Schedule for Queenstown Workshop 6-10 April 2021

All sessions take place in the **Rees Room**, on the 7th floor of the QT Hotel.

Wednesday 7 April

09:30–10:00 Clemency Montelle: *Iterative methods for determining the sine of one degree in late medieval Arabic, Persian, and Sanskrit sources*
10:00–10:30 Matthew Conder: *Discrete and free subgroups of* SL_2
10:30–11:00 Tea/coffee
11:00–11:30 Dillon Mayhew: *Definability and recognisability for graphs & hypergraphs*
11:30–12:00 Anton Baykalov: *Intersection of maximal solvable subgroups in finite classical groups*
12:00–13:00 Lunch

Thursday 8 April

09:30–10:00 Tanya Evans: *Mathematics education research: Insights for research-informed evidence-based practice*
10:00–10:30 Kaitlin Riegel: *Mathematics exam-related self-efficacy explained by achievement, gender, stress mindset, and emotions*
10:30–11:00 Tea/coffee
11:00–12:00 Discussion panel (Gaven Martin, Paul Smith and Steven Galbraith) chaired by Tanya Evans
12:00–13:00 Lunch

Friday 9 April [***Note earlier start***]

09:00–10:00 James Milne: *The Hodge, Tate, and standard conjectures, 60 years on*
10:00–10:30 Jianbei An: *The Inductive Alperin weight conjecture*
10:30–11:00 Tea/coffee
11:00–11:30 Jeremy Booher: *Doubly isogenous genus-2 curves with* D_4*-action*
11:30–12:00 Lukas Zobernig: *Superspecial abelian varieties*
12:00–13:00 Lunch

Saturday 10 April

09:30–10:00 Felipe Voloch: *Hearing algebraic curves*
10:00–10:30 Liam Jolliffe: *Sharpening Schaper's bounds for decomposition numbers*
10:30–11:00 Tea/coffee
11:00–11:30 Pedram Hekmati: *New knot invariants from finite group actions*
11:30–12:00 Dominic Searles: *Quasisymmetric functions and 0-Hecke modules*
12:00–13:00 Lunch

Abstracts for talks at Queenstown Workshop 6-10 April 2021

Jianbei An (University of Auckland, NZ)
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The Inductive Alperin weight conjecture

Abstract: Alperin's weight conjecture is one of the main open problems in the modular representation theory of finite groups. The conjecture and its stronger version, the block version, were both reduced to finite simple groups, by G. Navarro and P.H. Tiep in 2011 and B. Spath in 2013, respectively. In this talk, I'll give a survey of recent progress in the study of the conjecture.

Talk time: Friday 9 April, 10:00–10:30

Anton Baykalov (University of Auckland, NZ)
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Intersection of maximal solvable subgroups in finite classical groups

Abstract: Consider the following problem: Let H be a solvable subgroup of a finite group G that has no nontrivial solvable normal subgroups. Do there always exist five conjugates of H whose intersection is trivial? This problem is closely related to a conjecture by Babai, Goodman and Pyber (1997) about an upper bound for the index of a normal solvable subgroup in a finite group. In this talk, we discuss the latest progress on the problem.

Talk time: Wednesday 7 April, 11:30–12:00

Jeremy Booher (University of Canterbury, NZ)
Email: jeremy.booher@canterbury.ac.nz

Doubly isogenous genus-2 curves with D_4-action

Abstract: The zeta function of a curve over a finite field encodes the number of points on that curve. How much information does the zeta function of a curve plus the zeta function of other naturally related curves give about the original curve? I'll discuss a family of genus-2 curves where zeta functions gives much less information than one would expect, and explain this discrepancy. This is joint work with Vishal Arul, Steven R. Groen, Everett W. Howe, Wanlin Li, Vlad Matei, Rachel Pries, and Caleb Springer.

Talk time: Friday 9 April, 11:00–11:30

Matthew Conder (University of Auckland, NZ)
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***Discrete and free subgroups of* $\mathbf{SL}_2$**

Abstract: Certain properties of a topological group G (such as discreteness or freeness) can often be determined by considering the action of G on an appropriate geometric structure. For instance, by studying the action of $\mathrm{SL}(2,\mathbb{R})$ on the hyperbolic plane by Möbius transformations, one can determine whether or not a given two-generated subgroup of $\mathrm{SL}(2,\mathbb{R})$ is both discrete and free of rank two. In this talk, we consider finitely-generated subgroups of $\mathrm{SL}(2,K)$, where K is non-archimedean local field (such as the p-adic numbers). We study the action of these groups on the corresponding Bruhat-Tits tree, and discuss how this can be used to determine whether or not such a group G is both discrete and free.

