TALK SCHEDULE

Monday June 4

Venue: Rm 7.15, Ingkarni Wardli Building

Time: 10:15 - 11:05
Speaker: Jonathan Rosenberg
Title: Positive Scalar Curvature on Manifolds with Fibered Singularities
Abstract: A (compact) manifold with fibered P-singularities is a (possibly) singular pseudomanifold M_Σ with two strata: an open nonsingular stratum $\mathring{M}$ (a smooth open manifold) and a closed stratum βM (a closed manifold of positive codimension), such that a tubular neighborhood of βM is a fiber bundle with fibers each looking like the cone on a fixed closed manifold P. We discuss what it means for such an M_Σ with fibered P-singularities to admit an appropriate Riemannian metric of positive scalar curvature, and we give necessary and sufficient conditions (based on suitable versions of index theory) for this to happen when the singularity type P is either $\mathbb{Z}/k$ or S^1, and M and the boundary components of the tubular neighborhood of the singular stratum are simply connected and carry spin structures. This is joint work with Boris Botvinnik.

Time: 11:15 - 12:05
Speaker: Weiping Zhang
Title: Enlargeability and Positive Scalar Curvature on Foliations
Abstract: It is a classical result of Gromov-Lawson that an enlargeable closed spin manifold does not carry a metric of positive scalar curvature. We present an extension of this result to the case of foliations. This gives in particular a new proof of an earlier result that there is no foliation of positive leafwise scalar curvature on any torus.

Time: 13:45 - 14:35
Speaker: Nikolai Saveliev
Title: On Gauge Theoretic Invariants of Homology $S^1 \times S^3$
Abstract: I will survey some recent joint work on invariants of smooth 4-manifolds with homology of $S^1 \times S^3$. In our older work with Tom Mrowka and Daniel Ruberman, we used end-periodic index theory to define a Seiberg-Witten invariant of such manifolds. I will present a new formula (from our recent work with Jianfeng Lin and Daniel Ruberman) which expresses this invariant in terms of the monopole Floer homology. This formula has some interesting applications, including a new obstruction to the existence of metrics of positive scalar curvature.

Time: 15:00 - 15:50
Speaker: David Baraglia
Title: Obstructions to Smooth Group Actions on 4-Manifolds from Families Seiberg-Witten Theory
Abstract: Let X be a smooth, compact, oriented 4-manifold and consider the following problem. Let G be a group which acts on the second cohomology of X preserving the intersection form. Can this action of G on $H^2(X)$ be lifted to an action of G on X by diffeomorphisms? We study a parametrised version of Seiberg-Witten theory for smooth families of 4-manifolds and obtain obstructions to the existence of such lifts. For example, we construct compact simply-connected 4-manifolds X and involutions on $H^2(X)$ that can be realised by a continuous involution on X, or by a diffeomorphism, but not by an involutive diffeomorphism for any smooth structure on X.

Time: 16:00 - 16:50
Speaker: Guanheng Chen
Title: Cobordism Maps on PFH Induced by Lefschetz Fibration over Higher Genus Base
Abstract: In this talk, we will discuss the cobordism maps on periodic Floer homology (PFH) induced by Lefschetz fibration. Periodic Floer homology is a Gromov types invariant for three dimensional mapping torus and it is isomorphic to a version of Seiberg Witten Floer cohomology (SWF). Our result is to define the cobordism maps on PFH induced by certain types of Lefschetz fibration via using holomorphic curves method. Also, we show that the cobordism maps is equivalent to the cobordism maps on Seiberg Witten cohomology under the isomorphism PFH=SWF.

Tuesday June 5

Venue: Rm 7.15, Ingkarni Wardli Building

Time: 9:00 - 9:50
Speaker: Nigel Higson
Title: Discrete Series Representations and the Dirac Operator
Abstract: There are long-established links between Harish-Chandras parametrization of the discrete series representations, the Dirac operator and index theory that were pioneered by Atiyah and Schmid, Connes and Kasparov, and Lafforgue. In this talk I will try to examine discrete series and the Dirac operator from a different point of view, which is closer to Harish-Chandras original work using orbital integrals, but which is nonetheless grounded in C^*-algebras and noncommutative geometry. This is joint work with Tsuyoshi Kato.

Time: 10:15 - 11:05
Speaker: Peter Hochs
Title: Orbital Integrals in Index Theory and K-Theory
Abstract: An orbital integral of a function on a group is its integral over a conjugacy class in the group. Convergence of such integrals is a nontrivial matter, but when an orbital integral converges on a certain convolution algebra of functions, then it defines a trace on that algebra. If such a convolution algebra is dense in the reduced group C^*-algebra and closed under holomorphic functional calculus, this gives us a map from the K-theory of the reduced C^*-algebra of the group into the complex numbers. Applying this to the K-theoretic equivariant index of an elliptic operator gives a numerical invariant, which can be computed via index theorems by Lott, Wang-Wang and Xie-Yu for discrete groups, and in joint work with Wang for semisimple Lie groups. In the case of discrete groups, this has implications to geometry and topology, and can be used for example to study metrics of positive scalar curvature. For Lie groups, this leads to character formulas for representations. For both kinds of groups, orbital integrals help us understand the K-theory of their C^*-algebras.

