

Quantum Physics

Entanglement and nonlocality of a single relativistic particle

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Recent work has argued that the concepts of entanglement and nonlocality must be taken seriously even in systems consisting of only a single particle. These treatments, however, are nonrelativistic and, if single particle entanglement is fundamental, it should also persist in a relativistic description. Here we consider a spin-1/2 particle in a superposition of two different velocities as viewed by an observer in a different relativistically-boosted inertial frame. We show that the entanglement survives right up to the speed of light and that the boosted observer would see single-particle violations of Bell's inequality. We also discuss how quantum gates could be implemented in this way and the possible implications for quantum information processing.

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