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On the feasibility of Bell Inequality violation at ATLAS experiment with flavor entanglement of B meson pairs from proton-proton collisions

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The Bell inequality is a principal touchstone of testing the local realism posited by Einstein at the time of the formation of quantum theory. The violations of the Bell inequality have been found with the measured system of photons, electrons or nucleons at low energies, which reject local realism. Extending to systems with higher energies will be important for establishing the nonlocal nature universally.

This talk will present a simulation study on the feasibility of the Bell test by means of flavor entanglement of a pair of B mesons in the ATLAS experiment at CERN. Our results show that it is capable to find the maximal violation of the Bell inequality at the time difference of 1.5 ps in the decays of the two entangled B mesons, rejecting yet again the local realism at the highest energy scale 14 TeV ever. This will be the first case of Bell inequality violation in particle physics experiment, given that the earlier analysis with the Belle experiment was found to be inconclusive, due primarily to the lack of selection process of spacelike events and the inability of independent identification of the decay times.

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