Titles and Abstracts

Marat Aukhadiev: **On Semigroup C^*-algebras of Locally Compact Semigroups and Quantum Inverse Semigroups**.

Abstract. We start with the new C^*-algebra $C^*(\lambda(S))$ for a locally compact semigroup S, which embeds into a group $G = S^{-1}S$. This generalizes the group case $C^*(\lambda(G))$ defined by E. Bedos (*On the C^*-algebra generated by the left regular representation of a locally compact group*, Proc. AMS 120 (1994), 603–608), and the semigroup dicrete case $C_r^*(S)$ defined by X. Li (*Semigroup C^*-algebras and amenability of semigroups*, J. Funct. Anal. 262 (2012), 4302–4340). Several significant results on this algebra and the connection with other C^*-algebras associated with S are presented.

We consider the full semigroup C^*-algebra, as defined by X. Li. We observe that the generators satisfy relations which are suitable only for left cancellative semigroups. But for example an inverse semigroup is cancellative if and only if it is a group. So, we show that the full inverse semigroup C^*-algebra is a more general construction. For any inverse semigroup with a left Haar measure, we define $C^*(\lambda(S))$.

We show a way to obtain X. Li's $C^*(S)$ out of the inverse semigroup C^*-algebra $C^*(S^*)$, where S^* is a special inverse semigroup associated with S. In the case $G = S^{-1}S$, we get that S^* is precisely Exel's inverse semigroup $\mathcal{S}(G)$ associated with G (*Partial actions of groups and actions of inverse semigroups*, Proc. AMS 126 (1998), 3481–3494). This shows the connection of $C^*(S^*)$ and $C^*(S)$ with the partial crossed product through the result by D. Milan and B. Steinberg (*On inverse semigroup C^*-algebras and crossed products*, Groups Geom. Dyn. 8 (2014), 485–512).

Most of the mentioned C^*-algebras are shown to be '*algebras of functions on compact quantum inverse semigroups*'. We define this notion, based on the compact quantum group notion and the work of S. Duplij (*Weak Hopf Algebras and Singular Solutions of Quantum Yang-Baxter Equation*, Commun. Math. Phys. 225 (2002), 191–217). Given a locally compact semigroup S which generates a group $G = S^{-1}S$ we construct a compact quantum semigroup $\mathbb{QS}$ and we discuss the existence of a Haar state and co-unit in connection with amenability. We give a natural action of the quantum group $\hat{G}$ on these C^*-algebras, induced by the embedding into $\mathbb{QS}$. One more quantum group, which is abelian and lies inside $\hat{G}$ and $\mathbb{QS}$, acts on $\mathbb{QS}$. At the end we note that the quantum partial permutations semigroup $\tilde{S}_N^+$, defined by Banica and Skalski (*The quantum algebra of partial Hadamard matrices*, Linear Algebra Appl. 469 (2015), 364-380), also lies in the class of compact quantum inverse semigroups.

A part of this talk is based on the joint work with Yu. Kuznetsova, http://arxiv.org/abs/1504.00407. The research is supported by the Alexander von Humboldt Foundation.

Alcides Buss: **Symmetries of Noncommutative Spaces**.

Abstract. We explain how one can describe actions of certain non-Hausdorff spaces by viewing them as (étale) groupoid C^*-algebras. This gives rise to the notion of inverse semigroup actions by correspondences on groupoids and their C^*-algebras, which we interpret as Fell bundles over inverse semigroups.

This talk is based on recent joint work with Ralf Meyer.

Martijn Caspers: **Non-commutative commutator and Lipschitz estimates**.

Abstract. In 1964, Krein posed the following question. Let $f\colon \mathbb{R} \to \mathbb{C}$ be a Lipschitz function; then is it true that there is a constant C such that for every $A, B \in B(H)$ self-adjoint we have:

$$\|f(A) - f(B)\| \leq C\|A - B\|.$$

The question is studied widely in the literature and has a negative answer (Davies 1988) in the form it is stated here. However, if the uniform norm is replaced by the Schatten-Von Neumann L^p-norm then Krein's question has a positive answer: every Lipschitz function is also operator Lipschitz. In this talk we present a solution to this question that is moreover optimal: we give a sharp estimate for the non-commutative Lipschitz constant C.

