OPERATOR ALGEBRA IN THE SOUTH OF THE UK
BATH MEETING, 24TH NOVEMBER 2023

Schedule and location

Morning session - in the Chancellor building CB 3.9.
- 10.30: welcome tea & coffee
- 11-12: Xin Li

Afternoon session - in the Chancellor building CB 5.7.
- 13:15 - 13:40: Mahdie Hamdan (online)
- 13:40 - 14:05: Evelyn Lira Torres
- 14:05 - 15:05: Omar Moshen
  * Break *
- 15:30 - 16:30: Sophie Emma Zegers
- 16:30 - 17:00: Daniel Drimbe

Social Dinner. 18:30 at the Square Grill Restaurant
Address: 11-12 Abbey Churchyard, Bath BA1 1LY.

Speakers, titles and abstracts

Daniel Drimbe, University of Oxford
Rigidity theory for von Neumann algebras

Abstract. In the early 1940's, Murray and von Neumann found a natural way to associate a von Neumann algebra L(G) to any countable group G. The classification of von Neumann algebras has since been a central theme in operator algebras driven by the following question: what aspects of the group G are remembered by L(G)? The goal of this talk is to present major breakthroughs in the theory of von Neumann algebras and to survey some of the progress made recently using Popa's deformation/rigidity theory. We emphasise results which provide classes of groups that can be completely recovered from their von Neumann algebras.

Mahdie Hamdan, Cardiff University
Non-frustration free ground states of non-abelian quantum double models

Abstract. Quantum spin models are widely studied for their potential use in quantum computing, where they can serve as building blocks for quantum algorithms. Kitaev's quantum double model is of particular interest, as its properties could allow for fault-tolerance quantum computation. In two-dimensional quantum spin systems on the infinite lattice $\mathbb{Z}^2$, this model is known to exhibit a unique frustration-free ground state, although other ground states may exist, and it is theorized that these ground states always correspond to objects in a modular tensor category, deeply connected to the representation theory of the quantum double of an underlying group G. Using an operator algebraic approach, I will introduce Kitaevs quantum double model for a finite non-abelian group G on a lattice $\mathbb{Z}^2$ and present a complete family of non-frustration free ground states, called anyons, correlated to non-trivial irreducible representations of the quantum double $D(G)$. This is a joint work with Pieter Naaijkens.

Xin Li, University of Glasgow
Ample groupoids, topological full groups, algebraic K-theory spectra and infinite loop spaces

Abstract. Topological groupoids describe orbit structures of dynamical systems by capturing their local symmetries. The group of global symmetries, which are pieced together from local ones, is called the topological full group. This construction gives rise to new examples of groups with very interesting properties, solving outstanding open problems in group theory. This talk is about a new connection between groupoids and topological full groups on the one hand and algebraic K-theory spectra and infinite loop spaces on the other hand. Several applications in the context of homological invariants will be discussed. Parts of this connection already feature in work of Szymik and Wahl on the homology of Higman-Thompson groups.

Evelyn Lira Torres, Queen Mary University of London
Geometric Realisation of Spectral Triples

Abstract. We will introduce the formalism of Noncommutative Riemannian Geometry over unital algebras based on work by S. Majid and E. Beggs, this will set the basis to introduce a generalisation of A. Connes' Spectral Triples known as Geometric Realisation of Spectral Triples. With this we will show the geometric realisation of spectral triples on the Noncommutative Torus $\mathbb{C}_\theta[\mathbb{T}^2]$.

This is joint work with Prof. Shahn Majid in arXiv2208.07821.

Omar Mohsen, Université Paris-Saclay
On maximal hypoellipticity

Abstract. There are three questions one can naturally ask for linear differential operators: are there smooth solutions, are all solutions smooth, how many smooth solutions are there. I will try to give an overview of these questions. I will then present our work where we answer the second and third questions for a special class of differential operators called maximally hypoelliptic differential operators. This class contains both elliptic differential operators as well as Hörmanderś sum of squares operators.

This is joint work with Androulidakis and Yuncken.

Sophie Emma Zegers, Delft University of Technology
Split extensions and KK-equivalences for quantum flag manifolds

Abstract. In the study of noncommutative geometry, various classical spaces have been given a quantum analogue. Examples include Drinfeld-Jimbo quantum flag manifolds for which the C^*-completions have recently been described as graph C^*-algebras by Brzeziski, Krhmer, Buachalla and Strung. One example of a quantum flag manifold is the quantum complex projective space $C(\mathbb{C}P^n_q)$ which is known to be a graph C^*-algebra due to Hong and Szymaski.

In this talk, I will first present the explicit KK-equivalence between $C(\mathbb{C}P^n_q)$ and the commutative algebra $\mathbb{C}^{n+1}$ constructed in collaboration with Francesca Arici. The KK-equivalence is constructed by finding an explicit splitting for the short exact sequence of C^*-algebras $\mathcal{K} \to C(\mathbb{C}P^n_q) \to C(\mathbb{C}P^{n-1}_q)$. In the construction of a splitting it is crucial that $C(\mathbb{C}P^n_q)$ can be described as a graph C^*-algebra. Secondly, I will present how this approach can be used to construct KK-equivalences in the more general framework of quantum flag manifolds which is based on ongoing work with Ramonn Buachalla and Karen Strung.