Danish-Norwegian OA Workshop, Dec. 8-11, 2014, Lysebu

Sponsored by the Foundation for Danish-Norwegian Co-operation

Program

Monday, December 8

10.30-11.00 – Arrival, coffee/tea

11.00-11.05 Welcome

11.05-11.20 Greetings from the Foundation for Danish-Norwegian Co-operation

11.20-11.50 **G. Elliott** : *Recent progress in the classification of C^*-algebras.*

12.00-12.30 **J. Carrion** : *Almost flat bundles and K-theoretic quasidiagonality.*

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12.30-13.30 – Lunch

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15.00-15.30 **M. Landstad** : *Proper actions and coactions.*

15.30-16.00 – Coffee/tea

16.00-16.30 **N. Stammeier** : *Topological freeness for $*$-commuting covering maps.*

16.40-17.10 **A. Julien** : *K-theory of tiling groupoids, via a filtration.*

17.20-17.50 **T. Schmidt** : *Circle maps, transformation groupoids and Z_2-actions.*

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18.00-20.00 – Dinner

20.00 *Concert with Jacob Anderskov*

Tuesday, December 9

07.00-09.00 – Breakfast

09.00-09.30 **U. Haagerup** : *The Thompson groups F, T and V and their C^*- and von Neumann algebras.*

09.40-10.10 **H. Ando** : *On the noncommutativity of the central sequence algebra $F(A)$.*

10.10-10.40 – Coffee/tea

10.40-11.10 **S. Knudby** : *Approximation properties of simple Lie groups made discrete.*

11.20-11.50 **N. Larsen** : *C^*-completions of Gelfand pairs and property (T).*

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12.00-13.00 – Lunch

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Tuesday, December 9

15.00-15.30 **M. Matassa** : *An analogue of Weyl's law for quantized irreducible generalized flag manifolds.*

15.30-16.00 – Coffee/tea

16.00-16.30 **J. Kaad** : *Unbounded Kasparov products by differentiable Hilbert C*-modules.*

16.40-17.10 **B. Jordans** : *The Martin boundary of random walks on the dual of q-deformations of Lie groups.*

17.20-17.50 **B. Kwaśniewski** : *Pure infiniteness and ideal structure of C*-algebras associated with Fell bundles and product systems.*

18.00-18.30 **K. Li** : *Property A actions and proper cocycles.*

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19.00-21.00 – Dinner

Wednesday, December 10

07.00-09.00 – Breakfast

09.00-09.30 **S. Neshveyev** : *Quantum random walks and amenability.*

09.40-10.10 **T. Crisp** : *Hilbert bimodules and adjoint functors.*

10.10-10.40 – Coffee/tea

10.40-11.10 **L. Turowska** : *Schur multipliers of Cartan pairs.*

11.20-11.50 **E. Størmer** : *Normal states arising from quantum field theory.*

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12.00-13.00 – Lunch

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15.00-15.30 **D. Enders** : *On the Blackadar conjecture.*

15.30-16.00 – Coffee/tea

16.00-16.30 **N. Brownlowe** : *C*-algebras associated to graphs of groups.*

16.40-17.10 **T. Meier Carlsen** : *Graph algebras and orbit equivalence.*

17.20-17.50 **S. Arklint** : *Corners and other hereditary subalgebras of graph C*-algebras.*

18.00-18.30 **G. Restorff** : *Strong classification of purely infinite Cuntz-Krieger algebras and graph algebras.*

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19.00-21.00 – Dinner

Thursday, December 11

07.00-09.00 – Breakfast

09.00-10.00 – Departure

Speakers, titles and abstracts

Hiroshi Ando (University of Copenhagen):

On the noncommutativity of the central sequence algebra $F(A)$.

We show that the central sequence C*-algebra of the free group $\mathbb{F}_n$ ($n \geq 2$) is non-commutative, answering a question of Kirchberg from 2004. This is in contrast to the fact that the W*-central sequence algebra of the group von Neumann algebra $L(\mathbb{F}_n)$ is trivial. This is joint work with Eberhard Kirchberg.

Sara Arklint (University of Copenhagen):

Corners and other hereditary subalgebras of graph C^*-algebras.

