Facets of Operator Algebras
Facettes des algèbres opérateurs
(Org: **M. Ali Asadi-Vasfi** (Toronto), **George Elliott** (Toronto), **Ilijas Farah** (York), **Xuanlong Fu** (Fields) and/et **Maria Grazia Viola** (Lakehead))

JANANAN ARULSEELAN, McMaster University
Computable Continuous Logic, QWEP, and Type III Factors

By the recent MIP*=RE result, the QWEP conjecture is known to be false. Consequently, the universal theory of the hyperfinite II_1 factor is not computable. We discuss the uncomputability of the universal theories of other Powers factors and the lack of an effective axiomatization of QWEP C^* algebras. As an application we show that there is a ultraproduct of non-QWEP algebras with QWEP. This is joint work with Isaac Goldbring and Bradd Hart.

JASON CRANN, Carleton University
Quantum teleportation and subfactors

We will introduce quantum teleportation schemes in the commuting operator framework, in which locality is modelled by commuting observable algebras. For a large class of inclusions $N \subset M$ of tracial von Neumann algebras, we obtain a correspondence between "tight" teleportation schemes for the relative commutant $N' \cap M$ and unitary Pimsner-Popa bases for M over N. Time permitting, we will discuss applications to the representation theory of linking algebras of quantum automorphism groups. This is joint work with Alexandre Conlon, David Kribs and Rupert Levene.

KENNETH DAVIDSON, U. Waterloo & U. Ottawa
Positive Maps and Entanglement in Real Hilbert Spaces

Quantum mechanics is formulated as a complex theory, but our perception of the world is real. This was part of our motivation for studying positive maps on real Hilbert spaces. There are positive, hermitian maps on real spaces whose complexification is not positive. The notion of a separable map has a real version and a complex version, and there are real maps which are complex separable but not real separable. Finally we look at entanglement breaking maps and a real version of the PPT^2 conjecture.

ANDREW DEAN, Lakehead University
Structure and classification of real C-algebras*

We shall discuss recent progress on the structure and classification of real C^*-algebras.

JINTAO DENG, University of Waterloo
The coarse Baum-Connes conjecture for certain relative expanders

In 2000, G. Yu proved the coarse Baum-Connes conjecture for the metric space which admits a coarse embedding Hilbert space. However, there are counterexamples which are not coarsely embeddable into Hilbert spaces. Those counterexamples are so-called relative expanders. In this talk, I will talk about the coarse Baum-Connes conjecture for the relative expanders constructed by G. Arzhantseva and R. Tessera, based a joint work with Qin Wang and Guoliang Yu.

REMUS FLORICEL, University of Regina
C^*-subproduct and product systems

We introduce and discuss two-parameter subproduct and product systems of C^*-algebras as the operator-algebraic analogues of, and in relation to, Tsirelson's two-parameter product systems of Hilbert spaces. This is joint work with Brian Ketelboeter.

CRISTIAN IVANESCU, MacEwan University
The Cuntz semigroup and the structure of C-algebras*

In the early 2000s, Rordam and Toms constructed examples of non-isomorphic C*-algebras, which cannot be distinguished using K-theory, tracial simplexes and natural pairings, summed up as the Elliott invariant. Toms's algebras can be distinguished by their Cuntz semigroup. In subsequent work, Perera and Toms conjectured that adding Cuntz semigroup to the Elliott invariant classifies the class of simple, separable and nuclear C*-algebras. To date, no counter-examples to this conjecture are known. In my talk, I will explore various properties of the Cuntz semigroup. The ultimate goal is to make progress in the Perera-Toms conjecture.

