Groups and Operator Algebras – Provisional Schedule

Monday, 14 June:

9:00-9:10 Welcome

9:10-10:10 Kate Juschenko: Lecture 1

10:10-10:40 Coffee break

10:40-11:40 Rufus Willett: An overview of interactions between groups and operator algebras (Lecture 1)

11:45-12.30 Yair Hartman: On The Simplicity of Reduced Crossed Products, and Stabilizers

LUNCH

14:15-15:15 Kate Juschenko: Lecture 2

15:15-15:45 Coffee break

15:45-16:45 Rufus Willett: An overview of interactions between groups and operator algebras (Lecture 2)

WELCOME APERITIF

Tuesday, 15 June:

9:00-9:45 Denis Osin: Classifying group actions on hyperbolic spaces

9:50-10:35 Mehrdad Kalantar: TBA

10:35-11:00 Coffee break

11:00-11:45 Tatiana Nagnibeda: Self-similar groups and spectra of graphs

11:50-12:35 Georgii Veprev: Localization of eigenfunctions in amenable unimodular random graphs

LUNCH

14:15-15:00 Paul Jolissaint: Weakly almost periodic functions on the unitary groups of von Neumann algebras and applications

15:00-15:25 Coffee break

15:25-16:10 Bartosz Kwaśniewski: Galois correspondence for regular C*-irreducible inclusions

16:15-17:00 Kang Li: Maximal ideals of reduced group C*-algebras and Thompson's groups

Wednesday, 16 June:

9:00-9:45 Yemon Choi: The invariant uniform Roe algebra of a discrete group: questions and challenges

9:50-10:35 Kristin Gabe (Courtney): Operator system inductive limits of C*-algebras

10:35-11:00 Coffee break

11:00-11:45 Hanna Oppelmayer: Invariant random subalgebras
11:50-12:35 Tattwamasi Amrutam: Confinedness, Recurrence and C^*-simplicity

LUNCH

FREE AFTERNOON

Thursday, 17 June:

9:00-9:45 Sara Azzali: Traces in KK theory and index pairings
9:50-10:35 Sven Raum: K-theory and delocalised traces of right-angled Hecke C*-algebras

10:35-11:00 Coffee break

11:00-11:45 Daniel Drimbe: Von Neumann equivalence rigidity
11:50-12:35 Adriana Férnandez Quero: Non-amenable C*-superrigid groups that are not W*-superrigid

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14:15-15:00 Milan Donvil: W*-superrigidity for compact quantum groups

15:00-15:25 Coffee break

15:25-16:10 Enli Chen: Rigidity of graph product von Neumann algebras
16:15-17:00 Shuoxing Zhou: Structure and rigidity of noncommutative Poisson boundaries

RACLETTE DINNER

Friday, 18 June:

9:00-9:45 Siegfried Echterhoff: Simple subquotients of certain crossed products – Poguntke's theorem revisited
9:50-10:35 Max Carter: Boundary representations and Wiener's Tauberian for groups with a Gelfand pair

10:35-11:00 Coffee break

11:00-11:45 Michelle Bucher: Invariant cocycles on the Furstenberg boundary
11:50-12:35 Goulnara Arzhantseva: Simple and selfless reduced group C*-algebras

LUNCH

List of abstracts

Kate Juschenko
TBA

Rufus Willett
An overview of interactions between groups and operator algebras

I will attempt to give an overview of current (and some older) interactions between group theory and operator algebras, from an operator algebras point of view.