Combining non-stable K-theory considerations with basic moves on a graph E with finitely many vertices, one can show that a unital C*-algebra Morita equivalent to the unital graph C*-algebra $C^*(E)$ is itself a graph C*-algebra. As a consequence, corners of Cuntz-Krieger algebras are Cuntz-Krieger algebras, and hereditary subalgebras of unital real rank zero graph C*-algebras are graph C^*-algebras. Combined with K-theoretical classification of C*-algebras with finitely many ideals, this becomes a powerful tool for constructing well-known and manageable concrete representations of various C*-algebras. This is joint work with J. Gabe and E. Ruiz.

Nathan Brownlowe (University of Wollongong):

C^*-algebras associated to graphs of groups.

We start with a brief recap of Bass-Serre theory, which concerns the relationship between graphs of groups and the actions of groups on trees. To a class of graphs of groups we build two C*-algebras: a universal C*-algebra built from generators and relations encoding the algebraic and geometric data in the graph of groups, and the crossed product C*-algebra induced from the action of the fundamental group of a graph of groups on the boundary of the universal covering tree of a graph of groups. We will examine the relationship between these C*-algebras. This is ongoing joint work with Alexander Mundey, David Pask, Jack Spielberg and Anne Thomas.

Toke Meier Carlsen (NTNU, Trondheim):

Graph algebras and orbit equivalence.

Recently Matsumoto and Matui proved that if A and B are two irreducible square matrices with entries in 0,1, then the corresponding two-sided topological Markov shifts are flow equivalent if and only if there is an isomorphism between the stabilizations of the Cuntz-Krieger algebras of A and B which maps the canonical maximal abelian subalgebra onto each other. An important ingredient of their proof of this result is a theorem of Matsumoto which says that there is an isomorphism between the Cuntz-Krieger algebras of A and B which maps the canonical maximal abelian subalgebra onto each other if and only if the one-sided topological Markov shifts corresponding to A and B are continuously orbit equivalent. In this talk, I will report on a recent preprint with Nathan Brownlowe and Michael Whittaker from the University of Wollongong in which we generalise the latter result to arbitrary graph algebras.

José Carrion (Penn State University and University of Copenhagen):

Almost flat bundles and K-theoretic quasidiagonality.

We will discuss recent joint work with Marius Dadarlat relating so-called almost flat K-theory classes (after Connes-Gromov-Moscovici) with a notion of "K-theoretic" quasidiagonality for C*-algebras, which aims to try to "see" the K-theory of a group C*-algebra using approximately multiplicative maps.

Tyrone Crisp (University of Copenhagen):

Hilbert bimodules and adjoint functors.

Each bimodule over rings A and B gives, via tensor product, a functor between the categories of modules over A and B. Thanks to work of Rieffel, Haagerup, and others, similar constructions are available when A and B are C*-algebras, and when one considers categories of Hilbert space representations, Hilbert C*-modules, or operator modules. I shall discuss the question of adjointability of these tensor product functors, and give an application to the representation theory of real reductive groups. This is joint work with N. Higson and P. Clare.

George Elliott (University of Copenhagen and University of Toronto):

Recent progress in the classification of C^*-algebras.

A (very) brief survey will be given of recent progress in the classification of separable amenable C*-algebras. There has been progress both in the general theory (with striking results by Matui and Sato), and in the study of examples. (A number of different constructions have been shown to give rise to C*-algebras that are not only amenable but amenable to classification!).

Dominic Enders (University of Copenhagen):

On the Blackadar conjecture.

Blackadar's conjecture states that Kirchberg algebras (with the UCT) are semiprojective precisely when their K-groups are finitely generated. The forward implication is easy to establish, and the backward implication was proved by Spielberg under the added assumption that the K_1-groups in question are free. I will discuss a new approach to some of the open cases, such as the tensor product of O_3 by itself.

Uffe Haagerup (University of Copenhagen):

The Thompson groups F, T and V and their C^*- and von Neumann algebras.

In the talk, I will give an introduction to the three Thompson groups F, T and V, and discuss some recent result obtained in collaboration with Søren Haagerup, Maria Ramirez-Solano and Kristian Knudsen Olesen.

