Information booklet

Conference on noncommutative harmonic analysis and rigidity theory in operator algebras

21-25 August 2023, Delft

Schedule

Monday

Time	Activity	Speaker
9:15 - 9:45	Reception	
10:00 - 10:50	50 min talk	Vaes
10:50 - 11:20	Coffee break	
11:20 - 12:00	40 min talk	Conde-Alonso
12:00 - 13:30	Lunch break	
13:30 - 14:00	30 min talk	Enstad
14:10 - 14:50	40 min talk	De Laat
14:50 - 15:20	Coffee break	
15:20 - 16:00	40 min talk	Thiel
16:10 - 16:50	40 min talk	Skripka
17:00	Social drinks	

Tuesday

Time	Activity	Speaker
9:30 - 10:10	40 min talk	Xia
10:20 - 11:00	40 min talk	Bekka
11:00 - 11:30	Coffee break	
11:30 - 12:00	30 min talk	White
12:00 - 13:30	Lunch break	
13:30 - 14:20	50 min talk	Mei
14:30 - 14:50	20 min talk	Van Nuland
14:50 - 15:20	Coffee break	
15:20 - 16:00	40 min talk	Wiersma
16:10 - 16:50	40 min talk	McDonald

Wednesday

Time	Activity	Speaker
9:30 - 10:10	40 min talk	Turowska
10:20 - 10:40	20 min talk	Hekkelman
10:40 - 11:10	30 min talk	Tablate
11:10 - 11:40	Coffee break	
11:40 - 12:30	50 min talk	Peterson
12:30	Lunch break	
18:30	Conference Dinner	

Thursday

Time	Activity	Speaker
9:30 - 10:10	40 min talk	Le Merdy
10:20 - 11:00	40 min talk	Cadilhac
11:00 - 11:30	Coffee break	
11:30 - 12:00	30 min talk	Klisse
12:00 - 13:30	Lunch break	
13:30 - 14:20	50 min talk	Hong
14:30 - 14:50	20 min talk	Krajczok
14:50 - 15:20	Coffee break	
15:20 - 16:00	40 min talk	Ricard
16:10 - 16:50	40 min talk	Beltita

Friday

Time	Activity	Speaker
9:30 - 10:10	40 min talk	Anantharaman-de la Roche
10:20 - 10:50	30 min talk	Borst
10:50 - 11:20	Coffee break	
11:20 - 12:10	50 min talk	Sukochev
No lunch provided		

Practical information

Hotel

For invited speakers, we have reserved a room in the Hampshire hotel, Koepoortplaats 3, 2612 RR Delft. You can check in between 14:00 and midnight.

Conference location

The conference location is the EWI building, Mekelweg 4, 2628CD Delft. The talks will be held in lecture hall Chip; from the main entrance, continue walking straight until the end, then take the stairs and enter the lecture hall on the left side.

Social drinks

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

Conference dinner

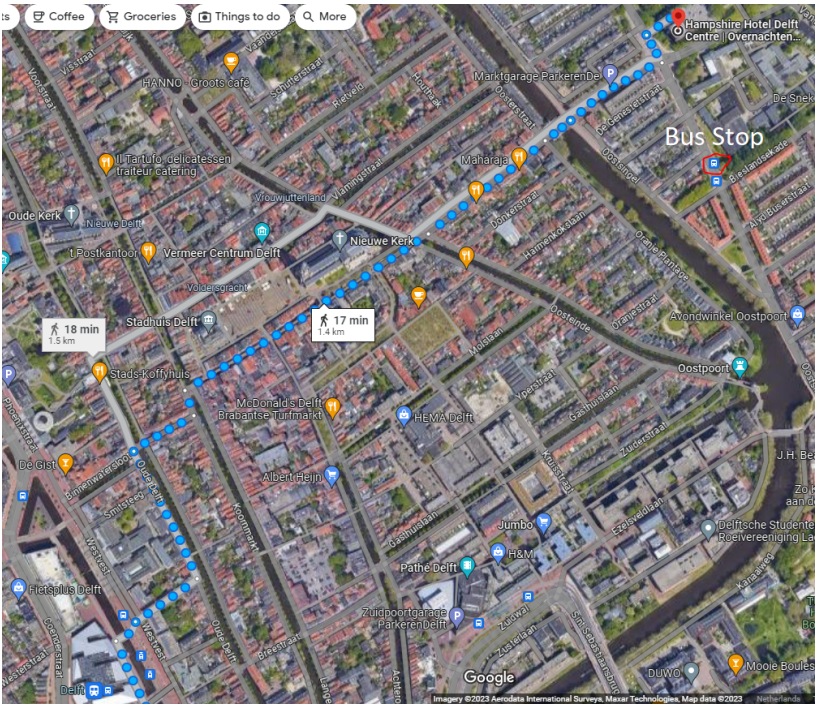
On Wednesday, we will have a conference dinner at restaurant 'Einstein', Spoorsingel 24, 2613 BE Delft. Walk-in starts at 18:30, the dinner will start around 19:00.