This is joint work with Denis Potapov, Fedor Sukochev and Dima Zanin.

Nhan-Phu Chung: **Dynamical and algebraic properties of algebraic actions**.

Abstract. Algebraic actions are rich sources of examples in dynamics. They have been studied extensively when the acting groups are $\mathbb{Z}^d$ by the works of Doug Lind, Klaus Schmidt, Thomas Ward,... The fact that the integral group ring of $\mathbb{Z}^d$ is a commutative factorial Noetherian ring plays a vital role for such study, as it makes the machinery of commutative algebra available. In this talk we will present recent results joint with Hanfeng Li and Andreas Thom for algebraic actions of general countable groups. Operator algebras, especially group von Neumann algebras and ℓ^1-algebras play important roles in our work.

Marius Dadarlat: **Deformations of nilpotent groups and K-homology**.

Abstract. Let G be a discrete finitely generated torsion free nilpotent group and let $I(G)$ be the kernel of the trivial representation $\iota\colon C^*(G) \to \mathbb{C}$. We show that each class in the reduced K-homology group of $I(G)$ is realized by a completely positive and contractive asymptotic homomorphism $\{\varphi_t\colon I(G) \to \mathbb{K}\}_{t\in[1,\infty)}$.

This is joint work with Ulrich Pennig.

Robin Deeley: **Relative constructions in geometry K-homology: Mapping cones and surgery**.

Abstract. The Baum-Douglas model for K-homology provides a geometric counterpart to the analytic construction of Kasparov. In the framework of index theory, the former is more related to the topological index, while the latter is more related to the analytic index. I will discuss applying a relative construction in geometric (i.e., Baum-Douglas) K-homology to the Baum-Connes assembly map. Two examples will be discussed in detail. The first is the geometric version of the analytic surgery exact sequence of Higson and Roe; the second is the geometric version of a recent construction of Chang, Weinbeger, and Yu.

This is joint work with Magnus Goffeng.

Caleb Eckhardt: **Representations of discrete nilpotent groups**.

Abstract. Most discrete groups are not Type I which produces considerable difficulties for the study of their representation theory. We discuss how recent successes of the classification program for nuclear C^*-algebras show that we can characterize the C^*-algebras generated by irreducible representations of nilpotent groups by their ordered K-theory. We illustrate this idea with ordered K-theory calculations for the irreducible representations of the 3-step unitriangular group.

Some of this is joint work with Kleski and McKenney.

James Gabe: **A new K-theoretic invariant for graph C^*-algebras**.

Abstract. Graph C^*-algebras may, up to stable isomorphism, be written as the crossed product of an endomorphism on a direct sum of the compact operators. This structure induces a Pimsner-Voiculescu

type sequence which is often used to compute the K-theory of such C^*-algebras. This Pimsner-Voiculescu sequence, up to a suitable equivalence relation, is in fact a K-theoretic invariant which classifies all graph C^*-algebras of real rank zero up to ideal-related KK-equivalence. In particular, this invariant classifies all purely infinite graph C^*-algebras up to stable isomorphism.

Eusebio Gardella: **Rokhlin dimension: tracial properties and crossed products**.

Abstract. We study compact group actions with finite Rokhlin dimension, particularly in relation to duality and crossed products. For example, we show that ideals in the crossed products are induced by invariant ideals in the algebra. Under the additional assumption of so-called commuting towers, we show that taking crossed products by such actions preserves a number of relevant classes of C^*-algebras, including: D-absorbing C^*-algebras for strongly self-absorbing D, stable C^*-algebras, purely infinite C^*-algebras, C^*-algebras with finite nuclear dimension (or decomposition rank). Additionally, and under some technical assumptions, we show that finite Rokhlin dimension with commuting towers implies the weak tracial Rokhlin property, and hence crossed products of TAF algebras are again TAF (by a result of Phillips.)

