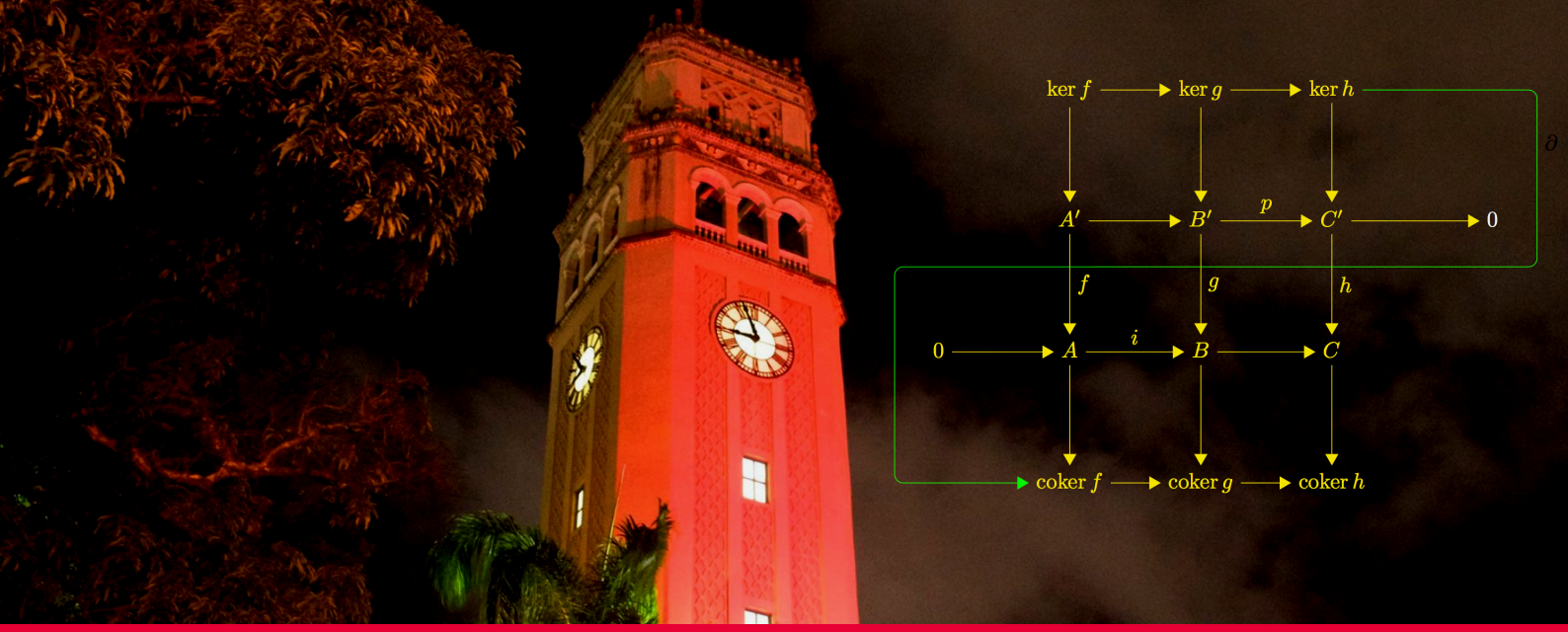

UNIVERSITY OF PUERTO RICO AT RIO PIEDRAS

SYMPOSIUM ON K-THEORY AND NON-COMMUTATIVE TOPOLOGY 2018

OCTOBER 21-26, 2018

Invited speakers

Michael Brannan, Nate Brown, Sarah Browne, José Carrión, Caleb Eckhardt, Eric Guentner, Chunlan Jiang, Marius Junge, Mehrdad Kalantar, Hanfeng Li, Huaxin Lin, Tao Mei, Zhuang Niu, Cornel Pasnicu, Chris Phillips, Lin Shan, Yanli Song, Xiang Tang, Iván Velázquez, Kun Wang, Rufus Willett, Zhizhang Xie, Guoliang Yu