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. For instance café Belvédère has many good beer options. For dinner, there are nice restaurants with terraces at the Beestenmarkt, the Markt or the Doelenplein. For quality pizza, we recommend Il Peperoncino.

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, see the following map:



Sadly, there is no good bus connection between the hotel and the conference location. It is about 26 minutes by foot. You can also take bus 60 to Michiel de Ruyterweg and walk the remaining 13 minutes.

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

- Martijn Caspers, M.P.T.Caspers@tudelft.nl
- Jordy van Velthoven, J.T.vanVelthoven@tudelft.nl
- Matthijs Vernooij, M.N.A.Vernooij@tudelft.nl
- Gerrit Vos, G.M.Vos@tudelft.nl
- Matthijs Borst, M.J.Borst@tudelft.nl

Titles and Abstracts

Monday

Stefaan Vaes

Measure equivalence embeddings of free groups and free group factors

I will present a simple and explicit proof that the free group F_2 admits a measure equivalence embedding into any nonamenable locally compact second countable group. I will also explain a new II_1 factor analogue for the concept of measure equivalence embeddings and discuss its basic properties. In particular, we prove that a II_1 factor M is nonamenable if and only if the free group factor $L(F_2)$ admits such a measure equivalence embedding into M. The talk is based on recent collaborations with Tey Berendschot and Daniel Drimbe.

José Manuel Conde Alonso

Fourier multipliers on Lie group von Neumann algebras I: local results

The Hörmander-Mikhlin is the most important criterion for boundedness of Euclidean Fourier multipliers on L_p. In this talk, we explain how we establish regularity conditions for L_p-boundedness of compactly supported Fourier multipliers on the group von Neumann algebras of general Lie groups. These give sharp canonical forms of the Hömander-Mikhlin criterion in this setting, in terms of Lie derivatives of the symbol. Our approach is substantially different from the approach to the dual problem, developed by Cowling, Müller, Ricci, Stein and many others over the last decades, and which may only be applied to spectral multipliers. Our results for simple Lie groups give optimal regularity around the singularity. Our approach is based on a strengthening of our recent result on singular Schur multipliers, which also refines the cocycle-based approach introduced by Junge, Mei and Parcet. Based on joint work with A. González Pérez, J. Parcet and E. Tablate.

Ulrik Enstad

Spanning properties of lattice orbits of discrete series representations

Given a discrete series representation of a locally compact group, when does its restriction to a given lattice admit a cyclic vector? This problem is of relevance in applied harmonic analysis and can be approached using von Neumann algebras as shown by Bekka. In my talk, I will

give an introduction to this problem and its variations. In particular, one can ask for additional regularity of the cyclic vector or improved spanning properties of its orbit, which leads to a problem better approached using C^*-algebras.

Tim de Laat

Actions of higher rank groups on uniformly convex Banach spaces

I will explain that all affine isometric actions of higher rank Lie groups and their lattices on arbitrary uniformly convex Banach spaces have a fixed point. This vastly generalises a recent breakthrough of Oppenheim. Combined with earlier work of Lafforgue and of Liao on strong Banach property (T) for non-Archimedean higher rank groups, this confirms a long-standing conjecture of Bader, Furman, Gelander and Monod. As a consequence, we deduce that box space expanders constructed from higher rank lattices are superexpanders. This is joint work with Mikael de la Salle.

Hannes Thiel

Rigidity results for L_p-operator algebras

An L_p-operator algebra is a Banach algebra that admits an isometric representation on some L_p-space (p not 2). Given such an algebra A, we show that it contains a unique maximal sub-C^*-algebra, which we call its C^*-core. The C^*-core is automatically abelian, and its spectrum is naturally equipped with an inverse semigroup of partial homeomorphisms. We call the associated groupoid of germs the Weyl groupoid of A.

