Noncommutativity behind the dunes

Information booklet

October 28 - November 1, 2024, Delft

Practical information

Hotel

For invited speakers, we have reserved a room in the Hampshire hotel, Koepoortplaats 3, 2612 RR Delft. You can check in from 3pm; the reception is open 24 hours a day but you may need to use the intercom on the left side of the entrance to contact them over night.

Conference location

The conference location is the EWI building, Mekelweg 4, 2628CD Delft. The talks will be held in lecture hall Pi every day except Wednesday. On Wednesday it will be held in hall Data. For both hall Pi and Data: from the main entrance, continue walking straight until the end, then take the stairs to the first floor. On the first day we will place sign posts to guide you from the main entrance.

Lunch

We will provide lunch for all participants on Monday to Friday.

Reception

On Monday after the last lecture, we will have some drinks near the lecture hall.

Conference dinner

On Wednesday, we will have a conference dinner at restaurant *'t Postkantoor*, Hippolytusbuurt 14, 2611 HN Delft. Walk-in starts at 18:00, the dinner will start around 18:30.

Bars and restaurants

The best place to have some drinks in the evening is the Beestenmarkt, a square with several bars, which is 10 minutes walk from the Hamphshire hotel.

Public transport

Since Delft is a small city, you can get around by foot if you don't mind walking. Otherwise, you can use the bus by scanning your bank card. To get from the train station to the Hampshire hotel, you can either take bus 60 to the stop Hugo van Rijkenlaan or walk ($\sim$ 20 min.).
To get from the hotel to the campus it takes a 30 minute walk. You may also use busses that go from bus stop 'Zuidpoort' to 'Stieltjesweg' (numbers 69, 174) or 'Christiaan Huygensweg' (number 455) and walk another 10-15 mintues. However the total travel time is still about 30 minutes. We use https://9292.nl/en to find online information about bus itineraries.

If you have any questions, you can always ask one of the organisers:

- Francesca Arici, f.arici@math.leidenuniv.nl
- Martijn Caspers, m.p.t.caspers@tudelft.nl
- Bram Mesland, b.mesland@math.leidenuniv.nl
- Teun van Nuland, teunvn@gmail.com
- Matthijs Vernooij, m.n.a.vernooij@tudelft.nl
- Sophie Zegers, s.e.zegers@tudelft.nl

Workshop schedule

Abstracts

Monday

Lyudmila Turowska

Absolutely dilatable module maps.

I will discuss the notion of absolute dilation for maps on von Neumann algebras, focusing primarily on maps on $B(\mathcal{H})$ with an additional modularity condition. The notion was recently defined and studied by C. Duquet and C. Le Merdy. They characterized dilatable Schur multipliers. We extend the results by replacing the requirement of being Schur by being modular over arbitrary von Neumann algebra, instead of maximal abelian selfadjoint algebra. Such maps are characterized by the existence of a tracial von Neumann algebra $(\mathcal{N}, \tau)$, called an ancilla, and a certain unitary operator. Different types of ancillas (abelian, finite-dimensional, etc.) lead to the definition of local, quantum, approximate quantum, and quantum commuting dilatable maps, and I will discuss the relationships between these types. The motivation to study different types of dilations comes from Quantum Information Theory. The interrelation between QIT and dilatable maps will be explained.

The talk is based on an ongoing project with A. Chatzinikolaou and I. G. Todorov.

Jesse Reimann

On the best constants of Schur multipliers of second order divided difference functions

We give a new proof of the boundedness of bilinear Schur multipliers of second order divided difference functions, as obtained earlier by Potapov, Skripka and Sukochev in their proof of Koplienko's conjecture on the existence of higher order spectral shift functions. Our proof is based on recent methods involving bilinear transference and the Hörmander-Mikhlin-Schur multiplier theorem. Our approach provides a significant sharpening of the known asymptotic bounds of bilinear Schur multipliers of second order divided difference functions. Furthermore, we give a new lower bound of these bilinear Schur multipliers, giving again a fundamental improvement on the best known bounds obtained by Coine, Le Merdy, Potapov, Sukochev and Tomskova.