It is a long standing open problem whether the Thompson group F is amenable, or equivalently whether its group von Neumann algebra $L(F)$ isomorphic to the hyper- finite II_1-factor R. Paul Jolissaint has proved that F is inner amenable and $L(F)$ has property Γ. In a recent work with Kristian Knudsen Olesen, we prove that T and V are not inner amenable and $L(T)$ and $L(V)$ does not have property Γ. We also prove that if the reduced C*-algebra $C_r^*(T)$ of T is simple, then F is non-amenable. In collaboration with Maria Ramirez-Solano and Søren Haagerup we use extensive numerical computations to test the amenability problem for F by estimating the norms of certain elements of $C_r^*(F)$. Numerical computations alone cannot detect whether or not F is amenable, but the results we have obtained suggest that the most likely outcome is that F is non-amenable.

Bas Jordans (University of Oslo):

The Martin boundary of random walks on the dual of q-deformations of Lie groups.

Let G be a compact semisimple simply connected Lie group and G_q its q-deformation. We will consider noncommutative random walks on the discrete dual $\widehat{G_q}$ of G_q. The restrictions of such a random walk to the dual of the torus and to the center of $\widehat{G_q}$ lead to classical random walks on the weight lattice P of G and on the cone of positive weights $P_+ \subset P$ of G. We will give a description of the Martin boundary of these classical random walks.

Antoine Julien (NTNU, Trondheim):

K-theory of tiling groupoids, via a filtration.

It is known that a C*-algebra associated with a free, minimal $\mathbb{Z}$-action on a Cantor set contain a "large" AF-subalgebra. In some cases, the K_0 group of this AF algebra is isomorphic to the one of the crossed-product algebra. When they are not, they are at least related by an exact sequence. Tiling C*-algebra are Morita equivalent to $\mathbb{Z}^d$-crossed products, and can be seen as a more general setting than $\mathbb{Z}$-actions. I will present a method (based on a paper by Putnam) for expressing the K-groups of a tiling algebra in terms of the K_0 group of an AF-subalgebra and the K-group of a "residual" algebra. By iteration, it can be shown that the computation of the K-groups of a tiling algebra can be reduced to the computation dimension groups and maps between them. This is joint work with Jean Savinien.

Jens Kaad (Hausdorff Institute for Mathematics, Bonn):

Unbounded Kasparov products by differentiable Hilbert C-modules.*

In this talk I will give an introduction to the current developments in unbounded KK-theory. The starting point for these investigations is to find explicit unbounded representatives for interior Kasparov products in bounded KK-theory. An example would here be to represent a K-homology class by an explicit spectral triple. This turns out to be deeply linked to the understanding of differentiable structures in Hilbert C*-modules.
After having reviewed the general framework I will focus on a situation of particular interest for the theory: One could consider an ideal in a C*-algebra which already carries a spectral triple (for example an open subset in n-dimensional Euclidean space). The problem of computing the unbounded Kasparov product then amounts to (the highly non-trivial task of) restricting the spectral triple to the ideal in question.

Søren Knudby (University of Copenhagen):

Approximation properties of simple Lie groups made discrete.

It has been known for about a century that the group $\mathrm{SO}(n)$ contains non-amenable, countable subgroups when $n \geq 3$. We show that when $n \leq 4$, all countable subgroups of $\mathrm{SO}(n)$ are weakly amenable, whereas for $n \geq 5$, $\mathrm{SO}(n)$ contains countable subgroups which are not weakly amenable. More generally, we consider the class of connected simple Lie groups equipped with the discrete topology. We show that within this class of groups the following approximation properties are equivalent: (1) the Haagerup property; (2) weak amenability; (3) the weak Haagerup property. In order to obtain this result, we prove that the discrete group $\mathrm{GL}(2, K)$ is weakly amenable with constant 1 for any field K. This is joint work with Kang Li.

Bartosz K. Kwaśniewski (University of Bialystok):

Pure infiniteness and ideal structure of C^*-algebras associated with Fell bundles and product systems.

We introduce the notions of exactness, topological freeness, aperiodicity and paradoxicality for Fell bundles over discrete groups. This will lead us to a complete description of ideal structure and criteria for pure infiniteness of associated reduced C^*-algebras. These results generalize the corresponding ones for (partial) crossed products due to Giordano, Sierakowski, Rørdam, or Archbold, Spielberg and others. We also plan to apply them to C^*-algebras associated with product systems over Ore semigroups. (Based on an ongoing joint work with Wojciech Szymanski).

