

# Non-closure of quantum correlation matrices and certain factorizable maps, traces on free product $C^*$ -algebras, and the Connes Embedding Problem

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We show that the convex set of factorizable quantum channels on a fixed matrix algebra of size at least 11 which factor through finite dimensional  $C^*$ -algebras is non-closed, and that there exist factorizable quantum channels on matrix algebras that require an ancilla of type  $II_1$ . We also give a simplified proof of the result by Dykema, Paulsen and Prakash that the set of synchronous quantum correlations  $C_q^s(5, 2)$  is non-closed. One can describe factorizable quantum channels on a given matrix algebra in terms of traces on the unital free product of that matrix algebra with itself. We give a description of which of these traces correspond to factorizable maps that can be approximated by ones with finite dimensional ancilla, and we relate this to the Connes Embedding Problem.

This is joint work with Magdalena Musat.

**Auteur principal:** RORDAM, Mikael (Univ. Copenhagen)

**Orateur:** RORDAM, Mikael (Univ. Copenhagen)