MASOUD KHALKHALI, Western
Double scaling limits of Dirac ensembles and Liouville quantum gravity

In this work we study ensembles of finite real spectral triples equipped with a path integral over the space of possible Dirac operators. In the noncommutative geometric setting of spectral triples, Dirac operators take the center stage as a replacement for a metric on a manifold. Thus, this path integral serves as a noncommutative analogue of integration over metrics, a key feature of a theory of quantum gravity. From these integrals in the so-called double scaling limit we derive critical exponents of minimal models from Liouville conformal field theory coupled with gravity. Additionally, the asymptotics of the partition function of these models satisfy differential equations such as Painlevé I, as a reduction of the KDV hierarchy, which is predicted by conformal field theory. This is all proven using well-established and rigorous techniques from random matrix theory. (Based on joint work with H. Hessam and N. Pagliaroli in arXiv:2204.14206)

FEODOR KOGAN, University of Toronto
Groupoid models of the irrational rotation algebra

Building on a paper by George Elliott and Dickson Wong where the authors give a groupoid construction of the Rieffel projection, we will take a look at a sequence of groupoid models of the irrational rotation algebra and compute the K-theory of the corresponding groupoid algebras by modifying the proof of the Pimsner-Voiculescu six term exact sequence.

ARUNDHATHI KRISHNAN, University of Waterloo
Markovianity and the Thompson Group F

We show that representations of the Thompson group F yield a large class of bilateral stationary noncommutative Markov processes. As a partial converse, bilateral stationary Markov processes in tensor dilation form (and in particular, in the commutative setting) are shown to yield representations of F. We point out analogous results between unilateral stationary Markov processes and representations of the Thompson monoid F^+. This is joint work with Claus Koestler and Stephen J. Wills.

MARCELO LACA, University of Victoria
Equilibrium on C-algebras of product systems*

We generalize recent work of Afsar, Larsen and Neshveyev [ALN] describing KMS states of quasi-free dynamics on the Toeplitz C*-algebras of product systems over quasi-lattice ordered semigroups. KMS states are parametrized by traces on the coefficient algebra that satisfy a positivity condition. This positivity condition can be reduced to a finite set of inequalities for a wide class of right LCM monoids that properly contains finite-type Artin monoids, answering a question raised in [ALN]. This allows us to exhibit a finite-type Artin monoid with a gap in its inverse temperature space. Our main technical result uses a certain

tree recently constructed by Boyu Li to study dilations of contractive representations. For Noetherian right LCM monoids we also obtain a reduction of the positivity condition to inequalities arising from a minimal subset. This is joint work with Luca E. Gazdag and Nadia S. Larsen.

THERESE LANDRY, Fields Institute for Research in Mathematical Sciences
Noncommutative Solenoids, Length Functions on Twisted Group C^*-Algebras, and Inductive Limits of Spectral Triples

Noncommutative solenoids are inductive limit algebras built from rotation algebras. By viewing noncommutative solenoids as twisted group C^*-algebras, we construct compact quantum metric spaces, as well as spectral triples. Building on the work of Christ and Rieffel, Long and Wu defined length functions on twisted group C^*-algebras. Both of our constructions rely on such length functions. In particular, our spectral triples on noncommutative solenoids can also be shown, in the sense of Floricel and Ghorbanpour, to be inductive limit spectral triples on rotation algebras. This is joint work with C. Farsi, N. Larsen, and J. Packer.

JAVAD MASHREGHI, Laval University
Lebesgue's constants in local Dirichlet spaces

The partial Taylor sums S_n, $n \geq 0$, are finite rank operators on any Banach space of analytic functions on the open unit disc. In the classical setting of disc algebra $\mathcal{A}$, the precise value of $\|S_n\|_{\mathcal{A}\to\mathcal{A}}$ is not known. These numbers are referred as the Lebesgue constants and they grow like $\log n$, modulo a multiplicative constant, when n tends to infinity. We study $\|S_n\|$ when it acts on the local Dirichlet space $\mathcal{D}_\zeta$. There are several distinguished ways to put a norm on $\mathcal{D}_\zeta$ and each choice naturally leads to a different operator norm for S_n, as an operator on $\mathcal{D}_\zeta$. We consider three different norms on $\mathcal{D}_\zeta$ and, in each case, evaluate the precise value of $\|S_n\|_{\mathcal{D}_\zeta\to\mathcal{D}_\zeta}$. In each case, we also show that the maximizing function is unique.

