On the superactivation of quantum nonlocality and the B-nonlocality

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Abstract

Some striking properties arise in quantum theory that are very 'strange' from a fundamental point of view, yet very useful in a practical way for the development of the so-called quantum technology. In this talk, we review two very recent results concerning entanglement and its relation to nonlocality, the latter understood in the sense of Bell's theorem [1]. It is well known that all separable states are local states. As proved by Werner, there also exist entangled states that are local [2]. The first result, through the concept of superactivation of quantum nonlocality [3, 4], makes possible to start from an entangled local Werner state ρ_W and, by taking k times its own direct product ($\rho_W^{\otimes k}$), obtain a new entangled state that is nonlocal. This very powerful and counterintuitive result suggests that the states ρ_W contain a kind of "hidden nonlocality" that can be activated through tensor products. We review and discuss the proof of such superactivation via the use of quantum game theory, within the framework of the Khot-Vishnoi game [5].

The second result is that all entangled states contain a kind of nonlocality [6], the Buscemi (B)-nonlocality [6], which in turn has been proven useful in the so-called semiquantum games. The relationship between the 'standard' nonlocality and this new B-nonlocality is an open problem; we give and outlook and discussion about this subject.

Keywords: Nonlocality, Superactivaction, Entanglement, Quantum games, Semiquantum games.

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