ABSTRACTS

MIKIO FURUTA

Title. 10/8-type inequalities and TQFT

Abstract. C. Manolescu and J. Lin gave 10/8-type inequalities for spin 4-manifolds with boundary. In this talk I formulate the inequalities in terms of 3+1 TQFT. Basically we have an inequality for each generalized cohomology theory under a mild condition. Joint work with T.J. Li.

PETER BOUWKNEGT

Title. Spherical T-duality

Abstract. T-duality is an equivalence of String Theories on manifolds which are circle (or more generally, torus) bundles equipped with a background flux. Mathematically it provides an isomorphism for twisted cohomology and K-theory for these manifolds. In this talk I will briefly review T-duality for circle bundles, and then discuss a recent generalisation to 3-sphere bundles, as well as the associated (generalised) geometry. This talk is based on joint work with Jarah Evslin and Mathai Varghese [arXiv:1405.5844/ 1409.1296/ 1502.04444], and work in progress with Brano Jurco and Jan Vysoky.

MARTIN GUEST

Title. Solutions of the tt*-Toda equations: a complete picture

Abstract. As an example of the topological-antitopological fusion equations in quantum field theory, Cecotti and Vafa made a number of conjectures regarding a special case of the 2-dimensional Toda equations (cyclic harmonic bundle or harmonic map equations), in a series of papers in the 1990's. By combining several techniques (p.d.e., isomonodromy theory, loop groups) in joint work with Alexander Its and Chang-Shou Lin, we have been able to confirm the truth of these conjectures and build up a complete picture of the solutions of the tt* equations in this case.

ZHOU ZHANG

Title. General Weak Limit for Kahler-Ricci Flow over Closed Manifolds

Abstract. We discuss the general existence problem for weak limit of Kahler-Ricci flow over closed manifolds. For the finite time case, we confirm a conjecture by Tian on the uniqueness of limit. Demaillys smooth approximation for positive current and the notion of minimal singularity come up naturally. The infinite time case is significantly different. The discussion is related to the general expectation on the behavior of Kahler-Ricci flow and can be applied to other flows of Kahler-Ricci type with great algebraic geometry interest.

LEO TZOU

Title. Riemann-Roch and Inverse Scattering on Surfaces With Euclidean Ends

Abstract. On a surface with Euclidean ends we recover the connection Laplacian, up to isomorphism, from wave scattering at a fixed frequency. This problem turns out to be intimately related to the topology of the surface and we see how classical index theorems such Riemann-Roch can play a significant role in understanding this relationship.

TSUYOSHI KATO

Title. K-theoretic degree of the covering monopole map

Abstract. I will present a construction of K-theoretic degree of the covering monopole map as a homomorphism between full group $C^\star$ algebras.

KIYONORI GOMI

Title. K-theory of the torus equivariant under the 2-dimensional crystallographic point groups

Abstract. It is well-known that the 2-dimensional space groups (or the crystallographic groups) are classified into 17 classes, and their points groups realize the possible 13 finite subgroups in the mapping class group $GL(2,\mathbb{Z})$ of the torus. Motivated by the classification of topological crystalline insulators, Ken Shiozaki, Masatoshi Sato and I recently computed the equivariant (twisted) K-theories of the torus acted by the point groups of the 2-dimensional space groups. The computations cover all the twists generated by group cocycles, and the module structure with respect to the representation ring is determined in each case. This result and the Borel equivariant cohomology up to degree 3 will be presented.

STEVE ROSENBERG

Title. Chern-Simons theory on loop spaces and diffeomorphism groups

Abstract. There are Chern-Weil-type characteristic classes on the tangent bundle to the loop space of a Riemannian manifold, defined using the Wodzicki residue in place of the ordinary matrix trace. The Chern-Simons classes in this theory detect elements of infinite order in the fundamental group of the diffeomorphism group of some special odd dimensional manifolds.

ADAM SIKORA

Title. Gaussian heat kernel estimates: from functions to forms

Abstract. On a complete non-compact Riemannian manifold satisfying the volume doubling property, we give conditions on the negative part of the Ricci curvature that ensure that, unless there are harmonic one-forms, the Gaussian heat kernel upper estimate on functions transfers to one-forms. These conditions do no entail any constraint on the size of the Ricci curvature, only on its decay at infinity. This is a joint work with Thierry Coulhon and Baptiste Devyver.

