Groups meet C*-algebras

Titles and abstracts

- **Claire Anantharaman-Delaroche**

  Amenability, exactness and weak containment for group actions and groupoids

  I will give a survey, partly historical, on the notion of amenable action on operator algebras and of amenable groupoids, in which I was involved, and that has known recently remarkable developments, due to Alcides Buss, Siegfried Echtehoff, Rufus Willett, Alex Bearden, Jason Crann, Yuhei Suzuki and Narutaka Ozawa. In particular, I will discuss the role played by exactness of groups and groupoids in the study of the weak containment problem, that is when the full and reduced associated C*-algebras are the same.

- **Francesca Arici**

  SU(2)*-symmetries and exact sequences of C*-algebras through subproduct systems*

  Motivated by the study of symmetries of C*-algebras as well as by multivariate operator theory, in this talk we will introduce the notion of an SU(2)-equivariant subproduct system of Hilbert spaces. We will describe their Toeplitz and Cuntz–Pimsner algebras and provide results about their topological invariants through K(K)-theory.
  In particular, we will show that the Toeplitz algebra of the subproduct system of an irreducible SU(2) representation is equivariantly KK-equivalent to the algebra of complex numbers, so that the (K)K-theory groups of the Cuntz–Pimsner algebra can be effectively computed using an exact sequence involving an analogue of the Euler class.
  Based on joint work with Jens Kaad (SDU).

- **Bachir Bekka**

  Unitary representations of algebraic groups over local fields

  In the talk, we will be concerned with the unitary representation theory of algebraic groups over a local field of characteristic zero. Extending results as well as techniques of Dixmier and Bernstein, we show that such a group is of type I; moreover, we characterize among them the groups which are CCR. This is joint work with S. Echterhoff.

- **Christian Bönicke**

  Dynamic asymptotic dimension and groupoid homology

  Dynamic asymptotic dimension is a dimension theory for group actions and more generally for étale groupoids developed by Guentner, Willett, and Yu, which generalizes Gromov's theory of asymptotic dimension. Having finite asymptotic dimension is known to have

important implications for the structure of the associated C*-algebras. In this talk I will report on recent joint work with Dell'Aiera, Gabe, and Willett in which we prove a homology vanishing result for groupoids with finite dynamic asymptotic dimension. We also investigate the relation between groupoid homology and the K-theory of the groupoid C*-algebra, a topic which received a lot of attention in recent years following a conjecture by Matui.

- **Alcides Buss**

  On my collaboration with Siegfried Echterhoff

  In this talk I will report on my joint collaboration – of roughly 10 years – with Prof. Siegfried Echterhoff. I will highlight the main topics that we have been researching together, ranging from Generalized Fixed Point Algebras passing through Exotic Crossed Products and more recently Amenable Actions. In the short time I have I will attempt to cover the main ideas and results of a total of 11 joint papers we have together, many of them also in collaboration with Rufus Willett.

- **Joachim Cuntz**

  On the K-theory of semigroup C-algebras associated with algebraic number fields*

  I will describe joint work with Siegfried Echterhoff and Xin Li on K-theory computations for the C*-algebras mentioned in the title. Our computation uses techniques connected to the Baum-Connes conjecture that have been developed by Echterhoff together with various collaborators. I will also try to briefly describe this background.

- **Ruy Exel**

  Isotropy algebras and Fourier analysis for regular inclusions

  Given a regular inclusion "$A \subseteq B$" of C*-algebras, with A abelian, we will define the notion of "isotropy algebra" for any given point x in the spectrum of A. We will then compare this notion with the usual notion of isotropy groups in the context of groupoid C*-algebras, showing that the isotropy algebra relative to the full groupoid C*-algebra is naturally isomorphic to the full group C*-algebra of the corresponding isotropy group. Based on the slightly generalized notion of "isotropy module", we will then introduce a method to analyze the structure of B paralleling the classical Fourier analysis. This talk is based on the paper [Characterizing groupoid C*-algebras of non-Hausdorff étale groupoids, arXiv:1901.09683 [math.OA][v3] Tue, 1 Jun 2021], joint with David Pitts.

- **Shirly Geffen**

  Nuclear dimension of C-algebras attached to partial group actions*

  C*-algebraic partial actions were introduced by Exel in the 1990s, and generalize the concept of classical group actions. Many important C*-algebras can be written as an especially accessible class of partial crossed products. In this talk, I will focus on partial

actions by finite groups, and by the group of integers. In connection with the classification program, I will review some cases in which structural properties (such as absorption of a strongly self-absorbing C*-algebra, or finite nuclear dimension) pass under formation of partial crossed products.
The talk is partially based on joint work with Fernando Abadie and Eusebio Gardella.

