted sequences over finite groups	Henry Bradford, Local permutation stability
2.00pm	Gareth A. Jones, Groups and the Bateman–Horn Conjecture	David Cushing, The curvature of Cayley graphs

2.30pm **Péter P. Pálfy**, Galois's theorems on $\mathrm{PSL}(2, p)$
(Lecture Theatre 2, Herschel Building)

3.30pm Tea/coffee

4.00pm **Pham Huu Tiep**, Character bounds for finite simple groups and applications, 1
(Lecture Theatre 2, Herschel Building)

Tuesday 2nd August

9.30am **Michel Brion**, Finite group schemes, 2
(Lecture Theatre 2, Herschel Building)

10.30am Tea/coffee

11.00am Contributed talks

	4th Floor Herschel, Teaching Room 4	4th Floor Herschel, Teaching Room 2
11.00am	Renu, The Schur Multiplier of finite p-groups of maximal class.	Víctor Sotomayor, Finite groups and the class-size prime graph
11.30am	Komma Patali, Bounding the exponent of a group and its commutator subgroup and Schur's exponent conjecture	M. Dolores Pérez-Ramos, Carter and Gaschütz theories beyond soluble groups

12.00pm Lunch break

1.30pm **Fanny Kassel**, Discrete subgroups of higher-rank semisimple Lie groups, 2
(Lecture Theatre 2, Herschel Building)

2.30pm **Miklos Abert**, Groups and graph limits
(Lecture Theatre 2, Herschel Building)

3.30pm Tea/coffee

4.00pm **Denis Osin**, Applications of descriptive methods in geometric group theory, 2
(Lecture Theatre 2, Herschel Building)

Wednesday 3rd August

9.30am **Denis Osin**, Applications of descriptive methods in geometric group theory, 3
(Lecture Theatre 2, Herschel Building)

10.30am Tea/coffee

11.00am **Pham Huu Tiep**, Character bounds for finite simple groups and applications, 2
(Lecture Theatre 2, Herschel Building)

12.00pm Lunch break

Thursday 4th August

9.30am **Fanny Kassel**, Discrete subgroups of higher-rank semisimple Lie groups, 3 (Lecture Theatre 2, Herschel Building)

10.30am Tea/coffee

11.00am **Julia Pevtsova**, Tensor triangular geometry in representation theory (Lecture Theatre 2, Herschel Building)

12.00pm Lunch break

1.30pm Contributed talks

	4th Floor Herschel, Teaching Room 4	4th Floor Herschel, Teaching Room 2
1.30pm	Mattia Brescia, On the absolute centre of a group	Peiran Wu, Irredundant bases for the primitive actions of the symmetric and the alternating groups
2.00pm	María José Felipe, Structure of a normal subgroup from its G-character tables	Hongyi Huang, Base-two primitive permutation groups

2.30pm **Alexander Hulpke**, The perfect groups of order up to two million (Lecture Theatre 2, Herschel Building)

3.30pm Tea/coffee

4.00pm **Pham Huu Tiep**, Character bounds for finite simple groups and applications, 3 (Lecture Theatre 2, Herschel Building)

Friday 5th August

9.30am **Michel Brion**, Finite group schemes, 3
(Lecture Theatre 2, Herschel Building)

10.30am Tea/coffee

11.00am Contributed talks

	4th Floor Herschel, Teaching Room 4	4th Floor Herschel, Teaching Room 2
11.00am	Marcel Herzog, On $D(j)$-groups with an element of order p^{j+1}	Luca Di Gravina, The Möbius function of finite classical groups
11.30am	Marco Trombetti, Uncountable Groups and Abstract Group Properties	Carmine Monetta, The structure of a finite group from a neighborhood's point of view
12.00pm	Rick Thomas, Word problems and formal language theory	Sofia Brenner, The socle of the center of a group algebra

12.30pm Lunch break

1.30pm **Pham Huu Tiep**, Character bounds for finite simple groups and applications, 4
(Lecture Theatre 2, Herschel Building)

2.30pm **Fanny Kassel**, Discrete subgroups of higher-rank semisimple Lie groups, 4
(Lecture Theatre 2, Herschel Building)

3.30pm Tea/coffee

4.00pm Contributed talks

	4th Floor Herschel, Teaching Room 4	4th Floor Herschel, Teaching Room 2
4.00pm	Àngel García Blàzquez, The Isomorphism Problem for Rational Group Algebras of Metacyclic Groups	Aluna Rizzoli, On the isometry group of a finite dimensional Banach space
4.30pm	Erzsébet Horváth, Constructing arbitrary depth with the help of wreath products	Vanthana Ganeshalingam, Subgroup Structure of the Exceptional Group of Type F_4

Saturday 6th August

9.30am **Simon Smith**, Local-to-global behaviour of groups acting on trees
(Lecture Theatre 2, Herschel Building)

10.30am Tea/coffee

11.00am Contributed talks

	4th Floor Herschel, Teaching Room 4	4th Floor Herschel, Teaching Room 2
11.00am	Thomas Breuer, Finite groups can be generated by a π-subgroup and a π'-subgroup	Mathew Timm, GBS Groups: A topological approach
11.30am	Maria Ferrara, On Groups Factorized by Mutually Permutable Subgroups	Alan Logan, The Conjugacy Problem for Ascending HNN-extensions of Free Groups

12.00pm Lunch (provided)

1.30pm **Bettina Eick**, Computational group theory and polycyclic groups
(Lecture Theatre 2, Herschel Building)

2.30pm **Denis Osin**, Applications of descriptive methods in geometric group theory, 4
(Lecture Theatre 2, Herschel Building)

3.30pm Tea/coffee

4.00pm **Michel Brion**, Finite group schemes, 4
(Lecture Theatre 2, Herschel Building)