Schedule

TRR Annual meeting, Blaubeuren, Sep 19-22, 2022

	Monday	Tuesday	Wednesday	Thursday
9-9:50		Brannan	Rosenthal	Dudas (zoom)
10-10:25		OSCAR II	Yun	Böhm
10:30-10:55			Mäurer	Teguia
11-11:30		coffee	coffee	coffee
11:30-12:30		time for discussions	time for discussions	11:30-11:55 Lassueur
12:30-14		lunch	lunch	lunch
14-14:50	Bley	hike/ time for discussions	Ranganathan	time for discussions
15-15:25	OSCAR I		Rober	
15:30-15:55			Rademacher	
16-16:30	coffee		coffee	coffee
16:30-16:55	Stanojkovski	coffee	time for discussions	
17-18	Snapshots	time for discussions	General meeting	
18-19	Dinner	Dinner	Dinner	
19	Women's night	Steering committee		

Snapshots: Annika Bartelt, Tobias Braun, Loujean Cobigo, Marie Roth, Julien Schanz, Victoria Schleis

Titles and abstracts

- **Werner Bley:** *Stably free cancellation over integral group rings.*

  For a finite group G we write $\mathbb{Z}[G]$ for the integral group ring. We say that $\mathbb{Z}[G]$ has stably free cancellation, if $P \oplus \mathbb{Z}[G]^n \simeq \mathbb{Z}[G]^{n+m}$ implies $P \simeq \mathbb{Z}[G]^m$ for all $\mathbb{Z}[G]$-modules P.

  We will present an algorithm which for a given finite group G decides whether $\mathbb{Z}[G]$ has stably free cancellation or not.

  This is a report on joint work in progress with Tommy Hofmann and Henri Johnston.
- **Michael Brannan:** *Quantum symmetries and quantum information.*

  In this talk I will survey some recent interactions that have emerged between quantum information theory and quantum group theory. I will focus for the most part on examples of non-local games in quantum information theory, and explain how winning strategies for these games are encoded by certain classes of quantum symmetry groups and their representation theories. This connection between quantum physics and quantum algebra has been extremely fruitful for both fields, and I'll take some time to explain some interesting results that have emerged in both fields as a consequence.
- **Olivier Dudas:** *Decomposition numbers for finite groups of Lie type.*

  Decomposition numbers encode how ordinary characters break into irreducible consitituents after reduction modulo a prime number. In this talk I will explain some of the results and conjectures to compute these numbers for finite groups of Lie type. Most of the recent techniques are based on the underlying geometry of these finite groups, following ideas of Deligne and Lusztig.
- **Caroline Lassueur:** *On the trivial source character tables of small finite groups.*

  The aim of this talk is to review results obtained towards the calculation of trivial source character tables of small finite groups, and the creation of a database of such tables.
- **Fabian Mäurer:** *TensorCategories.jl - Category Theory in Julia.*

  In this talk I want to present the early stage of the Julia package TensorCategories.jl. It provides a framework for tensor and fusion categories such that explicit computations can be performed. I will show some exemplary use cases and present the state of the current main goal: The computation of the center of a fusion category.
- **Daniel Rademacher:** *Constructive Recognition of Classical Groups*

  Matrix group recognition is an international research effort within the area of computational group theory with the aim of answering fundamental questions about arbitrary matrix groups over finite fields.

  One possible solution is a data structure called composition tree which was suggested by Charles Leedham-Green and Eamonn O'Brien in 1990. In this approach computations of a large matrix group are decomposed onto smaller matrix groups until this process cannot be repeated anymore. The remaining leaf groups are the finite simple groups which includes the classical groups.

  Therefore, effective algorithms to deal with classical groups are essential for the overall performance of the composition tree. One elementary aim is to develop an efficient algorithm for the constructive recognition of these groups.

- **Dhruv Ranganathan:** *Quantum geometry for matroids.*

  Gromov-Witten theory probes the geometry of algebraic manifolds by studying the space of algebraic curves that lie within that manifold. In the last decade, it has emerged that matroids, which are combinatorial abstractions of a certain class of manifolds, possess many of the structures that one typically attaches to manifolds. This is true even when there is no direct connection to geometry. I will discuss a new direction in this interplay between matroids and geometry, by defining and examining the Gromov-Witten theory of matroids. The talk is based on joint work with Jeremy Usatine (Brown).
- **Friedrich Rober:** *Wreath Product Decompositions.*

  In this talk, I will present the current status of my PhD project regarding the constructive recognition of primitive permutation groups that are defined as subgroups of wreath products.

  Moreover, I will report on joint work with Dominik Bernhardt, Alice C. Niemeyer and Lucas Wollenhaupt in which we describe efficient algorithms for finding conjugating elements, conjugacy classes, and centralisers in wreath products.
- **Joachim Rosenthal:** *What mathematics is used in Post Quantum Cryptography?*

  Public key cryptography has been at the center of modern cryptography. It is not only used for the exchange of secret keys but also for the authentication of entities on the Internet, for digital signatures and for the construction of digital currencies.

  Until a few years ago most public key systems were based on the hardness of factoring integers or on the hardness of the discrete logarithm problem in an elliptic curve.

  With the realization that a quantum computer would make many practically used public key cryptographic systems obsolete it became an important research topic to design public key systems which are expected to be secure even if a powerful quantum computer would exist.

  This new area of research is called post-quantum cryptography and there has been in the last couple of years a lot of efforts to come up with new standards to be used in everyday applications.

  The main part of the lecture will overview this recent development and will explain the underlying mathematical problems.
- **Mima Stanojkovski:** *Subspaces fixed by a nilpotent matrix.*

  The linear spaces that are fixed by a nilpotent nn matrix form a subvariety of the Grassmannian. I will report on joint work with Marvin Hahn, Gabriele Nebe and Bernd Sturmfels in which we classify such varieties for small n and, as a result, settle a conjecture of Mutiah, Weekes and Yacobi regarding their radical ideals.
- **Bertrand Teguia:** *Series defined by quadratic differential equations.*

  Differential polynomials of degree at most one annihilate D-finite functions. We consider annihilators of degree at most two and present a general strategy to represent power series solutions of resulting differential equations given enough initial values. Using techniques from algebraic geometry, our method extends to representations of Laurent-Puiseux series. Our algorithmic attempts enable us to define a class of functions that naturally extends D-finiteness. We present some case studies of this class and demonstrate how our method highlights a reverse methodology that finds application in

Guessing: recovering a non-D-finite function from a truncation of its power series expansion.

Parts of this presentation came from joint work with Wolfram Koepf and Anna-Laura Sattelberger.

- **OSCAR I:** *Michael Joswig.*
  OSCAR Status Report 2022.
- **OSCAR II:** *Mara Belotti, Chiara Meroni, Victoria Schleis, Johannes Schmitt.*
  OSCAR Case Studies.
- **Claudia Yun:** *Discrete Morse Theory for Symmetric Delta-complexes.*
  In this talk, we generalize discrete Morse theory to the context of symmetric Delta-complexes. First introduced by Forman, discrete Morse theory is an adaptation of Morse theory for regular CW-complexes. It gives a schematic for collapsing cells in a CW-complex without changing its homotopy type. On the other hand, symmetric Delta-complexes are a generalization of cell-complexes. They are topological spaces built from quotients of standard simplices, and they have played important roles in recently developments of tropical geometry. We generalize various concepts from discrete Morse theory, including discrete Morse functions and acyclic matchings on face posets, and prove parallel theorems for symmetric Delta-complexes.