Time: 11:15 - 12:05
Speaker: Hang Wang
Title: Higher Nahm Transform in Noncommutative Geometry
Abstract: Abstract: Anti-self-dual (ASD) connections for a compact smooth four manifold arise as critical values for the Yang-Mills action functional. Nahm transform is a nice correspondence between a vector bundle with ASD connections and vector bundle with ASD connections over Picard torus associated to X. In this talk we propose a noncommutative geometric version of the Nahm transform that generalises the Connes-Yang-Mills action functional formulated using Dixmier trace. This is joint work with Tsuyoshi Kato and Hirofumi Sasahira.

Time: 13:45 - 14:35
Speaker: Galina Levitina
Title: Fredholm Module for Electromagnetic Massive Dirac Operator
Abstract: We provide an algorithm to compute the sign of the massive Dirac operator $D_m, m > 0$, on $\mathbb{R}^d, d \geq 2$, perturbed by an electromagnetic potential V, modulo arbitrarily small weak Schatten ideals. As a corollary, we prove a necessary and sufficient conditions for the quantised derivative $i[\mathrm{sgn}(D_m + V), 1 \otimes M_f]$ of a bounded function f on $\mathbb{R}^d$ to belong to the weak Schatten ideal $\mathcal{L}_{d,\infty}$.

Time: 15:00 - 15:50
Speaker: Bryan Wang
Title: Geometric Baum-Connes Assembly Map for Twisted Lie Groupoids
Abstract: Given a Lie groupoid with a twisting given by a principal $PU(H)$-bundle, I will discuss its geometric twisted K-homology groups and construct the Baum-Connes assembly map taking values in the twisted K-theory of the Lie groupoid. The construction is based on the use of geometric deformation groupoids, these objects allow in particular to give a geometric construction of the associated pushforward maps and to establish the functoriality. This is joint work with Paulo Carrillo Rouse.

Time: 16:00 - 16:50
Speaker: Diarmuid Crowley
Title: Disconnecting the G_2-Moduli Space
Abstract: G_2-manifolds (M, g) are 7-dimensional Riemannian manifolds with special holonomy in the exceptional Lie group G_2. They have moduli spaces which are orbifolds of dimension equal to the third Betti number of M. In general, little is known about the topology of the the G_2-moduli space. In this talk I will report on joint work with Johannes Nordstrm and Sebastian Goette, where we define an analytic invariant of a G_2-manifold which is sufficient to show that the G_2-moduli space is disconnected in some cases.

Wednesday June 6

Venue: Santos Lecture Theatre, Marjoribanks Building

Time: 9:00 - 9:50
Speaker: Jozef Dodziuk
Title: Gromov-Lawson Tunnels with Estimates
Abstract: Gromov and Lawson and independently Schoen and Yau proved that connected sums of manifolds of positive scalar curvature carry Riemannian metrics with the same property. These constructions did not give estimates on the size of the tube aka tunnel connecting the two disks in the original manifolds. We prove that the tunnels can be made metrically small (length, girth, volume) if the disks themselves have small radii.

Time: 10:00 - 10:50
Speaker: Xianzhe Dai
Title: Conical Singularity and Conical Degeneration
Abstract: Conical singularity is the simplest type of singularity that occur quite often and naturally. Conical degeneration refers to a family of smooth metrics limiting to a singular metric of conical type. Under rather general conditions, the basic analytic quantities such as the eigenvalues and eigenfunctions will converge. So will the heat kernels and Green's functions. It is rather different story for global geometric invariants defined in terms of the eigenvalues. We will discuss some recent work in this direction.

Time: 11:00 - 11:50
Speaker: Stanley Chang
Title: The Parallels Between Positive Scalar Curvature and the Rigidity of Manifolds
Abstract: In this talk I will discuss the theory that runs alongside the story of positive scalar curvature metrics. Surgery theory is used to determine the structure sets of manifolds in different categories. In certain classes of aspherical manifolds, results in curvature theory can predict adjacent results in surgery theory. This talk will introduce the surgery exact sequence and offer examples of computations.

