

High Energy Physics - Phenomenology

Spin Correlation Effects in Top Quark Pair Production at the LHC

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At a 14 TeV proton-proton collider, the Large Hadron Collider (LHC), we show that top quark pair production is dominated at low invariant mass by the fusion of two like-helicity gluons, producing top quark pairs in the left-left or right-right helicity configurations. Whereas, at higher invariant mass the production is dominated by the fusion of unlike-helicity gluons, producing top quark pairs in the up-down or down-up off-diagonal configurations, identical to top quark pair production via quark-antiquark annihilation. We study in detail the low invariant mass region, and show that the spin correlations can be easily observed in this region by looking at the distribution of the difference in the azimuthal angles, $\Delta\phi$, of the dileptons decay products of the top quarks in the laboratory frame. Due to the large cross section for top pair production at the LHC, even with a cut requiring that the invariant mass of the top quark pair be less than 400 GeV, the approximate yield would be 10^4 di-lepton (e, μ) events per fb^{-1} before detector efficiencies are applied. Therefore, there is ample statistics to form the $\Delta\phi$ distribution of the dilepton events, even with the invariant mass restriction. We also discuss possibilities for observing these spin correlations in the lepton plus jets channel.

Comments: 27 pages, 11 postscript figures. A trivial error in Fig 11 was corrected which does not affect the conclusions

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