This is based on joint work with Ilan Hirshberg and Luis Santiago.

Ilan Hirshberg: **Nuclear dimension of C^*-algebras of homeomorphisms**.

Abstract. Suppose X is a compact metrizable space with finite covering dimension, and h a homeomorphism of X. Let A be the crossed product of $C(X)$ by the induced automorphism. It was shown first by Toms and Winter, and in a different way by the speaker, Winter and Zacharias, that if h is a minimal homeomorphism then A has finite nuclear dimension. Szabo then showed that it suffices to assume that h is free. In this talk, I'll report on work in progress with Jianchao Wu which settles the issue for arbitrary homeomorphisms.

David Kerr: **Quasidiagonality and crossed products** .

Abstract. Recently Downarowicz, Huczek, and Zhang proved that every countable amenable group can be tiled by translates of finitely many Følner sets. I will explain how this result can be applied in conjunction with arguments of Ozawa, Rørdam, and Sato to show that every elementary amenable group admits many uniquely ergodic actions whose crossed product is quasidiagonal.

Søren Knudby: **A complete characterization of connected Lie groups with the Approximation Property**.

Abstract. The Approximation Property (AP) is the group analogue of the operator approximation property for C^*-algebras. In 2011, Lafforgue and de la Salle showed that $\mathrm{SL}(3,\mathbb{Z})$ and $\mathrm{SL}(3,\mathbb{R})$ do not have the AP. In 2013, Haagerup and de Laat extended the result to cover all simple Lie groups of real rank at least two. In this talk, based on joint work with Haagerup and de Laat, we further generalize the previous results to include non-simple Lie groups, thus obtaining a complete characterization of all connected Lie groups with the AP.

To this end, we introduce property (T*), a strengthening of property (T), which is a natural obstruction to the AP, and we exploit an important permanence result about property (T*).

Bartosz Kwasniewski: **Purely infinite C^*-algebras associated to Fell bundles**.

Abstract. In this talk we present conditions implying pure infiniteness of the reduced cross-sectional C^*-algebra $C_r^*(\mathcal{B})$ of a Fell bundle $\mathcal{B}$ over a discrete group G. We introduce notions of aperiodicity, $\mathcal{B}$-paradoxicality and residual $\mathcal{B}$-infiniteness. We discuss their relationship with similar conditions studied, in the context of crossed products, by the following duos: Laca, Spielberg; Jolissaint, Robertson; Sierakowski, Rørdam; Giordano, Sierakowski and Kirchberg, Sierakowski. The obtained results are shown to be optimal when applied to graph C^*-algebras. They are also applied to a class of Exel-Larsen crossed products.

Based on joint work with Wojciech Szymański.

Tim de Laat: **Fixed point properties of high rank groups**.

Abstract. It is well-known that for a locally compact group with property (T), every continuous affine isometric action of this group on a real Hilbert space has a fixed point. A Banach space analogue of this property was introduced by Bader, Furman, Gelander and Monod. Let X be a Banach space. A locally compact group G is said to have property (F_X) if every continuous action of G on X by affine isometries has a fixed point. Bader, Furman, Gelander and Monod proved that locally compact groups with property (T) satisfy property (F_X) for certain Banach spaces, the most notable examples being L^p-spaces. They also conjectured that semisimple Lie/algebraic groups with higher rank simple factors satisfy property (F_X) for every superreflexive Banach space X. For such groups over non-Archimedean local fields, this conjecture was confirmed in the work of Lafforgue and the work of Liao. I will explain recent joint works with Mikael de la Salle and Masato Mimura, in which we investigate the case of real Lie/algebraic groups and their lattices. It turns out that given a superreflexive Banach space satisfying certain conditions on its geometry, we can find a number n such that groups of rank at least n satisfy property (F_X) for this Banach space X.

Hyun Ho Lee: **Non-commutative sigma model on the noncommutative torus and an action on field maps**.

