SPP 2026
GEOMETRY
AT INFINITY

April 1, 2019 – April 5, 2019

Part 1: General overview

Part 2: Schedule Section talks

Part 3: Title and Abstracts

Part 1

Monday, April 1

11:00	Registration with coffee and refreshments: Schloss, Foyer
12:00	Lunch
14:00	Opening address
14:30	**John Lott**: Long-time behavior in geometric flows
15:30	Coffee break: Schlossgarten Café
17:00	**Ailana Fraser**: Sharp estimates for higher eigenvalues on surfaces
18:00	Welcome reception: Schloss Foyer

Tuesday, April 2

9:30	**Nathalie Wahl**: Strings on manifolds
10:30	Coffee break: Schloss, Foyer
11:00	**Oscar Randal-Williams**: Cohomology of Torelli groups
12:00	Lunch
14:00	Section talks

Wednesday, April 3

9:30	**Francoise Dal'Bo**: Growth of groups acting by isometries and applications
10:30	Coffee break: Schlossgarten Café
11:00	**Jeffrey Danciger**: Affine geometry and the Auslander conjecture
12:00	Lunch
14:00	Section talks

Thursday, April 4

9:30	**András Vasy**: The stability of Kerr-de Sitter space and global analysis
10:30	Coffee break: Schlossgarten Café
11:00	**Alexander Strohmaier**: Index theorems and hyperbolic evolution equations
12:00	Lunch
14:00	Section talks
19:00	Conference Dinner: Schlossgarten Café

Friday, April 5

9:30	**Guoliang Yu**: The Novikov conjecture, the group of volume preserving diffeomorphisms, and Hilbert-Hadamard spaces
10:30	Coffee break: Schloss, Foyer
11:00	**Anne Thomas**: Large-scale geometry of right-angled Coxeter groups
12:00	Lunch, end of conference

Part 2

Section Talks

Tuesday, April 2nd

Time/room	203	204	205	SR1 c	SR 4
14:00 – 14:40	Claudia Grabs	Shantanu Dave	Gye-Seon Lee	Bernd Ammann	Simone Cecchini
14:50 – 15:30	Elmar Schrohe	Andreas Hermann	Andreas Ott	Anand Dessai	Thorsten Hertl
15:30 – 17:00	Coffee break				
17:00 – 17:40	Wolfgang Maurer	Abdellah Laaroussi	Naeem Pundeer	Eric Schlarmann	Jian Wang
17:50 – 1830	Guofang Wang	Michael Schwarz	Beatrice Pozzetti	Wolfgang Steimle	Christos Onti

Wednesday, April 3rd

Time/room	203	204	205	SR1 c	**SR 4**
14:00 – 14:40	Mauricio Bustamante	Thomas Mettler	Klaus Kröncke	Lashi Bandara	Benjamin Brück
14:50 – 15:30	Ian Hambleton	Marcel Schmidt	Lynn Heller	Matthias Ludewig	Jonas Beyrer
15:30 – 17:00	Coffee break				
17:00 – 17:40	Claudio Meneses	Hemanth Saratchandran	Roger Bielawski	Saskia Roos	Sebastian Hensel
17:50 – 1830	Markus Upmeier	Tobias Weich	Malte Behr	Mehran Seyedhosseini	Stephan Stadler

Thursday, April 4th

Time/room	203	204	205	SR1 c	**SR 4**
14:00 – 14:40	Sebastian Hannes	Michael Wiemeler	Florian Johne	Sara Azzali	Dawid Kielak
14:50 – 15:30	Max Lewandowski	Jan-Bernhard Kordaß	Elena Mäder-Baumdicker	Alexander Engel	Steffen Kionke
15:30 – 17:00	Coffee break				
17:00 – 17:40	Oliver Lindblad Petersen	Diego Corro	Miles Simon	Christopher Wulff	Tam Nguyen-Phan
17:50 – 1830	Viktoria Rothe	Manuel Amann	Boris Vertman	Vito Felice Zenobi	Grigori Avramidi

Part 3

Title and Abstracts

Main Speaker:
(in alphabetical order)

Dal'Bo, Francoise: Growth of groups acting by isometries and applications
Abstract: Let G be a group acting properly discontinously by isometries on a hyperbolic space. Denote by D(G) the limit when R goes to infinity of Ln N(R)/R, where N(R) is the number of elements in the intersection of G(O) and B(O,R). Consider a subgroup H of G, under which condition do D(G)=D(H) hold? Joint work with Rémi Coulon and Andrea Sambusetti

Danciger, Jeffrey: Affine geometry and the Auslander Conjecture
The Auslander Conjecture is an analogue of Bieberbach's theory of Euclidean crystallographic groups in the setting of affine geometry. It predicts that a complete affine manifold (a manifold equipped with a complete torsion-free flat affine connection) which is compact must have virtually solvable fundamental group. The conjecture is known up to dimension six, but is known to fail if the compactness assumption is removed, even in low dimensions. We discuss some history of this conjecture, give some basic examples, and then survey some recent advances in the study of non-compact complete affine manifolds with non-solvable fundamental group.

Fraser, Ailana: Sharp estimates for higher eigenvalues on surfaces
When we choose a metric on a manifold we determine the spectrum of the Laplace operator. Thus an eigenvalue may be considered as a functional on the space of metrics. For example the first eigenvalue would be the fundamental vibrational frequency. In some cases the normalized eigenvalues are bounded independent of the metric. In such cases it makes sense to attempt to find critical points in the space of metrics. For some surfaces it is possible to find metrics that maximize the first nonzero eigenvalue. In this talk we will discuss the question of maximizing higher eigenvalues on surfaces.

