Program and Abstracts

An NZIMA conference on
"Geometry: Interactions with Algebra and Analysis"

Auckland, New Zealand
February 14–18, 2005

The left column of parallel talks are in ALR 1 and the right in ALR 3
(School of Architecture, 26 Symonds Street, University of Auckland).

Monday

0900 - 1000	Laci Kóvacs (Canberra), "On tensor induction of representations of finite groups"	
1000 - 1030	*Morning tea*	
1030 - 1130	Chuck Miller (Melbourne), "Finiteness conditions for subdirect products of groups"	
1130 - 1145	*Break*	
1145 - 1245	Arjeh Cohen (Eindhoven), "BMW algebras of Artin groups other than braid groups"	
1245 - 1430	*Lunch*	
1430 - 1455	Wolfgang Knapp (Tübingen) "Some problems of Wielandt revisited"	Rod Gover (Auckland) "Operators on differential forms and global invariants"
1500 - 1525	Colva Roney-Dougal (St Andrews) "Constructing maximal subgroups of finite groups"	George Willis (Newcastle) "Ergodic $\mathbb{Z}^d$-actions by automorphisms"
1530 - 1555	Michael Giudici (Western Australia), "A global approach to the study of locally s-arc transitive graphs"	Günter Steinke (Canterbury), "The universal covering group of $SL(2,\mathbb{R})$ as group of automorphisms of geometries"
1600 - 1625	Primož Potočnik (Auckland) "Imprimitive permutation groups with blocks of size two"	Est'ate Khmaladze (Victoria University of Wellington) "Derivatives of set-valued mappings in measure"
1630 - 1700	*Afternoon tea*	
1700 - 1800	Marcel Herzog (Tel Aviv), "Characterization of non-nilpotent groups with two irreducible character degrees"	
1800 -	*Reception*	

Tuesday

0900 - 1000	Roger Bryant (Manchester), "Groups acting on free Lie algebras"	
1000 - 1030	*Morning tea*	
1030 - 1130	Peter Fleischmann (Kent), "Some aspects of modular invariant theory of finite groups"	
1130 - 1145	*Break*	
1145 - 1245	Lawrence Reeves (Melbourne), "Cannon-Thurston maps and boundaries of word-hyperbolic groups"	
1245 - 1430	*Lunch*	
1430 - 1455	Scott Murray (Eindhoven) "Conjugacy and twisted conjugacy in classical groups"	Jasbir Chahal (Brigham Young) "Congruent numbers and elliptic curves"
1500 - 1525	Daniel Frohardt (Wayne State) "Generating systems of low genus"	Garry Tee (Auckland) "Surface area and capacity of n-dimensional ellipsoids"
1530 - 1555	Shih-Chang Huang (Auckland), "Dade's conjecture for the Chevalley groups $G_2(q)$ in defining characteristic"	Roger Baker (Brigham Young) "Riemann's contributions to geometry"
1600 - 1625	Mike Newman (Canberra) "Prime-power groups via geometry and Lie algebras"	Krzysztof Jarosz (Southern Illinois), "Small perturbations of Banach algebras and almost multiplicative functionals"
1630 - 1700	*Afternoon tea*	
1700 - 1800	Bill Kantor (Oregon), "Projective planes via groups"	

Wednesday

0900 - 1000	Peter Schmid (Tübingen) "The solution of the k(GV) problem"
1000 - 1030	*Morning tea*
1030 - 1130	Cheryl Praeger (Western Australia), "On small subdegrees of finite primitive permutation groups"
1145 -	*Tours*

