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Quantum Entanglement and Bell Inequality Violation in Semi-Leptonic Top Decays

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Quantum entanglement is a fundamental property of quantum mechanics. Recently, studies have explored entanglement in the top-anti-top system at the Large Hadron Collider (LHC) when both the top quark and anti-top quark decay leptonically. Entanglement is detected via correlations between the polarizations of the top and anti-top and these polarizations are measured through the angles of the decay products of the top and anti-top. In this talk, I propose searching for evidence of quantum entanglement in the semi-leptonic decay channel where the final state includes one lepton, one neutrino, two b-flavor tagged jets, and two light jets from the W decay. This channel is both easier to reconstruct and has a larger effective quantity of data than the fully leptonic channel. As a result, the semi-leptonic channel is 60% more sensitive to quantum entanglement and a factor of 3 more sensitive to Bell inequality violation, compared to the leptonic channel.

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