Fall 2015

- **September 10**
  Speaker: **Wiktor Mogilski** (Binghamton University)
  Title: **The weighted Singer conjecture for Coxeter groups** *Abstract:*
  Associated to a Coxeter system (W,S) there is a contractible simplicial complex Σ called the Davis complex on which W acts properly and cocompactly by reflections. Given an S-tuple of positive real numbers $\mathbf{q}$, one can define the weighted L^2-(co)homology groups of Σ and associate to them a nonnegative real number called the weighted L^2-Betti number. Within the spectrum of weighted L^2-(co)homology there is a conjecture of interest called the Weighted Singer Conjecture, which was formulated in a 2007 paper of Davis–Dymara–Januszkiewicz–Okun. The conjecture claims that if Σ is an n-manifold, then the weighted L^2-(co)homology groups of Σ vanish above dimension $\frac{n}{2}$ whenever $\mathbf{q}\leq\mathbf{1}$ (that is, all terms of the multiparameter $\mathbf{q}$ are less than or equal to 1). I will provide an overview of the current progress on the conjecture and present proofs of the conjecture (and variations of it) when $n=3,4$..
- **September 17**
  Speaker: **Dmytro Yeroshkin** (Syracuse University)
  Title: **On Poincaré Duality for Orbifolds** *Abstract:*
  This talk will examine the obstructions to integer-valued Poincaré duality for (underlying spaces of) orbifolds. In particular, it will be shown that in dimensions 4 and 5, the obstruction is controlled by the orbifold fundamental group. A consequence of this is that if the orbifold fundamental group is naturally isomorphic to the fundamental group of the underlying space, then the orbifold satisfies integer-valued Poincaré duality.
- **September 24**
  Speaker: **Federico Rodriguez Hertz** (Pennsylvania State University)
  Title: **Stable ergodicity in low dimensions** *Abstract:*
  We shall give an overview of what is known about stable ergodicity for partially hyperbolic systems in low dimensions (either of the manifold or of the center bundle). We shall also state some old and new problems and give the main obstacles towards their solution.
- **October 1** *Joint with Combinatorics Seminar*
  Speaker: **Florian Frick** (Cornell University)
  Title: **Equivariant topology of mass partitions by hyperplanes** *Abstract:*
  I will review the configuration-space/test-map scheme which is central to the study of many problems in topological combinatorics. I will then apply this method to investigate the existence of fair partitions of measures in Euclidean space by affine hyperplanes. One important instance of this is the Ham Sandwich theorem, which guarantees that any sandwich made of bread, ham, and cheese can be fairly cut into two pieces with a long knife. I will use equivariant obstruction theory to prove results about higher-dimensional sandwiches (that is, collections of measures) that have to be cut into several equal pieces. This is joint work with Pavle Blagojevic, Albert Haase, and Gunter M. Ziegler.
- **October 8**

  Dean's Lecture in Geometry and Topology.
  Speaker: **Christopher Croke** (University of Pennsylvania)
  Title: **Geometric Rigidity Problems** *Abstract:*
  In this talk we introduce some geometric rigidity problems that ask if you can determine a compact Riemannian manifold with boundary from measurements taken from the outside. The problems includes the boundary rigidity problem: Can you determine the metric inside if you know the distances (measured through the inside) between

all pairs of boundary points? The lens rigidity problem: Can you determine the metric if you know how each entering geodesic exits and how long it takes to exit? We will present some counterexamples and some theorems as well as mention some relations to other problems and potential applications.

- **October 13, 2:50pm** *Joint with algebra seminar.*
  Speaker: **Robert Bieri** (Binghamton University)
  Title: **Groups of piecewise isometric permutations of lattice points** *Abstract:*
  An orthant (of the orthogonal integral lattice) $L\subseteq \mathbb Z^n$ is the image of the standard orthant $\mathbb ℕ^n$ under an affine-orthogonal transformation. And a permutation $p: S\longrightarrow S$ of a subset $S\subseteq \mathbb Z^n$ is piecewise-Euclidean-isometric (pei), if S is a disjoint union of finitely many orthants, $S = \bigcup_{i}L_i$, on each of which p restricts to an isometric embedding $L_i\rightarrow S$. I will talk about the group $\text{pei}(S)$ of all pei-permutations of various subsets S and its subgroup $\text{pet}(S)$ of all piecewise-Eucliden-translation permutations. In the case when S consists of the lattice points on the union of n positive coordinate axes then $\text{pet}(S)$ is the Houghton group H_n. This is joint work with Heike Sach: we prove finiteness properties of some pei- and pet- groups, and have, as a consequence, that $\text{pei}(\mathbb Z^n)$ admits a K(G,1)-complex with finite $(2^n – 1)$-skeleton. An interesting point is that prominent groups like Richard Thompson's group V crop up when we extend the consideration to the $\text{SL}_2(\mathbb Z)$-lattice in the hyperbolic plane..