SCHEDULE OF SYMPOSIUM ON K-THEORY AND NONCOMMUTATIVE TOPOLOGY				
	10/22/18	**10/23/18**	**10/24/18**	**10/25/18**
8:00-8:50	Speech of Dean/Chair (8:15-8:30 am)	Huaxin Lin	Chris Phillips	Nate Brown (8:30-9:20 am)
9:00-9:50 am	Guoliang Yu (8:30-9:20 am)	Zhuang Niu	Tao Mei	Marius Junge (9:30-10:20 am)
Tea Break 9:50-10:10 am	Rufus Willet (9:30-10:20 am)	Tea Break 9:50-10:10 am	Tea Break 9:50-10:10 am	Tea Break (10:20-10:50 am)
10:10-11:00	Tea Break (10:20-10:50 am)	Kun Wang	Zhizhang Xie	Michael Brannan (10:50--11:40 am)
11:10-12:00	Yanli Song (10:50-11:40 am)	Cornel Pasnicu	Mehrdad Kalantar	
Lunch Break	Lunch Break	Lunch Break	Lunch Break	Lunch Break
2:30-3:20	Hanfeng Li		Chunlan Jiang	Xiang Tang
3:30-4:20	Jose Carrion		Caleb Eckhardt	Eric Guentner
Tea Break 4:20-4:50	Tea Break 4:20-4:50		Tea Break 4:20-4:50	Tea Break 4:20-4:50
4:50-5:40	Lin Shan		Sarah Browne	Ivan Velazquez

Contents

Monday, October 22, 2018

K-theory of operator algebras associated to groups

Guoliang Yu
Texas A& M University
guoliangyu@math.tamu.edu

SYMPOSIUM ON K-THEORY AND
NON-COMMUTATIVE TOPOLOGY

October 12, 2018

Abstract

I will discuss K-theory of Banach and C^*-algebras associated to groups and applications to geometry, topology, and representation theory.

Monday
October 22
8:30am

TBA

Rufus Willett
University of Hawaii
rufus@math.hawaii.edu

October 12, 2018

SYMPOSIUM ON K-THEORY AND
NON-COMMUTATIVE TOPOLOGY

Abstract

TBA

Monday
October 22
9:30am

An equivariant index theorem on non-compact manifolds and Kasparov product

Yanli Song
Washington University in St. Louis
yanlisong@wustl.edu

SYMPOSIUM ON K-THEORY AND NON-COMMUTATIVE TOPOLOGY

October 12, 2018

Abstract

Braverman introduced an index theorem for a non-compact manifold using a Dirac operator and a vector field which has a compact vanishing set. In this talk, I will discuss a KK-theory approach to Braverman's index theory. In this framework, we can prove a generalized version of cobordism invariance of index on non-compact manifolds.

Monday
October 22
10:10am

Bivariant Sylvester rank functions

Hanfeng Li
SUNY at Buffalo
hfli@buffalo.edu

October 12, 2018

SYMPOSIUM ON K-THEORY AND
NON-COMMUTATIVE TOPOLOGY

Abstract

For a unital ring R, a Sylvester rank function assigns a nonnegative real number (the rank) to each rectangular matrix over R, or equivalently, to each finitely presented left R-module. The Sylvester rank functions play a vital role in the proof of Kaplansky's direct finiteness conjecture for sofic groups, L2-invariants theory, and classification program for C^*-algebras. I will discuss how to extend each Sylvester rank function to a bivariant one for pairs (A, B) with A being a submodule of any left R-module B, and give some applications of this extension.

Monday
October 22
2:30pm

A von Neumann-algebraic approach to the classification of C^*-algebras

José R. Carrión
Texas Christian University
j.carrion@tcu.edu

October 12, 2018

SYMPOSIUM ON K-THEORY AND NON-COMMUTATIVE TOPOLOGY

Abstract

Monday
October 22
3:30pm

We report on a joint project with James Gabe, Christopher Schafhauser, Aaron Tikuisis, and Stuart White that aims to provide a new abstract approach the classification of simple nuclear C^*-algebras.

The concentration property of expanders and group extension.