Thursday

0900 - 1000	Akos Seress (Ohio State), "Quasiprimitive 2-arc transitive graphs of product action type"	
1000 - 1030	*Morning tea*	
1030 - 1130	Colin Maclachlan (Aberdeen), "2-generator arithmetic Fuchsian and Kleinian groups"	
1130 - 1145	*Break*	
1145 - 1245	Bob Howlett (Sydney), "Specht modules and W-graphs"	
1245 - 1430	*Lunch*	
1430 - 1455	Marta Morigi (Bologna) "The probability of generating prosoluble groups"	Dave Witte Morris (Lethbridge) "Some arithmetic groups that cannot act on 1-manifolds"
1500 - 1525	Andrei Jaikin (Madrid) "Probabilistic aspects of profinite groups"	Dmitry Malinin (USP, Fiji) "On the existence of finite Galois stable subgroups of GL_n"
1530 - 1600	*Afternoon tea*	
1600 - 1700	Martin Liebeck (Imperial), "Transitive and regular subgroups of primitive groups"	
1830 -	*Conference dinner*	

Friday

0900 - 1000	Marston Conder (Auckland), "Compact hyperbolic 4-manifolds of small volume"	
1000 - 1030	*Morning tea*	
1030 - 1130	Carlo Scoppola (L'Aquila), "Obliquity and periodicity for pro-p-groups and graded Lie algebras"	
1130 - 1145	*Break*	
1145 - 1245	Paul Norbury (Melbourne), "Morse field theory"	
1245 - 1430	*Lunch*	
1430 - 1455	Ilknur Tulunay (Sophia) "Representations of the Hecke algebra ..."	Gerhard Rosenberger (Dortmund), "Commutative transitive and restricted Gromov one-relator groups"
1500 - 1525	Ben Martin (Canterbury), "Complete reducibility, geometric invariant theory, and a question of Serre"	
1530 - 1600	*Afternoon tea*	
1600 - 1700	Gus Lehrer (Sydney), "Invariant theory and structure of unitary reflection groups"	

Riemann's contributions to geometry
Roger Baker
Brigham Young University
baker@math.byu.edu

I discuss Riemann's innovations in his two works that concern geometry. One of these is his Habilitation lecture, which contains just one formula.The other is a prize essay which, superficially, concerns the flow of heat; it was submitted in Latin to the Paris academy. (The prize was not awarded.) I note the influence of each work and examine his debt to previous scholars.

Groups acting on free Lie algebras
Roger Bryant
University of Manchester
roger.bryant@manchester.ac.uk
Coauthors: Manfred Schocker

I shall describe some recent results concerned with the module structure of a free Lie algebra under the action of a group. Let G be a group, K a field and V a finite-dimensional KG-module. Let $L(V)$ be the free Lie algebra over K that has V as a subspace and every basis of V as a free generating set. The action of each element of G on V extends to a Lie algebra automorphism of $L(V)$. Thus $L(V)$ becomes a KG-module, and each homogeneous component $L^n(V)$ is a KG-submodule called the nth Lie power of V. I shall describe a general decomposition theorem for Lie powers and discuss some intriguing connections with Adams operations and symmetric powers.

Congruent numbers and elliptic curves
Jasbir S Chahal
Brigham Young Universty
jasbir@math.byu.edu

We shall talk about the history of the congruent number problem, its relation to the arithmetic of elliptic curves and some interesting results obtained by the author and others.

BMW algebras of Artin groups other than braid groups

Arjeh M. Cohen
Technische Universiteit Eindhoven
A.M.Cohen@tue.nl
Coauthors: Die Gijsbers and David Wales

In much the same way the Hecke algebra can be used to construct the Jones polynomial of a knot, the BMW algebra (named after Birman, Murakami, Wenzl) can be used to construct the Kauffman polynomial of an unoriented link.

The braid groups are well known to be the Artin groups of type A_n. We discuss similar algebras, of type D_n and E_n. We establish the structure of these algebras, and, for type D_n, provide an interpretation of these algebras as tangle algebras.