Talk time: Wednesday 7 April, 10:00–10:30

Tanya Evans (University of Auckland, NZ)
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Mathematics education research: insights for research-informed evidence-based practice

Abstract: Mathematics education is a relatively new field of research (50 years old) characterised by tensions stemming from polarised research traditions. In this talk, I will give an overview of the field formation focusing on the state-of-the-art evidence-based research findings and illustrate how they can be exploited to improve the teaching and learning of university mathematics.

Talk time: Thursday 8 April, 09:30–10:00

Pedram Hekmati (University of Auckland, NZ)
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New knot invariants from finite group actions

Abstract: We introduce an infinite family of concordance invariants for knots and discuss some of their properties and applications. These invariants are constructed using tools from gauge theory and equivariant stable homotopy theory for finite group actions.

Talk time: Saturday 10 April, 11:00–11:30

Liam Jolliffe (University of Cambridge, UK)
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Sharpening Schaper's bounds for decomposition numbers

Abstract: Determining the decomposition numbers for the symmetric group has been an active area of research for a number of decades, but still we only have a number of ad hoc methods for this task. Perhaps the best of these is a sum formula Schaper introduced in his thesis. In this talk we shall see how we can improve this formula by defining and studying the 'Schaper number' of a partition.

Talk time: Saturday 10 April, 10:00–10:30

Dillon Mayhew (Victoria University of Wellington, NZ)
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Definability and recognisability for graphs and hypergraphs

Abstract: Definability refers to the power of a logical language to define a class of mathematical objects. Recognisability refers to the ability of a computing machine to test membership of a class. Classical theorems by Buchi and Courcelle, as well as recent work by Bojancyzk and Pilipczuk, show there is a strong connection between these concepts when the objects are strings or graphs. We will discuss the connection when the objects are hypergraphs.

Talk time: Wednesday 7 April, 11:00–11:30

James Milne (University of Michigan, USA)
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The Hodge, Tate, and standard conjectures, 60 years on

Abstract: About sixty years ago, Hodge, Tate, and Grothendieck made some optimistic conjectures concerning algebraic cycles on algebraic varieties. Although little progress has been made in proving the conjectures, they have dramatically influenced the subject of arithmetic geometry. I'll try to explain how.

Talk time: Friday 9 April, 09:00–10:00

Clemency Montelle (University of Canterbury, NZ)
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Iterative methods for determining the sine of one degree in late medieval Arabic, Persian, and Sanskrit sources

Abstract: The determination of trigonometric chords or sines of certain arcs or angles using geometry first appeared in classical antiquity. Using key geometric relations and repeated bisections, the chord or sine of any integer multiple of three degrees can be produced exactly, but other values, such as the chord or sine of one degree (due to the impossibility of trisecting an angle under Euclidean constraints), can be determined only approximately. However, for those early mathematicians compiling tables of trigonometric functions, providing values for each degree was crucial. We explore and evaluate the ingenious iterative techniques first proposed by Arabic scholars, and later modified by Persian and Sanskrit mathematicians, which offered staggeringly precise approximations for this key quantity.

Talk time: Wednesday 7 April, 09:30–10:00

Kaitlin Riegel (University of Auckland, NZ)
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Mathematics exam-related self-efficacy explained by achievement, gender, stress mindset, and emotions

Abstract: Addressing student affect around assessment is vital, given it is tightly interwoven with cognition. This study describes the relationship between exam-specific affect and stress mindset in a university mathematics course. The results are discussed with opportunities to adapt learners? stress mindset and the development of exam-related self-efficacy.

Talk time: Thursday 8 April, 10:00–10:30

Dominic Searles (University of Otago, NZ)
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Quasisymmetric functions and 0-Hecke modules

Abstract: The algebra of quasisymmetric functions contains the symmetric functions, and certain bases of quasisymmetric functions generalize the famed Schur basis of symmetric functions. We interpret two such bases in terms of modules of 0-Hecke algebras, answering a question of S. Mason and E. Niese (2015), and classify when these modules are indecomposable. This talk contains joint work with J. Bardwell.

Talk time: Saturday 10 April, 11:30–12:00

Felipe Voloch (University of Canterbury, NZ)
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Hearing algebraic curves

Abstract: We show how to recover an algebraic curve over a finite field from L-functions associated with it. We also relate this problem with a number of similar problems of recovering geometric objects from spectral information and will discuss whether our methods might extend.

Talk time: Saturday 10 April, 09:30–10:00

Lukas Zobernig (University of Auckland, NZ)
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Superspecial abelian varieties

Abstract: Superspecial abelian varieties are interesting in various ways: In contrast to 'ordinary' ones, there exist only finitely many superspecial ones for each prime p. Their isogeny graphs are finite, connected, and have excellent expansion properties, making them interesting for cryptographic applications. We will see how in dimension 2 and higher, there is essentially only one superspecial abelian variety and that much of the theory can be reduced to dimension 1.

Talk time: Friday 9 April, 11:30–12:00