Lin Shan
University of Puerto Rico
lin.shan@upr.edu

SYMPOSIUM ON K-THEORY AND
NON-COMMUTATIVE TOPOLOGY

October 12, 2018

Abstract

In this talk, we will discuss the concentration property of expanders into Hadamard manifolds and its application to the coarse embedding into group extensions.

Monday
October 22
4:50pm

Tuesday, October 23, 2018

TBA

Huaxin Lin
University of Oregon
hlin@uoregon.edu

October 12, 2018

SYMPOSIUM ON K-THEORY AND
NON-COMMUTATIVE TOPOLOGY

Abstract

TBA

Tuesday
October 23
8:00am

TBA

Zhuang Niu
University of Wyoming Laramie
zniu@uwyo.edu

October 12, 2018

SYMPOSIUM ON K-THEORY AND
NON-COMMUTATIVE TOPOLOGY

Abstract

TBA

Tuesday
October 23
9:00am

Classification of C^*-algebras and its invariant

Kun Wang
University of Puerto Rico
kun.wang@upr.edu

SYMPOSIUM ON K-THEORY AND NON-COMMUTATIVE TOPOLOGY

October 12, 2018

Tuesday
October 23
10:10am

Abstract

In this talk, I will introduce different kinds of invariant for classification of C^*-algebras, such as the Elliott invariant, extended Elliott invariant, Stevens invariant, $\mathrm{inv}_0(\cdot)$ and $\mathrm{inv}(\cdot)$. I will show some classification results to let you know how powerful those invariants are. Furthermore, I will study the relation between those invariant.

The extended Elliott invariant contains the Elliott invariant and all extended valued traces. It characterizes the ideal structure of C^*-algebras. I will show that the extended Elliott invariant and Stevens invariant are equivalent when we consider stably finite C^*-algebras with the ideal property. For invariants $\mathrm{inv}_0(\cdot)$ and $\mathrm{inv}(\cdot)$, where the former is a subset of the latter, I will show that they are equivalent for AH-algebras with finitely many ideals.

Keywords: Classification, C^*-algebra, ideal property, Elliott invariant

References

[1] C. Jiang, K. Wang, A complete classification of limits of splitting interval algebras with the ideal property, *J. Ramanujan Math. Soc.* 27, No.3 (2012) 305-354.

[2] Q. Pan, K. Wang, About the bound of the C^* exponential length, *Canadian Mathematical Bulletin* 57(2014), no. 4, 853-869. http://dx.doi.org/10.4153/CMB-2014-044-8

[3] K. Wang, Equivalence of two Invariants of C^*-algebras with the ideal property, accepted by Journal of Noncommutative Geometry.

The weak ideal property and topological dimension zero

Cornel Pasnicu
University of Texas at San Antonio
cpasnicu@gmail.com

SYMPOSIUM ON K-THEORY AND NON-COMMUTATIVE TOPOLOGY

October 12, 2018

Abstract

Following up on previous work, we prove a number of results for C^*-algebras with the weak ideal property or topological dimension zero, and some results for C^*-algebras with related properties. Some of the more important results include:

- The weak ideal property implies topological dimension zero.
- For a separable C*-algebra A, topological dimension zero is equivalent to $\mathrm{RR}(\mathcal{O}_2 \otimes A) = 0$, to $D \otimes A$ having the ideal property for some (or any) Kirchberg algebra D, and to A being residually hereditarily in the class of all C*-algebras B such that $\mathcal{O}_\infty \otimes B$ contains a nonzero projection.
- Extending the known result for $\mathbb{Z}_2$, the classes of C*-algebras with residual (SP), which are residually hereditarily (properly) infinite, or which are purely infinite and have the ideal property, are closed under crossed products by arbitrary actions of abelian 2-groups.
- If A and B are separable, one of them is exact, A has the ideal property, and B has the weak ideal property, then $A \otimes_{\min} B$ has the weak ideal property.
- If X is a totally disconnected locally compact Hausdorff space and A is a $C_0(X)$-algebra all of whose fibers have one of the weak ideal property, topological dimension zero, residual (SP), or the combination of pure infiniteness and the ideal property, then A also has the corresponding property (for topological dimension zero, provided A is separable).
- Topological dimension zero, the weak ideal property, and the ideal property are all equivalent for a substantial class of separable C*-algebras including all separable locally AH algebras.
- The weak ideal property does not imply the ideal property for separable Z-stable C*-algebras.