Abstract. We re-examine some known nonlinear sigma models under Mathai and Rosenberg's unified approach. We explain a connection between different sigma models and introduce an action on field maps that are solutions of nonlinear noncommutative PDEs.

Kang Li: **Exactness of locally compact groups**.

Abstract. Kirchberg and Wassermann introduced exactness for locally compact groups in order to study continuous bundles of C^*-reduced crossed products. For a discrete group, exactness is equivalent to topological amenability of the canonical action on its Stone-Čech compactification. In the talk, we will discuss their relation for general locally compact groups. Recently, Roe and Willett proved that a metric space without property A always admits non-compact ghosts. As a consequence, we are able to answer a question raised by Anantharaman-Delaroche in 2002.

This is joint work with Jacek Brodzki and Christopher Cave.

Xin Li: **Topological dynamics and C^*-algebras**.

Abstract. This talk is about continuous orbit equivalence of topological dynamics and Cartan subalgebras in C^*-algebras.

Hervé Oyono-Oyono: **K-theory, propagation and large scale geometry**.

Abstract. The study of elliptic differential operators from the point of view of index theory and its generalizations to higher order indices gives rise to C^*-algebras where propagation makes sense and encodes the underlying large scale geometry. Prominent examples for such C^*-algebras are Roe algebras, group C^*-algebras and crossed product C^*-algebras. Unfortunately, K-theory for operator algebras does not keep track of these propagation properties. Together with G. Yu, we have developed a quantitative version of K-theory that takes into account propagation phenomena. In this lecture we explain how this quantitative K-theory can be computed by using a quantitative version of Mayer-Vietoris six terms exact sequence.

Francesc Perera: **Abstract bivariant Cuntz semigroups**.

Abstract. The category Cu of abstract Cuntz semigroups is a symmetric monoidal category, as was already shown by Antoine, Thiel, and the speaker. Thus, it appears as a natural question to find out whether Cu is also a closed category. Since the set $\mathrm{Cu}(S,T)$ of Cu-morphisms between two Cu-semigroups S and T is a partially ordered semigroup that generally fails to satisfy the axioms of the category Cu, the construction of an internal-hom bifunctor requires a fresh approach.

In this talk, I will discuss how this question has a positive answer, and sketch the construction of the aforementioned internal hom-bifunctor. The tools used for this construction also allow to show that the category Cu admits arbitrary products and inverse limits. If time allows, I will indicate how we expect these ideas to fit into the development of a theory of a bivariant Cuntz semigroup.

This is joint work in progress with Ramon Antoine and Hannes Thiel.

Yasuhiko Sato: **Elementary amenable groups and Quasidiagonality**.

Abstract. It is known that any elementary amenable group is quasidiagonal. I intend to consider quasidiagonality of some groups near the border of elementary and non-elementary amenable groups.

Aidan Sims: **Simplicity of crossed products by quasifree actions**.

Abstract. Any assignment of an element of the k-torus to each edge of a directed graph determines a quasifree action of $\mathbb{Z}^k$ on the associated graph algebra. The crossed product can then be realised as a twisted C^*-algebra of an associated $(k+1)$-graph. I will discuss recent work that characterises simplicity of twisted k-graph C^*-algebras using the technology of groupoids and Fell bundles. I'll then describe what this result says when we specialise to crossed products by quasifree actions.

This is joint work with Alex Kumjian and David Pask.

Jan Spakula: **Operator theory and coarse geometry**.

Abstract. (Some) operator theorists study Fredholmness of certain operators on $\ell^2(\mathbb{Z}^n)$ using the so-called operator spectrum. John Roe, in 2004, explained that the operators of interest are really just elements of the Translation C^*-algebra (also called the uniform Roe algebra) of $\mathbb{Z}^n$, the C^*-algebra encoding the large scale (or coarse) structure of $\mathbb{Z}^n$.