- **October 15**
  Speaker: **Andrew Geng** (University of Chicago)
  Title: **Classification and examples of 5-dimensional geometries** *Abstract:*
  Thurston's eight homogeneous geometries formed the building blocks of 3-manifolds in the Geometrization Conjecture. Filipkiewicz classified the 4-dimensional geometries in 1983, finding 18 and one countably infinite family. I have recently classified the 5-dimensional geometries. I will review what a geometry in the sense of Thurston is, survey related ideas, and outline the classification in 5 dimensions. Salient features, especially those first occurring in dimension 5, will be illustrated using particular geometries from the list. The classification touches a number of topics including foliations, fiber bundles, representations of compact Lie groups, Lie algebra cohomology, Galois theory in algebraic number fields, and conformal transformation groups. I hope to give some indication of how all of these come into play..
- **October 22** *Joint with Analysis Seminar*
  Speaker: **Jiuyi Zhu** (John Hopkins University)
  Title: **Doubling estimates, vanishing order and nodal sets of Steklov eigenfunctions** *Abstract:*
  Recently the study of Steklov eigenfunctions has been attracting much attention. We investigate the qualitative and quantitative properties of Steklov eigenfunctions. We obtain the sharp doubling estimates for Steklov eigenfunctions on the boundary and interior of the manifold using Carleman inequalities. As an application, optimal vanishing order is derived, which describes quantitative behavior of strong unique continuation property. We can ask Yau's type conjecture for the Hausdorff measure of nodal sets of Steklov eigenfunctions. We derive the lower bounds for interior and boundary nodal sets. In two dimensions, we are able to obtain the upper bounds for singular sets and nodal sets. Part of work is joint with Chris Sogge and X. Wang.
- **October 29**
  Speaker: **Anisah Nu'Man** (Trinity College)
  Title: **Intrinsic tame filling functions** *Abstract:*
  Let G be a group with a finite presentation $P = \langle A|R \rangle$ such that A is inverse-closed. Let $f \colon \mathbb{N}[\frac{1}{4}] \rightarrow \mathbb{N}[\frac{1}{4}]$ be a nondecreasing function. Loosely, f is an intrinsic tame filling function for $(G,\mathcal{P})$ if for every word w over $A^∗$ that represents the identity element in G, there exists a van Kampen diagram $\triangle$ for w over P and a continuous choice

of paths from the basepoint $\ast$ of $\triangle$ to the boundary of $\triangle$ such that the paths are steadily moving outward as measured by f. The isodiametric function (or intrinsic diameter function) introduced by Gersten and the extrinsic diameter function introduced by Bridson and Riley are useful invariants capturing the topology of the Cayley complex. Tame filling functions are a refinement of the diameter functions introduced by Brittenham and Hermiller and are used to gain insight on how wildly maximum distances can occur in van Kampen diagrams. Brittenham and Hermiller showed that tame filling functions are a quasi-isometry invariant and that if f is an intrinsic (respectively extrinsic) tame filling function for $(G,\mathcal{P})$, then $(G,\mathcal{P})$ has an intrinsic (respectively extrinsic) diameter function equivalent to the function $n \rightarrow [f(n)]$. In contrast to diameter functions, it is unknown if every pair $(G,\mathcal{P})$ has a finite-valued tame filling function. In this talk I will discuss intrinsic tame filling functions for graph products (a generalization of direct and free products) and certain free products with amalgamation.

- **November 9, 3:30pm** *Note special day and time!*
  Speaker: **Renato G. Bettiol** (University of Pennsylvania)
  Title: **Positive biorthogonal curvature in dimension 4** *Abstract:*
  A 4-manifold is said to have positive biorthogonal curvature if the average of sectional curvatures of any pair of orthogonal planes is positive. In this talk, I will describe a construction of metrics with positive biorthogonal curvature on the product of spheres, and then combine it with recent surgery stability results of Hoelzel to classify (up to homeomorphism) the closed simply-connected 4-manifolds that admit a metric with positive biorthogonal curvature.
- **November 19**
  Speaker:
  Title: **TBA** *Abstract:*
  TBA.
- **December 3**
  Speaker: **Matt Brin** (Binghamton)
  Title: **Elementary amenable subgroups of PL homeomorphisms of the interval that are not very elementary.** *Abstract:*
  Among the piecewise linear homeomorphisms of the unit interval, we find a sequence of easily described 2-generator groups of rapidly increasing complexity. In spite of their complexity, we can (oxymoronically) calculate an exact measure of each group's complexity. We will define terms, give the exact contructions and give some details of the analysis..