We give other related results, as well as counterexamples to several other statements one might hope for.

This is joint work with N. Christopher Phillips and it appeared in the Canad. J. Math. 2017.

Tuesday
October 23
11:10am

Wednesday, October 24, 2018

Nonunital tracially Z-stable C^*-algebras

Chris Phillips
University of Oregon
ncp@uoregon.edu

SYMPOSIUM ON K-THEORY AND
NON-COMMUTATIVE TOPOLOGY

October 12, 2018

Abstract

We define tracial Z-stability for nonunital simple C^*-algebras, and prove some properties of nonunital tracially Z-stabie C^*-algebras. Some properties and results are new even in the unital case. For example, we give unital tracially Z-stabie C^*-algebras which are not Z-stabie, and we show that the action of the symmetric group on an n-fold minimal tensor product of tracially Z-stabie C^*-algebras has the appropriate (nonunital) version of the weak tracial Rokhlin property (using comparison, not traces) whenever the tensor product is finite.

This is joint work with Massoud Amini, Nasser Golestani, and Saeid Jamali.

Wednesday
October 24
8:00am

Hilbert Transforms on Free Groups

Tao Mei
Baylor University
tao_mei@baylor.edu

SYMPOSIUM ON K-THEORY AND NON-COMMUTATIVE TOPOLOGY

October 12, 2018

Abstract

Let $\mathbb{F}_\infty$ be the free group with free generators $g_1, g_2, \ldots$. Let $\mathscr{L}_{g_i^+}, \mathscr{L}_{g_i^-}$ be the subsets of $\mathbb{F}_\infty$ of reduced words starting respectively with g_i, g_i^{-1}. Let $L_{g_i^\pm}$ be the projection onto $\lambda(\mathscr{L}_{g_i^\pm})$ with λ the left regular representation of $\mathbb{F}_\infty$.

The following map is a free analogue of the classical Hilbert transform [1]

$$H_\varepsilon = \varepsilon_1 L_{g_1^+} + \varepsilon_{-1} L_{g_1^-} + \varepsilon_2 L_{g_2^+} + \varepsilon_{-2} L_{g_2^-} + \ldots$$

for $\varepsilon_i = \pm 1$. P. Biane and G. Pisier asked the question whether H_ε is bounded on the noncommutative L^p space $L^p(\hat{\mathbb{F}}_\infty)$ for all $1 < p < \infty$. Joint with E. Ricard, we answered this question positively in [1].

Very recently, in a joint work with Q. Xu, we further study the class of Fourier multipliers sending

$$\lambda_g \mapsto m(g)\lambda_g$$

with $m(g)$ a scalar depending merely on the first block in the reduced word, and give a characterization on the complete boundedness of these Fourier multipliers on $L^p(\hat{\mathbb{F}}_\infty)$. A Dirac operator on free groups plays an essential role in the proof.

Wednesday
October 24
9:00am

Keywords: Free Groups, Noncommutative L^p-spaces, Hilbert Transforms, Completely Bounded Map

References

[1] T. Mei, E. Ricard, Free Hilbert transforms, *Duke Mathematical Journal*, 166 (2017), no. 11, 2153-2182.

[2] T. Mei, Q. Xu, A Mikhlin Multiplier Theory for Free Groups, preprint.

[1] Hilbert transform had appeared in the work of Arverson and the work of Voiculescu with different point of views.

Higher rho invariants and pairings with higher dimensional cyclic cocycles

Zhizhang Xie
Texas A& M University
xie@math.tamu.edu

SYMPOSIUM ON K-THEORY AND NON-COMMUTATIVE TOPOLOGY

October 12, 2018

Abstract

Wednesday
October 24
10:10am

In this talk, I will discuss precise connections between the Higson-Roe's higher rho invariants and Lott's higher eta invariants. In my joint work with Guoliang Yu, we showed that the pairing of delocalized traces (i.e. traces determined conjugacy classes away from the identity element) and a higher rho invariant is equal to Lott's delocalized eta invariant, under the assumption that the corresponding conjugacy class has polynomial growth. In the language of cyclic cohomology, the above pairing is simply the pairing between higher rho invariants and 0-dimensional cyclic cocycles of the group algebra. My student Sheagon John extended the above pairing to higher dimensional cyclic cocycles for groups that have polynomial growth. In my recent joint work with Jinmin Wang and Guoliang Yu, we extend this pairing to higher dimensional cyclic cocycles for hyperbolic groups.