Lott, John: Long-time behavior in geometric flows
A geometric flow is a way of evolving a geometry on a manifold. The hope is that as time goes on, the geometry converges to something recognizable. I will talk about what's known, and what's not known, for two geometric flows in three dimensions. The first flow is the Ricci flow, used by Perelman to prove Thurston's geometrization conjecture. The second flow is the Einstein flow, which generates solutions of the vacuum Einstein equations on a four dimensional spacetime.

Randal-Williams, Oscar: Cohomology of Torelli groups
It is a basic problem in the cohomology of moduli spaces of Riemann surfaces to describe the cohomology of the Torelli group---the subgroup of the mapping class group of those diffeomorphisms which act trivially on the first cohomology of the surface---as a representation of Sp(2g, Z), at least in a stable range depending on the genus of the surface. This question can be generalised to higher dimensions by replacing the genus g surface with its analogue #^g S^n x S^n. I will present joint work with Alexander Kupers in which we answer this question in dimensions at least 6. Our description is also valid in the classical case 2n=2 assuming a finiteness

conjecture about the cohomology of this Torelli group.

Strohmaier, Alexander: Index theorems and hyperbolic evolution equations
The famous Atiyah-Singer index theorem relates the index of geometric elliptic operators to computable topological invariants.
I will give a review of results around index theory in the theory of hyperbolic evolution equations in curved spacetimes and discuss applications in physics.

Thomas, Anne: Large-scale geometry of right-angled Coxeter groups
Given a simplicial graph \Gamma with vertex set S, the associated right-angled Coxeter group W_\Gamma has generating set S, and relations s^2 = 1 and st = ts whenever s and t are adjacent vertices in \Gamma. Right-angled Coxeter groups are often studied via their action on the associated Davis complex, a CAT(0) cube complex with 1-skeleton the Cayley graph of W_\Gamma. We discuss joint work with Pallavi Dani on the rate of divergence of geodesics in the Cayley graph of W_\Gamma. For triangle-free \Gamma we characterise quadratic divergence, and we exhibit a family of graphs \Gamma_d such that the associated right-angled Coxeter group has geodesics diverging at polynomial rate of degree d.

Vasy, András: The stability of Kerr-de Sitter space and global analysis
I will discuss, based on joint work with Peter Hintz, the stability of the family of Kerr-de Sitter (KdS) black holes, which are rotating black holes in a spacetime with positive cosmological constant, as solutions of Einstein's vacuum equation: spacetimes evolving from initial data close to those of a KdS metric stay globally close to this KdS spacetime, and are indeed asymptotic to a nearby member of the KdS family.
I will discuss the general setup and formulate the result, and then in the second half of the talk focus on general analytic aspects of this problem, involving global analysis, together with the choice of a gauge to break the diffeomorphism invariance of Einstein's equation and the role of constraint damping which has also played a key role in numerical general relativity (and thus LIGO and the detection of gravitational waves).

Wahl, Nathalie: Strings on manifolds
String topology is the study of the structure of the homology of the free loop space of a manifold. I'll describe joint work with Nancy Hingston about (non-trivial) string topology operations, and about what these operations compute.

Yu, Guoliang: The Novikov conjecture, the group of volume preserving diffeomorphisms, and Hilbert-Hadamard spaces
I will introduce the Novikov conjecture and explain that the Novikov conjecture holds for manifolds whose fundamental groups admit proper and isometric actions on certain non-positively curved infinite dimensional spaces called Hilbert-Hadamard spaces. In particular, this implies the Novikov conjecture when the fundamental groups are geometrically discrete subgroups of the group of volume preserving diffeomorphisms of a compact smooth manifold. An important ingredient in the proof is certain isometry rigidity of infinite dimensional spaces. This talk is based on joint work with Sherry Gong and Jianchao Wu (arxiv1811.02086).

Section talks

Tuesday, April 2

14:00 – 14:40

Grabs, Claudia: Minimal elastic energy surfaces (203)
We consider deformations of elastic bodies, which we model as embeddings of compact Riemannian manifolds with non-empty boundary into another Riemannian manifold. This leads to a non-linear elliptic boundary value problem. The solutions can be seen as generalized minimal surfaces.
In this talk I want to briefly introduce the necessary background, show numerical simulations (done with SageMath) and compare the results with experiments.The experiments have been done in a collaboration with scientists from the Applied Condensed-Matter Physics group at Potsdam University.Moreover, we derive some properties for the corresponding linearized operator.

Dave, Shantanu: Index of geometric hypoelliptic operators (204)
Many geometric operators such as the BGG turn out to be (maximally) hypoelliptic. These operators arise from filtered manifold in natural way. So you have them on foliations, contact manifolds, Engel manifolds, flag manifolds, parabolic geometries.... Can one learn more about these geometries using hypoelliptic operators? It would be natural to expect that the index of these operators encodes some geometrically significant information.In this talk I will introduce the analysis of geometric hypoelliptic (Rockland) operators including their heat kernel asymptotics and provide examples and implications.

Lee, Gye-Seon: Hitchin components for orbifolds (205)
In this talk, I will explain how to generalize the notion of Hitchin components of surface groups to orbifold groups and describe the topology of Hitchin components of orbifold groups. I also give the interesting applications to the study of the pressure metric on the Hitchin components for surface groups, and to the deformation theory of real projective structures on 3-manifolds. Joint work with Daniele Alessandrini and Florent Schaffhauser.

