

**Seminar in Summer Semester 2023:
Tensor Products and Kirchberg's Conjectures**

Some of the most central and nuanced constructions in operator algebras are tensor products. Universal facts from the purely algebraic setting become powerful properties that hold for only certain classes of operator algebras, and some of the deepest questions and most powerful techniques in the field can be captured or characterized in the language of tensor products. One of the chief players in the evolution of our understanding of the depth and power of C^* -tensor products was Eberhard Kirchberg. In this seminar, we will explore the nuances of the theory and delve into Kirchberg's remarkable insights into the structure of tensor products and how the language of tensor products can create a bridge connecting seemingly distant problems in von Neumann algebras, C^* -algebras, group theory, Free Probability/Random Matrix Theory, Quantum Information and Computability Theory, etc.. This seminar will also serve as a lead up to the conference "C*-Algebras: Tensor Products, Approximation & Classification" held in Münster on 17-21 July 2023.

Suggested Topics

1. Injectivity and weak injectivity.
2. Exact sequences of tensor products.
3. Exactness and tensor products.
4. Tensor products of residually finite (dimensional) group C^* -algebras.
5. Kirchberg's Local Lifting Property (LLP).
6. Tensorial Characterizations of weak injectivity and the LLP.
7. Kirchberg's conjectures (including QWEP).
8. Coding unitaries and the (failure of) the local lifting property for $B(\ell^2)$.
9. Connes Embedding Problem, hyperlinear groups, and matrix-microstates/random matrices.
10. Model Theory and Connes Embedding Problem.
11. The equivalence of Connes Embedding Problem with Kirchberg's QWEP conjecture.
12. Tsirelson's Problem for quantum correlations and Kirchberg's QWEP conjecture.
13. Property (T), Residual finiteness, and the LLP. (Factorization property and non-LLP groups.)
14. Exotic C^* -tensor norms.
15. \mathcal{O}_2 embedding/ \mathcal{O}_∞ stability.

Practical Info

- The seminar takes place Wednesdays, 14:15-15:45 Room TBA.
- The seminar is aimed at masters students who have seen Operator Algebras I. It will run in tandem with Operator Algebras II, sometimes anticipating and sometimes supplementing material therein.
- The preliminary meeting takes place on **1. February, 2023 at 16:00 (sharp = s.t.) in SRZ 216/217.**
- Students may request preferred topics at the meeting or following the meeting by emailing either Prof. Courtney or Dr. Evington.
- You will be expected to submit a draft of the write up at least two weeks before the presentation, at which point a meeting with either Prof. Courtney or Dr. Evington should be arranged to discuss the presentation and clarify any details from the material as needed. The final write up should be submitted within a week of the presentation. Naturally we are available for questions outside of this meeting.