- **Thierry Giordano**

  Extensions and von Neumann algebras

  In 1976, Dan Voiculescu proved his famous non-commutative Weyl-von Neumann theorem, and that any separable unital sub-C*-algebra of the Calkin algebra is equal to its (relative) bi-commutant. In this talk, I will describe generalizations of these results in particular for type II_∞ von Neumann factors.
  Joint work with Victor Kaftal and Ping Ng.

- **Kang Li**

  Rigidity for Roe algebras and measured asymptotic expanders

  (Uniform) Roe algebras are C*-algebras associated to metric spaces, which reflect coarse properties of the underlying metric spaces. It is well known that if X and Y are coarsely equivalent metric spaces with bounded geometry, then their (uniform) Roe algebras are (stably) *-isomorphic. The rigidity problem refers to the converse implication. The first result in this direction was provided by Ján Špakula and Rufus Willett, who showed that the rigidity problem has a positive answer if the underlying metric spaces have Yu's property A. I will in this talk review all previously existing results in literature, and then report on the latest development in the rigidity problem by means of measured asymptotic expanders. This is joint work with Ján Špakula and Jiawen Zhang.

- **Xin Li** (This talk is also part of the Colloquium Wilhelm Killing.)

  Interactions between C-algebras, topological dynamics and group theory*

  C*-algebras are algebras of bounded linear operators on Hilbert spaces. Originally introduced as a mathematical foundation for quantum physics, these structures turn out to be interesting on their own right and exhibit a rich interplay with several other mathematical disciplines. Indeed, as I will explain, several key ideas which were initially developed to classify C*-algebras also lead to classification results for topological dynamical systems. At the same time, it was discovered recently that all C*-algebras which have been classified arise from dynamics in a precise sense. Surprisingly, this circle of ideas also leads to new constructions of groups which answered several open questions in group theory.

- **Wolfgang Lück**

  Baum-Connes and Farrell-Jones meet group C-algebras and group rings*

  We give a survey about the Baum-Connes Conjecture and the Farrell-Jones Conjecture and about their connections. We discuss some interesting applications of them to problems

concerning the classification of some C*-algebras, hyperbolic groups and their boundary, the Cannon Conjecture for hyperbolic 3-manifolds, the Unit and the Kaplansky Conjecture, and topological rigidity. At the end I will briefly explain the status of the project of Arthur Bartels and myself about the K-theoretic Farrell-Jones Conjecture for the Hecke algebras of reductive p-adic groups.

- **Magdalena Musat**

  Factorizable quantum channels, non-closure of quantum correlations and the Connes Embedding Problem

  Factorizable quantum channels, introduced by C. Anantharaman-Delaroche within the framework of operator algebras, have proven to have important applications in the analysis of quantum information theory, leading also to reformulations of the Connes Embedding Problem. In recent work with M. Rørdam, we show that (infinite dimensional) von Neumann algebras are, indeed, needed to describe such channels. The proof uses analysis of matrices of correlations arising from projections, respectively, unitaries, in tracial von Neumann algebras. We also establish a new view point on factorizable channels, leading to central questions in C*-algebra theory.

- **Ryszard Nest**

  Projective representations of compact quantum groups and the quantum assembly map

  The torsion phenomena play important role in the construction of the assembly map in the context of Baum-Connes conjecture. The corresponding case of quantum groups is more involved, since the torsion phenomena are not necessarily associated to torsion subgroups. An important role in this context is played by projective representations of quantum groups. We will describe the general structure of projective representations, associated twisted group C*-algebras and the related torsion phenomena for compact quantum groups. We will also describe the role that these results play in the context of the assembly map for compact quantum groups. This is work in progress joint with Kenny De Commer and Ruben Martos.

- **Hervé Oyono-Oyono**

  K-theory, groupoids and propagation

  Decomposability for groupoids was introduced by E. Guentner, R. Willett and G. Yu. The idea was to generalised the "cut and pasting" strategy developed by G. Yu in order to compute the K-theory of the Roe algebra of a finitely generated group with finite asymptotic dimension. In this lecture, we give some applications of decomposability to K-computability problems for groupoid crossed-product algebras.