The Weyl groupoid contains information about the internal dynamics of the algebra A, and in some some cases it is a complete invariant. For example, given a topologically free action on a compact space, the Weyl groupoid of the reduced L_p-crossed product is simply the transformation groupoid of the action. This leads to strong rigidity results for reduced groupoid algebras and reduced crossed products.

We use our results to answer a question of Phillips: The L_p-analog of the Cuntz algebra O_2 is not isomorphic to its tensor square.

(Joint work with Yemon Choi and Eusebio Gardella.)

Anna Skripka

Asymptotic inference in quantum statistical models

We will discuss asymptotic equivalence of quantum statistical experiments pertaining to certain gauge invariant quasifree states on Fock spaces to classical experiments. The respective asymptotic equivalence is understood in the sense of the quantum Le Cam distance measuring the least trace-norm error incurred while mapping one model into another via quantum channels.

Tuesday

Runlian Xia

Fourier multipliers on HNN extensions

In this talk, we introduce some L_p-bounded Fourier multipliers for HNN extensions, with the help of Khinchine type inequalities on these groups. This work is based on a recent work with Adrián González and Javier Parcet. It is related to the results of Mei, Ricard and Xu who proved L_p-boundedness of the same type of Fourier multipliers on amalgamated free products of von Neumann algebras.

Bachir Bekka

The Bohr compactification of arithmetic groups

The Bohr compactification bG of a topological group G is a compact group naturally associated to G which is defined by a universal property with respect to all continuous homomorphisms from G to compact groups. In this talk, we will be concerned with the structure of bG in the case where G is an arithmetic group G in an algebraic group H. Using a Levi decomposition of H, we show how the study of bG reduces to the cases where H is unipotent and where H is semisimple. In the first case, bG admits a neat description in terms of the Bohr compactification of the abelianization of G and of the profinite completion of G. In the second case, using Margulis' superrigidity results, we can describe bG when H satisfies a higher rank condition.

Jared White

Asymptotic properties of group representations and ideals of measure algebras

Connections between the representations of a locally compact group and the ideal structure of the algebras associated with it have long been

known. For instance, the most basic example of this is a description of the maximal modular left ideals of the group C^*-algebra as annihilators of vectors in the irreducible representations of the group. In this talk we discuss recent work which establishes a connection between the weak*-closed maximal left ideals of the measure algebra $M(G)$, and the irreducible representations of G that vanish at infinity. We also discuss how a result of Barnes on integrable irreducible representations can be reinterpreted in this setting. Time permitting, we shall discuss some work in progress about two-sided ideals and weak*-simplicity.

Tao Mei

L^p-unconditional decompositions for free group von Neumann algebras

Let $\mathbb{F}_n, 2 \leq n \leq \infty$, be the non-abelian free group of n-free generators, and $\mathbb{F}_n^{(i)}$ be the subset of $\mathbb{F}_n$ consisting of reduced words starting with the i-th generator. The decomposition $\mathbb{F}_n = \cup_i \mathbb{F}_n^{(i)} \cup \{e\}$ is geometrically paradoxical and implies the nonameanablility of $\mathbb{F}_n$.

In a recent joint work with E. Ricard, we show that this decomposition for $\mathbb{F}_n, n \leq \infty$ is unconditional with respect to the noncommutative L^p-norm. This implies that the group von Neumann algebra of $\mathbb{F}_\infty$ admits a L^p-unconditional decomposition with infinitely many components that satisfy a geometrical paradoxical property. It is a mystery whether the group von Neumann algebra of $\mathbb{F}_2$ (or $\mathbb{F}_n$ for any n finite) admits such a decomposition.

In this talk, I wish to introduce recent progress in this direction. Part of the talk is based on a joint work with E. Ricard and Q. Xu.

Teun van Nuland

Spotting multiple operator integrals in nature

Multiple Operator Integrals are creatures that help us to deal with operators that do not commute. They can be defined in a couple of different ways, which is part of their beauty! Most definitions involve an integral over bounded operators alternately sandwiched between functions of unbounded operators. You are sure to spot one when approximating a function of an operator. Occasionally, they can be seen fluttering in big or small noncommutative spaces, or lounging about in the quantum fields.