Compact hyperbolic 4-manifolds of small volume

Marston Conder
University of Auckland
m.conder@auckland.ac.nz
Coauthors: Colin Maclachlan (Aberdeen)

In the case of dimension 4 (as with all even dimensions), the volume of a hyperbolic manifold is a constant multiple of its Euler characteristic. Ratcliffe and Tschantz (2000) proved the existence of *non-compact* orientable hyperbolic 4-manifolds of minimal Euler characteristic 1, and until recently, the *compact* orientable hyperbolic 4-manifold of smallest known volume was the Davis manifold (1985), which has Euler characteristic 26. In this lecture, we will explain how a search for torsion-free subgroups of minimal index in the [5,3,3,3] Coxeter group has been used to establish the existence of a compact non-orientable hyperbolic 4-manifold of Euler characteristic 8, and an orientable double cover of this manifold, of Euler characteristic 16. These examples give the smallest known volumes so far in the compact case. Furthermore, these two 4-manifolds and the Davis manifold are all arithmetic, and have the same arithmetic structure, and hence are commensurable (in that they have a common finite cover).

Some Aspects of Modular Invariant Theory of Finite Groups

Peter Fleischmann
University of Kent at Canterbury
pf10@ukc.ac.uk

Let F be a field and G a finite group, acting on the polynomial ring $A := F[x_1, \ldots, x_d]$ by graded F - algebra automorphisms. The ring of invariants $A^G := \{f \in A \mid g(f) = f\}$ is the main object of study in Invariant theory. The theory is very well developed in the "classical case" where the characteristic of F is zero, but far less so in the case of positive characteristic p, in particular the "modular case" where p divides the group order $|G|$.

Unlike the classical case, modular invariant rings are in general not Cohen - Macaulay rings. There are open questions about their constructive complexity, measured for example by degree bounds for generators, and about their structural complexity, measured by the depth of A^G. In my talk I will report on some recent results dealing with both the structural and constructive aspects of invariant theory.

Generating systems of low genus

Daniel Frohardt
Wayne State University, Detroit, MI 48202
danf@math.wayne.edu
Coauthors: Robert Guralnick, USC, and Kay Magaard, Wayne State University

Let G be a primitive permutation group of degree n. The genus g of a generating r-tuple for G is determined by the Riemann-Hurwitz equation. Apart from known infinite families, the ratio of g/n is asymptotically at least $1/84$. We discuss the proof of this and report on the enumeration of the exceptional systems of genus at most two.

A global approach to the study of locally s-arc transitive graphs

Michael Giudici
The University of Western Australia
giudici@maths.uwa.edu.au
Coauthors: Cai Heng Li and Cheryl E. Praeger

Previously, the study of locally s-arc transitive graphs has focussed on analysing the structure of vertex stabilisers and their actions on the neighbourhood of a vertex. In this talk we outline a global approach which involves taking normal quotients and using our knowledge of quasiprimitive groups to obtain information about the action of the automorphism group on the vertex set. This approach enables us to construct many new examples and achieve various classification results.

Operators on differential forms and global invariants

A Rod Gover
University of Auckland
r.gover@auckland.ac.nz

We look at some families of operators on differential forms that were recently discovered in joint work with Tom Branson (University of Iowa). On the one hand there are conformally invariant differential operators that generalise the Maxwell operator and include as an extreme a critical Laplacian type operator on functions due Graham-Jenne-Mason-Sparling. On the other there are conformally invariant non-local operators which in a suitable sense map between cohomology spaces. There is an intriguing relationship between these two completely different types of operator and possibly a new connection between analysis and topology.

Characterization of non-nilpotent groups with two irreducible character degrees

Marcel Herzog
Tel-Aviv University
herzogm@post.tau.ac.il
Coauthors: M.Bianchi, A.Gillio, G.Qian, W.Shi

Non-nilpotent groups, with irreducible characters of degrees 1 and m, for some integer m¿1, are completely characterized. This is done, using a detailed description of solvable groups in which the commutator subgroup is a minimal normal subgroup.