Ammann, Bernd: Moduli spaces of Riemannian and Lorentzian manifolds (SR1 c)
The goal of the talk is to explain some unexpected correspondences between moduli spaces of Riemannian and Lorentzian manifolds.In the first part we describe joint research with Klaus Kr\"oncke, Hartmut Wei\ss{} and Olaf M\"uller. Let M be a compact spin manifold. We consider the moduli space of Riemannian metrics on M carrying a (non-trivial) parallel spinor. They are Ricci-flat, and all known Ricci-flat compact Riemannian manifolds are -- up to a finite covering -- of this kind. We explain that any curve in the moduli space of Ricci-flat metrics with parallel spinors yields a Lorentzian metric with a parallel lightlike spinor on $[a,b]\times M\times (-\epsilon,\epsilon)$. Under some mild conditions loops in the moduli space of Ricci-flat metrics with parallel spinors yield a Lorentzian metric with a parallel lightl ike spinor on $S^1\times M\times (-\epsilon,\epsilon)$. In the second part we explain recent work by my student J. Gl\"ockle which provides non-trivial homotopy groups in the space of intial data sets for Lorentzian manifolds satisfying the dominant energy condition strictly. In general relativity, the dominant energy condition expresses non-negative local mass distribution. For totally geodesic spacelike hypersurfaces M it yields that M has non-negative scalar curvature. We consider the space
$$DEC:=\{(g,k)\mid \textrm{strict dominant energy condition}\}.$$
The pair $(g,0)$ is in DEC iff g is in $\mathcal{R}^+(M)$, the space of metrics on M with positive scalar curvature. We describe a map from the suspension of $\mathcal{R}^+(M)$ to DEC with the following property: if $S^k\to \mathcal{R}^+

(M)$ represents a non-trivial homotopy class detected by an index, then we obtain a map $S^{k+1}\to DEC$ with „the same'' index.

Cecchini, Simone: Enlargeable metrics on nonspin manifolds (SR 4)

A well-known result of Gromov and Lawson states that an enlargeable spin manifold cannot carry a complete metric of positive scalar curvature. We extend this result to the case when the manifold is not spin and the metric is not necessarily complete by using the minimal hypersurface technique. When the manifold has dimension greater than eight, we use the main result of the recent paper by Schoen and Yau that extends the minimal hypersurfaces method to arbitrary dimensions. This is joint work with Thomas Schick.

14:50 – 15:30

Schrohe, Elmar: Bounded H_∞-calculus for parameter-elliptic boundary problems on conic manifolds and applications to the porous medium equation (203)

We show that parameter-elliptic boundary value problems on manifolds with boundary and conical singularities have a bounded H_∞-calculus. This allows us to use maximal regularity methods in order to establish the existence of short time solutions to the porous medium equation on such spaces and to analyze their behavior near the tip of the cone.
(Joint work with N. Roidos (Hannover) and J. Seiler (Turin))

Hermann, Andreas: The mass of a compact manifold (204)

This is joint work with Emmanuel Humbert. Let (M,g) be a compact Riemannian manifold without boundary. Assume that the conformal Laplace operator L acting on smooth functions on M is strictly positive and that the metric g is flat on an open neighborhood of a point p in M. Then the mass m(g,p) of (M,g) at the point p is defined as the constant term in the expansion of the Green function of L at p. We prove a variational characterization of m(g,p). Then we give some applications to the ADM mass of an asymptotically flat Riemannian manifold which might be useful to obtain a proof of the Positive Mass Theorem in the general case.

Ott, Andreas: Bounded cohomology in large degree (205)

I will discuss recent progress on the computation of the continuous bounded cohomology of Lie groups in large degree.

Dessai, Anand: Moduli spaces of metrics of nonnegative sectional curvature (SR1 c)

We review recent results on the topology of moduli spaces of metrics of nonnegative sectional curvature on closed manifolds with finite fundamental group.

Hertl, Thorsten: Cubical approximation of positive scalar curvature metrics (SR 4)

In this talk, I will outline a construction of a cubical set that naturally contains as zero-cubes $\mathrm{R}^+(M)$, the space of all Riemannian metrics of positive scalar curvature on a given closed smooth manifold M. After a brief summary of the theory of cubical sets, I will present some properties of this cubical set and explain how it might help to derive information about $\mathrm{R}^+(M)$. This is work in progress.

17:00 – 17:40

Maurer, Wolfgang: Flow without singularities by powers of mean curvature (203)
We prove existence for the flow by powers of mean curvature ($\partial_t X = H^\alpha \nu$, $\alpha>0$) starting from a complete graphical hypersurface of positive mean curvature. The flow is a so-called flow without singularities, which implies that the flow exists for all positive times and singularities are located at infinity. The main technical tools are local a priori estimates.

Laaroussi, Abdellah: Family of isospectral but non-diffeomorphic nilmanifolds and spectral asymptotics (204)
In this talk we discuss a Subriemannian structure on quotients $\Gamma\backslash\mathbb{G}$, where $\mathbb{G}$ is a 2-step nilpotent Lie group and Γ a lattice of this group. Based on an explicit representation of the heat kernel for the Sublaplacian on $\Gamma\backslash\mathbb{G}$ and a recent classification of pseudo-H-type Lie algebras we give a family of isospectral but non-diffeomorphic manifolds. We also discuss the asymptotics of the eigenvalue counting function in this non-elliptic case.

Pundeer, Naeem: Semiconformal curvature tensor and fluid space-time in general relativity (SR1 c)
In this talk, the divergence of the semiconformal curvature tensor has been studied in detail. The semiconformal curvature tensor is considered invariant under conharmonic transformation and the necessary and sufficient conditions for the semiconformal curvature tensor to be divergence-free in a perfect fluid spacetime has been obtained. It is seen that aforenamed spacetimes either satisfy the vacuum-like equation of state or represent an FRW cosmological model. The semiconformal curvature tensor has also been expressed with regards to different known tensors in the literature and association between their divergences have been acquired.