Time: 13:45 - 14:35
Speaker: Pedram Hekmati
Title: Hermitian-Einstein Metrics on Foliated Manifolds
Abstract: It is well-known that the existence of canonical metrics in complex geometry is related to a stability condition in algebraic geometry. In this talk we will present an extension of the Hitchin-Kobayashi correspondence for Hermitian-Einstein metrics to compact foliated manifolds with a transverse Hermitian structure. As we will see, the natural notion of stability for transverse holomorphic bundles will require that the foliation is taut. We will elucidate the relation to higher dimensional instantons on Sasakian manifolds and discuss other applications. This is joint work with David Baraglia.

Student Talks

Time: 14:45 - 15:10
Speaker: Simon Kitson
Title: Spin^c-Structures for Orientifolds
Abstract: Orientifolds generalize both orbifolds and Real spaces (as defined by Atiyah in K-theory and Reality, 1966). Complex vector bundles over orientifolds carry group actions which are implemented by a combination of linear and anti-linear maps. The resulting K-theory captures various other K-theories including KR, KO and equivariant K-theory. I will discuss the definition and classification of Spin^c structures over global quotient orientifolds using a modification of equivariant Čech cohomology.

Time: 15:15 - 15:40
Speaker: Shuaige Qiao
Title: G-Equivariant Anti-Self-Dual (ASD) Moduli Spaces
Abstract: The introduction of gauge theory to low-dimensional manifolds during 1980s has revolutionised our understanding of 3- and 4-manifolds. In this short presentation, I will briefly review the history of Yang-Mills gauge theory and the applications of ASD moduli spaces to 4-manifolds; discuss some of the earlier applications of G-invariant ASD moduli space in investigating 4-manifolds with finite group action, then report my PhD project on G-equivariant Donaldson invariants.

Time: 15:45 - 16:10
Speaker: Michael Hallam
Title: End-Periodic K-Homology and Spin Bordism
Abstract: This talk introduces a new 'end-periodic' variant of geometric K-homology that is tailored to a recent index theorem for even-dimensional manifolds with periodic ends. This index theorem, due to Mrowka, Ruberman and Saveliev, is a generalisation of the Atiyah-Patodi-Singer index theorem for manifolds with odd-dimensional boundary. As in the APS index theorem, there is an (end-periodic) eta invariant that appears as a correction term for the periodic end. Invariance properties of the standard relative eta invariants are elegantly expressed using K-homology and spin bordism, and this continues to hold in the end-periodic case. In fact, there are natural isomorphisms between the standard K-homology/bordism theories and their end-periodic versions, and moreover these isomorphisms preserve relative eta invariants. The study is motivated by results on positive scalar curvature, namely obstructions and distinct path components of the moduli space of PSC metrics. Our isomorphisms provide a systematic method for transferring certain results on PSC from the odd-dimensional case to the even-dimensional case. This work is joint with Mathai Varghese.

Time: 16:15 - 16:40
Speaker: Hao Guo
Title: Index of Equivariant Callias-Type Operators
A**bstract**: Suppose M is a smooth Riemannian manifold on which a Lie group G acts properly and isometrically. In this talk I will explore properties of a particular class of G-invariant operators on M, called G-Callias-type operators. These are Dirac operators that have been given an additional $\mathbb{Z}_2$-grading and a perturbation so as to be "invertible outside of a cocompact set on M". It turns out that G-Callias-type operators are equivariantly Fredholm and so have an index in the K-theory of the maximal group C^*-algebra of G. This index can be expressed as a KK-product of a class in K-homology and a class in the K-theory of the Higson G-corona. In fact, one can show that the K-theory of the Higson G-corona is highly non-trivial, and thus the index theory of G-Callias-type operators is not obviously trivial. As an application of the index theory of G-Callias-type operators, I will mention an obstruction to the existence of G-invariant metrics of positive scalar curvature on M.

Time: 16:45 - 17:10
Speaker: John McCarthy
Title: Hitchin's Projectively Flat Connection for the Moduli Space of Higgs Bundles
Abstract: In this talk I will introduce the moduli space of Higgs bundles over a compact Riemann surface, and discuss its geometric quantization via Kähler polarisations in comparison with the case of stable bundles covered by Hitchin and Axelrod, Pietra and Witten. The moduli space of stable bundles is compact, so the quantum Hilbert spaces of holomorphic sections are finite-dimensional, and Hitchin constructed a projectively flat connection on the bundle of these vector spaces over Teichmüller space. Such a connection gives a canonical identification of the (projectivizations of the) Hilbert spaces for various choices of Kähler polarisations. In the case of Higgs bundles, the moduli space is non-compact, but comes with a natural $\mathbb{C}^*$-action. This action lifts to the spaces of polarised sections, which therefore split into a sum of finite-dimensional weight spaces. At least in the case of rank-1 Higgs bundles where the moduli space is the cotangent bundle of the Jacobian, one can write down a projectively flat Hitchin connection for these weight spaces of polarised sections, and show that these connections combine to identify the infinite-dimensional quantum Hilbert spaces. I will describe this connection, and comment on the difficulties for higher rank.