Matthew Wiersma

New tensor products of C^*-algebras and characterization of rigidly symmetric C^*-algebras

We construct several new classes of bifunctors $(A, B) \mapsto A \otimes_\alpha B$, where $A \otimes_\alpha B$ is a cross norm completion of $A \odot B$ for C*-algebras A and B. For the first class of bifunctors considered $(A, B) \mapsto A \otimes_p^u B$ $(1 \leq p \leq \infty)$, $A \otimes_p^u B$ is a Banach algebra cross-norm completion of $A \odot B$ constructed in a fashion similar to p-pseudofunctions of a locally compact group. We also consider $\otimes_{p,q}^u$ for Hölder conjugate $p, q \in [1, \infty]$ – a Banach $*$-algebra analogue of the tensor product $\otimes_p^u$. By taking enveloping C*-algebras of $A \otimes_{p,q}^u B$, we arrive at a third bifunctor $(A, B) \otimes A \otimes_{C^*_{p,q}}^u B$, where the resulting algebra $A \otimes_{C^*_{p,q}}^u B$ is a C*-algebra.

For groups belonging to a large class of non-amenable discrete groups possessing both the rapid decay and Haagerup property, we show that the tensor products $C_r^*(G_1) \otimes_{C^*_{p,q}}^u C_r^*(G_2)$ coincide with a Brown-Guentner type C*-completion of $\ell^1(G_1 \times G_2)$, allowing us to conclude that if $2 \leq p' < p \leq \infty$, then the canonical quotient map $C_r^*(G_1) \otimes_{C^*_{p,q}}^u C_r^*(G_2) \to C_r^*(G_1) \otimes_{C^*_{p',q'}}^u C_r^*(G_2)$ is not injective.

A Banach $*$-algebra A is *rigidly symmetric* if the Banach space projective tensor product $A \otimes_\gamma B$ is symmetric for every C*-algebra B. A theorem of Kügler asserts that every type I C*-algebra is rigidly symmetric. Leveraging our new constructions, we establish the converse of Kügler's theorem by showing for C*-algebras A and B that $A \otimes_\gamma B$ is symmetric if and only if A or B is type I.

This is based on joint work with H.-H. Lee and E. Samei.

Edward McDonald

Operator Lipschitz and differentiable functions in quasi-Banach ideals

The continuity of functional calculus for bounded self-adjoint operators and for self-adjoint Schatten $\mathcal{L}_p$ class operators for $p > 1$ is now well-understood, but the quasi-Banach range $0 < p < 1$ presents new difficulties. The traditional techniques based on Littlewood-Paley theory or complex analysis break down for quasi-Banach spaces, and so it is necessary to use more advanced methods in approximation theory. I present some recent and forthcoming results in this direction (joint work with F. Sukochev).

Wednesday

Lyudmila Turowska

No-signalling values of cooperative quantum games

Finding values, the optimal winning probability, of various non-local games over different strategies has been an important task in Quantum Information Theory and also for resolving the Connes Embedding Problem. In this talk I will discuss values of quantum games (games with quantum inputs and outputs), arising from the type hierarchy of quantum no-signalling correlations, establishing operator space tensor norm expressions for each of the correlation types. This is a joint work with Jason Crann, Rupert Levene and Ivan Todorov.

Eva-Maria Hekkelman

Unbounded multiple operator integrals

Many formulas and cocycles in noncommutative geometry can be succinctly described as a multiple operator integral (MOI). Examples include Taylor expansions of the spectral action, the JLO cocycle and the "improper cocycle" in Higson's proof of the local index formula. For practical use, it would be very convenient to be able to make sense of a MOI as an unbounded operator when one of its entries is an unbounded operator. We provide a framework to do just that and use it to answer a question about the existence of certain asymptotic expansions. Joint work with Teun van Nuland, Fedor Sukochev and Dmitriy Zanin.

Eduardo Tablate Vila

Fourier multipliers on Lie group von Neumann algebras II: global results

In this talk we will explore global Hörmander-Mihklin type results for the L_p-boundedness of noncommutative Fourier multipliers on Lie group von Neumann algebras. We will consider first the case of nilpotent Lie groups, in which the regularity conditions are related with the decay properties of the Lie derivatives of the symbol with respect to the subRiemannian metric. This result is related with an anisotropic strengthening of some previous results on Schur multipliers that applies beyond the context of Schur multipliers in $\mathbb{R}^n$. We will also present some global results on semisimple Lie groups that generalize and im-

prove the results for $\mathrm{SL}_n(\mathbb{R})$ proved by Parcet, Ricard and de la Salle. This is a joint work with J. Conde, A. González-Pérez and J. Parcet.