Schlarmann, Eric: Smooth classifying spaces for differential K-theory (SR1 c)
For a generalized cohomology theory on the category of smooth manifolds, a differential refinement is a functor that in addition to the topology takes into account geometric information. In this talk, we will see how to construct a differential extension of topological K-theory based on smooth Banach manifold models for the spaces that appear in the K-theory spectrum, together with a refined notion of homotopy. This is part of my ongoing PhD project at the university of Augsburg.

Wang, Jian: Contractible 3-manifolds and positive scalar curvature (SR 4)
It is not known whether a contractible 3-manifold admits a complete metric of positive scalar curvature. For example, the Whitehead manifold is a contractible 3-manifold but not homeomorphic to R^{3}. In this talk, I will present my proof that it does not have a complete metric with positive scalar curvature. I will further explain that a contractible genus one 3-manifold, a notion introduced by McMillan, does not admit a complete metric of positive scalar curvature.

17:50 – 18:30

Wang, Guofang: Analysis for Lagrangian surfaces (203)
In the talk I will talk about analytic results for Lagrangian surfaces

Schwarz, Michael: Courant's Nodal Domain Theorem for Regular Dirichlet Forms (204)
The classical nodal domain theorem of Courant states that an eigenfunction f for the n-th eigenvalue of the Dirichlet Laplacian has at most n nodal domains, i.e., \emph{topological} connected components of $\{f>0\}$ and $\{f<0\}$. Later, in 2001, Davies, Gladwell, Leydold, and Stadler proved a discrete version of Courant's theorem. Their theorem states that the upper bound of the number of nodal domains of an eigenfunction f for the n-th eigenvalue of the Laplacian on a finite graph is given by $n+k-1$, where k
denotes the multiplicity of the eigenvalue and a nodal domain is a \emph{graph} connected component of $\{f>0\}$ or $\{f<0\}$.
The stronger bound in the classical theorem is the result of a unique continuation principle, which holds for the Laplacian on $\mathbb{R}^N$ but not for the Laplacian on a graph. We are discussing Courant's nodal domain theorem in the setting of regular Dirichlet forms, which includes both examples mentioned above. To do this, we first introduce a notion of nodal domains which does only depend on the Dirichlet form and not the topology of the space. We show that in this setting, the number of nodal domains of an eigenfunction for the n-th eigenvalue is bounded from above by $n+k-1$, where k denotes the multiplicity of the eigenvalue. Furthermore, if the form is local and satisfies a unique continuation principle, we show that an eigenfunction for the n-th eigenvalue has at most n nodal domains.

Pozzetti, Maria Beatrice: Critical exponent and Hausdorff dimension for Anosov representations (205)
Whenever G is a convex cocompact subgroup of the group of isometries of the hyperbolic space, Patterson-Sullivan theory allows to relate the asymptotic growth rate of orbit points for the action of G on H^n to the Hausdorff dimension of the limit set of G on the boundary. Anosov representations form a robust generalization of convex cocompactness for discrete subgroups of higher rank Lie groups. However the relation between the Hausdorff dimension of their limit set and a suitable orbit growth rate is much more elusive since, on the one hand, the action of G on the boundary is not conformal, and, on the other hand, many different orbit growth functions can be considered. In my talk I'll report on joint work with A. Sambarino and A. Wienhard in which we find large classes of Anosov representations for which we can obtain such a relation.

Steimle, Wolfgang: Secondary kappa-classes and exotic fiber bundles (SR1 c)
Kappa-classes, or generalized Morita-Miller-Mumford classes, are prominent characteristic classes of smooth fiber bundles. We introduce a notion of secondary kappa-class which we use to show the existence of certain exotic fiber bundles -- that is, smooth fiber bundles which are non-trivial but trivial when considered as topological fiber bundles. This builds on works of M. Weiss on rational Pontryagin classes and of Hebestreit-Land-Lück-Randal-Williams on vanishing of (primary) kappa-classes for many smooth bundles with aspherical fibers. (Joint work with D. Crowley and Th. Schick.)

Onti, Christos: Conformally flat submanifolds with flat normal bundle (SR 4)
A Riemannian manifold M^n is said to be conformally flat if each point lies in an open neighborhood conformal to an open subset of Euclidean space $\R^n$. This is

always the case for manifolds endowed with metrics of constant sectional curvature. In the talk we will present recent results on conformally flat submanifolds with flat normal bundle in $\R^N$. For instance, we will see that such submanifolds are always holonomic, that is, they admit a principal coordinate system. As one of the consequences of this fact, we will see that the Ribaucour transformation can be used to construct an associated large family of immersions with induced conformal metrics holonomic with respect to the same coordinate system. This is a joint work with M. Dajczer and Th. Vlachos.

Wednesday, April 3

14:00 – 14:40

Bustamante, Mauricio: Symmetries of exotic negatively curved manifolds (203)
Let N be a smooth manifold that is homeomorphic but not diffeomorphic to a closed hyperbolic manifold M. To what extent does N admit as much symmetry as M?. In this talk, I wil show that it's possible to find N with maximal symmetry, i.e. Isom(M) acts on N by isometries with respect to some negatively curved metric on N. For these examples, Isom(M) can be made arbitrarily large. On the other hand, one can also find N with little symmetry, i.e. no subgroup of Isom(M) of “small” index, acting by diffeomorphisms of N. This is ongoing joint work with Bena Tshishiku.