Magnus B. Landstad (NTNU, Trondheim):

Proper actions and coactions.

If a locally compact group G acts on a locally compact space X, the action is called *proper* if the map $(g, x) \mapsto (gx, x)$ is proper. This is the usual definition, but there is also a weaker notion (usually called *wandering*) which only requires that the map $g \mapsto gx$ is proper for all x. I shall discuss various extensions of these concepts to actions and coactions of groups on C^*-algebras. This is joint work with S. Kaliszewski and J. Quigg.

Nadia S. Larsen (University of Oslo):

C^*-completions of Gelfand pairs and property (T).

Given an almost normal group-subgroup pair (Γ, Γ_0) one can associate a natural convolution $*$-algebra, the Hecke algebra $H(\Gamma, \Gamma_0)$, and work of Hall showed that $H(\Gamma, \Gamma_0)$ need not in general admit an enveloping C*-algebra. The Schlichting completion of the Hecke pair is given by a locally compact totally disconnected group G with a compact open subgroup U, as shown by Tzanev and, independently, by Kaliszewski, Landstad and Quigg. Then there are two C*-completions of the Hecke algebra, the enveloping C*-algebra of the L^1-Banach algebra of (G, U), and its quotient $p\,C^*(G)\,p$, where p is the projection equal to the characteristic function of U. Recently, Palma showed that $C^*(L^1(G, U))$ and $p\,C^*(G)\,p$ are distinct for the pair $(SL_n(\mathbb{Q}_p), SL_n(\mathbb{Z}_p))$ at $n = 2$. In the talk I will present joint work with R. Palma where the similar result is proved for all n larger than 3. I will also briefly discuss the question of existence of an enveloping C*-algebra of $H(G, U)$ when (G, U) is an arbitrary Gelfand pair.

Kang Li (University of Copenhagen):

Property A actions and proper cocycles.

Let G and H be locally compact second countable groups. Assume that G acts on a standard probability space (X, μ) in a measure class preserving way, then we can consider proper cocycles with target in H in the sense of Jolissaint. We define a notion for the pair (G, X), which is called "property A pair". Every amenable pair in the sense of Zimmer has property A. In this setting, if H has property A, so does G. In particular, property A is closed under group extensions and if G admits a lattice, which is an exact group, then G itself has property A.

Marco Matassa (University of Oslo):

An analogue of Weyl's law for quantized irreducible generalized flag manifolds.

We prove an analogue of Weyl's law for quantized irreducible generalized flag manifolds. By this we mean defining a zeta function, similarly to the classical setting, and showing that it satisfies the following two properties: as a functional on the quantized algebra it is proportional to the Haar state; its first singularity coincides with the classical dimension. The relevant formulae are given for the more general case of compact quantum groups.

Sergey Neshveyev (University of Oslo):

Quantum random walks and amenability.

Given a C*-tensor category $\mathcal{C}$ and a probability measure μ on the set of isomorphism classes of its simple objects, we define the Poisson boundary of $(\mathcal{C}, \mu)$. This is a new C*-tensor category $\mathcal{P}$ together with a unitary tensor functor $\Pi\colon \mathcal{C} \to \mathcal{P}$. The construction has appeared before under different guises. For example, the passage from a finite index subfactor to its standard model can be interpreted as a computation of the Poisson boundary of a category of Hilbert bimodules. Our main result is that if the classical random walk defined by μ has trivial Poisson boundary, then Π is a universal unitary tensor functor defining the amenable dimension function on $\mathcal{C}$. This unifies and generalizes various results in the literature on amenability of subfactors, quantum groups and C*-tensor categories. The result can also be used to classify a class of quantum groups, as well as to prove nonexistence of quantum groups with certain properties. (Joint work with Makoto Yamashita.)

Gunnar Restorff (University of the Faroe Islands):

Strong classification of purely infinite Cuntz-Krieger algebras and graph algebras.