Stationary states and their applications to C^*-simplicity problems

Mehrdad Kalantar
University of Houston
kalantar@math.uh.edu

October 12, 2018

SYMPOSIUM ON K-THEORY AND NON-COMMUTATIVE TOPOLOGY

Abstract

We introduce the notion of stationary states on C^*-algebras, and give some applications in simplicity problems of crossed product C^*-algebras. This is based on joint works with Yair Hartman, and Tattwamasi Amrutam.

Wednesday
October 24
11:10am

Classfication for the AH algebras with ideal property

Chunlan Jiang
Hebei Normal University
cljiang@hebtu.edu.cn

October 12, 2018

SYMPOSIUM ON K-THEORY AND NON-COMMUTATIVE TOPOLOGY

Abstract

In this talk, we give a completely isomorphism invariants of AH algebras with ideal property by using K-theory; Huasdorffized K_1-group and trace space.

Wednesday
October 24
2:30pm

C^*-rigidity of two-step nilpotent groups

Caleb Eckhardt
Miami University
ceckhard@gmail.com

October 12, 2018

SYMPOSIUM ON K-THEORY AND NON-COMMUTATIVE TOPOLOGY

Abstract

(Joint work with Sven Raum) We examine the following classic question–Does a group ring remember its generating group?– from a C^*-algebraic perspective. A group G is called C^*-superrigid if $C_r^*(G) \cong C_r^*(H)$ implies $G \cong H$ for any other group H. It has long been known that torsion free abelian groups are C^*-superrigid because such a group G is recovered as the quotient of the unitary group of $C^*(G)$ by the connected component of the identity. Beyond abelian groups very little was known about C^*-superrigid groups. The "next" natural class of groups to consider are the nilpotent ones. In this talk I will discuss a recent result with S. Raum that shows finitely generated two-step nilpotent groups are C^*-superrigid.

Wednesday
October 24
3:30pm

Quantitative E-theory

Sarah L. Browne
Penn State University
slb570@psu.edu

October 12, 2018

SYMPOSIUM ON K-THEORY AND NON-COMMUTATIVE TOPOLOGY

Abstract

Quantitative E-theory is an ongoing project joint with Nate Brown which aims to create a new approach to tackling results like the Universal Coefficient Theorem(UCT) for new classes of C*-algebras. In recent years, many people have been working on classifying C*-algebras and these results assume the UCT, which requires further understanding. The inspiration is work by Oyono-Oyono-Yu, who used a quantitative approach of K-theory to prove the Kunneth Theorem for new classes of C*-algebras. An ongoing project of Willett-Yu extends the quantitative approach to the KK-context. Quantitative E-theory is a generalisation of E-theory and so I will begin my talk by defining the notion of E-theory and talk about how we get the definition of Quantitative E-theory. Then I will state results connecting this definition to E-theory and the UCT.

Wednesday
October 24
4:50pm

Thursday, October 25, 2018

C^*-structure and the UCT

Nate Brown
Penn State University
npb2@psu.edu

October 12, 2018

SYMPOSIUM ON K-THEORY AND NON-COMMUTATIVE TOPOLOGY

Abstract

In 2015 a monumental classification theorem was proved, following decades of work by dozens of researchers. The final ingredients, appearing in papers by Elliott/Gong/Lin/Niu and Tikuisis/White/Winter, bridged a gap between a broad classification theorem and a powerful reduction theorem. This bridge was built on a deep understanding of the structure of nuclear C^*-algebras. We believe a similar bridge is ready to be built in the context of the UCT. In this talk I'll discuss how recent advances in the theory of quantitative K-theory and K-homology, together with C^*-structure theorems inspired by topological and asymptotic dimension, suggest it's time to adapt the template used in Elliott's classification program for a full assault on the UCT.