Mettler, Thomas: Minimal Lagrangian connections (204)
A connection on the tangent bundle of a smooth manifold M can be understood as a map into an affine bundle over M whose total space carries a pseudo-Riemannian metric as well as a symplectic form, both of which can be constructed in a canonical fashion from the projective equivalence class of the connection. This viewpoint gives rise to the notion of a minimal Lagrangian connection. I will discuss the classification of minimal Lagrangian connections on compact oriented surfaces of non-vanishing Euler characteristic and talk about relations to convex projective geometry and dynamical systems.

Kröncke, Klaus: Perelman's entropy functionals for manifolds with conical singularities (205)
In this talk we discuss Perelman’s Lambda-functional as well as shrinker and the expander entropy on a class of manifolds with isolated conical singularities. On such manifolds, a singular Ricci de Turck flow preserving the isolated conical singularities exists. We prove that the entropies are monotonous along the singular Ricci de Turck flow. We employ these entropies to show that in the singular setting, under a curvature condition on the cross section, Ricci solitons are gradient and that steady or expanding Ricci solitons are Einstein. This is joint work with Boris Vertman.

Bandara, Lashi: Boundary value problems for general first-order elliptic operators (SR1 c)
The Bär-Ballmann framework is a comprehensive framework to consider elliptic boundary value problems (and also their index theory) for first-order elliptic operators on manifolds with compact and smooth boundary. A fundamental assumption in their work is that the induced operator on the boundary is symmetric. Many operators satisfy this requirement including the Hodge-Dirac operator as well as the Atiyah-Singer Dirac operator. Recently, there has been a desire to study more general operators with the quintessential example being the Rarita-Schwinger Dirac operator, which is an operator that fails to satisfy this hypothesis.

Brück, Benjamin: Topology of free factor complexes
In joint work with Radhika Gupta, we study the topology of the free factor complex FC_n, a simplicial complex associated to Out(F_n), the outer automorphism group of the free group. This is done by interpreting FC_n as a structure at infinity of Culler-Vogtmann's Outer space.
Outer Space is often seen as an Out(F_n)-analogue of symmetric spaces. Following this analogy, the free factor complex can be thought of as an analogue to spherical

buildings, which by results of Borel-Serre describe the topology at infinity of symmetric spaces. In our work, we first show that the free factor complex is homotopy equivalent to a certain subcomplex of the simplicial boundary of Outer space. We then use this to obtain connectivity results by exploiting the geometry of projection maps from the boundary of Outer space to its interior. As a consequence of that, we are able to show that FC_n is homotopy equivalent to a wedge of (n-2)-spheres

14:50 – 15:30

Hambleton, Ian: Co-compact discrete group actions and the assembly map (203)
A discrete group Γ can act freely and properly on $S^n \times R^k$, for some K, n > 0 if and only if Γ is a countable group with periodic Farrell cohomology: Connolly-Prassidis (1989),assuming vcd(Γ) finite, and Adem-Smith (2001). For free *co-compact* actions there are additional restrictions „at infinity", but no general sufficient conditions are known. The talk will survey this problem and its connection to the Farrell-Jones assembly maps in K-theory and L-theory.
Schmidt, Marcel: On the uniqueness class, stochastic completeness and volume growth for graphs (204)
A graph is called stochastically complete if the associated (minimal) continuous time random walk has infinite lifetime. This stochastic property is equivalent to the uniqueness of bounded solutions to the heat equation. In this talk we present new results on the optimal uniqueness for the heat equation on graphs. More precisely, we show that the uniqueness class on globally local graphs (graphs where the jump size of the process decays fast enough) is the same as on Riemannian manifolds. This is surprising as the result does not hold on the simplest non-globally graph, the line $\Z$. As a consequence to the uniqueness class we discuss optimal volume growth criteria for stochastic completeness for all graphs. This is joint work with X. Huang and M. Keller.
Heller, Lynn: Rectangular constrained Willmore minimizers and the Willmore conjecture (205)
We show that the well-known family of 2-lobed Delaunay tori $\;f^b\;$ in $\;S^3,\;$ parametrized by $\;b \in\R_{\geq1},\;$ uniquely minimizes the Willmore energy among all immersions from tori into 3-space of conformal class $\;(a,b)$. As a corollary we obtain an alternate proof of the Willmore conjecture in 3-space. This new strategy can be generalized to arbitrary codimensions provided a classification of isothermic constrained Willmore tori is possible and all f^b remain stable in all codimensions.
Ludewig, Matthias: Atomic Limit and Hilbert Modules (SR1 c)
A recent breakthrough in condensed matter physics was the discovery of so-called topological insulators. These are materials for which a topological non-triviality in their mathematical description forces them to behave „non-local“ in a certain sense. We model this by a Riemannian manifold carrying a cocompact action of a discrete symmetry group G, together with a G-invariant Hamiltonian operator. The question is then whether a certain spectral subspace of $L^2(X)$ has a G-basis of rapidly decaying functions, called „Wannier functions“. We show that this is equivalent to the (non-)triviality of the spectral subspace, when considered as a Hilbert module over the group C*-algebra $C^*_r(G)$. This is joint work with Guo Chuan Thiang.
Beyrer, Jonas: Cross ratios and marked length spectrum rigidity for cube complexes (SR 4)
In recent years, CAT(0) cube complexes have become an important tool to address problems in group theory, low dimensional topology and related areas; e.g. in Agol and Wises proof of the virtual Haken conjecture. Often it is the combinatorial structure of those complexes that allows for better „accessibility“ of many problems. In this talk we want to show that marked length spectrum rigidity holds for many group actions on CAT(0) cube complexes - while in the case of universal covers of negatively curved manifolds this is a long standing problem. More precisely, we want to show that if a

group G acts properly discontinuously and cocompactly on two CAT(0) cube complexes X,Y without free faces, then X and Y are equivariantly isomorphic if and only if the translation lengths in X and Y (w.r.t. the l^1 metric) coincide for all g in G. Note that the assumptions on the spaces or the group actions can even be weakened.
For the proof we develop a cross ratio on a boundary of the cube complex and work out some of its properties. Such a cross ratio is a standard tool in negative curvature and should be of independent interest.

