# Abstracts

## Groups of Kac-Moody type over $F_2$

Sebastian Bischof
Justus-Liebig-Universität Gießen

Twin buildings are combinatorial objects which were introduced by Ronan and Tits in the late 1980s. Their definition was motivated by the theory of Kac-Moody groups over fields and they are natural generalizations of spherical buildings. Spherical buildings were classified by Tits in the 1970s and this result is based on a local-to-global result on spherical buildings. Tits asked the question whether a similar result holds for twin buildings. This has been confirmed by Mühlherr and Ronan under an additional assumption which is not satisfied for twin buildings associated with Kac-Moody groups over $F_2$. We give a construction of groups of Kac-Moody type over $F_2$ which shows that the local-to-global result does not hold in general. If time permits, I will discuss some applications including finiteness properties and Property (T).

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## A pro-$p$ version of Sela's accessibility

Ilaria Castellano
Universität Bielefeld

Accessibility of splittings over finite groups (i.e., as a graph of groups with finite edge groups) was studied by Dunwoody who proved that finitely presented groups are accessible but found an example of an inaccessible finitely generated group. This initiated naturally a search for a kind of accessibility that holds for finitely generated groups. The breakthrough in this direction is due to Sela who proved $k$-acylindrical accessibility for finitely generated groups: accessibility provided the stabilizer of any segment of length $k$ of the group acting on its standard tree is trivial for some $k$.

In general finitely generated pro-$p$ groups are not accessible, as shown by Wilkes, and it is an open question whether finitely presented are. In this talk we will present the pro-$p$ version of Sela's result and, time permitting, we will provide an application for it.

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## A first algorithm to solve the word problem for 3-free Artin groups

María Cumplido Cabello

Universidad de Sevilla

Artin groups are the groups defined by a finite set of generators and relations of the form $sts\ldots = tst\ldots$ where $s$ and $t$ are generators and both words of the equality have the same length. Despite these groups are easily defined, they are quite mysterious: basic problems of classic group theory remain open, as it is the case for the word problem. There have been many (geometric and algebraic) approaches to solve the word problem for particular families of Artin groups (being the braid group the flagship example). In this talk we will explain a method of rewriting words that allows us to obtain geodesic representatives for elements in Artin groups that do not have a relation of length 3 (also known as braid relations) and, as a direct consequence, we will solve the word problem in this (big) family of Artin groups.

This is a joint work with Rubén Blasco-García and Rose Morris-Wright.

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## Some questions related to conciseness and outer commutator words

Gustavo A. Fernández-Alcober

UPV/EHU

Outer commutator words are constructed by iterating commutators, but always using different variables. In this talk we will consider several problems regarding the cardinalities of the set of word values and of the verbal subgroup corresponding to an outer commutator word, both in general and profinite groups, and some generalizations.

*Unfortunately this talk had to be cancelled.*

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## On the cohomology of groups

Oihana Garaialde Ocaña
UPV/EHU

Group cohomology provides a framework to study intrinsic algebraic properties of a given group and it has many applications in algebra and number theory. However, computing the cohomology of a group may be intrinsically hard.

The aim of this talk is to provide some (computer-free) explicit computations and to present some of the (recent) results in the area.

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## Detecting free factors in profinite completions

Alejandra Garrido
Universidad Autónoma de Madrid

If one is interested in finitely generated residually finite groups, it is natural to ask to what extent it is determined by its profinite completion. Perhaps the boldest question in this area is that attributed to Remeslennikov: "If $G$ has the same profinite completion as a free group of finite rank, must $G$ be isomorphic to that free group?" The answer to this still seems remote, given current knowledge, but some success has been found on variants of it, restricting the type of group $G$ is allowed to be. Another natural variant of Remeslennikov's question is whether a free factor of a group $G$ can be detected from its profinite completion: if $G$ has a subgroup $H$, whose closure in the profinite completion of $G$ is a profinite free factor, must $H$ be a free factor of $G$? This question is still hard, with positive known answer only when $G$ itself is a free group.

I will report on joint work with A. Jaikin in which it is shown that this question has positive answer when $G$ is a virtually free group. The methods are different to those used previously and may be extended to other classes of groups if some challenging questions are answered on their completed group algebras.

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# Fusion systems, localities and the classification of finite simple groups

Ellen Henke

Technische Universität Dresden

Saturated fusion systems are categories modelling the $p$-local structure of finite groups (i.e. the structure of the normalizers of non-trivial $p$-subgroups of finite groups). They play a role in Aschbacher's program to revisit the proof of the classification of finite simple groups, in the modular representation theory of finite groups and in certain parts of homotopy theory. Linking systems associated to fusion systems were introduced by Broto, Levi and Oliver to study "$p$-completed classifying spaces of fusion systems", but recent results suggest that they are also important from a purely algebraic point of view. Chermak showed that every linking system corresponds to a group-like structure called a locality. After an introduction to the subject, I will report in this talk on an attempt at simplifying Aschbacher's program using the theory of localities.

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# Upper bounds for the first $L^2$-Betti number of groups

Steffen Kionke

FernUniversität in Hagen

Over the last 30 years $L^2$-Betti numbers have become a major tool in the investigation of infinite groups with a number of intriguing applications.