In this talk, I will explain how to generalise the limit operator theory framework not only to other discrete groups, but to general discrete metric spaces. Furthermore, I will show how to further exploit the inherent connections to coarse geometry to generalise a recent result of Lindner and Siedel, which significantly simplifies the Fredholmness criterion (they refer to the problem they solve as 'The core issue on Limit Operators (on $\mathbb{Z}^n$)').

This is a joint work with Rufus Willett.

Karen Strung: **Minimal dynamics and the Jiang-Su algebra**.

Abstract. I will present a construction for minimal dynamical systems on point-like spaces. Such a system may be taken to be uniquely ergodic and in this case the C^*-algebra associated to its orbit-breaking equivalence relation is isomorphic to the Jiang-Su algebra.

This is joint work with Robin Deeley and Ian Putnam.

Yuhei Suzuki: **Construction of minimal skew products of amenable minimal dynamical systems**.

Abstract. We give a generalization of a result of Glasner and Weiss. This provides many new examples of amenable minimal dynamical systems. We also study the pure infiniteness of the crossed products of dynamical systems arising from this result. For this purpose, we introduce and study a notion of the finite filling property for étale groupoids, which generalizes a result of Jolissaint and Robertson. As an application, we show that for any connected closed topological manifold M, every countable non-amenable exact group admits an amenable minimal free dynamical system on the product of M and the Cantor set whose crossed product is a Kirchberg algebra. This extends a result of Rørdam and Sierakowski.

Aaron Tikuisis: **Classifying maps by traces and covering dimension for C^*-algebras**.

Abstract. A pair of homomorphisms between unital C^*-algebras A and B are said to agree on traces if they induce the same map $T(B)$ to $T(A)$ (the tracial state spaces). One can ask, what further structure can we conclude from knowing that two homomorphisms agree on traces? I will discuss some answers to this question (after putting more hypotheses on A and B). An important application of these ideas is a computation of noncommutative covering dimension, i.e., nuclear dimension and decomposition rank.

This is joint work with Joan Bosa, Nate Brown, Yasuhiko Sato, Stuart White, and Wilhelm Winter.

Alessandro Vignati: **Quantifier elimination in C^*-algebras**.

Abstract. We study quantifier elimination for C^*-algebras in the setting of continuous logic. We prove that if A is noncommutative and different from $M_2(\mathbb{C})$ there is a finitely generated F and two embeddings of F into A and A^U such that there is no embedding of A into A^U making the diagram commute. In particular no such A has quantifier elimination. We then provide a list of consequences.

This is joint work with C. J. Eagle, I. Farah and E. Kirchberg.

Rufus Willett: **Dynamic Asymptotic Dimension and Nuclear Dimension**.

Abstract. I'll warm up with a discussion of how 'small' groupoids give rise to (recursive) subhomogeneous C^*-algebras, without assuming much knowledge of groupoids and their C^*-algebras. Dynamic asymptotic dimension is a condition whereby an action (equivalently, a transformation groupoid, or maybe a more general étale groupoid) can be 'locally' split into finitely many pieces, each of which is a small groupoid in the sense above, and explain how this gives bounds on nuclear dimension. I'll briefly discuss examples, and show how the main estimate specialises to theorems of Toms-Winter on integer actions, and of Winter-Zacharias on Roe algebras. Time permitting, I'll also say a little bit about how these conditions give techniques to compute K-theory.

This is based on joint work with Erik Guentner and Guoliang Yu.

Joachim Zacharias: **A bivariant version of the Cuntz semigroup**.

Abstract. Based on ideas of Winter we develop a bivariant version of the Cuntz semigroup as equivalence classes of order zero maps. This bivariant theory behaves analogously to Kasparov's bivariant K-theory. We develop bivariant analogues of the description of the Cuntz semigroup as classes of Hilbert modules and classes of open projections. In the commutative case Cuntz homology, the theory which is dual to the Cuntz semigroup can be determined. We consider a number of examples and show that the bivariant Cuntz semigroup can be used to classify certain classes of C^*-algebras. (E.g. AF-algebras and other algebras which have been classified previously.)

Joint with Joan Bosa and Gabriele Tornetta.