



IGA/AMSI Australia-China Conference in Noncommutative Geometry and Related Areas

Conference Manual

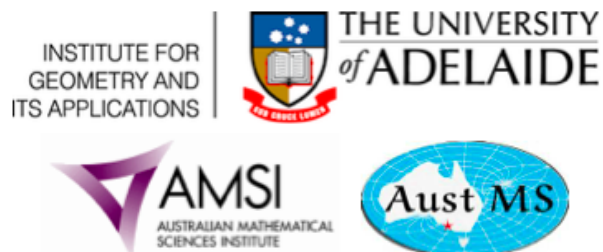
18-22 December 2017
Inkarni Wardli 7.15
University of Adelaide



Organisers:

Elder Professor Mathai Varghese
Professor Guoliang Yu
Professor Alan Carey
Dr Hang Wang
Dr Guo Chuan Thiang

Sponsors:



Aim of the conference

Noncommutative geometry (NCG) is a theory using algebra of operators to study a class of nonstandard spaces, initially arising from quantum mechanics. Over the past few decades, it developed into an active research area with connections to many branches of mathematics and physics. This conference will bring together leading experts and early career researchers working in several streams of NCG, namely, C*-algebra, dynamics, K-theory, representation theory and mathematical physics, to promote the dissemination of novel research findings. This conference is a great opportunity for research communications and collaborations between Australian and Chinese mathematicians, and between students and experts in this field.

Conference website

iga.adelaide.edu.au/workshops/December2017/

Speakers

(1 hour keynote lecture)

Peter Bouwknegt (Australian National University)
Varghese Mathai (University of Adelaide)
Fedor Sukochev (University of New South Wales)
Guihua Gong (University of Puerto Rico)
Hanfeng Li (State University of New York, Buffalo)
Guoliang Yu (Texas A&M University)
Weiping Zhang (Chern Institute, Nankai University)

(50-minute research talk)

Chris Bourne (Tohoku University)
Yoshiyasu Fukumoto (East China Normal University)
Sherry Gong (Massachusetts Institute of Technology)
Roozbeh Hazrat (Western Sydney University)
Galina Levitina (University of New South Wales)
Benben Liao (Texas A&M University)
Fei Han (National University of Singapore)
Peter Hochs (University of Adelaide)
Yanli Song (Washington University of St. Louis)
Kun Wang (Texas A&M University)
Qin Wang (East China Normal University)
Shilin Yu (Texas A&M University)
Jiawen Zhang (University of Southampton)

(30-minute talk)

Hao Guo (University of Adelaide)
Michael Hallam (University of Adelaide)
Zhenxi Huang (University of Adelaide)

Conference Program

Monday

- 10:00-11:20 registration + refreshment
- 11:20-11:30 Opening speech by Elder Professor Mathai Varghese
- 11:30-12:30 Hanfeng Li (State University of New York, Buffalo)
 - Title: L2-invariants and Dynamical Systems
 - Abstract: In the last decade there has emerged connections between the theory of L2-invariants and dynamical systems, through the study of algebraic actions. I will survey the progress.
- 12:30-14:00 Welcome Lunch (Lounge outside the conference venue)
- 14:00-14:50 Shilin Yu (Texas A&M University)
 - Title: A new perspective on orbit method
 - Abstract: Kirillov's coadjoint orbit method claims that irreducible unitary representations of a Lie group G should arise as quantization of coadjoint orbits of G , which are naturally symplectic manifolds. The case of noncompact semisimple groups is beyond the reach of the usual geometric quantization procedure, which challenges our understanding of "quantization". On the other hand, Kronheimer discovered that coadjoint orbits of a complex semisimple group G admit hyperkahler metrics, whose role in orbit method has not been fully exploited yet. In this talk, I will combine this fact with deformation quantization to suggest a new approach to orbit method. This is joint work in progress with Conan Leung.
- 14:50-15:00 conference photo
- 15:00-15:30 Tea break
- 15:30-16.20 Yoshiyasu Fukumoto (East China Normal University)
 - Title: G -homotopy Invariance of Higher Signature of Proper G -manifolds for Low Degree Cohomology
 - Abstract: The signature is a homotopy invariant for closed manifolds. Novikov conjecture asks whether the higher signature is homotopy invariant for closed manifolds as well as the ordinary signature. In this talk, we will discuss on an extension of the higher signature to proper G -manifolds and its G -equivariant homotopy invariance for low degree cohomology classes. Here the acting group G may not be discrete, and we do not need any geometric assumption on G .
- 16:30-17:00 Zhenxi Huang (University of Adelaide)
 - Title: Special Kähler geometry of the Hitchin system
 - Abstract: Hitchin system is a complex integrable system that ties together many different branches of geometry and physics. There is a naturally defined metric on the base of the Hitchin system known as special Kähler metric. This metric depends on the periods of the fibers, and the Donagi-Markman cubic computes the variation of the periods. In this talk, I will introduce a new formula of the Donagi-Markman cubic obtained recently with David Baraglia by looking at the spectral curves of the fibers of the Hitchin system. It turns out that the special Kähler metric on the regular part of the Hitchin system can be derived from one generic fiber.

