YOUNG WOMEN IN C^*-ALGEBRAS 2017
ABSTRACTS AND SCHEDULE

Mini-course

Magdalena Musat, University of Copenhagen

Quantized Functional Analysis, Tensor Norms and the Grothendieck Program

Lecture I: Classical and quantum correlations, tensor norms, and an asymptotic behaviour of quantum channels

In 1980, Tsirelson showed that Bell's inequalities—that have played an important role in distinguishing classical correlations from quantum ones, and that were used to test, and ultimately disprove the Einstein-Podolski-Rosen postulate of "hidden variables", coincide with Grothendieck's famous inequalities from functional analysis. Tsirelson further studied sets of quantum correlations arising under two different assumptions of commutativity of observables. While he showed that they are the same in the finite dimensional case, the equality of these sets was later proven to be equivalent to the most famous still open question in operator algebras theory: the Connes embedding problem.

I will survey several reformulations of the Connes embedding problem, starting with Kirchberg's deep work from 1993, continuing with the results of Fritz (2009) and Ozawa (2012) connecting it to Tsirelson's conjecture, and the more recent work, joint with Haagerup (2015), concerning an asymptotic property of quantum channels posessing a certain factorizability property (that originates in operator algebras), introduced by Anantharaman-Delaroche. I will also discuss the remarkable recent breaktrough of Slofstra (June, 2016).

Lecture II: Grothendieck's inequalities—from classical to noncommutative

The highlight of Grothendieck's celebrated "Résumé", published in 1956, is a highly non-trivial factorization result for bounded bilinear forms on $C(K_1) \times C(K_2)$, where K_1 and K_2 are compact sets, which is now referred to as the Grothendieck Theorem (or, Grothendieck Inequality). The "Résumé" contains several equivalent formulations of it, all describing fundamental relationships between Hilbert spaces (e.g., L_2), and the Banach spaces L_∞, respectively, $C(K)$, and L_1. It ends with a remarkable list of six problems, one of which is the conjecture that an analogue factorization for bounded bilinear forms on the product of (noncommutative) C*-algebras holds. This was later proven by Pisier (under an approximability assumption), and by Haagerup (in full generality).

I will survey Grothendieck's inequalities, from classical to noncommutative, including extensions to the setting of completeley bounded bilinear forms on C*-algebras and operator spaces, due to Pisier-Shlyakhtenko (2002), and joint work of Haagerup and myself (2008). I will also explain the connection with Tsirelson's result, announced in the first lecture. This makes crucial use of various tensor norms, and their interconnections. A brief background on operator spaces, so-called *quantized Banach spaces*, will be provided along the way.

Colloquium

Claire Anantharaman-Delaroche, University of Orléans

A brief history of type II_1 factors

I will discuss some highlights of the story of II_1 factors, starting with the pioneering papers of von Neumann and Murray-von Neumann and ending with new techniques that were developed these last 20 years and are the source of remarkable breakthroughs.

Date: 5-6 August 2017.

Maria Stella Adamo, Università degli Studi di Catania
Representable functionals on Banach quasi *-algebras

Some physical models which stem out from quantum statistical mechanics or quantum field theory do not fit in the mathematical background founded on C*-algebras proposed by Haag and Kastler. One way to study these problems is to enlarge the algebraic set-up, considering locally convex quasi *-algebras. A particular class of these objects is given by Banach quasi *-algebras, in which the topology is generated by only one norm.

Several different notions were introduced on locally convex quasi *-algebras, such as full-representability, *-semisimplicity and full-closability. We want to compare these notions concentrating our attention on the case of Banach quasi *-algebras. A relevant role in our discussion is played by the notion of representable functional on a Banach quasi *-algebra.

Throughout the talk, we will see briefly the mathematical properties of Banach quasi *-algebras, giving some examples, and provide an overview on other aspects concerning representable functionals over a Banach quasi *-algebra. At the end, if time permits, we will discuss physical applications related to Banach quasi *-algebras and future directions.

Zahra Amiri, Ferdowsi University of Mashhad
Wavelet transforms via generalized quasi-regular representations

The construction of the well-known continuous wavelet transform has been extended before to higher dimensions. Then it was generalized to a group which is topologically isomorphic to a homogeneous space of the semidirect product of an abelian locally compact group and a locally compact group. In this present, we consider a more general case. We introduce a class of continuous wavelet transforms obtained from the generalized quasi-regular representation. To define such representation of a group G, we need a homogeneous space with a relatively Radon measure and a character of G.