Jesse Peterson

Biexact von Neumann algebras

The notion of biexactness for groups was introduced by Ozawa in 2004 and has since become a major tool used for studying solidity of von Neumann algebras. We introduce the notion of biexactness for von Neumann algebras, which allows us to place many previous solidity results in a more systematic context, and naturally leads to extensions of these results. We will also provide solid factors that are not biexact, for example, q-Gaussian von Neumann algebras associated to infinite dimensional Hilbert spaces with q not equal to -1, 0, or 1. This is based on joint work with Changying Ding.

Thursday

Christian le Merdy

A characterization of absolutely dilatable Schur multipliers

Let Ω be a separable measure space and let $\phi \in L^\infty(\Omega^2)$ be a function which induces a bounded Schur multiplier $T_\phi : B(L^2(\Omega)) \to B(L^2(\Omega))$. We characterize those functions ϕ for which there exist a tracial von Neumann algebra M with separable predual, a w^*-continuous trace preserving unital $*$-homomorphim $J : B(L^2(\Omega)) \to M$ and a trace preserving $*$-automomorphim $U : M \to M$ such that $T_\phi^k = EU^kJ$ for all integer $k \geq 0$, where $E\colon M \to B(L^2(\Omega))$ is the conditional expectation associated with J.

Léonhard Cadilhac

Noncommutative Calderon-Zygmund theory at the L_1 endpoint

Calderon-Zygmund operators were introduced in the middle of the 20th century and have since become a fundamental and polyvalent tool in classical harmonic analysis. Their adaptation to noncommutative integration more than ten years ago lead to several significant applications. This talk, mainly based on joint work with Parcet and Conde-Alonso, will be concerned with their behavior at the L_1 endpoint. I will discuss the improvements made to Parcet's original proof of weak (1,1) boundedness and the applications that have been following since.

Mario Klisse

Crossed products as compact quantum metric spaces

In 2013 Hawkins, Skalski, White and Zacharias constructed and investigated spectral triples on crossed product C*-algebras by actions of discrete groups which are in a natural sense equicontinuous. Following Connes, one of the ingedients of their construction are certain multiplication operators associated with length functions on the group. In their article they further formulated the question for whether their triples turn the corresponding crossed product C*-algebras into compact quantum metric spaces. By combining Rieffel's ideas on horofunction boundaries of groups with results from metric geometry, I will demonstrate that this is indeed the case for virtually abelian groups, equipped with suitable length functions.

Guixiang Hong

Sharp endpoint L_p estimates of quantum Schrodinger groups

We establish sharp endpoint L_p estimates of Schrödinger groups on general measure spaces which may not be equipped with good metrics but admit submarkovian semigroups satisfying purely algebraic assumptions. One of the key ingredients of our proof is to introduce and investigate a new noncommutative high-cancellation BMO space by constructing an abstract form of P-metric codifying some sort of underlying metric and position. This provides the first form of Schrödinger group theory on arbitrary von Neumann algebras and can be applied to many models, including Schrödinger groups associated with non-negative self-adjoint operators satisfying purely Gaussian upper bounds on doubling metric spaces, standard Schrödinger groups on quantum Euclidean spaces, matrix algebras and group von Neumann algebras with finite dimensional cocycles.

Jacek Krajczok

AP of locally compact quantum groups

One of the most widely studied properties of groups is the notion of amenability - in one of its many formulations, it gives us a way of approximation the constant function by functions in the Fourier algebra. The notion of amenability was relaxed in various directions: a very weak form of amenability, called the approximation property (AP),

was introduced by Haagerup and Kraus in 1994. It still gives us a way of approximating the constant function by functions in the Fourier algebra, but in a much weaker sense. During the talk I'll introduce AP for locally compact quantum groups, discuss some of its permanence properties and relation to w*OAP of quantum group von Neumann algebra. The talk is based on a joint work with Matthew Daws and Christian Voigt.

Éric Ricard

Sums of free variables

We aim to give norm estimates on sums of free variables with amalgamation in general symmetric spaces. This unifies the work of Junge Parcet and Xu for L_p spaces and Johnson-Schechtman inequalities by Sukochev and Zanin (when there is no amalgamation). This is a joint work with Léonard Cadilhac.

Ingrid Beltita

Open coadjoint orbits and representations of C^*-algebras of solvable Lie groups

We characterize the square-integrable representations of simply connected solvable Lie groups in terms on the bijective Pukànszky correspondence between the generalized orbits of the coadjoint action and the quasi-equivalence classes of normal representations. We show that the quasi-equivalence classes of type I square-integrable representations are in bijection with the simply connected open coadjoint orbits. Moreover, we show that the normal representations corresponding to open coadjoint orbits are always type I, and the existence of an open coadjoint orbit implies the existence of a compact open subset of the space of primitive ideals of the group C^*-algebra.