Specht modules and W-graphs

Bob Howlett
University of Sydney
R.Howlett@maths.usyd.edu.au

Given a partition of n it is possible to construct a representation of the symmetric group of degree n, or the corresponding Iwahori-Hecke algebra, on a space with basis parametrized by the standard tableaux corresponding to the given partition. The method that is simplest to describe produces the so-called seminormal form of the corresponding representation of the symmetric group. Unfortunately this yields matrices that are not integral. Using instead the Murphy basis produces matrices that are integral, though harder to compute. The transition matrix relating these two bases is upper triangular. A third equivalent version of the module will be described, related to the others by another upper triangular basis change. This basis is constructed by a variant of the Kazhdan-Lusztig W-graph algorithm; the upshot is that it is now possible to determine the structure of the left cells of the symmetric groups by means of an algorithm that just works with tableaux of a fixed shape.

Dade's conjecture for the Chevalley groups $G_2(q)$ in defining characteristic

Shih-Chang Huang
Department of Mathematics
shua003@math.auckland.ac.nz

In 1992/1995, Dade announced that his "final" conjecture can be proved by verifying it for all the non-abelian finite simple groups. This conjecture implies several of the other very important conjectures and is one of the central problems in the modular representation theory. In this talk, I will report on the current progress on Dade's conjecture for the Chevalley groups $G_2(q)$.

Probabilistic aspects of profinite groups

Andrei Jaikin
Universidad Autonoma de Madrid
ajaikin@uam.es
Coauthors: Laci Pyber

Any profinite group can be viewed as a probabilistic space. This approach was explored intensively during the last years. On one hand, the people have been interested in properties of this probabilistic space like to be PFG (positively finite generated). A profinite group is called PFG if for some k, random k elements of the group generate it with positive probability. On the other hand, the probabilistic aspect of profinite groups is used in the solution of different kind of problems. In the first direction we present new characterizations of PFG profinite groups which permit us to prove that an open subgroup of a PFG profinite group is also PFG. In the second direction we solve a problem posed by A. Mann, showing that there exist a constant c such that the number of finite groups of order n which can be defined by r relations is at most n^{cr}.

Small perturbations of Banach algebras and almost multiplicative functionals

Krzysztof Jarosz
Southern Illinois University Edwardsville
kjarosz@siue.edu

A deformation of a normed algebra $(\mathcal{A}, \cdot)$ is a new multiplication $\times$ defined on the same space $\mathcal{A}$ such that

$$\|a \cdot b - a \times b\| \leq \delta \|a\| \|b\|, \qquad \text{for } a, b \in \mathcal{A},$$

for some small constant δ. A linear functional F on an algebra $(\mathcal{A}, \cdot)$ is almost multiplicative if

$$|F(ab) - F(a)F(b)| \leq \delta \|a\| \|b\|, \qquad \text{for} \quad a, b \in A.$$

An algebra is called *functionally stable* or *f-stable* if any almost multiplicative functional is close to a multiplicative one. The question whether an algebra is f-stable can be interpreted as a question whether A lacks an *almost corona*, that is, a set of almost multiplicative functionals far from the set of multiplicative functionals. We provide a brief history of the problem, and its relation to quasiconformal maps as well as the most recent developments and a list of open problems.

Projective planes via groups

William M. Kantor
University of Oregon (Eugene)
kantor@darkwing.uoregon.edu

Affine planes correspond to 2-transitive *sets* of permutations. If the "stabilizer" of some point in such a set is a group then there is a simplification in terms of double cosets; there are also additional collineations of the plane. This talk will discuss two recent attempts to exploit these facts - ultimately unsuccessful attempts.

Derivatives of set-valued mappings in measure

Est'ate Khmaladze
Victoria University of Wellington
estate.khmaladze@mcs.vuw.ac.nz

We introduce the new notion of the derivative of a set-valued mapping. As a particular result we establish, under broad conditions, the following equality: if $C(t) \in R^d$ converges to $C(0)$ in Hausdorff metric and

$$A(t) = C(t) \triangle C(0)$$

is symmetric difference, and finally, if P is a measure in R^d, then

$$d/dtP(A(t)) = Q(d/dtA(t))$$

where Q is some other measure, depending on $C(0)$ and P (but not on the set-valued mapping $C(t)$). We use this notion of the differentiability to establish the limiting process of the "local point processes" in the neighbourhood of a set $C = C(0)$ — an object required in a certain class of statistical problems.

