# FINITE-DIMENSIONAL APPROXIMATIONS OF QUANTUM SYSTEMS AND CONNES' EMBEDDING CONJECTURE

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We study the requirements for and implications of the existence of finite-dimensional approximations of quantum systems with an infinite number of degrees of freedom. We find a close relationship between these physical questions and the embedding problem of Alain Connes, appearing in the theory of von Neumann algebras. We are mainly interested in the bipartite scenario known from quantum information theory, where two independent parties act on a joint physical system, *i.e.* by performing measurements. This later example leads to Tsirelson's problem, which asks whether the modeling of bipartite situations using the usual approach of tensor product of Hilbert spaces compared to the situation of only commuting observables leads to the same correlation tables. We model this situation using the theory of operator systems and explain the connection to Connes' embedding problem. We go on by employing the language of operator systems to elaborate on the requirements for the existence of finite-dimensional approximations for general quantum systems. We furthermore introduce the concept of ultraproducts of operator systems and use it to study the implications of two different kinds of finite-dimensional approximations.

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