17:00 – 17:40

Meneses, Claudio: Geometric models and wall-crossing for moduli of parabolic Higgs bundles in genus 0 (203)
In this talk I will describe recent work on the geometry of moduli spaces of parabolic Higgs bundles over the Riemann sphere. Such case is exceptional in that a construction of explicit geometric models is possible, whose nature elucidates the wall-crossing behavior of the moduli spaces in question under variations of parabolic weights. I will also explain some motivating results related to the cohomology of natural Kähler forms on the moduli spaces and their relation to the computation of certain symplectic volumes.

Saratchandran, Hemanth: Complements of 2-tori in closed smooth simply connected 4-manifolds that admit a complete finite volume hyperbolic structure (204)
The study of hyperbolic knot complements has a long history
leading to many exciting results in the field of 3-manifold topology.
In this talk, I will present a 4-dimensional analogue of this study.
Namely, I will consider when a closed smooth simply connected 4-manifold can contain a collection of 2-tori, whose complement can admit a complete finite volume hyperbolic structure. I will start by presenting some necessary conditions, based on a classification theorem of S. Donaldson and M. Freedman, and then move on to outline how one can try to build such complements.

Bielawski, Roger: Differential geometry of Hilbert schemes of curves (205)
We describe the natural differential geometry of Hilbert schemes of curves in the projective 3-space and, in some cases, in P^n, n > 3.

Roos, Saskia: The Dirac operator on collapsing sequences of manifolds (SR1 c)
We will talk about the behavior of the Dirac spectrum on collapsing sequences of manifolds with bounded curvature and diameter in the case of a smooth manifold. We show that in the limit we obtain the spectrum of a twisted Dirac operator with an explicit potential. Moreover we characterize the case where we converge to the spectrum of the Dirac operator on the limit space.

Hensel, Sebastian: Geometry of handlebody groups (SR 4)
Mapping class groups of surfaces have been studied intensively by geometric group theorists over the last years, and their large-scale geometry is by now fairly well understood. Mapping class groups of 3-dimensional handlebodies are much less understood, and show behavior more akin to that of outer automorphism groups of free groups. In this talk, we present some recent results (partly joint with Ursula Hamenstädt) that begin to shed some light on geometric properties of these groups.

17:50 – 18:30

Upmeier, Markus: Orientation problems in gauge theory (203)
Besides compactness, orientations are an essential ingredient for the construction of enumerative invariants from moduli spaces. After discussing the general elliptic theory of orientations and a powerful excision technique in this context, I shall focus on a case of current interest, the Donaldson-Segal program in special holonomy. It proposes to extend familiar techniques for
anti-self-dual connections on 4-manifolds to higher-dimensional special geometries. This includes Calabi-Yau 3-folds, G2-manifolds, and Spin(7)-holonomy manifolds. Finally, I will outline a recent result (joint with D. Joyce) that solves the orientation problem for G2-instantons in 7-dimensions.

Weich, Tobias: Dynamical resonances and topology (204)
Dynamical Resonances have been introduced by Ruelle and Pollicott in order to study mixing properties of chaotic dynamical systems. In the past years they have additionally evolved to an interesting spectral invariant for geometric and topological questions. For example, Dyatolv and Zworski (Inventiones 210 -- 2017) have shown that on compact surfaces with strict negative curvature the multiplicity of a certain dynamical resonance equals the first Betti number. In this talk I will explain a generalization of this result to higher dimensions. A crucial passage in our proof is a reduction to the boundary at infity of the universal covering space which allows to apply vector valued Poisson transformations. This is joint work with Benjamin Küster (Paris Orsay)

Behr, Malte: Generalized Blow-up of p-Submanifolds (205)
In a recent paper, Chris Kottke and Richard B. Melrose introduced the notion of generalized blow-up of boundary faces of a manifold with corners. However, there are various situations where one is interested in performing blow-ups of more general p-submanifolds than boundary faces. As work in progress, we examine the possibilities of developing the theory of generalized blow-up in this setting. In this talk, we will give an introduction to the paper by Kottke and Melrose and then present our ongoing work, which is joint with Dennis Sobotta and Daniel Grieser.

Seyedhosseini, Mehran: Around the Relative Index (SR1 c)
I will first recall the construction of the relative index map of Chang, Weinberger and Yu and the definition of the relative index of Dirac operators on manifolds with boundary.
This will be followed by a discussion of the relationship between the relative index and absolute indices defined in the presence of positive scalar curvature (psc) at the boundary. This relationship can be used to give a conceptual proof of the fact that the relative index is an obstruction to the existence of a psc metric.
Finally, I will sketch how one can define secondary invariants associated to psc metrics on manifolds with boundary.

Stadler, Stephan: Minimal planes vs. circles at infinity (SR 4)
We show that for rank two Hadamard spaces there is a one to one correspondence between minimal planes of quadratic area growth and closed geodesics in the Tits boundary. To pass from a geodesic at infinity to a minimal plane, we solve an asymptotic Plateau problem. In the other direction, we show that a minimal plane of quadratic area growth has a unique tangent cone at infinity.

Thursday, April 4

14:00 – 14:40

Hannes, Sebastian: Boundary value problems for the Lorentzian Dirac operator (203)

The Dirac operator of a globally hyperbolic spin manifold with compact, spacelike Cauchy hypersurface is known to be Fredholm under APS boundary conditions. In this talk I want to discuss a more general class of boundary conditions for the Dirac operator and explain how to reproduce results on regularity and Fredholm property in certain cases.