After a short introduction to $L^2$-invariants, we will take a closer look at the first $L^2$-Betti number. We will explain how the first $L^2$-Betti number can be studied using the geometry of the Cayley graph and present a simple method to extract upper bounds. We discuss applications; in particular, such bounds can be used to prove the vanishing of the first $L^2$-Betti number of Burnside groups of large prime exponent.

A remarkable feature of the Cayley graph approach is that it still works for a family of "generalized" first Betti numbers. We conclude the talk with an outlook to this generalized setting.

(Based on joint work with Carsten Feldkamp)

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## Decomposition of 2-parts spin representations of symmetric groups

Lucia Morotti

Heinrich-Heine-Universität Düsseldorf

In odd characteristic, the part of the decomposition matrix corresponding to characteristic 0 spin supermodules indexed by 2-parts partitions and their composition factors is triangular, possibly with more rows than columns. This is not true any more in characteristic 2. In this case columns can be split to obtain a triangular matrix (with more rows than columns) and a matrix with at most 2 non-zero rows. I will also show what are the possible composition factors and how most of the corresponding decomposition numbers in characteristic 2 can be explicitly computed.

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## Extending branch groups to simple groups and beyond

Eduard Schesler

FernUniversität in Hagen

Given an infinite rooted tree $T$, I will extend some known constructions of groups acting continuously on $T$ (e.g. some classical branch groups) by allowing some discontinuous behavior. As a result, we obtain a group $H$ with a variety of exotic properties: Every finite quotient of $H$ is a product of non-abelian simple groups, $H$ is amenable while possessing an infinite simple quotient, and $H$ gives rise to a continuum of Grothendieck pairs. Guided by the construction of such a group $H$, I will introduce so-called $B$-systems of groups. These take a group $B$ and a directed system of groups as an input and produce groups with properties similar to those of $H$. This talk is based on a joint work with Steffen Kionke.

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## Exotic and block-exotic fusion systems

Patrick Serwene

Technische Universität Dresden

One of the main problems in the theory of fusion systems is the conjecture whether a fusion system arises in the form of a finite group if and only if it arises in the form of a $p$-block of a finite group. We discuss some advances tackling this conjecture by discussing classes of fusion systems for which we know it holds true and we also discuss the status of the conjecture for fusion systems of blocks of finite simple groups. We introduce a category, generalising block fusion systems, which plays an important role in our reduction theorems.

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## Test elements and retracts in groups

Ilir Snopche

Universidade Federal do Rio de Janeiro

An element $x$ of a group $G$ is called a test element if for any endomorphism $\Phi$ of $G$, $\Phi(x) = x$ implies that $\Phi$ is an automorphism. A subgroup $R$ of a group $G$ is said to be a retract of $G$ if there is a homomorphism $r : G \to R$ that restricts to the identity on $R$. Turner proved that test elements of a free group $F$ of finite rank are exactly the elements not contained in any proper retract of $F$.

I will talk about test elements and retracts in groups. In particular, I will give examples of groups which have many test elements and will discuss the following question raised by Bergman: Let $F$ be a free group of finite rank and let $R$ be a retract of $F$. Is it $H \cap R$ is a retract of $H$ for every finitely generated subgroup $H$ of $F$?

This talk is based on a joint work with Slobodan Tanushevski and Pavel Zalesskii.

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## Normal 2-coverings of finite groups

Pablo Spiga

Università degli Studi di Milano-Bicocca

Let $G$ be a finite group. Let $H_1, \ldots, H_\ell$ be a collection of proper subgroups of $G$. This collection is said to be a normal covering if each element of $G$ has a conjugate in $H_i$, for some $i$. The minimum value of $\ell$ is called the covering number of $G$. It follows from a theorem of Jordan that $\ell \geq 2$ for each finite group $G$. In this talk we discuss recent investigations on finite groups having normal covering number 2 and some generalizations of the concept of normal covering.

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## Subgroup growth meets combinatorial geometry

Christopher Voll

Universität Bielefeld

A finitely generated group has only finitely many subgroups of each finite index. How does the number of index-n-subgroups growth with $n$? Subgroup growth is an umbrella term for the study of asymptotic questions like this, as well as ensuing arithmetic ones.

Zeta functions are important tools in subgroup growth, as well as related areas such as representation growth of infinite groups. In my talk I will explain how ideas from combinatorial geometry have led to recent advances in the arithmetic theory of (normal) subgroup zeta functions of nilpotent groups, for instance in joint work with A. Carnevale and M. M. Schein.

I will assume no previous knowledge about subgroup growth, zeta functions or combinatorial geometry.

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# Root graded groups

Torben Wiedemann
Justus-Liebig-Universität Gießen

Let $\Phi$ be a finite root system. A $\Phi$-graded group is a group $G$ together with a family of subgroups $(U_\alpha)_{\alpha \in \Phi}$ satisfying some purely combinatorial axioms. The main examples of $\Phi$-graded groups are the Chevalley groups of type $\Phi$, which are defined over a commutative ring and which satisfy the well-known Chevalley commutator formula. We show that if $\Phi$ is of rank at least 3, then every $\Phi$-graded group is defined over some algebraic structure (e.g. a ring, possibly non-commutative or, in low ranks, even non-associative) such that a generalised version of the Chevalley commutator formula is satisfied. A new computational method called the blueprint technique is crucial in overcoming certain problems in characteristic 2. This method is inspired by a paper of Ronan-Tits.

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