Yair Hartman
On The Simplicity of Reduced Crossed Products, and Stabilizers

For a minimal action of a countable group G on a compact space X, we establish a necessary condition for the simplicity of the corresponding reduced crossed product C*-algebras in terms of stabilizer subgroups. In particular, our result gives a complete characterization of the simplicity of the reduced crossed products associated with minimal actions of some classes of groups (including linear and hyperbolic groups), answering a question of Ozawa (2014) for these groups. Joint work with Mehrdad Kalantar

Denis Osin
Classifying group actions on hyperbolic spaces

For a given group G, it is natural to ask whether one can classify all isometric G-actions on Gromov hyperbolic spaces. I will discuss a formalization of this problem based on the complexity theory of Borel equivalence relations. Our focus will be on actions of general type, i.e., non-elementary actions without fixed points at infinity, as these are particularly useful from the perspective of geometric group theory. The main result in this direction is the following dichotomy: for every countable group G, either all general type G-actions on hyperbolic spaces can be classified by an explicit invariant ranging in an infinitely dimensional projective space, or they are unclassifiable in a very strong sense. In terms of Borel complexity theory, we show that the equivalence relation associated with the classification problem is either smooth or K_σ-complete. Groups $SL_2(F)$, where F is a countable field of characteristic 0, satisfy the former alternative, while non-elementary hyperbolic (and, more generally, acylindrically hyperbolic) groups satisfy the latter. The proof of the main theorem draws on several results of independent interest and provides new insights into the boundary dynamics of group actions on hyperbolic spaces. The talk is based on a joint paper with K. Oyakawa.

Mehrdad Kalantar
TBA

Tatiana Nagnibeda
Self-similar groups and spectra of graphs

Self-similar groups are infinite finitely generated groups defined by their actions on infinite rooted trees. These groups are of great interest in geometric group theory, but they also give rise to interesting families of finite and infinite graphs exhibiting self-similar features. In spectral graph theory, they provide examples of such remarkable phenomena as cospectrality, gaps in the spectrum, singular spectral measures. Methods used to study these graphs include approximation by finite graphs, renormalization techniques, spectral theory of Schroedinger operators with aperiodic order.

Georgii Veprev
Localization of eigenfunctions in amenable unimodular random graphs

Motivated by Kaplansky's conjecture, Elek showed that for any element of the group algebra of an amenable group Γ the existence of an eigenfunction in $l^2(\Gamma)$ implies the existence of a finitely supported eigenfunction with the same eigenvalue. Moreover, all eigenfunctions are generated by finitely supported ones. We will discuss a similar question in the context of unimodular random graphs.

Paul Jolissaint
Weakly almost periodic functions on the unitary groups of von Neumann algebras and applications

Let $M \subset B(H)$ be a von Neumann algebra. We consider two types of actions of the unitary group U_M: The first one is by conjugation on $B(H)$, and we prove that M is finite iff, for every $x \in M$ and for all $\xi, \eta \in H$, the coefficient function $u \mapsto \langle uxu^*\xi|\eta\rangle$ is weakly almost periodic. The second type of action is on M-bimodules (also called correspondences): we consider, for a given such bimodule H, the unitary representation π_H on H defined by $\pi_H(u)\xi = u\xi u^*$. Then, for instance, if M is a II_1 factor, then it does not have Connes' property T iff it has an approximation property expressed in terms of representations π_H which are weakly mixing. All needed concepts will be recalled briefly.

Bartosz Kwaśniewski
Galois correspondence for regular C*-irreducible inclusions

A C*-inclusion is C*-irreducible if all intermediate C*-subalgebras are simple (Rordam). Such inclusions arise naturally in the study of actions of groups on C*-algebras, either as crossed products (Kishimoto, Cameron-Smith, Amrutam-Kalantar), fixed point algebras (Izumi, Mukohara) or their mixture (Echterhoff-Rordam). In this talk I will discuss C*-irreducible inclusions which are regular in the sense of Kumjian. They correspond to outer Fell bundles over discrete groups, and so up to Morita-equivalence all such inclusions are given by crossed products by an outer group action. Using a modification of Magajna's separation theorem considered recently by Kennedy-Ursu, I can give a simple proof that the intermediate C*-subalgebras are in bijective correspondence with subgroups of the associated group. This generalises Galois correspondence of Cameron-Smith, and improves upon results of Izumi and Mukohara in the case of abelian groups.