Friday

Claire Anantharaman-Delaroche

Amenability, exactness and weak containment property for groupoids

We will begin by comparing the various notions of exactness for groups and groupoids. It turns out that exactness plays a very important role in the study, for groupoids, of the analogue of Hulanicki's theorem: does the coincidence of the full and reduced C*-algebras of a groupoid

implies its amenabiliy? After reviewing the known partial results in the subject, we will conclude with a list of open problems.

Matthijs Borst

The CCAP for graph products of operator algebras

For a simple graph Γ and for unital C*-algebras with GNS-faithful states $(\mathbf{A}_v, \varphi_v)$ for every vertex v, we consider the reduced graph product $(\mathcal{A}, \varphi) = *_{v,\Gamma}(\mathbf{A}_v, \varphi_v)$, and show that if every individual C*-algebra $\mathbf{A}_v$ has the completely contractive approximation property (CCAP) and satisfies some additional condition, then the graph product has the CCAP as well. The additional condition imposed is satisfied in natural cases, for example for the reduced group C*-algebra of a discrete group G that possesses the CCAP. This result is an extension of the result of Ricard and Xu where they prove this result under the same conditions for free products. Moreover, this result also extends a result of Reckwerdt, where he proved for groups that weak amenability with Cowling-Haagerup constant 1 is preserved under graph products.

Fedor Sukochev

Alain Connes' question on spectral asymptotics

Take the Dirac operator $\mathcal{D} = \sum_{j=1}^{d} \gamma_j \otimes D_j$ on the Euclidean space $\mathbb{R}^d$ or torus $\mathbb{T}^d$, $d \geq 2$. This is an unbounded linear operator on the Hilbert space $\mathbb{C}^N \otimes L_2(\mathbb{R}^d)$. Its sign is defined by functional calculus or, equivalently, by

$$\operatorname{sgn} \mathcal{D} := \sum_{j=1}^{d} \gamma_j \otimes \frac{D_j}{\sqrt{D_1^2 + \ldots + D_d^2}}.$$

For a given measurable scalar function f on $\mathbb{R}^d$, we denote by M_f the linear operator in $L_2(\mathbb{R}^d)$ of pointwise multiplication by f. In this setting the quantum derivative is the operator $\bar{f} := i\,[\operatorname{sgn} \mathcal{D}, 1 \otimes M_f]$ acting on $\mathbb{C}^N \otimes L_2(\mathbb{R}^d)$.

We discuss Weyl type asymptotics for the quantised derivative $\bar{f}$ of a function f and the spectral asymptotics of the operator

$$(1 - \Delta)^{-\frac{d}{4}} M_f (1 - \Delta)^{-\frac{d}{4}},$$

where Δ is the Laplacian. This discussion is prompted by the 2017 conference "Noncommutative Geometry: State of the Art and Future

Prospects", where Alain Connes asked whether spectral asymptotic for the second operator can be proved in a direct manner. The answer to this question appears to be positive.

We provide a few examples. Let $d \geq 2$. If $f \in \dot{W}^1_d(\mathbb{R}^d)$ is real-valued, then

$$\lim_{t\to\infty} t^{\frac{1}{d}}\mu(t,\bar{f}) = \kappa_d \|\nabla f\|_{L_d(\mathbb{R}^d)},$$

where κ_d is a universal constant depending on d only. If $f \in L\log L(\mathbb{T}^d)$, the so-called Zygmund space, and if Δ is the Laplacian on $\mathbb{T}^d$, then there exists a limit

$$\lim_{t\to\infty} t\mu\big(t,(1-\Delta)^{-\frac{d}{4}} M_f (1-\Delta)^{-\frac{d}{4}}\big) = c_d\|f\|_1.$$

If $f \in L\log L(\mathbb{R}^d)$ is such that

$$\int_{\mathbb{R}^d} |f(s)|\cdot\log(1+|s|)ds < \infty$$

and if Δ is the Laplacian on $\mathbb{R}^d$, then there exists a limit

$$\lim_{t\to\infty} t\mu\big(t,(1-\Delta)^{-\frac{d}{4}} M_f (1-\Delta)^{-\frac{d}{4}}\big) = c_d\|f\|_1.$$

A similar assertion is available for compact Riemannian manifolds. This talk is based on several joint works with Rupert Frank and Dmitriy Zanin.