

Von Neumann Algebras meet Quantum Information Theory

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Abstract: The study of quantum correlations arising under two different assumptions of commutativity of observables, initiated by Tsirelson in the 80's, has proven over the last decade to have deep interconnections with important problems in operator algebras theory, including various reformulations of the Connes Embedding Problem. In very recent work with M. Rørdam, we show that in every dimension $n \geq 11$, the set of $n \times n$ correlation matrices arising from unitaries in finite dimensional von Neumann algebras is not closed. As a consequence, in each such dimension there are quantum channels that admit type II_1 -von Neumann algebras as ancillas, but not finite dimensional ones.

I will also discuss in (more) detail the class of quantum channels that possess a certain factorizability property (introduced by Anantharaman-Delaroche). The study of these channels has led to counterexamples to the Asymptotic Quantum Birkhoff Conjecture, as well as to further reformulations of the Connes Embedding Problem.