Some problems of Wielandt revisited

Wolfgang Knapp
University of Tuebingen, Germany
wolfgang.knapp@uni-tuebingen.de

Let G be a primitive permutation group acting on a finite set Ω and let $\Delta = (\alpha, \beta)^G$ be a non-diagonal orbital. Wielandt proposed the problem to determine the structure of G_α or even of G if the subconstituent $G_\alpha^{\Delta(\alpha)}$ is nilpotent or regular.

In my contribution, Wielandt's results in the nilpotent case and my own previous results in the regular case are improved to some extent.

On tensor induction of representations of finite groups

L G Kovacs
Australian National University
kovacs@maths.anu.edu.au

This talk will report on results from the PhD thesis of Emanuele Pacifici (Firenze 2003). It is well known that if D is an irreducible complex representation of a finite group G, then every direct summand of the restriction of D to a subgroup H must have degree at least as large as the degree of D divided by the index $|G : H|$; moreover, D is induced from H if and only if the restriction does have a direct summand whose dimension is equal to this quotient. The thesis explored the possibility of an analogous result for tensor induction, under the additional assumptions that D is faithful, quasi-primitive and not a tensor product (of projective representations of degree greater than 1), and that the Fitting subgroup $F(G)$ is not in the center $Z(G)$. The main question was this: if the restriction has a (projective) tensor factor whose degree is the $|G : H|$th root of the degree of D, does it follow that D is tensor induced from H? Examples were given to show that the answer can be negative when the index is 2. An affirmative answer was proved for normal subgroups of odd index, and also for arbitrary subgroups of odd prime index.

Invariant theory and structure of unitary reflection groups
Gus Lehrer
University of Sydney
G.Lehrer@maths.usyd.edu.au

Unitary reflection groups arise in diverse areas such as representation theory of reductive groups, monodromy of Painleve differential equations, algebraic geometry, and homotopy theory through their connection with configuration spaces. I shall present some new results in invariant theory, which suitably interpreted, throw light on the structure and eigenspace geometry of these reflection groups.

Transitive and regular subgroups of primitive groups
Martin Liebeck
Imperial College
m.liebeck@imperial.ac.uk

I will discuss some results on transitive subgroups of primitive permutation groups, and also regular subgroups. The topic has ramifications in the theory of factorizations of groups, automorphism groups of Cayley graphs, B-groups, and maximal subgroups of finite simple groups.

2-generator arithmetic Fuchsian and Kleinian groups
Colin Maclachlan
University of Aberdeen, Scotland
C.Maclachlan@maths.abdn.ac.uk

Arithmetic Fuchsian and Kleinian groups are defined in very similar ways. However, while a great deal is known about 2-generator arithmetic Fuchsian groups, much less is known for the Kleinian case. I will discuss these similarities and differences.

On the existence of finite Galois stable subgroups of GL_n
Dmitry Malinin
USP, Fiji
dmalinin@mail.ru

The fields $F(G)$ obtained via adjoining to a number field F all matrix coefficients of all matrices $g \in G \subset GL_n(E)$ for a finite group G are discussed. Let O_K be the maximal orders of a number field K.

Theorem. *Let $K/\mathbf{Q}$ be a normal extension with Galois group Γ, and let $G \subset GL_n(O_K)$ be a finite Γ-stable subgroup. Then $G \subset GL_n(O_{K_{ab}})$ where K_{ab} is the maximal abelian over $\mathbf{Q}$ subfield of K.*

Similar results for totally real extensions $K/\mathbf{Q}$ were considered by the author earlier. In this case there are some interesting arithmetic applications to positive definite quadratic lattices and Galois cohomology.