Preprint: arXiv:2405.00464

Eduardo Tablate Vila

The local geometry of idempotent Schur multipliers

Idempotent Schur multipliers have symbols $M = \chi A$ that are characteristic functions of smooth submanifolds $A \subset X \times X$ (where A satisfies a very lax and reasonable condition). Our main result provides a complete characterisation of Schur multipliers $S\_\chi A$ that are (locally) bounded on the Schatten classes in terms of the local geometry of A. Essentially it establishes that they are modelled by the triangular truncation. This has unexpected applications in the context of the von Neumann algebras of connected Lie groups, providing a complete description and characterisation of the nonsmooth Fourier multipliers that are (locally) bounded in their noncommutative L_p spaces. Both results are great noncommutative generalisations of the celebrated Fefferman's ball theorem. This is joint work with J. Parcet and M. de la Salle.

Runlian Xia

Proper cocycles and transferences for L_p-bounded Fourier multipliers

One of Haagerup's results gives a transference method from Fourier multipliers on a lattice of a locally compact group to the whole group. For a lattice $\Gamma < G$, some functions m on Γ can be transferred to functions $\tilde{m}$ on G with

$$\|T_{\tilde{m}}\|_{cb,\mathcal{L}(G)\to\mathcal{L}(G)} \leq \|T_m\|_{cb,\mathcal{L}(\Gamma)\to\mathcal{L}(\Gamma)},$$

where $T_{\tilde{m}}, T_m$ are Fourier multipliers associated with $\tilde{m}$ and m that are defined on the group von Neumann algebras $\mathcal{L}(G)$ and $\mathcal{L}(\Gamma)$, respectively. In this talk, we will present generalisations of Haagerup's result to the L_p case for any $1 < p < \infty$. As an application, we obtained new L_p-bounded Fourier multipliers on $SL(2, \mathbb{R})$ from the Hilbert transform on its lattice $SL(2, \mathbb{Z})$. This talk is based on joint work with Simeng Wang and Gan Yao.

Zhen-Chuan Liu

An unconditional decomposition of the Schatten-p classes.

This presentation will delve into the (complete) boundedness of Schur multipliers on the Schatten p-classes. In the1980s, J. Bourgain established a Marcinkiewicz-type testing condition for Toeplitz type Schur multipliers. Recently, we have shown that an analogue of J. Bourgain's theorem is applicable to non-Toeplitz type Schur multipliers as well. As an application, we obtain an unconditional decomposition for the Schatten-p class with $1 < p < \infty$. This talk is based on joint work with Chian Yeong Chuah and Tao Mei (arXiv:2209.13108).

Eske Ewert

Shubin calculi for actions of graded Lie groups

We introduce a new class of pseudodifferential operators associated to actions of graded Lie groups on vector spaces. In particular, this allows to extends the classical Shubin calculus on Euclidean space to these nilpotent groups. We use a groupoid approach similar to the one by van Erp and Yuncken to define the calculus and study how the properties of the action are reflected. A key application lies in the study of certain globally hypoelliptic operators which arise as generalizations of the harmonic oscillator. These have a principal symbol which is invertible in a noncommutative C*-algebra. Computing the spectrum of this C*-algebra allows to characterize ellipticity in the calculus. This is joint work with Philipp Schmitt (https://arxiv.org/abs/2407.14347).

Malte Leimbach

On spectral and Peter–Weyl truncations

In an attempt to treat physical constraints on the availability of spectral data, Connes–van Suijlekom introduced the notion of spectral truncations and asked if the state spaces of these converge as more spectral data is taken into account. We give an overview of some of the state of the art methods which have been used in tackling this problem, focussing in particular on Rieffel's compact quantum metric spaces, Kerr–Li's complete Gromov–Hausdorff distance and Li's invariant Lip-norms. We will see these methods at work in the examples of spectral truncations of tori and Peter–Weyl truncations of compact quantum groups.