Wiemeler, Michael: Positively curved manifolds with isometric torus actions (204)

The classification of positively (sectional) curved manifolds is a long standing open problem in Riemannian geometry. So far it was a successful approach to consider the problem under the extra assumption of an isometric group action. In this talk I will report on recent joint work with Lee Kennard and Burkhard Wilking in this direction.

Johne, Florian: Surgery for List flow on three-manifolds (205)

List flow is an extended Ricci flow system. The motivation to study this system on three-manifolds is two-fold: There is a connection to static vacuum solutions in General Relativity and a connection to Ricci flow on four-manifolds with circle symmetry. We describe new a-priori estimates, which allow us to perform surgery in the spirit of Hamilton-Perelman. Moreover, we prove a finite time extinction result.

Azzali,Sara: A Baum--Connes conjecture localised at the unit element of a discrete group (SR1 c)

Let Γ be a discrete group. In this talk, we study a variant of the Baum--Connes isomorphism conjecture which can be called ‘localised at the unit element of Γ.

The localised assembly map is constructed in KK-theory with coefficients in $\mathbb{R}$. These KK-groups are natural receptacles of elements coming from traces on C^*-algebras.

We show that the localised Baum--Connes conjecture is weaker than the classical Baum--Connes conjecture but still implies the strong Novikov conjecture. Moreover, it does not see the difference between the reduced and maximal group C^*-algebras.

We explain these constructions and show the relation with the Novikov conjecture by explicitly comparing the classifying space for free and proper actions $E\Gamma$ with the classifying space for proper actions $\underline E\Gamma$ at the level of K-homology with real coefficients.

This is joint work with Paolo Antonini and Georges Skandalis.

Kielak, Dawid: Property (T) for $\mathrm{Aut}(F_n)$ (SR 4)

I will present a very recent proof of Kazhdan's property (T) for the group of automorphisms of a free group F_n (with $n \geqslant 5$) (obtained jointly with Marek Kaluba and Piotr Nowak).

Property (T) is a very strong rigidity property restricting possible affine actions of a group on Hilbert spaces. It has many important applications in group theory and geometry. Property (T) was classically established by Kazhdan for $\mathrm{SL}_n(\mathbb Z)$ and other lattices in semi-simple Lie groups of higher rank. The proof I will present gives also an alternative proof of Kazhdan's result for $\mathrm{SL}_n(\mathbb Z)$, and strengthens the analogy between automorphism groups of free and free-abelian groups.

14:50 – 15:30

Lewandowski, Max: Physical states for quantum field theory on globally hyperbolic spacetimes (203)
A major issue when doing quantum field theory on curved spacetimes is the lack of a distinguished vacuum. To any triple, consisting on a globally hyperbolic spacetime M, a Riemannian vector bundle E and a Green-hyperbolic operator P acting on smooth sections in E, the algebraic approach assigns an abstract C^*-algebra A. States are then defined as positive linear functionals on A and allow for the construction of familar setting, i.e. a Hilbert space with distinguished vacuum vector and the elements of A acting on it as observables. The task therefore is to find admissible states on A and it turns out that the elements of a certain subclass, the quasifree states, are entirely determined by a certain bidistribution on M called two-point-function of the state. In fact this bidistribution is a bisolution of $Pu=0$ and has certain symmetry- and positivity-properties. Moreover for physical reasons one demands that its wave front set satisfies the so-called Hadamard condition. In my talk I will present the construction of bidistributions complying with those requirements in the case of a formally self-adjoint wave operator.
Kordaß, Jan-Bernhard: Spaces of riemannian metrics satisfying surgery stable curvature conditions (204)
We will introduce spaces of Riemannian metrics on a smooth manifold satisfying a curvature condition given by a subset in the space of algebraic curvature operators. Provided this condition is surgery stable, which is a notion based on the work of S. Hoelzel guaranteeing the condition can be preserved under surgeries of a certain codimension, we can generalize several theorems from positive scalar curvature geometry to this setting. Notably, we will comment on a generalization of a theorem of V. Chernysh on the homotopy type of the space of psc metrics and point to cases where we can distinguish connected components using invariants from spin geometry.
Mäder-Baumdicker, Elena: The free boundary setting of the area preserving curve shortening flow (205)
Under the area preserving curve shortening flow (APCSF), a convex simple closed plane curve converges smoothly to a circle with the same enclosed area as the initial curve. Note that an embedded circle is the solution of the isoperimetric problem in the plane. Corresponding to the outer isoperimetric problem for a convex domain we present results about the APCSF with Neumann free boundary conditions outside of a convex domain. Under certain conditions on the initial curve the flow does not develop any singularity, and it subconverges smoothly to an arc of a circle sitting outside of the given convex domain and enclosing the same area as the initial curve. On the other hand, there are many examples of convex initial curves developing a singularity in finite time. In all these cases, the curvature blows up with a certain rate. In contrast to the behavior in the closed setting, we suspect that some curves developing a singularity stay embedded under the flow.
Engel, Alexander: Duality and the coarse assembly map (SR1 c)
We investigate injectivity of exterior products on the Higson-Roe sequence. To this end we construct suitable slant products and use results of Emerson and Meyer about the co-assembly map.
Kionke, Steffen: Profinite properties of arithmetic groups (SR 4)
An arithmetic group is, roughly speaking, a group of matrices
with integer entries; e.g. the special linear group SL(n, Z). In this talk we discuss properties of arithmetic groups that can be read off from the finite quotient groups - such properties are called ”profinite”. In particular, we discuss the profiniteness of homological invariants of arithmetic groups and their locally symmetric spaces such as the L2-Betti numbers and the Euler characteristic.
(This is based on joint work with H. Kammeyer, J. Raimbault and R. Sauer.)