Complete reducibility, geometric invariant theory, and a question of Serre

Ben Martin
University of Canterbury
B.Martin@math.canterbury.ac.nz
Coauthors: Michael Bate, Martin Liebeck, Gerhard Roehrle, Aner Shalev

Let G be a reductive linear algebraic group over an algebraically closed field k. A closed subgroup H of G is said to be *G-completely reducible* if whenever H is contained in a parabolic subgroup of G, H is contained in a Levi subgroup of that parabolic; this generalises the notion of a completely reducible subgroup of a general linear group GL_n. I will describe a recent approach to G-complete reducibility using geometric invariant theory and ideas of R.W. Richardson, which allowed Bate, Roehrle and me to answer a question of Serre. I will give an application to finite groups of Lie type (joint work with Liebeck and Shalev).

Finiteness conditions for subdirect products of groups

Chuck Miller
Univeristy of Melbourne
c.miller@ms.unimelb.edu.au

A subgroup G of a direct product of groups is called a subdirect product if the projections map G surjectively onto the factors. A subdirect product of two groups is the same as a pull-back or fibre product of two homomorphisms from the factors onto the same quotient group. An old result of Mihailova is that the direct product of two free groups has finitely generated subgroups for which membership is recursively undecidable. Grunewald showed these subgroups are not finitely presented, and more generally Baumslag and Roseblade showed the direct product of two free groups has only the obvious finitely presented subgroups. In this talk I will report on joint efforts with a number of colleagues to determine when subdirect products are finitely presented and what other finiteness and homological properties they enjoy. Many algorithmic problems for finitely presented subgroups of direct products of very nice groups can be unsolvable.

The probability of generating prosoluble groups

Marta Morigi
University of Bologna, Italy
mmorigi@dm.unibo.it
Coauthors: Andrea Lucchini (University of Brescia, Italy) Federico Menegazzo (University of Padova, Italy)

Let F be the free prosoluble group of rank d. Mann proved that F is positively finitely generated (equivalently, F has polynomial maximal subgroup growth). Let $d_p(F)$ be the minimum integer k such that the probability of generating F with k elements is positive. We determine the exact value of $d_p(F)$ for $d > 9$ and provide lower and upper bounds for $3 \leq d \leq 9$. Our techniques also allow us to determine the degree of maximal subgroup growth of F.

Some arithmetic groups that cannot act on 1-manifolds

Dave Witte Morris
University of Lethbridge
Dave.Morris@uleth.ca
Coauthors: Lucy Lifschitz

It is known that finite-index subgroups of the arithmetic group $SL(3, \mathbf{Z})$ have no interesting actions on the real line. This naturally led to the conjecture that most other arithmetic groups (of higher real rank) also cannot act on the line. This problem remains open, but joint work with Lucy Lifschitz verifies the conjecture for many examples. This includes all finite-index subgroups of $SL(2, \mathbf{Z}[\alpha])$, where α is the square root of any square free integer greater than 1. The proofs are based on the fact, proved by D. Carter, G. Keller, and E. Paige, that every element of these groups is a product of a bounded number of elementary matrices.

Conjugacy and twisted conjugacy in classical groups

Scott H. Murray
Technical University Eindhoven
smurray@win.tue.nl
Coauthors: Arjeh Cohen (Eindhoven), Sergei Haller (Eindhoven), Don Taylor (Sydney)

This talk will present algorithms for computing conjugacy of elements in finite classical groups and their extensions. Computing conjugacy in extensions naturally leads to the problem of twisted conjugacy, which is solved nonconstructively by Lang's theorem.

Prime-power groups via geometry and Lie algebras

M.F. Newman
Australian National University
newman@maths.anu.edu.au

The study of groups with prime-power order provides many challenges. The fundamental challenge is: "find" all groups with prime-power order. This talk will deal with a part of the fundamental challenge which has benefitted from a geometric point of view. The geometry here is projective. It, in turn, benefits from being looked at in terms of Lie algebras.

Morse field theory
Paul Norbury
University of Melbourne
pnorbury@ms.unimelb.edu.au
Coauthors: Ralph Cohen

One can define a topological quantum field theory by mapping graphs to a manifold and assigning Morse functions on the manifold to edges of the graphs. This produces the cohomology ring of the manifold. In this talk I will describe a moduli space of graphs that enables one to get further homological invariants of a manifold.

