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Entanglement for any definition of two subsystems

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The notion of entanglement of quantum states is usually defined with respect to a fixed bipartition. Indeed, a global basis change can always map an entangled state to a separable one. The situation is however different when considering a set of states. This talk presents the notion of "absolutely entangled set" of quantum states: sets such that for any possible choice of global basis, at least one of the states in the set is entangled. Such a set has the peculiarity of featuring entanglement for any possible definition of the subsystems. We present a minimum example of this phenomenon, with a set of four states in C^4=C^2⊗C^2. Moreover, we propose a quantitative measure for absolute set entanglement. To lower-bound this quantity, we develop a method based on polynomial optimization to perform convex optimization over unitaries, which is of independent interest.

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