17:00 – 17:40

Lindblad Petersen, Oliver: Wave equations with initial data on compact Cauchy horizons (203)
I will present a new existence and uniqueness result for wave equations with initial data on compact Cauchy horizons in Lorentzian manifolds. As an application, we prove that any vacuum spacetime containing a compact Cauchy horizon with constant non-zero surface gravity admits a Killing vector field. This result is closely related to Penrose's strong cosmic censorship conjecture in general relativity.

Corro, Diego: Manifolds with singular Riemannian foliations by aspherical leafs (204)
Singular Riemannian foliations are generalizations of smooth group actions acting by isometries.
In particular, torus actions by isometries on a given Riemannian manifold have been studied to understand the topology of the manifold or properties the Riemannian metric might have.
We extend this study to the setting of singular Riemannian foliatons by tori. We show that some techniques developed for comparing two torus actions can be carried to the foliated setting. For the case when the foliation has codimenision 2 we obtain the following result:
If (M,F) is an singular Riemannian foliation of codimension 2 by tori, on a compact, simply-connected Riemannian manifold, then the foliation is induced by a smooth torus action.

Simon, Miles: Some local results for the Ricci flow (205)
We prove certain local regularity results for the Ricci flow, under the assumption that certain geometric conditions hold at the initial time and for the solution.

Wulff, Christopher: Coronas for properly combable spaces (SR1 c)
The construction of coronas (i.e. boundaries at infinity) of combable spaces has been an open problem for quite a while. In this talk, I will present a very conceptual construction of such coronas under a convincing new additional assumption on the combing, called properness. Under two further additional conditions, coherence and expandingness, the compactification of a Rips complex construction by this corona can be shown to be contractible. This yields applications to isomorphism conjectures and dimension estimates for groups.

Avramidi, Grigori: On groups of isometries preserving multiple horospheres (SR 4)
Suppose that a group G acts on a Hadamard manifold X by covering space transformations. Let Fix^0(Γ) be the set of points at infinity whose horospheres are preserved by Γ. I will discuss the topology of Fix^0 and the relation between the dimension of Γ and the dimension of Fix^0(Γ). Joint work with Tam Nguyen Phan.

17:50 – 18:30

Rothe, Viktoria: Semilinear wave equations and the Yamabe problem on Lorentzian manifolds (203)
In this talk we will discuss some local and almost global existence theorems for semilinear wave equations on globally hyperbolic Lorentzian manifolds. In particular, we will consider the Yamabe problem on 3+1-dimensional Lorentzian manifolds: Given a metric g on a Lorentzian manifold, find a metric which is conformal to g with constant scalar curvature. This problem is equivalent to finding a positive smooth solution to the Yamabe equation. We will examine under which conditions we can find such a solution for all times in a given compact interval.

Amann, Manuel: On the topology of transitive and cohomogeneity one actions (204)
Homogeneous spaces and manifolds of cohomogeneity one, i.e. manifolds admitting isometric actions with a one-dimensional orbit space, form rather important classes and, most importantly, rich sources of examples in Riemannian geometry. They are particularly of interest in the field of non-negative curvature metrics. Despite their significance, they still leave a lot of room for open questions. In this talk I shall illustrate how on the one hand side we can answer classical questions from equivariant cohomology (such as “equivariant formality”) for new manifold subclasses. On the other hand—motivated by the manifold counterpart and by the point of view of non-negative sectional curvature— we shall discuss questions related to the topology and equivariant cohomology in the singular framework of cohomogeneity one Alexandrov spaces. This talk reports on several joint projects in progress.

Vertman, Boris: Ricci flow on singular spaces (205)
We will report on the recent advances in the study of Ricci flow on manifolds cone edge singularities, including existence, stability and preservation of positive scalar curvature along the flow. This is joint work with Klaus Kröncke and Tobias Marxen.

Zenobi, Vito: Lie groupoids, Coarse C*-algebras and long exact sequences (SR1 c)
Let $\widetilde{X}$ be a smooth manifold with a cocompact action of a discrete group Γ. Let G be the Lie groupoid $\widetilde{X}\times_\Gamma\widetilde{X}$. I’ll prove that the Higson-Roe long exact sequences is isomorphic to the long exact sequence in K-theory associated to the adiabati deformation of G
are isomorphic.

Nguyen-Phan, Tam: A geometric analogue of the rational Tits building in nonpositive curvature (SR 4)
Locally symmetric manifolds of noncompact type form an interesting class of nonpositively curved manifolds. The topology of the end of an arithmetic locally symmetric space is controlled by an arithmetically-constructed object called the "rational Tits building". The rational Tits building can be thought of abstractly or as a subset of the visual boundary of the universal cover of M and is homotopically a wedge of spheres of dimension q-1, where q is the "Q-rank" of the locally symmetric space. In general, q is less or equal than half the dimension of the locally symmetric space. We show that this is not an arithmetic phenomenon but a consequence of nonpositive curvature alone. We build a geometric analog of the rational Tits building for general noncompact, finite volume, complete, n-manifolds of bounded nonpositive curvature. We use this to show that any polyhedron, in the thin part (i.e. the end) of M that lifts to the universal cover can be homotoped within the thin part of M to one with dimension less or equal than (n/2 - 1). Loosely speaking, this says that any topological feature that survives from being pushed to infinity must be in dimension less than n/2. I will describe how this is done. This is joint work with Grigori Avramidi. This talk is about nonpositively curved geometry. No knowledge of Tits buildings is required (or will be given).