Thursday June 7

Venue: Rm 7.15, Ingkarni Wardli Building

Time: 9:00 - 9:50
Speaker: Melissa Tacy
Title: Equidistribution of Random Waves on Small Balls
Abstract: In the 1970s Berry conjectured that the behaviour of high energy, quantum-chaotic billiard systems could be well modelled by random waves. That is random combinations of the plane waves $e^{ik\cdot x}$. On manifolds it is more natural to randomise over the eigenfunctions of the Laplace-Beltrami operator. In this talk I will present results showing that such random waves equidistribute on fixed balls with radius larger than the wavelength scale. For collections of balls with radii above the square root of the wavelength we additionally see a uniformity of equidistribution.

Time: 10:15 - 11:05
Speaker: Mathai Varghese
Title: Index Theory of Pseudodifferential Algebra Bundles
Abstract: We formulate and prove the Index Theorem for algebra bundles over a smooth base manifold, with typical fibre the algebra of classical pseudodifferential operators acting on smooth sections of a vector bundle over a compact manifold and of integral order, using the setting and results of our earlier paper, which studied the geometry and topology of such algebra bundles. This is joint work with Richard Melrose.

Time: 11:15 - 12:05
Speaker: Jesse Gell-Redman
Title: Index of Dirac-Type Operators on Iterated Wedge Spaces
Abstract: We study Dirac-type operators on stratified spaces endowed with incomplete Riemannian metrics which undergo iterated conic-type degeneration at the singular strata. Examples of such spaces include orbifolds and also the crossing incomplete cone-edge spaces studied in recent work on Kaehler-Einstein manifolds in dimension four. We construct a Fredholm problem for such operators and prove an index formula generalizing the Bismut-Cheeger index formulas on spaces with conical singularities. Along the way we develop the theory of elliptic operators on such spaces, in particular constructing Green's functions of some elliptic differential operators and their heat kernels. In the end we manage to generalize the Getzler rescaling of the heat kernel to this setting, which allows us to evaluate the supertrace of the heat kernel in the short time limit. This is joint work with Pierre Albin at UIUC.

Friday June 8

Venue: Rm 7.15, Ingkarni Wardli Building

Time: 9:00 - 9:50
Speaker: Heather Macbeth
Title: A Gluing Construction for Kähler-Ricci Solitons
Abstract: I will explain the construction of a large new family of steady Ricci solitons. The solitons are Kähler, and the underlying Calabi-Yau manifolds are equivariant crepant resolutions of $\mathbb{C}^n/G$, where G is a finite subgroup of $SU(n)$. This is joint work with Olivier Biquard.

Time: 10:15 - 11:05
Speaker: Matthias Ludewig
Title: Supersymmetric Path Integrals: Integrating Differential Forms on the Loop Space
Abstract: We construct an integral map for differential forms on the loop space of Riemannian spin manifolds. For example, Bismut-Chern character forms are integrable with respect to this map, with their integrals given by indices of Dirac operators. Moreover, the map satisfies a localization principle, which provides a rigorous background for path integral proofs of the Atiyah-Singer Index theorem by Atiyah, Witten, Bismut and others.

Time: 11:15 - 12:05
Speaker: Huijun Yang
Title: Contact Structures on 9-Manifolds.
Abstract: In this talk, I will provide necessary and sufficient conditions for a 9-manifold to admit a contact structure. I will also compare index theoretic obstructions to the existence of almost contact structures with index theoretic obstructions to positive scalar curvature metrics on the other. This is joint work with Diarmuid Crowley.

Time: 13:45 - 14:35
Speaker: Fei Han
Title: T-Duality in an H-Flux and Exotic Twisted Equivariant Cohomology Theories
Abstract: T-duality is an equivalence of two physical theories (quantum field theories or string theories) with different spacetime geometries. It originates from string theories, finds applications in condensed matter physics and has profound connections with topology/geometry. In this talk, I will first briefly review the elegant mathematical formulation of T-duality in an H-flux by Bouwknegt-Evslin-Mathai. Then I will describe our joint work with Mathai about developing exotic twisted $\mathbb{T}$-equivariant cohomology theories in order to enhance the T-duality by capturing the exchange of winding and momentum, a fundamental feature of T-duality.

Time: 15:00 - 15:50
Speaker: Guochuan Thiang
Title: Twisted Indices and T-Dualities from Bulk-Boundary Correspondence Principle
Abstract: The index theory of Toeplitz operators expresses a bulk-boundary correspondence BBC for supersymmetric Hamiltonians on a half-infinite $1D$ lattice. I will explain how new index theorems, involving torsion twisted K-theory indices, may be derived by extending this physical BBC heuristic to the crystallographic setting. A whole zoo of "crystallographic T-dualities" will also be given, based on "super-Baum-Connes" isomorphisms.