Imprimitive permutation groups with blocks of size two
Primož Potočnik
University of Auckland
potocnik@math.auckland.ac.nz

Let G be a transitive permutation group on the set V of size $2n$, let B be a G-invariant partition of V into blocks of size 2, let G^B be the permutation group induced by the action of G on B, and let K be the kernel of this action. Then K is normal in G and is isomorphic to the elementary abelian group Z_2^k, for some k not greater than n.

Question: What can we say about the groups G and K if we know the permutation group G^B.

I will show that this question is closely related to some other problems in the theory of group representations and algebraic combinatorics, and give a partial answer in the case when G^B is primitive and contains a cyclic regular subgroup.

On small subdegrees of finite primitive permutation groups
Cheryl E Praeger
University of Western Australia
praeger@maths.uwa.edu.au
Coauthors: Michael Giudici, Cai Heng Li, Akos Seress, Vladimir Trofimov

The problem of finding the smallest length of a suborbit of a finite primitive permutation group arose in a study of limits of finite vertex-primitive graphs. We investigated this quantity for primitive subgroups of wreath products in product action, giving in many cases a connection with the same quantity for the primitive component. We discovered that the primitive groups of twisted wreath type exhibit different (but interesting) behaviour from the other primitive types.

Cannon-Thurston maps and boundaries of word-hyperbolic groups
Lawrence Reeves
University of Melbourne
reeves@ms.unimelb.edu.au

Given an inclusion $\iota : H \to G$ of word-hyperbolic groups it is natural to ask about the existence of a continuous extension $\iota' : (H \cup \partial H) \to (G \cup \partial G)$. We will discuss various sufficient conditions and their relationship to the topology of the boundary.

Constructing maximal subgroups of finite groups
Colva Roney-Dougal
University of St Andrews
colva@dcs.st-and.ac.uk
Coauthors: Derek Holt

Given a finite group G, if one can construct the maximal subgroups of each of the nonabelian composition factors of G then one can construct the maximal subgroups of G. In this talk I will discuss various approaches towards the problem of maximal subgroup construction, and present recent work which largely solves this problem for the classical groups.

Commutative transitive and restricted Gromov one-relator groups
Gerhard Rosenberger
University of Dortmund
Gerhard.Rosenberger@mathematik.uni-dortmund.de

Power commutative, commutation transitive, power transitive, conjugately separated abelian and restricted Gromov groups appear in various contexts, especially in connection with hyperbolic groups. We investigate relations between these groups and show that there are many equivalences under certain additional conditions. For applications, we consider especially the case of a one-relator group.

The solution of the k(GV) problem
Peter Schmid
Mathematisches Institut, Universiät Tübingen (Germany)
peter.schmid@uni-tuebingen.de
Coauthors: David Gluck, Kay Magaard, Udo Riese

A long-standing conjecture of R. Brauer is the claim that $k(B) \leq |D|$ whenever B is a p-block of a finite group with defect group D, p any prime. Here $k(B)$ is the number of irreducible characters belonging to B. This conjecture is still open in generality but has been settled now for p-solvable groups. In this special case Clifford theory reduces the problem as follows: Show that $k(GV) \leq |V|$ whenever V is a faithful $\mathbb{F}_pG$-module for some finite p'-group G, $k(GV)$ being the number of conjugacy classes of the semidirect product GV.

The $k(GV)$ problem is of interest in its own right. The fundamental ideas for attacking the problem have been developed by R. Knörr (1980), R. Gow (1993), G. Robinson and J.G. Thompson (1996). This will be discussed in some detail in the talk, as well as the more recent work on the problem.

Obliquity and periodicity for pro-p-groups and graded Lie algebras

Carlo M Scoppola
Universita' dell'Aquila
scoppola@univaq.it
Coauthors: Norberto Gavioli, Valerio Monti

We deal with the notions of obliquity and periodicity for pro-p-groups and graded modular Lie algebras. We will show the interplay of the two notions, and how it is possible to use information on Lie algebras to get relevant information on groups, and vice versa.

