

XXI CLA - Session S12

Group Theory

S12 - July 28, 15:00 – 15:25

THE RELATIVE STABLE CATEGORY

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Let G be a finite group and k an algebraically closed field of characteristic $p > 0$. Let \mathcal{H} be a collection of p -subgroups of G . We investigate the relative stable category $\mathbf{stmod}_{\mathcal{H}}(kG)$ of finitely generated modules modulo \mathcal{H} -projective modules. Triangles in this category correspond to \mathcal{H} -split sequences. Hence, compared to the ordinary stable category there are fewer triangles and more thick subcategories. Our interest is in the spectrum of this category and its relationship to the induction functor. Of particular note is that in some cases, the spectrum of the category is not Noetherian.

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GROUPS OF CIRCLE HOMEOMORPHISMS WITH INVARIANT LAMINATIONS.

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Together with H. Baik and E. Samperton, we study subgroups of $\mathit{Homeo}^+(S^1)$ according to the laminations they preserve. Our most specific goal is to characterize the main examples that arise from hyperbolic geometry of surfaces and 3-manifolds.

I will give an overview of this topic, focusing on the Tits alternative for groups preserving two transverse laminations.

Joint work with Hyungryl Baik (Rheinische Friedrich-Wilhelms-Universität Bonn) and Eric Samperton (UC Davis).

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SIMPLE GROUPS OF INTERMEDIATE GROWTH

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We will describe a construction transforming an arbitrary non-free minimal action of the infinite dihedral group on the Cantor set into a finitely generated infinite periodic group. If the associated action has low complexity (is linearly repetitive), then the group is of intermediate growth. In particular, we construct the first examples of simple groups of intermediate growth.

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LARGE SCALE GEOMETRY OF HEINTZE GROUPS

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Negatively curved homogeneous manifolds were characterized by Heintze. Each such manifold is isometric to a solvable Lie group X_α equipped with a left invariant metric, and the group is a semi-direct product $N \rtimes_\alpha \mathbb{R}$ where N is a connected, simply connected, nilpotent Lie group, and α is a derivation of $\text{Lie}(N)$ whose eigenvalues all have positive real parts. Such a group is called a Heintze group.

An important conjecture regarding the large scale geometry of (purely) real Heintze groups states that two such groups are quasi-isometric if, and only if, they are isomorphic.

In this talk I will describe some quasi-isometry invariants, defined by L^p -cohomology methods, and I will show how they can be used in order to understand the quasi-isometry classes of Heintze groups.

Joint work with Emiliano Sequeira (Universidad de la República, Uruguay).

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WORD MAPS ON FINITE SIMPLE GROUPS

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The theory of word maps on finite non-abelian simple groups has attracted much recent attention over recent years. In particular, maps for certain words have been proved surjective on all finite simple groups. We will report on results and illustrate techniques of proof.

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FLEXIBILITY OF REPRESENTATIONS OF $\pi_1(\Sigma)$ INTO THE SPACE OF ORIENTATION PRESERVING HOMEOMORPHISMS OR THE LINE.

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This is a joint work with Juan Alonso and Cristobal Rivas. Let Σ be a closed hyperbolic surface and $\text{Hom}(\pi_1(\Sigma), \text{Homeo}_+(\mathbb{R}))$ the space of representations of its fundamental group into the group of orientation preserving homeomorphisms of the line. We showed that there are no locally rigid representations in this space. With this perturbation techniques we were also able to show

The space of representation without global fixed points is connected. ($x \in \mathbb{R}$ is a global fixed point for the action ρ if $\rho(g)(x) = x$ for every $g \in \pi_1(\Sigma)$) In fact there exists a representation without global fixed points whose conjugacy class is dense in $\text{Hom}(\pi_1(\Sigma), \text{Homeo}_+(\mathbb{R}))$.

Any representation can be approximated by another without global fixed points.

The space of left invariant orders in $\pi_1(\Sigma)$ is a Cantor set.

Joint work with Juan Alonso (Universidad de la República, Uruguay) and Cristobal Rivas (Usach, Chile).

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TOWARDS ALGEBRAIC NIELSEN-THURSTON CLASSIFICATION FOR BRAIDS

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We attach to the braid group (more generally to any Garside group) a Gromov-hyperbolic graph on which the group acts by isometries: the additional length graph. For braids, this is meant to be an algebraic analog of the curve complex attached to the Mapping Class Group of the punctured disk. We will present positive results and open questions on a conjectured dictionary between Nielsen-Thurston classification and the classification of isometries of the additional length graph as a hyperbolic space.