JAMES MINGO, Queen's University
The Infinitesimal Distribution of Commutators and Anti-commutators

Given a unitarily invariant random matrix X_N and a fixed finite rank matrix F_N, it is known from the work of Sklyakhtenko (2018) and Collins, Hasabe, and Sakuma (2018) that X_N and F_N are asymptotically infinitesimally free. In joint work with Pei-Lun Tseng (NYU Abu Dhabi), we consider the commutator $i(X_N F_N - F_N X_N)$ and the anti-commutator $X_N F_N + F_N X_N$ and present a simple formula for their asymptotic infinitesimal distributions.

ZHUANG NIU, University of Wyoming
Weak Rokhlin Property and Weak Tracial Approximation

Consider a minimal C*-dynamical system (A, Γ), where A is a unital C*-algebra and Γ is a discrete amenable group. Let us study the structure of the crossed product C*-algebra $A \rtimes \Gamma$. Assume the system (A, Γ) has the Weak Rokhlin Property (WRP), then the crossed product C*-algebra $A \rtimes \Gamma$ is shown to be weakly tracially approximated by matrix algebras over hereditary sub-C*-algebras of A. As a consequence, if A locally has finite nuclear dimension, then C*-algebra $A \rtimes \Gamma$ is $\mathcal{Z}$-stable if, and only if, $\mathrm{Cu}(A \rtimes \Gamma) \cong \mathrm{Cu}((A \rtimes \Gamma) \otimes \mathcal{Z})$. Moreover, in the case that $|\Gamma| = \infty$, the C*-algebra $A \rtimes \Gamma$, $\mathcal{Z}$-stable or not, always has stable rank one if (A, Γ) has the property of Cuntz comparison of Open Sets (COS). It is also studied when the properties (WRP) and (COS) hold. This is a joint work with George Elliott, Chun Guang Li, and Qingyun Wang.

DOLAPO OYETUNBI, University of Ottawa
On ℓ-open and ℓ-closed C^*-algebras.

A separable C^*-algebra A is said to be ℓ-open (or ℓ-closed) when the image of Hom(A, B) is open (or closed) in Hom(A, B/I), for all separable C^*-algebras B and ideals I. The concept of semiprojectivity has been used many times in the classification of C*-algebras. Bruce Blackadar introduced ℓ-open and ℓ-closed C^*-algebras as a superclass of semiprojective C^*-algebras.

In recent work with A. Tikuisis, we characterize ℓ-open and ℓ-closed C^*-algebras and deduce that ℓ-open C^*-algebras are ℓ-closed as conjectured by Blackadar. Moreover, we show that the notion of ℓ-open C^*-algebras and semiprojective C^*-algebras coincide for commutative unital C^*-algebras.

CAMILA FABRE SEHNEM, University of Waterloo

A uniqueness theorem for Toeplitz algebras of semigroups

I will report on recent work with M. Laca, in which for each submonoid P of a group we define a universal Toeplitz C*-algebra $\mathcal{T}_u(P)$ via generators and relations that is canonically isomorphic to Li's semigroup C*-algebra when independence holds and works as expected when independence fails. I will focus on faithfulness of representations and uniqueness theorems for Toeplitz C*-algebras, presenting results that are new also for monoids that satisfy independence.

PAUL SKOUFRANIS, York University

Joint Majorization in Continuous Matrix Algebras

The notion of majorization of one self-adjoint $n \times n$ matrix by another appears in many different results in mathematics. A "multivariate majorization" often called joint majorization occurs by generalizing the notion of majorization from self-adjoint matrices to tuples of commuting self-adjoint matrices. In this talk, various notions of joint majorization will be examined in continuous matrix algebras. The relative strengths of these notions are established via proofs and examples. In addition, the closed convex hulls of joint unitary orbits are completely characterized in continuous matrix algebras via notions of joint majorization. Some of these characterizations are extended to subhomogeneous C*-algebras. (This is joint work with Xavier Mootoo and was funded by an NSERC USRA).

AARON TIKUISIS, University of Ottawa

Groupoids with prescribed torsion homology

The 0$^{\text{th}}$ homology group of an étale groupoid is an invariant closely connected to the C*-algebraic K_0-group. I will discuss a construction of étale groupoids with certain prescribed abelian groups as this invariant. Interestingly, we are able to arrange for a mixture of torsion and non-torsion. This is joint work with Hung-Chang Liao.