Camila Fabre-Sehnem, Göttingen University
A bicategorical interpretation for Cuntz-Pimsner algebras

The bicategory of functors from $(\mathbb{N}, +)$ to the correspondence bicategory gives rise to a bicategory whose objects are correspondences over C^*-algebras. In this talk, I will define a new bicategory, in which objects are given by triples $(A, \mathcal{E}, J)$, where $\mathcal{E}$ is a correspondence over A and J is an ideal acting by compact operators on $\mathcal{E}$. This new bicategory contains a reflective subbicategory and we will show that, up to adjoint equivalence between functors, the left biadjoint to its inclusion is determined by the relative Cuntz-Pimsner algebra associated to correspondences.

Marzieh Forough, IPM Teheran
On the tracial Rokhlin property for finite group actions

In this talk, first, I will discuss the stability of the property that all traces are quasidiagonal by taking crossed products of finite group actions with Rokhlin types properties on unital C*-algebras. I mainly consider finite group actions with the tracial Rokhlin property, the weak tracial Rokhlin property or having finite Rokhlin dimension with commuting towers. As an application, under some assumptions on the trace space, the finiteness of decomposition rank passes from the underlying unital algebras to the crossed product algebras by finite group actions with the weak tracial Rokhlin property.

In a joint work with N. Golestani, we define and study the tracial Rokhlin property for finite group actions on simple C*-algebras which are not necessarily unital. We also give a definition for simple, not necessarily unital, tracial rank zero C*-algebras. Our notion generalizes Lin's definition of simple unital tracial rank zero C*-algebras. In the second part of this talk, I will discuss the finite group actions with the tracial Rokhlin property on simple C*-algebras. In particular, I will show that if α is an action of a finite group G with the tracial Rokhlin property on a simple tracial rank zero C*-algebra A, then $A \rtimes_\alpha G$ is a simple tracial rank zero C*-algebra.

Magdalena Georgescu, Ben-Gurion University
Approximation of groupoids

I will describe a method of approximating a Lindelöf groupoid G as an inverse limit of second countable groupoids which are (sort-of) quotients of G. Some of the nice properties of G can be shown to pass to the quotient groupoids. The construction is such that structures associated to G (e.g. system of Haar measures) can also be approximated. I will conclude by discussing an application of this approach to representation theory. This is joint work with Kyle Austin and Joav Orovitz.

Maria Gerasimova, TU Dresden
Unitarisability of discrete groups

A discrete group G is called *unitarisable* if for every Hilbert space H and every uniformly bounded representation $\pi : G \to B(H)$ (that is $\|\pi(g)\| < C$ for every $g \in G$ and some constant C) there exists an invertible operator $S \in B(H)$ such that for every $g \in G$ the operator $S\pi(g)S^{-1}$ is unitary. It is well known that amenable groups are unitarisable. The following question is still open:
Dixmier problem: Are unitarisable groups amenable?
The significant progress was obtained by Pisier who showed that if one incorporates in Dixmier's question the fact that the similarity S can be found with $\|S\|\|S^{-1}\| \leq \|\pi\|^{\alpha}$ for some $\alpha < 3$, then the answer is affirmative. This α is called a *similarity degree* $d(G)$. It was also shown that unitarisability with $d(G) = N$ can be characterized by the existence of the complete surjection W_N:

$$W_N : \ell^1(G) \otimes_h \ldots \otimes_h \ell^1(G) \to C^*(G).$$

The proof of this fact is quite complicated and based on the theory of operator spaces. We will discuss existence of this surjection and explain in several ways why $d(G) = 1$ implies that G is finite. We will also give a new proof of the fact that amenability implies existence of the complete surjection $W_2 : \ell^1(G) \otimes_h \ell^1(G) \to C^*(G)$ using only classical definition of amenability.

Safoura Jafar-Zadeh, Université de Franche-Comté
On the left uniform compactification of a locally compact group

For a locally compact group G, let $C_b(G)$ be the space of all complex-valued, continuous and bounded functions on G equipped with the sup-norm, and $LUC(G)$ be the subspace of $C_b(G)$ consisting of all functions f such that the map $G \to C_b(G); x \mapsto l_x f$ is continuous, where $l_x f$ is the function defined by $l_x f(y) = f(xy)$, for each $y \in G$. The subspace $LUC(G)$ forms a unital commutative C*-algebra. We can induce a multiplication on the Gelfand spectrum of $LUC(G)$, G^{LUC}, with which G^{LUC} forms a semigroup. In this talk, I study some properties of the compact semigroup G^{LUC}. I also discuss the question of when the outgrowth, $G^{LUC} \setminus G$, determines the underlying topological group G.