YOSUKE KUBOTA

Title. Controlled topological phases and bulk-edge correspondence

Abstract. In condensed matter physics, it is known that some physical quantities are related to the topology of the Hamiltonian as a self-adjoint operator with a spectral gap. A classification of topological phases in 10 types is given by Kitaev in relation to the Bott periodicity, which is formulated by Freed-Moore in terms of twisted equivariant K-theory. In this talk, we introduce a variant of the notion of topological phases reflecting metric structure of the real space. In this framework we can deal with quantum systems which are not periodic (such as materials with disorders or quasi-crystals) with all symmetry types in Kitaev's periodic table. Here the twisted equivariant K-groups of Roe algebras give generalizations of existing invariants such as the Hall conductance for the integer quantum Hall effect or the Kane-Mele $\mathbb{Z}_2$-invariant for AII topological insulators. As a consequence, we obtain a mathematical proof of bulk-edge correspondence for possibly non-periodic quantum systems with arbitrary symmetry types by using the coarse Mayer-Vietoris exact sequence.

YOSHIKATA KIDA

Title. Mostow-type rigidity of the mapping class group and its generalization

Abstract. The mapping class group of a surface is the group of isotopy classes of homeomorphisms from the surface onto itself. This group has many aspects in common with simple Lie groups and their lattices. Among other things, Ivanov showed Mostow-type rigidity of the mapping class group: Any isomorphism between finite index subgroups of the mapping class group is inner conjugation. This rigidity can be generalized to the setting for measured groupoids associated with probability-measure-preserving actions of the mapping class group. As its application, we describe locally compact second countable groups containing a lattice isomorphic to the mapping class group. I will explain these results and some ideas to prove them.

JOSEPH A. WOLF

Title. Geometry and Analysis on Nilpotent Lie Groups

Abstract. There are some new developments on Plancherel formula and growth of matrix coefficients for unitary representations of nilpotent Lie groups. These have some consequences for the geometry of weakly symmetric spaces and analysis on parabolic subgroups of real semisimple Lie groups, and they have some extensions to (infinite dimensional) locally nilpotent Lie groups.

ALAN CAREY

Title. Invariants from KK theory

Abstract. I will discuss how unbounded KK bimodules lead to explicit index pairings with application to topological phases of matter.

ADAM RENNIE

Title. Factorisation of equivariant spectral triples

Abstract. We provide sufficient conditions to factorise an equivariant spectral triple as a Kasparov product of unbounded classes constructed from the group action on the algebra and from the fixed point spectral triple. Our results are for the action of compact abelian Lie groups, and we demonstrate them with examples from manifolds and θ-deformations. In particular we show that equivariant Dirac-type spectral triples on the total space of a torus principal bundle always factorise.

Joint work with Iain Forsyth.

FLORICA CÎRSTEA

Title. Recent results on classification of isolated singularities for nonlinear elliptic equations

Abstract. In this talk, we will review recent developments on the classification of isolated singularities for several classes of nonlinear elliptic equations, which may include Hardy–Sobolev type potentials. In particular, we shall reveal the critical role played by the fundamental solution(s) of the elliptic operator in the interaction with the nonlinear part of the equation. We also provide sharp results on the existence of solutions with singularities, besides optimal conditions for the removability of all singularities. I will discuss several results obtained with various collaborators including T.-Y. Chang, J. Ching, M. Mihăilescu and F. Robert.

KEITH HANNABUSS

Title. B-C-T, bulk-boundary and all that

Abstract. New light can be shed on recent work in condensed matter theory by applying techniques such as T-duality developed for use in String Theory.

ANDREW HASSELL

Title. Asymptotic distribution of the spectrum of unitary operators arising in geometric analysis

Abstract. Unitary operators arise in many places in geometric analysis. I will consider two cases: the scattering matrix for a perturbation of the Laplacian in Euclidean space, and the Cayley transform of the semiclassical Dirichlet-to-Neumann operator on a compact Riemannian with boundary. (It might be thought that the second example is artificial, but I will explain that this is not so.) In these examples, one has a family of unitary operators $U(h)$, depending on a Planck constant $h \to 0$. As unitaries, these operators have spectrum on the unit circle. Under suitable conditions, the spectrum is discrete away from the point 1 on the unit circle, and one can count the number of eigenvalues in any interval of the unit circle away from 1. I will discuss various settings in which we have been able to obtain such asymptotics.

ANNE THOMAS (DIFFERENTIAL GEOMETRY SEMINAR)

Title. Quasi-isometry classification of certain hyperbolic Coxeter groups

Abstract. Let Γ be a finite simple graph with vertex set S. The associated right-angled Coxeter group W is the group with generating set S, so that $s^2 = 1$ for all $s \in S$ and $st = ts$ if and only if s and t are adjacent vertices in Γ. Moussong proved that the group W is hyperbolic in the sense of Gromov if and only if Γ has no "empty squares". We consider the quasi-isometry classification of such Coxeter groups using the local cut point structure of their visual boundaries. In particular, we find an algorithm for computing Bowditch's JSJ tree for a class of these groups, and prove that two such groups are quasi-isometric if and only if their JSJ trees are the same. This is joint work with Pallavi Dani (Louisiana State University).