If time permits I will also apply a recent characterisation of detection of ideals for crossed products by special groups obtained by Geffen-Ursu. This result allows to produce examples of C*-irreducible inclusion given by fixed point subalgebras of the circle, but also can be used to give a partial positive answer to a question of Pitts-Zarikian, recently modified by Zarikian. Namely for every topologically regular C*-inclusion detection of ideals in every intermediate C*-algebra is equivalent to uniqueness of the pseudo-expectation.

Kang Li
Maximal ideals of reduced group C*-algebras and Thompson's groups

In this talk, I will present joint work with Kevin Aguyar Brix, Chris Bruce, and Eduardo Scarparo on the ideal structure of reduced group C*-algebras. We develop a general framework for comparing ideals using a conditional expectation onto a C*-subalgebra. In this setting, induction of ideals and a complementary operation called co-induction form a Galois connection between ideal lattices. We apply this framework to reduced group C*-algebras arising from actions of discrete groups on their Furstenberg boundary. Using boundary stabilizers, we obtain a characterization of maximal ideals in terms of maximal co-induced ideals. As applications, we show that the reduced C*-algebra of Thompson's group T has a unique maximal ideal, and that if Thompson's group F is amenable, then the reduced C*-algebra of T has infinitely many ideals. If time permits, I will also present a follow-up result building on these ideas.

Yemon Choi
The invariant uniform Roe algebra of a discrete group: questions and challenges

For a discrete group Γ, its uniform Roe algebra $C_u^*(\Gamma)$ can be described as the norm-closure of the set of finite-bandwidth operators on $\ell^2(\Gamma)$; the invariant subalgebra $C_u^*(\Gamma)^\Gamma$ consists of those operators in $C_u^*(\Gamma)$ that commute with right translations. Clearly, $C_u^*(\Gamma)^\Gamma$ contains all left translation operators, and hence it contains the reduced group C^*-algebra. While no examples are known where the containment is strict, it is believed that such examples might be found among higher-rank lattices. In this survey talk, I will sketch how $C^{u}_{(}\Gamma)^{\Gamma}$ arises independently from ideas and constructions in abstract harmonic analysis, make some modest observations about this algebra when Γ is exact, and highlight some questions that might be interesting for those working on operator algebras or group actions.

Kristin Gabe (Courtney)
Operator system inductive limits of C*-algebras

Hanna Oppelmayer
Invariant random subalgebras

The notion of invariant random subgroups (IRS) is a fruitful, well-studied concept in dynamics on groups. I will explain what it is and how to extend this to group von Neumann algebras LG, where G is a discrete countable group. We call it invariant random sub-von Neumann algebra (IRA). As an application, I will provide a result concerning amenable IRAs, which generalises a theorem of Bader-Duchesne-Lécureux about amenable IRSs. This is joint work with Tattwamasi Amrutam and Yair Hartman. Moreover, in ongoing work with Pierre Fima and Leyan Tao we extend the notion of IRA to C*-algebras.

Tattwamasi Amrutam
Confinedness, Recurrence and C^*-simplicity

We introduce the notion of confined subalgebras in the context of the group von Neumann algebra. We also define Uniformly Recurrent States—an operator-algebraic analog of Uniformly Recurrent Subgroups. Using this framework, we show that a countable discrete group is C^*-simple if and only if it admits no non-trivial amenable confined subalgebras. This generalizes the well-known result of Kennedy that characterizes C^*-simplicity in terms of trivial amenable uniformly recurrent subgroups. This is a joint work with Yongle Jiang.

Sara Azzali
Traces in KK theory and index pairings

Traces on C*-algebras play an important role in index theory, for instance they allow to extract numerical invariants from classes in K-theory. When real coefficients are introduced in Kasparov bivariant K-theory, traces naturally induce classes in KK-theory with real coefficients. In this talk, we explain these constructions and some of their applications to discrete group actions on spaces and C*-algebras. In particular, we present a natural class that represents the Godbillon-Vey invariant of a foliation of codimension one. This is based on collaborations with Paolo Antonini (Università del Salento) and Georges Skandalis (Université Paris Cité).