- **Jean Renault**

  Abelian twisted groupoid extensions

When a twisted locally compact groupoid with Haar system possesses a closed normal subgroupoid with Haar system over which the twist is abelian, there is a natural Gelfand isomorphism from the C*-algebra of the twisted groupoid onto the C*-algebra of another twisted groupoid. This covers Mackey normal subgroup analysis when the subgroup is abelian in the non-smooth case as well as in the smooth case. This will also be applied to C*-algebraic deformation quantization and to multiplier representations of locally compact abelian groups.

- **Mikael Rørdam**

  Irreducible inclusions of simple C-algebras*

  There are many naturally occurring interesting examples of inclusions of simple C*-algebras with the property that all intermediate C*-algebras likewise are simple. By an analogy to von Neumann algebras, we refer to such inclusions as being C*-irreducible. We give an intrinsic characterization of C*-irreducible inclusions, and use this characterization to exhibit (and revisit) such inclusions, both known ones and new ones, arising from groups and dynamical systems. By a theorem of Popa, an inclusion of II_1-factors is C*-irreducible if and only if it is irreducible with finite Jones index. We also mention how one can construct C*-irreducible inclusions from inductive limits.

- **Karen Strung**

  Cuntz-Pimsner algebras associated to C-correspondences over commutative C*-algebras*

  A full and invertible C*-correspondence over a commutative C*-algebra $C(X)$ is always given by a right module of sections for some line bundle over X, with left multiplication given by composition with a homeomorphism $\alpha : X \to X$. In this case, the C*-correspondence has the structure of a Hilbert $C(X)$-bimodule, and we can think of the associated Cuntz–Pimsner algebra as a generalised crossed product by this bimodule. When the line bundle is trivial, we get the usual crossed product, but in general what we get is a twisted groupoid algebra where the twist is over the transformation groupoid $X \times \mathbb{Z}$. I will discuss these C*-algebras from the point of view of their classification.
  Joint work with M. S. Adamo, D. Archey, M. Forough, M. Georgescu, J. A Jeong, and M. G. Viola.

- **Wojciech Szymanski**

  On polynomial endomorphisms of graph algebras

  I will discuss polynomial endomorphisms of graph C*-algebras. In particular, I will describe how to associate the so-called coding graph to such an endomorphism and how to obtain some information about the endomorphism from that graph. For example, one can get an if and only if condition for the endomorphism to restrict to an automorphism of the diagonal MASA. The dynamics induced this way on the space of infinite paths (the spectrum of the MASA) is generated by an asynchronous transducer.
  This talk is primarily based on a joint work with Rune Johansen and Adam Sørensen.

- **Aaron Tikuisis**

  Classifying embeddings of C-algebras*

  The problems of understanding and classifying *-homomorphisms between C*-algebras is both a natural problem in its own right, and (under the guise of "existence" and "uniqueness" theorems), a common approach used to prove isomorphism theorems. In joint work with J. Carrión, J. Gabe, C. Schafhauser, and S. White, we have classified *-homomorphisms between finite C*-algebras using abstract (and, in a sense, minimal) hypotheses on the domain A and codomain B: A can be any separable exact C*-algebra satisfying the UCT, and B can be any separably $\mathcal{Z}$-stable C*-algebra with compact tracial state space and with strict comparison with respect to traces. I will discuss the problem and our approach.

- **Alain Valette**

  Explicit Baum-Connes for some semi-direct products $\mathbb{Z}^2 \rtimes \Gamma$

  We discuss how the Baum-Connes conjecture without coefficients can be proved by hand for some semi-direct products $G = \mathbb{Z}^2 \rtimes \Gamma$ where Γ is a non-amenable subgroup of $SL_2(\mathbb{Z})$, due to the presence of a 3-dimensional model for the classifying space for proper actions of G. This is joint work with R. Flores and A. Zumbrunnen.

- **Rufus Willett**

  Amenable group actions on C-algebras*

  There are several notions of amenable action for a group on a C*-algebra: roughly, these entail that the actions behaves like the action of an amenable group (actions of amenable groups are always amenable). Until recently, there were several definitions of amenable actions, particularly in the locally compact case, but even for discrete groups the situation was not clear. I will discuss recent results that have clarified the situation. I will particularly focus on applications to the weak containment problem, i.e. when the associated maximal and reduced crossed products agree. This is based on joint work with Alcides Buss and Siegfried Echterhoff, although some recent results of Alex Bearden, Jason Crann, Yuhei Suzuki, and Narutaka Ozawa will also feature prominently.