Quasiprimitive 2-arc transitive graphs of product action type

Ákos Seress
The Ohio State University
akos@math.ohio-state.edu
Coauthors: Cai Heng Li

An s-arc in a graph Γ is a sequence of vertices $(v_0, ..., v_s)$ such that $\{v_i, v_{i+1}\}$ is an edge for all $i < s$ and v_i is different from v_{i+2} for all $i < s - 1$. The graph Γ is called s-arc transitive if an s-arc can be mapped to any other s-arc by a graph automorphism. A permutation group is called quasiprimitive if all nontrivial normal subgroups are transitive.

C. Praeger proved that any non-bipartite s-arc transitive graph is a cover of one that has a quasiprimitive group of automorphisms, and so a first step of classification of s-arc transitive graphs may be the study of quasiprimitive ones. Praeger's "O'Nan-Scott type" classification of quasiprimitive groups divides them into eight classes; it was known that four of these classes cannot contain automorphism groups of 2-arc transitive graphs, three of them could, and the status of the product action type was unknown.

In this talk, we provide examples of quasiprimitive 2-arc transitive graphs of product action type, and report progress toward the classification of all such graphs.

The universal covering group of SL(2,R) as group of automorphisms of geometries

Günter Steinke
Department of Mathematics and Statistics, University of Canterbury, Christchurch
G.Steinke@math.canterbury.ac.nz
Coauthors: Rainer Löwen

The analytic and group structures of the universal covering group of SL(2,R) are well known. However this group is most elusive as it permits no faithful linear representation and only a few geometries are known on which it acts as a group of automorphisms. We extend the Moulton planes and the action of the Moulton groups on these affine planes in order to obtain flat Laguerre planes on which this universal covering group acts.

Surface area and capacity of n-dimensional ellipsoids

Garry Tee
University of Auckland
tee@math.auckland.ac.nz

The surface area of a general n-dimensional ellipsoid is represented as an abelian integral, which can readily be evaluated numerically. If there are only 2 values for the semi-axes then the area is expressed as an elliptic integral, which reduces in most cases to elementary functions. The capacity of a general n-dimensional ellipsoid is represented as a hyperelliptic integral, which can readily be evaluated numerically. If no more than 2 lengths of semi-axes occur with odd multiplicity, then the capacity is expressed in terms of elementary functions. If only 3 or 4 lengths of semi-axes occur with odd multiplicity, then the capacity is expressed as an elliptic integral.

Representations of the Hecke algebra related to Gelfand-Graev character for a finite conformal symplectic group of degree 4

Ilknur Tulunay
Sophia University, Tokyo
ilknurtu@hotmail.com
Coauthors: Prof. K. Shinoda

I will start my talk by giving the definitions of the Gelfand-Graev character for a connected reductive algebraic group defined over a finite field, and the Hecke algebra related to the Gelfand-Graev character. After stating the Curtis's formula, involving Green polynomials, on the irreducible representations of the Hecke algebra, I will present the explicit values, involving Gauss sums, of the irreducible representations on sufficiently many standard basis elements for a finite conformal symplectic group of degree 4.

Ergodic $\mathbb{Z}^d$-actions by automorphisms

George Willis
University of Newcastle
George.Willis@newcastle.edu.au
Coauthors: S.G. Dani, N. Shah

The existence of an ergodic $\mathbb{Z}^d$-action by automorphisms of a locally compact group G implies that G has a compact normal subgroup K such that G/K is a direct sum of vector groups. In the special case when $d = 1$, G must be compact, as was conjectured by P. Halmos.

The proofs of these assertions rely on the structure theory of locally compact groups. Approximation by Lie groups is used to deal with the connected factor of G and new techniques that parallel Lie theory are used to deal with the totally disconnected factor. The talk will focus on the totally disconnected case by outlining these new techniques and showing how they are used.