Sven Raum
K-theory and delocalised traces of right-angled Hecke C*-algebras

For every Coxeter group, a classical construction provides a continuous family of complex *-algebras deforming its group algebra. These are called Iwahori–Hecke algebras. At certain parameters, they arise as double-coset Hecke algebras of totally disconnected groups. Their completions to Hecke C*-algebras form an interesting class of examples for developing structure and classification results for non-amenable C*-algebras. For right-angled Coxeter types, there have been significant advances on this problem.

In this talk, I will focus on the classification aspect, reporting on K-theory calculations and on a computation of the pairing with delocalised traces for right-angled Hecke C*-algebras. This yields partial classification results. As an important intermediate step, we obtain Schwartz subalgebras inside Hecke C*-algebras of hyperbolic, right-angled type.

This talk is based on joint works with Piotr Nowak, Sanaz Pooya, and Adam Skalski.

Daniel Drimbe
Von Neumann equivalence rigidity

The notion of measure equivalence of discrete groups has been introduced by Gromov as a measurable variant of the topological notion of quasi-isometry. Measure equivalence of groups is tightly related to the theory of II_1 factors: if G and H are measure equivalent, then they admit free ergodic probability measure preserving action for which their von Neumann algebras are stably isomorphic. Also, two groups G and H are called W*-equivalent if their group von Neumann algebras are stably isomorphic.

A few years ago, Ishan, Peterson and Ruth discovered that there is an even coarser notion of equivalence of groups, coined von Neumann equivalence, which is implied by both measure equivalence and W*-equivalence. In this talk I will present a unique prime factorization for products of hyperbolic groups up to von Neumann equivalence. This is joint work with Stefaan Vaes.

Adriana Férnandez Quero
Non-amenable C*-superrigid groups that are not W*-superrigid

In this talk, I will recall the notions of C*- and W*-superrigidity for groups. I will then present examples of non-amenable groups that can be completely reconstructed from their reduced C*-algebras, but not from their group von Neumann algebras. These groups are constructed as infinite direct sums of amalgamated free product groups and provide the first known examples of non-amenable groups exhibiting this behavior. This is joint work with Juan Felipe Ariza Mejía and Ionut Chifan.

Milan Donvil
W*-superrigidity for compact quantum groups

A group G is called W*-superrigid if it is completely remembered by its group von Neumann algebra in the following sense: any other group with the same group von Neumann algebra must be isomorphic to G. By now, there are many examples of W*-superrigid groups. Of course, a group von Neumann algebra is also a compact quantum group, hence one can ask whether superrigidity also holds in this larger class. Surprisingly, many of the typical W*-superrid groups in the literature fail to remain superrigid as quantum groups. I will present a recent joint work with Stefaan Vaes where we prove certain (cohomological) obstructions to 'quantum W*-superrigidity'. We also build on previous work to find the first examples of discrete groups and (non-cocommutative) compact quantum groups which are quantum W*-superrigid.

Enli Chen
Rigidity of graph product von Neumann algebras

Graph products provide a fundamental construction in both group theory and the theory of C*- and von Neumann algebras. They can be viewed as a unifying framework that interpolates between tensor products and free products of operator algebras, with the underlying graph encoding the relevant combinatorial structure.

In this talk, we present recent results on the rigidity properties of graph products in the setting of von Neumann algebras. Specifically, we show that if two graph products—constructed from arbitrary non-amenable von Neumann algebras within a certain class and graphs with a mild condition–are isomorphic, then the underlying graphs must themselves be isomorphic. Moreover, the von Neumann algebras associated with corresponding vertices are stably isomorphic. Then we will also present a similar rigidity result in the amenable setting: for graph products of the amenable II_1 factor, one still obtains graph reconstruction, albeit for a different class of graphs than in the non-amenable case.

This work is based on joint research with Matthijs Borst and Martijn Caspers.