Tuesday

Amaury Freslon

Gaussian processes on unitary quantum groups

Lévy processes on compact quantum groups are objects of probabilistic nature with connections to many different topics like cohomology or non-commutative geometry. Among these, the class of Gaussian processes is expected to play an important role, but appears to be quite subtle to handle. I will introduce these objects and explain results on Gaussian processes on unitary quantum groups from two perspectives. Firstly, a local one of classifying all the possible Gaussian processes and secondly a global one of understanding the so-called "Gaussian part" of the quantum groups. This is based on joint works with U. Franz and A. Skalski.

Mateusz Wasilewski

Frucht theorem for finite quantum groups

I will report on an on-going project with Michael Brannan, Daniel Gromada, Junichiro Matsuda, and Adam Skalski.

A classical result of Frucht says that every finite group can be realized as an automorphism group of a finite graph. Due to Banica and McCarthy, the following analogue does not hold: not every finite quantum group is a quantum automorphism group of a finite graph, e.g. the dual of the permutation group on three generators. Nevertheless we obtained a version of Frucht's theorem utilizing quantum graphs: every finite quantum group is a quantum automorphism group of a finite quantum graph. Moreover, the argument is more efficient than the original one in the case of classical groups. For a given finite quantum group we also tackled the following question: when can we find a quantum Cayley graph, whose quantum automorphism group is the original finite quantum group. I will offer some answers, mostly for duals of classical groups.

Uwe Franz

On the cohomology groups of free quantum groups

We will discuss the Hochschild cohomology of the free permutation quantum group and the free unitary and orthogonal compact quantum groups. For O_N^+ and U_N^+ we use free resolutions which allow also to compute other cohomology groups. This talk is based on joint work with Julien Bichon, Malte Gerhold, Isabelle Baraquin, Anna Kula and Mariusz Tobolski.

Suvrajit Bhattacharjee

Crystallization and K*-theoretical aspects of the quantum twistor bundle*

In this talk, I will report on an ongoing work with Sophie Emma Zegers. I will focus on the K-theoretical aspects of the quantum twistor bundle, which is an example of a quantum fiber bundle with a quantum homogeneous space as fibers, as introduced by Brzeziński and Szymański. In a recent work, Zegers describes the K-theory group of the total space of the bundle and conjectures a relation amongst the K-theory (and K-homology) groups of the fiber, the total space and the base of the quantum twistor bundle. I will describe this conjecture and how, using tools from the recently introduced notion of crystallization by Matassa-Yuncken and Laca-Neshveyev-Yamashita, we are able to settle this conjecture affirmatively.

Priyanga Ganesan

Noncommutative graphs and quantum homomorphisms

In this talk, I will discuss about a noncommutative generalization of graphs, known as Quantum Graphs and provide an overview of the different approaches to quantum graphs, in the context of operator algebras, noncommutative geometry and quantum information theory. We will see how homomorphisms between quantum graphs may be defined in the various contexts and how these different notions relate to one another.

Ulrik Enstad

Classifiability of C^*-algebras associated with point sets

A common construction in operator algebras associates to a discrete group a full and reduced group C*-algebra. In particular, this can be done for a lattice in a locally compact group. This talk concerns a more general construction that associates a (full or reduced) C*-algebra to a discrete point set in a locally compact group, for instance an approximate lattice. The main result I will present gives conditions

for when this C*-algebra is classifiable by its Elliott invariant. In particular, this is the case for certain aperiodic point sets in nilpotent Lie groups.

Wednesday

Evgenios Kakariadis

Operator algebras of product systems

Product systems provide a common language and context to encode geometric structures such as semigroups, graphs, dynamics etc. Their operator algebras have been under thorough study in the past 40 years with much success giving rise to two objects: (a) the maximal Fock-covariant C*-algebra, and (b) the minimal strong covariant C*-algebra. There are further links between these objects by using the nonselfadjoint operator algebra generated in the Fock representation. In this talk I will give an overview of the latest results in the field.