Tuesday

- 9:00-10:10 Weiping Zhang (Chern Institute, Nankai University)
 - Title: Positive scalar curvature and the Euler class
 - Abstract: We describe a joint work with Jianqing Yu which extend the classical Lichnerowicz vanishing theorem to a twisted case involving the Euler class of a flat vector bundle.
- 10-10:30 tea break
- 10:30-11:20 Yanli Song (Washington University of St. Louis)
 - Title: K-type multiplicities of tempered representations via coadjoint orbits
 - Abstract: The ‘quantization commutes with reduction’ principle of Guillemin and Sternberg is a way to compute multiplicities of irreducible representations in representations obtained by quantizing symplectic manifolds in an appropriate sense. This principle was proved for compact Lie groups acting on compact symplectic manifolds by Meinrenken and others in the 1990s, after a version for compact Kähler manifolds by Guillemin and Sternberg themselves in 1982. It has since been generalised to noncompact groups and manifolds, and from symplectic manifolds to the more general Spin-c manifolds. The most important motivation for these generalisations is their potential for applications to representation theory. In joint work with Peter Hochs and Shilin Yu, we use a version for noncompact Spin-c manifolds to express multiplicities of K-types of tempered representations as indices of Dirac operators on certain compact manifolds. These manifolds are constructed from coadjoint orbits via a Spin-c version of the symplectic reduction construction of Marsden and Weinstein. This extends work by Paradan, who did this for discrete series representations.
- 11:30-12:20 Galina Levitina (University of New South Wales)
 - Title: Noncommutative plane and Cwikel estimates
 - Abstract: We present a new approach to the definition of the noncommutative plane and calculus there. Using this approach we establish a general version of Cwikel estimates in weak Schatten ideals.
- 12:20-14:00 Lunch break
- 14:00-15:00 Fedor Sukochev (University of New South Wales)
 - Title: Connes integration formula for the noncommutative plane (joint with D. Zanin)
 - Abstract: Our aim is to prove the integration formula on the noncommutative (Moyal) plane in terms of singular traces a la Connes.
- 15:00-15:30 Tea break
(program continues on the next page)

- 15:30-16:20 Roozbeh Hazrat (Western Sydney University)
 - Title: Classification of path algebras via graded/equivariant K -theory
 - Abstract: We give a survey of how the graded/equivariant K -theory can be a suitable candidate for the classification of graph C^* -Leavitt algebras.

- 16:30-17:20 Chris Bourne (Tohoku University)
 - Title: Index theory and topological phases of aperiodic lattices
 - Abstract: Given a quite general discrete subset of \mathbb{R}^d , Kellendonk showed how we can construct an étale groupoid. In this talk, we consider C^* -algebraic and K -theoretic properties of this groupoid. Our motivation comes from topological insulators, where our lattice models atomic configurations at low temperatures and our index pairings have physical meaning.