Shuoxing Zhou
Structure and rigidity of noncommutative Poisson boundaries

As an analogue of ergodic group theory, I will give a brief introduction to the noncommutative ergodic theory of W*-inclusions, especially the noncommutative Poisson boundary theory initiated by Das-Peterson. Then I will present some results that bridge the group and von Neumann algebra settings, such as the characterization of different properties through the Poisson boundaries, and the Furstenberg entropy theory in both settings. For most of these results, the classical group case came first and inspired the von Neumann algebra counterpart. However, at the end of the talk, we will see a surprising example of the exact opposite.

Siegfried Echterhoff
Simple subquotients of certain crossed products – Poguntke's theorem revisited

We study conditions for actions of abelian groups on C*-algebras that will imply that all simple subquotients of the associated crossed products are Morita equivalent to twisted group C*-algebras of abelian groups. As one consequence, we obtain a new proof of Poguntke's theorem, saying that the simple subquotients of group C*-algebras of connected groups are isomorphic to the compact operators on some Hilbert space or Morita equivalent to a simple noncommutative n-torus for some $n \leq 2$. If time allows, we shall also briefly discuss the situation for almost connected groups.

Max Carter
Boundary representations and Wiener's Tauberian for groups with a Gelfand pair

It is a classical result of Norbert Wiener from the 1930's, referred to as "Wiener's Tauberian theorem", that a function $f \in L^1(\mathbb{R}^d)$ generates a dense ideal if and only if its Fourier transform vanishes nowhere. Then, given a general locally compact group G, one can ask whether the Fourier transform on $L^1(G)$ also satisfies this property. In the case that this property holds for $L^1(G)$, G is called a "Wiener group". It was a classical question in Banach algebra theory during the 20th century to determine which groups are Wiener. It is a celebrated result in the area that compactly generated groups of polynomial growth and nilpotent groups are all Wiener groups. On the other hand, it is generally difficult to show that a group is not Wiener, and essentially the only known class of non-Wiener groups are connected semisimple Lie groups. In this talk I will discuss recent work where we show that many non-amenable totally disconnected locally compact groups are not Wiener, including reductive algebraic groups over non-archimedean local fields. The proofs make extensive use of representations of the given groups on their Furstenberg boundary.

Michelle Bucher
Invariant cocycles on the Furstenberg boundary

It is well known that there exists, up to a constant, a unique measurable function $f : \mathbb{C} \setminus \{0,1\} \to \mathbb{R}$ satisfying the 5-terms equation

$$f(x) - f(y) + f\left(\frac{y}{x}\right) - f\left(\frac{1-y}{1-x}\right) + f\left(\frac{x}{y} \cdot \frac{1-y}{1-x}\right) = 0.$$

Indeed any such function is necessarily a multiple of the Bloch-Wigner dilogarithm. For smooth functions it is easy to show this with a few derivations. In the case of measurable functions, Bloch's proof relies on an identification of the measurable cohomology in degree 3 of $\mathrm{PSL}(2,\mathbb{C})$, and boils down to the claim that the latter cohomology group is the cohomology of $\mathrm{PSL}(2,\mathbb{C})$-invariant cochains on $P^1(\mathbb{C})$.

In this talk, we will be interested in possible generalisations of this claim, replacing $\mathrm{PSL}(2,\mathbb{C})$ by a semisimple connected Lie group G with finite center and $P^1(\mathbb{C})$ by the corresponding Furstenberg boundary G/P, where P is a minimal parabolic subgroup. We will see in particular that the study of the case of $G = \mathrm{PSL}(2,\mathbb{C}) \times \mathrm{PSL}(2,\mathbb{C})$ leads to invariant functions $f : (\mathbb{C} \setminus \{0,1\})^2 \to \mathbb{R}$, whose geometric interpretation remains mysterious, satisfying the corresponding 5-terms relations without being a linear combination of the Bloch-Wigner dilogarithms on the factors.

We will also explore the regularity of such functions (measurable vs continuous) to deduce several new cases of a conjecture on bounded cohomology by Nicolas Monod from 2004.

This is joint work with Alessio Savini.

Goulnara Arzhantseva
Simple and selfless reduced group C*-algebras

We discuss classical and recent examples of finitely generated groups whose reduced C*-algebras are simple and selfless, and highlight a number of open questions.