Walter van Suijlekom

A generalization of K-theory to operator systems

We propose a generalization of K-theory to operator systems. Motivated by spectral truncations of noncommutative spaces described by C^*-algebras and inspired by the realization of the K-theory of a C^*-algebra as the Witt group of hermitian forms, we introduce new operator system invariants indexed by the corresponding matrix size. A direct system is constructed whose direct limit possesses a semigroup structure, and we define the K0-group as the corresponding Grothendieck group. This is an invariant of unital operator systems, and, more generally, an invariant up to Morita equivalence of operator systems. For C^*-algebras it reduces to the usual definition. We illustrate our invariant by means of the spectral localizer.

Felipe Flores *Polynomial growth and functional calculus in algebras of integrable cross-sections.*

Given a Fell bundle over a locally compact group with polynomial growth, we show that the application of real-valued, compactly-supported smooth functions to compactly-supported continuous cross-sections of the bundle yields an integrable cross-section. This makes the Banach *-algebra of integrable cross-sections very special and close to a C*-algebra: many of its elements admit a functional calculus based on smooth functions. We explain the consequences of such a property. They include uniqueness of c*-norms, preservation of spectra and properties of automatic continuity. The talk will be based on arXiv:2401.09730.

Marzieh Forough *Recursive subhomogeneity or orbit breaking subalgebras of C^*-algebras associated to minimal homeomorphisms twisted by line bundles*

Recursive subhomogeneous algebras are a particularly tractable class of unital subhomogeneous C^*-algebras, which are given by iterated pullbacks of the form $C(X, M_n)$ for X a compact Hausdorff space. In this talk I will discuss that the orbit breaking subalgebras of Cuntz–Pimsner algebras associated to minimal homeomorphisms twisted by line bundles are recursive subhomogeneous algebras. This allows us to investigate further properties like $\mathcal{Z}$-stability of this class of C^*-algebras and their orbit-breaking subalgebras. This talk is based on joint work with Jeong and Strung.

Thursday

Are Austad

The ideal separation property for dense inclusions of $*$-algebras in C^*-algebras

We introduce the ideal separation property (ISP) for a dense inclusion of a $*$-algebra A into a C^*-algebra B, such as $L^1(G) \subseteq C_r^*(G)$ for a locally compact group G. The ISP says that closed ideals in B can be recovered by their intersection with A. Such inclusions satisfy several attractive properties from the point of view of harmonic analysis and noncommutative geometry. In particular, one can detect weak containment of $*$-representations of B, as well as describe the primitive ideal space of B, using elements from A.

This is based on joint work with Hannes Thiel.

Valerio Proietti

The rational HK conjecture

Building on previous work by Davis and Lück, and recent constructions of KK-theory as a stable ∞-category, I will sketch the construction of a Chern character running from the left-hand side of the Baum–Connes conjecture for ample groupoids with torsion-free isotropy to the periodicized homology groups of the given groupoid. This map is a rational isomorphism, thereby establishing a modified form of Matui's HK conjecture (after in-tegral counterexamples have been found). This construction also computes the rational homotopy type of the algebraic K-theory spectrum of ample groupoids as defined in a recent work by X. Li. This is joint work-in-progress with M. Yamashita.

Angus Alexander

Levinson's theorem as an index pairing in the presence of resonances

For Schrödinger operators on $L^2(\mathbb{R}^n)$, the wave operators of scattering theory can be shown to have a rather simple universal form. This form allows us to recognise the classical Levinson's theorem, which computes the number of eigenvalues, as an index pairing between the K-theory class of the scattering operator and an appropriate spectral triple. A careful analysis of the high and low energy behaviour of the scattering operator allows us to use the topological flexibility of this framework to prove Levinson's theorem in all dimensions, even in the presence of resonances.

