Program and Abstracts

NZIMA workshop on
"Geometry: Interactions with Algebra and Analysis"

Massey University (Auckland)
June 27–28, 2005

Nilpotent Blocks of Finite Classical Groups

Jianbei An
University of Auckland

Let p be a prime number and G a finite group. Then G is p-nilpotent if G is a semi-direct product of a Sylow p-subgroup and a normal p'-subgroup of G. Frobenius in 1907 showed that G is p-nilpotent if and only if for any p-subgroup P, the quotient $N_G(P)/C_G(P)$ is a p-group. Replacing a p-subgroup P by a Brauer pair (P, b_P), Broué and Puig in 1980 introduced nilpotent blocks of a finite group, and Puig in 1988 determined the structure of a source algebra of a nilpotent block.

The nilpotent blocks of a finite sporadic group and an alternating group was classified by C. Eaton. In this talk, I will discuss the nilpotent blocks of finite classical groups.

Harmonic majorants and the cos pi lambda theorem

Peter Fenton
University of Otago

I will look at problems of majorising subharmonic functions in the context of the Denjoy-Carleman-Ahlfors theorem for entire functions. The techniques lead to a new version of the cos pi lambda theorem and a sharp form of the analogous theorem for meromorphic functions.

Grafting hyperbolic 3-manifolds

Richard Evans
University of Auckland

I will present a technique for grafting hyperbolic 3-manifolds of infinite volume developed by Bromberg based upon work of Hodgson-Kerckhoff. The techniques rely upon the theory of cone-manifolds. Having presented some of this theory I will then present applications of grafting to Jorgensens conjecture and the ending lamination conjecture.

Commensurability of cusped hyperbolic 3-manifolds
Oliver Goodman
University of Melbourne

Two manifolds are said to be commensurable if they have a finite sheeted cover in common. A stronger condition is that they cover a common orbifold. Simple observations regarding horosphere packings in hyperbolic space lead to a practical algorithm for determining when two cusped (i.e. finite volume, non-compact) hyperbolic manifolds cover a common orbifold. For cusped hyperbolic 3-manifolds we are able to completely determine the commensurability classes: arithmetic classes are determined by the invariant trace field; non-arithmetic classes have the nice property that any two manifolds cover a common orbifold.

Conditions for the compactness of the resolvent of the Laplace-Beltrami operator on a Manifold
Mark Harmer
Massey University (Auckland)

We discuss the history and recent contributions to the problem of finding conditions equivalent to the compactness of the resolvent— and thence discreteness of the spectrum—of the Laplace-Beltrami operator on a class of smooth Riemannian manifolds.

On the topology of the space of once-punctured torus groups
John Holt
Massey University (Auckland)

The interior of the space of once-punctured torus groups is a topological ball, but the full space, its closure, is not a manifold, and has many points at which it "self-bumps". We describe a geometric condition called "wrapping", and show that if a point does not wrap then it is not a point of self-bumping. All known examples of self-bumping points wrap. Joint work with Juan Souto.

Geometric invariant theory and subgroups of reductive algebraic groups

Ben Martin
University of Canterbury

Let G be a reductive algebraic group over an algebraically closed field k. R.W. Richardson devised the following way to study conjugacy classes of closed subgroups of G. Given a closed subgroup H, find a set of topological generators $h_1, \ldots, h_n$. The group G acts on the product G^n by simultaneous conjugation, and properties of H can be determined by applying methods from geometric invariant theory to the orbit $G \cdot (h_1, \ldots, h_n)$. I will discuss the ideas behind Richardson's approach and give some applications.

Complexity in products of word hyperbolic groups

Chuck Miller
University of Melbourne

Word hyperbolic groups as introduced by Gromov play a central role in geometric group theory. They are all finitely presented groups and enjoy a number of good algorithmic properties. Still they can have some undecidable problems, and subgroups of a direct product of several word hyperbolic groups are algorithmically difficult. These direct products are biautomatic and have a very strong solution to the word problem. We will review a number of the nice properties of word hyperbolic groups and outline some constructions which illustrate bad algorithmic behaviour.

Reflection groups and embeddings of complex star-closed line systems

Don Taylor
University of Sydney

A *star* is a planar set of three lines in which the angle between each pair is 60 degrees. A set of lines is said to be *star-closed* if for every pair of its lines that are at 60 degrees, the set contains the third line of the star. In 1976 Cameron, Goethals, Seidel and Shult showed that in Euclidean space, the indecomposable star-closed sets are the root systems of types A_n, D_n, E_6, E_7, and E_8. This result was a key part of their determination of all graphs with least eigenvalue -2.

Recent work of Cvetković, Rowlinson and Simić determined all one-line extensions of the Euclidean star-closed line systems. We extend this result to the complex case and show the connection with results of Burkhardt and Mitchell (1914) on the classification of complex reflection groups.

This is joint work with Muraleedaran Krishnasamy.