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Search for the SM (and BSM) production of four top quarks in the ATLAS detector at the LHC

The top quark is the heaviest elementary particle we know. Therefore, it plays a very special role in the Standard Model of particle physics (SM). Its Yukawa coupling to the Higgs boson is close to one, which makes this particle a key element of many Beyond the Standard Model (BSM) theories.

The LHC, located at CERN (Geneva, Switzerland) is a proton - proton collider with a center-of-mass energy of 13 TeV since 2015. The LHC runs at the highest energy and luminosity ever reached by an accelerator. It is then able to study very rare collision scenarios, or “events”, such as four top production: $t\bar{t}t\bar{t}$.

This reaction $pp \rightarrow t\bar{t}t\bar{t}$ is extremely rare, and has a theoretical cross-section of 9.2 fb, so we expect to produce only ~ 1000 such events in the LHC by 2018, compared to the 40 million events per second!

Therefore, the analysis performed to study these events selects only events with two leptons of the same charge, to reject most of the background events coming from $t\bar{t}$ events.

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