Koen van den Dungen

Dirac-Schrödinger operators, index theory, and spectral flow

I will describe a general notion of Dirac-Schrödinger operators with arbitrary signatures (with or without gradings), which allows us to study index pairings and spectral flow simultaneously. I will provide a general Callias-type Theorem, which computes the index (or the spectral flow) of Dirac-Schrödinger operators from their restriction to a compact hypersurface. Time permitting, I will also discuss the relation with Toeplitz-type operators. These results generalise various known results from the literature, while presenting them in a common unified framework.

Dimitris Gerontogiannis

Heat operators and isometry groups of Cuntz–Krieger algebras

In this talk, we explore the heat semigroups of Cuntz–Krieger algebras using spectral noncommutative geometry. The key tool is the logarithmic Dirichlet Laplacian for Ahlfors regular metric measure spaces, which produces spectral triples on Cuntz–Krieger algebras from singular integral operators. These spectral triples exhaust the K-homology and for Cuntz algebras their heat operators turn out to be Riesz potential operators. Moreover, the isometry groups of the spectral triples admit a concrete description in

terms of symmetries of the associated directed graph of the Cuntz–Krieger algebra. Finally, Voiculescu's noncommutative topological entropy vanishes on those isometry groups. This is joint work with Magnus Goffeng (Lund) and Bram Mesland (Leiden).

Sara Azzali

Traces, KK-theory, and the Godbillon-Vey invariant

Traces on C*-algebras play an important role in index theory, particularly in extracting numerical invariants from classes defined in K-theory. By introducing real coefficients in Kasparov bivariant K-theory (KK-theory), traces can be regarded as classes in $KK_{\mathbb{R}}$. The process of applying a trace then corresponds to taking the Kasparov product. In this talk, we shall explain these constructions and their applications. Specifically, we will investigate a natural $KK_{\mathbb{R}}$-class that represents the Godbillon-Vey invariant of a foliation of codimension one. We shall see how the Godbillon-Vey invariant relates to a (densely defined) infinite trace, and its connection to the index theorem for measured foliations. This work is in collaboration with Paolo Antonini (Università del Salento) and Georges Skandalis (Université Paris Cité).

Friday

Mario Klisse

The Choquet-Deny property for groupoids

A countable discrete group is called Choquet-Deny if, for any irreducible probability measure on the group, the corresponding space of bounded harmonic functions is trivial. Despite many partial results, a characterization of this property in terms of the underlying structure of the group remained an open question for a long time. Only recently, building on the previous work of Jaworski, a complete characterization of Choquet-Deny groups was achieved by Frisch, Hartman, Tamuz, and Ferdowski. In this talk I will give a brief introduction into Choquet-Deny groups and then sketch how to define a suitable analogue of the Choquet-Deny property within the framework of discrete measured groupoids. Finally, I will explain our primary result, which offers a complete characterization of this property in terms of the isotropy groups and the equivalence relation associated with the given groupoid. This talk is based on joint work with Tey Berendschot, Soham Chakraborty, Milan Donvil, and Sam Kim.

Emilie Elkiær

Kazhdan-like rigidity for groups and algebras acting on Banach spaces

Property (TE) of Bader, Furman, Gelander, and Monod is a Kazhdan-like rigidity property concerning how a group may act on Banach spaces belonging to a class, E. In this talk, we explore different generalizations of this property to C*-algebras and Banach algebras and discuss how Property (TE) for a discrete or locally compact group is related to Property (TE) for its associated pseudofunction algebras. We are specifically interested in the case where E is the class of Lp-spaces. This talk is based on joint work with Sanaz Pooya.

Tatiana Shulman *On the (Local) Lifting Property*

The (Local) Lifting Property ((L)LP) is introduced by Kirchberg and deals with lifting completely positive maps. We will discuss various examples, characterizations and closure properties of the (L)LP and, if time permits, connections with some other lifting properties of C*-algebras. Joint work with Dominic Enders.