Wednesday

- 8:30-9:30 Varghese Mathai (University of Adelaide)
 - Title: Spectral gap-labelling conjectures for magnetic Schrodinger operators
 - Abstract: We formulate the spectral gap-labelling conjecture for magnetic Schrodinger operators using the MQ-formalism, and prove it in the physically interesting low dimensional cases. More precisely, given a constant magnetic field on Euclidean space determined by a skew-symmetric matrix Θ , and a lattice-invariant probability measure on the disorder set, we conjecture that the corresponding Integrated Density of States of any self-adjoint operator affiliated to the twisted crossed product algebra in this context takes on values on spectral gaps in an explicit countable subgroup of the real numbers involving Pfaffians of Θ and its sub-matrices that we describe, with multiplier associated to Θ . This is joint work with Moulay Tahar Benameur.
- 9:30-10:20 Fei Han (National University of Singapore)
 - Title: Loop Spaces and equivariant cohomology theories
- 10:30-11:10 Michael Hallam (University of Adelaide)
 - Title: End-periodic K -homology and positive scalar curvature
 - Abstract: In this talk I will introduce a new variant of K -homology, called ‘end-periodic K -homology’, that is tailored to a recent index theorem for end-periodic manifolds by Mrowka, Ruberman and Saveliev. The new K -homology groups elegantly encapsulate invariance properties of end-periodic rho invariants, and in fact are naturally isomorphic to the standard K -homology groups. The isomorphism preserves rho invariants, and so can be used to transfer results on positive scalar curvature for odd-dimensional manifolds to even-dimensional manifolds. This is joint work with Mathai Varghese.
- 11:10-12:00 Sherry Gong (Massachusetts Institute of Technology)
 - Title: Marked link invariants: Khovanov, instanton, and binary dihedral invariants for marked links.
 - Abstract: We introduce a version of Khovanov homology for alternating links with marking data, ω , inspired by instanton theory. We show that the analogue of the spectral sequence from Khovanov homology to singular instanton homology (Kronheimer and Mrowka, *Khovanov homology is an unknot-detector*) collapses on the E_2 page for alternating links. We moreover show that the Khovanov homology we introduce for alternating links does not depend on ω ; thus, the instanton homology also does not depend on ω for alternating links. Finally, we study a version of binary dihedral representations for links with markings, and show that for links of non-zero determinant, this also does not depend on ω .
- 12:00-18:30 Free afternoon
- 18:30-22:00 Conference Dinner at Parlamento-Italian Cuisine Adelaide

www.parlamento.com.au

140 North Terrace, Adelaide South Australia 5000

Thursday

- 9:00-10:00 Peter Bouwknegt (Australian National University)
 - Title: Lie algebroid gauge theories and applications
 - Abstract: In this talk I will discuss the gauging of a quantum field theory with respect to a Lie algebroid symmetry. In particular, I will discuss the gauging of 2D sigma models with respect to a (possibly non-isometric) Lie algebroid symmetry and the application to T-duality.
- 10:00-10:30 Tea break
- 10:30-11:20 Jiawen Zhang (University of Southampton)
 - Title: Introduction to Coarse Median Spaces (Groups)
 - Abstract: Coarse median spaces were introduced by Bowditch recently as a unified way to study Gromov's hyperbolic spaces, mapping class groups and CAT(0) groups. They have several nice properties, including Property RD and Property A. In my talk, I will introduce the basic conceptions and our recent work on this class of spaces. If time permits, I will also discuss the asymptotic dimension growth of coarse median spaces with finite rank. This is a joint work with G. Arzhantseva, G. Niblo and N. Wright.
- 11:30-12:20 Benben Liao (Texas A&M University)
 - Title: Convolution algebras on L^p spaces and K-theory
 - Abstract: Let G be a discrete group. As generalizations of the reduced group C^* algebra $C_r^*(G)$ and the algebra of integrable functions $l^1(G)$, we define and study L^p analogues of $C_r^*(G)$ and $l^1(G)$. These are natural group Banach algebras parameterized by p . We show that their K theory groups are continuous in an inductive sense. Via an L^p version of the property of rapid decay, one is able to show for several important classes of groups, K theory groups do not depend on the parameter p . This is based on the joint work with Guoliang Yu.
- Lunch break 12:20-14:00
- 14:00-15:00 Guihua Gong (University of Puerto Rico and Hebei Normal University)
 - Title: Classification of non commutative spaces
 - Abstract: In this talk, I will present the complete classification of unital simple separable C^* algebras of finite nuclear dimensions with UCT property. The talk is based on joint work with Lin-Niu and with Elliott-Lin-Niu.
- 15:00-15:30 tea break
(program continues on the next page)

- 15:30-16:20 Kun Wang (Texas A&M University)
 - Title: Classification of C^* -algebras and the relation between different Invariants
 - Abstract: In this talk, I will show some classification results for non-simple C^* -algebras by using Stevens invariant. Then I will talk about the relations between Stevens invariant, Elliot invariant and the Cuntz semigroup.

- 16:30-17:00 Hao Guo (University of Adelaide)
 - Title: Positive Scalar Curvature for Proper Actions
 - Abstract: Let G be a Lie group acting properly on a G -Spin manifold M . In this talk I will explain recent work, joint with Mathai Varghese and Hang Wang, on certain obstructions to, and existence of, G -invariant metrics of positive scalar curvature on M . The principal obstruction we obtain comes by proving a vanishing theorem in equivariant index theory, giving as a corollary a recent result of Weiping Zhang. Existence of G -invariant metrics of positive scalar curvature is established under certain general hypotheses on the G -action on M , and makes use of a result of Vilms adapted to the equivariant setting, together with a theorem of Lawson and Yau.