The most natural way to extend K-theory of a C*-algebra to K-theory of a C*-algebra with a distinguished finite ideal lattice is to consider the so-called filtered K-theory. Purely infinite Cuntz-Krieger algebras have been shown to be classified by the filtered K-theory (up to stable isomorphism). Meyer-Nest have given counter examples to classification of purely infinite C*-algebras (separable, stable, nuclear, in the bootstrap class with finitely many ideals) by filtered K-theory, and Bentmann-Khler have characterized which ideal lattices give such a classification. We present an example of a purely infinite Cuntz-Krieger algebra with four primitive ideals, for which the filtered K-theory does not give strong classification (of the stabilization). We also show that for a smaller invariant - the reduced filtered K-theory - we have strong classification for all the stabilization of purely infinite Cuntz-Krieger algebras with at most four primitive ideals. If time permits, this will be compared to a recent result by Bentmann-Meyer. This is joint work with Sara Arklint and Efren Ruiz.

Thomas L. Schmidt (University of Aarhus):

Circle maps, transformation groupoids and Z_2-actions.

Starting with a self-map ϕ of the circle, we construct two tale groupoids, R_ϕ and R_ϕ^+, and study their reduced groupoid C^*-algebras. We show that $C_r^*(R_\phi)$ comes equipped with an outer order-two automorphism Γ, and that $C_r^*(R_\phi^+)$ is the fixed-point algebra of this automorphism. Under certain assumptions on ϕ, we use classification results to show that $C_r^*(R_\phi)$ is an AF-algebra while $C_r^*(R_\phi^+)$ is not, and calculate the K-theory of the two algebras. This is joint work with Klaus Thomsen and Benjamin Johannesen.

Nicolai Stammeier (University of Münster):

Topological freeness for $*$-commuting covering maps.

A countable family of $*$-commuting surjective, non-injective local homeomorphisms of a compact Hausdorff space X gives rise to an action θ of a countably generated, free abelian monoid P. To such a dynamical system (X, P, θ), we associate a universal C^*-algebra $\mathcal{O}[X, P, \theta]$. Within this setting we show that the following four conditions are equivalent: (X, P, θ) is topologically free, $C(X) \subset \mathcal{O}[X, P, \theta]$ has the ideal intersection property, the natural representation of $\mathcal{O}[X, P, \theta]$ on $\ell^2(X)$ is faithful, and $C(X)$ is a masa in $\mathcal{O}[X, P, \theta]$. As an immediate application, we characterise simplicity of $\mathcal{O}[X, P, \theta]$ by minimality of (X, P, θ). The approach is an adaptation of the strategy of Toke Meier Carlsen and Sergei Silvestrov for the corresponding result for a single covering map.

Erling Størmer (University of Oslo):

Normal states arising from quantum field theory.

In the C*-algebra setting of quantum field theory we have an increasing sequence of type I infinity factors N_n such that the relative commutant of N_n in N_{n+1} is also a type I infinity factor. Furthermore there is a vector x which is cyclic and separating for all N_n. The aim of the lecture is to study states which are convex sums of states of the form $B \to (A^*BAx, x)$ with A, B in the union of the N_n. For all n there is a minimal projection E in N_{n+1} such that $(Ax, x)\, E = EAE$ for all A in N_n. The main part of the talk will be on the $*$-algebra consisting of sums of operators $AEB,\ A, B$ in N_n and their relation to the states described above.

Lyudmila Turowska (Chalmers University of Technology):

Schur multipliers of Cartan pairs.

The von Neumann algebra $B(l^2)$ may be viewed as a set of infinite matrices. The diagonal matrices D form a maximal abelian selfadjoint subalgebra (a masa), and the normal D-bimodule maps turn out to be given by entrywise multiplication by a fixed matrix. These matrices are precisely the classical Schur multipliers of $B(l^2)$. In the 1970's, Feldman and Moore described a class of von Neumann algebras M arising from a countable measured equivalence relation, and this construction also gives a natural masa A in M. We explain how the normal masa bimodule maps in this context are again given by pointwise multiplication by a fixed function, and we call such functions the Schur multipliers of M. We also show that Grothendieck's characterisation of the Schur multipliers of $B(l^2)$ as $D \otimes_{eh} D$ does not generalise, since $A \otimes_{eh} A$ need not exhaust the Schur multipliers of M. This is joint work with R. Levene, N. Spronk and I. Todorov.

DNOA Workshop, Lysebu, Dec. 8-11, 2014 – Participants

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George Elliott (University of Copenhagen and University of Toronto)
Dominic Enders (University of Copenhagen)
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