Thursday
October 25
8:00am

Towards an index theorem for noncommutative, noncompact spaces

Marius Junge
University of Illinois at Urbana Champaign
mjunge@illinois.edu

SYMPOSIUM ON K-THEORY AND NON-COMMUTATIVE TOPOLOGY

October 12, 2018

Abstract

In a modest to attempt to understand some aspects of noncommutative geometry, my coauthor Li Gao and I tried to write down the content of the famous Connes-Skandils index theorem for noncommutative versions of $\mathbb{R}^n$, called Moyal Plane or Instanton Algebras. This are examples of noncommutative, noncompact manifolds. Despite the similarity with $\mathbb{R}^n$, reducing the index formulae to one remotely resembling the case of manifolds appears to be a non-trivial task which requires a fair amount of theory of pseudodifferential operators. I will explain how this connects to noncommutative harmonic analysis, and how a natural choice of noncommuting vector fields leads to expression resembling a B field. If time and the orgnizers permit, I will also share my experience on an IGL (Illinois Geometry Lab) Project for Undergraduates on Noncommutative Geometry.

This is joint work with Li Gao (Texas A& M) and Ed McDonald (UNSW).

Thursday
October 25
9:00am

Quantum permutations and their matrix models

Michael Brannan
Texas A& M University
michael.p.brannan@gmail.com

October 12, 2018

SYMPOSIUM ON K-THEORY AND NON-COMMUTATIVE TOPOLOGY

Thursday
October 25
10:10am

Abstract

A quantum permutation matrix is an $N \times N$ matrix P whose entries are orthogonal projections on a Hilbert space H with the property that the rows and columns of P sum to the identity operator on H. In the special case where H is the one dimensional Hilbert space, a quantum permutation matrix is simply an ordinary permutation matrix, and can be thought of as describing a symmetry of an N point set. In this talk I will explain how arbitrary quantum permutation matrices describe the "quantum symmetries'" of an N point set. Putting all of these quantum permutation matrices together in a cohesive way yields the structure of a quantum group, which is commonly called the Quantum Permutation Group on N letters. Unlike the classical permutation groups, quantum permutation groups turn out to highly infinite and noncommutative objects – in many ways they behave algebraically like the C^*- and von Neumann algebras associated to nonabelian free groups. Despite their inherent infiniteness, I will show how quantum permutation groups can still be well-approximated by finite-dimensional structures. In particular, these objects turn out to be residually finite as discrete quantum groups, and this residual finiteness can in fact be achieved using very simple finite-dimensional matrix models which I will describe. (Joint work with Alexandru Chirvasitu and Amaury Freslon.)

A longitudinal index theorem on an open foliation manifold

Xiang Tang
Washington University in St. Louis
xtang@wustl.edu

SYMPOSIUM ON K-THEORY AND
NON-COMMUTATIVE TOPOLOGY

October 12, 2018

Abstract

In this talk, we will introduce the concept of Roe C^*-algebra for a locally compact groupoid whose unit space is in general not compact, and that is equipped with an appropriate coarse structure and Haar system. Using Connes' tangent groupoid method, we will define an analytic index for an elliptic differential operator on a Lie groupoid equipped with additional metric structure, which takes values in the K-theory of the Roe C^*-algebra. And we will discuss applications of our developments to longitudinal elliptic operators on an open foliated manifold. This is joint work with Rufus Willett and Yi-Jun Yao.

Thursday
October 25
2:30pm

TBA

Eric Guentner
University of Hawaii
erik@math.hawaii.edu

SYMPOSIUM ON K-THEORY AND
NON-COMMUTATIVE TOPOLOGY

October 12, 2018

Abstract

TBA

Thursday
October 25
3:30pm

TBA

Iván Velázquez University of Puerto Rico, Río Piedras

October 12, 2018

SYMPOSIUM ON K-THEORY AND
NON-COMMUTATIVE TOPOLOGY

Abstract

TBA

Thursday
October 25
4:50pm

Author Index