Joint work with Bert Wiest (université de Rennes 1).

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CIRCULAR ORDERINGS ON THE FREE GROUP

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We discuss the space of circular orders of a group. We give a characterization of orderings that are isolated in term of its dynamical realization. As an application, we show that the free group on two or more generators admits infinitely many conjugacy classes of isolated orderings.

Joint work with Kathryn Mann (University of California, USA).

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ON SET-THEORETIC SOLUTIONS TO THE YANG-BAXTER EQUATION

Victoria Lebed

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Since the seminal work of Drinfel'd, the study of set-theoretic solutions to the Yang-Baxter equation (with we will simply call solutions) has always remained a dynamic research area. To any solution, one can associate a group, which opens the way for applying group-theoretic tools to the study of the YBE. This construction is classical and well explored. In this talk, to any solution we will associate another type of structure, called a shelf. This is a set with a binary operation $*$ satisfying the self-distributivity relation $(a * b) * c = (a * c) * (b * c)$. The associated shelf captures many properties of the original solution, and in particular contains information about its associated group. Thus to understand the group-theoretic aspects of solutions, it is instructive to look at their shelves, which are much easier to deal with. These ideas are also fruitful in the study of the (co)homology of solutions.

Joint work with Leandro Vendramin (Universidad de Buenos Aires, Argentina).

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CRYPTOSYSTEMS USING SUBGROUP DISTORTION

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We propose cryptosystems based on subgroup distortion in hyperbolic groups. We also include examples of Hyperbolic groups with exponentially and $\exp(\exp)$ distorted subgroups that would be useful for the protocols.

Joint work with Indira Chatterji (University of Nice, France) and Ni Lu (CUNY Graduate Center, USA).

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CONNECTEDNESS OF GENERATING SETS FOR FINITE GROUPS

Marston Conder

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Suppose G is a finitely-generated group, and X and Y are two generating sets for G with $|X| = |Y|$. Under what conditions can X be ‘transformed’ to Y by a sequence of single-element replacements? This very general question relates to a number of things, including the product replacement algorithm, T-systems for finite groups, and expansion in Cayley graphs. Some recent progress will be described, especially in the case of 2-generator finite groups.

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MULTIFRACTION REDUCTION IN ARTIN-TITS GROUPS

Patrick Dehornoy

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A classical result of Ore says that, if M is a cancellative monoid and any two elements of M admit a least common multiple, that every element of the enveloping group $U(M)$ of M can be represented by a unique irreducible fraction on M . We extend this result by showing that, when common multiples need not exist but a certain “3-Ore condition” is satisfied, every elements of $U(G)$ can be represented by a unique irreducible iterated fraction, leading to a solution of the Word Problem reminiscent of the Dehn algorithm for hyperbolic groups. This applies in particular to Artin-Tits groups of FC-type and, conjecturally, to all Artin-Tits groups.

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BRACES, GENERALIZATIONS AND APPLICATIONS TO THE YANG-BAXTER EQUATION

Leandro Guarnieri

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Braces were introduced by Rump as a generalization of radical rings to study non-degenerate involutive set-theoretic solutions of the Yang-Baxter equation. We generalize Rump's braces to the non-commutative setting and use this new structure to study not necessarily involutive non-degenerate set-theoretical solutions of the Yang-Baxter equation. Based on results of Bachiller and Catino and Rizzo, we develop an algorithm to enumerate and construct classical and skew braces of small size (up to isomorphism). With this algorithm we were able to produce a database of classical and skew braces of small size. We present several open problems and conjectures. See arXiv:1511.03171.

Joint work with Leandro Vendramin (Universidad de Buenos Aires).

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PRO- p COMPLETIONS OF POINCARÉ DUALITY GROUPS

Igor Lima

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We consider some sufficient conditions for the pro- p completion of an orientable Poincaré duality group of dimension $n \leq 3$ to be a virtually pro- p Poincaré duality group of dimension at most $n \leq 2$. This is a work published in Israel Journal of Mathematics (2014).

Joint work with D.H. Kochloukova (University of Campinas, Brazil) and J.A. Hillman (University of Sydney, Australia).