Fatemeh Khosravi, Ferdowsi University of Mashad
Idempotent states on quantum groups via von Neumann algebras

We study idempotent states on locally compact quantum groups and their dual quantum groups and figure out their relations with quantum subgroups. We establish a one to one correspondence between idempotent states on a locally compact quantum group G and integrable coideal von Neumann subalgebras of $L^{\infty}(G)$ that are preserved by the scaling group. This talk is based on joint work with Paweł Kasprzak.

Sanaz Pooya, Université de Neuchâtel
Explicit Baum-Connes assembly map for $F \wr \mathbb{F}_n$ Part I: K-homology of $\underline{E}F \wr \mathbb{F}_n$

Let $F \wr \mathbb{F}_n$ be the wreath product of a finite group F with the free group $\mathbb{F}_n$. We denote by $\underline{E}F \wr \mathbb{F}_n$ the classifying space for proper $F \wr \mathbb{F}_n$-actions. In order to describe the topological side of the assembly map, we need to compute the equivariant K-homology of $\underline{E}F \wr \mathbb{F}_n$. This is possible, thanks to the existence of a 2-dimensional model for $\underline{E}F \wr \mathbb{F}_n$. We construct a concrete model for $\underline{E}F \wr \mathbb{F}_n$ and specify the generators of the topological K-groups. This provides us with an explicit picture of the left-hand side of the assembly map for this class of groups. In the second talk, we will describe the analytical side of the assembly map. Our motivation is to understand explicitly the Baum-Connes assembly map for these groups.

Maria Ramirez Solano, University of Southern Denmark
Computational explorations of the Thompson group T for the amenability problem of F

I will discuss how we can estimate the norm of a certain element in the complex group ring of T, considered as an operator via the left regular representation of T. By a result of U. Haagerup and K. Olesen, it follows that the value of this norm is closely related to the amenability problem of the Thompson group F. This is joint work with Uffe Haagerup and Søren Haagerup, which is a continuation of the work started in "A computational approach to the Thompson group F", by the same authors.

Mayuko Yamashita, Tokyo University
Coarse index theory of complete Riemannian manifolds

The classical Atiyah-Singer index theorem allows us to calculate the index of Dirac operators in terms of characteristic classes, on compact even-dimensional Riemannian manifolds. Using coarse (equivariant) C*-algebras and the six-term exact sequence in operator K-theory, we get the analytic surgery exact sequence and it gives a framework for index theory of complete, non-compact Riemannian manifolds. In this talk, I will explain its construction and its relations with topological problems, such as positive scalar curvature problems and the Novikov conjecture.

Masoumeh Zare, Ferdowsi University of Mashad
Standard shearlet group in arbitrary space dimensions and its square integrable representations

This talk is devoted to definition the standard higher dimension shearlet group $S = R^+ \times R^{n-1} \times R^n$, in arbitrary space dimensions and concerned with the square integrable (irreducible and square integrable) representations of this group. Further, I give a characterization of admissible vectors associated with the Hilbert spaces corresponding to each square integrable representation.

Schedule

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<tr><td>9:20 - 9:30</td><td colspan="2">Welcome from the organisers</td></tr>
<tr><td>9:30 - 10:00</td><td colspan="2" rowspan="2">M. Musat</td><td colspan="2" rowspan="2"></td></tr>
<tr><td>10:00 - 10:30</td></tr>
<tr><td>10:30 - 11:00</td><td colspan="2">Coffee Break</td><td colspan="2">Coffee Break</td></tr>
<tr><td>11:00 - 12:00</td><td colspan="2">Gong Session</td><td colspan="2">C. Anantharaman-Delaroche</td></tr>
<tr><td>12:00 - 14:00</td><td colspan="2">Lunch + mentor group discussion</td><td colspan="2">Lunch + mentor group discussion</td></tr>
<tr><td rowspan="4">14:00 - 16:00</td><td rowspan="4">Contributed Talks</td><td>M. Gerasimova</td><td rowspan="4">Contributed Talks</td><td>M. Georgescu</td></tr>
<tr><td>S. Jafar-Zadeh</td><td>S. Pooya</td></tr>
<tr><td>M. Zare</td><td>M. Yamashita</td></tr>
<tr><td>M. Ramirez Solano</td><td>F. Khosravi</td></tr>
<tr><td>16:00 - 16:30</td><td colspan="2">Coffee Break</td><td colspan="2" rowspan="4"></td></tr>
<tr><td rowspan="3">16:30 - 18:00</td><td rowspan="3">Contributed Talks</td><td>M. Forough</td></tr>
<tr><td>Z. Amiri</td></tr>
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