Friday

- 9:00-10:00 Guoliang Yu (Fudan University and Texas A&M University)
 - Title: Higher invariants of elliptic operators and its applications
 - Abstract: I will introduce certain higher invariants of elliptic differential operators and discuss its applications to geometry and topology. This is joint work with Shmuel Weinberger and Zhizhang Xie.
- 10:00-10:30 Tea break
- 10:30-11:20 Qin Wang (East China Normal University)
 - Title: Coarse geometry and higher index problems on warped cones
 - Abstract: Warped cones are metric spaces introduced by John Roe from discrete group actions on compact metric spaces to produce interesting examples in coarse geometry. These spaces have lately become attracted a lot of interest. In this lecture, we will discuss the progress and its connection to expanders, coarse embeddability and higher index theory. In particular, we show that a certain class of warped cones $\mathcal{O}_\Gamma(M)$ admit a fibred coarse embedding into a L_p -space ($1 \leq p < \infty$) if and only if the discrete group Γ admits a proper affine isometric action on a L_p -space. This actually holds for any class of Banach spaces stable under taking Lebesgue-Bochner L_p -spaces and ultraproducts, e.g., uniformly convex Banach spaces or Banach spaces with nontrivial type. It follows that the maximal coarse Baum-Connes conjecture or the coarse Novikov conjecture hold for a certain class of warped cones or its level sets which do not coarsely embed into any L_p -space for any $1 \leq p < \infty$.
- 11:30-12:20 Peter Hochs (University of Adelaide)
 - Title: Blattner's formula as an index theorem
 - Abstract: Let G be a semisimple Lie group, K a maximal compact subgroup of G , and T a maximal torus in K . Suppose G has discrete series representations, i.e. representations whose matrix coefficients are square integrable. This is the case if and only if T is a Cartan subgroup of G . Blattner's formula is a combinatorial formula for the way in which discrete series representations decompose into irreducible representations of K after restriction to K . This was proved by Schmid and Hecht. Paradan proved that the right hand side of this formula is the K -equivariant index of a Dirac operator on the space G/T . With Higson and Song, we show that the left hand side of the formula is the K -equivariant index of another Dirac operator on G/T , and that the two indices are equal. This is a new proof of Blattner's formula. The arguments also give insight into the analytic properties of the Dolbeault operator on G/T , and show that Tian and Zhang's analytic proof that quantisation commutes with reduction simplifies considerably if the manifold in question is Kähler.
- 12:30 End of Conference

Timetable

	Monday	Tuesday	Wednesday	Thursday	Friday
9-10		W. Zhang	Mathai	Bouwknegt	G. Yu
10-10:30	refreshment	tea break	tea break	tea break	tea break
10:30-11:20	registration + opening	Song	Han	J. Zhang	Q. Wang
11:30-12:20	Li (1 hour)	Levitina	M. Hallam (30 min)	Liao	Hochs
12:30-14	Welcome Lunch	lunch break	S. Gong (12:10-1:00)	lunch break	
14-15	S. Yu (50 min)	Sukochev		G. Gong	
15-15:30	tea break	tea break		tea break	
15:30-16:20	Fukumoto	Hazrat		K. Wang	
16:30-17:00	Huang	Bourne (50 min)		Guo	
18:30			Conference Dinner		

Other Registered Participants

David Baraglia (University of Adelaide)
 David Brook (University of Adelaide)
 Alex Fok (University of Adelaide)
 Huitao Feng (Chern Institute, Nankai University)
 David Glynn (Flinders University)
 Daniel John (University of Adelaide)
 Simon Kitson (Australian National University)
 Johnny Lim (University of Adelaide)
 Lachlan Macdonald (University of Wollongong)
 Sam Mills (University of Adelaide)
 Alexander Munday (University of Wollongong)
 Konrad Pilch (California Institute of Technology)
 Justin Sawon (University of North Carolina at Chapel Hill)
 Guangxiang Su (Chern Institute, Nankai University)
 Ahnaf Tajwar Tahabub (University of Adelaide)
 Bai-Ling Wang (Australian National University)
 Dapeng Zhou (East China Normal University)