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Measurement of the top quark pole mass using double differential cross section with the ATLAS detector at the LHC

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The top quark mass (m_t) is a key parameter of the Standard Model (SM). Its large size, of the order of the electroweak scale, is associated with a Yukawa coupling of order 1, that gives important contributions, via radiative corrections, to SM observables. After the Higgs boson discovery and the accurate measurement of its mass, the allowed values of the W boson and top quark masses have become strongly correlated, so that an accurate determination of both would lead to a SM test of considerable precision. The top mass value is also critical in the issue of vacuum stability in the SM.

The determination of the top quark pole mass ($m_{t,pole}$) requires the measurement of quantities that can be calculated theoretically, for example the inclusive $t\bar{t}$ production cross section, which depends on $m_{t,pole}$. Therefore, its measurement allows to indirectly measure $m_{t,pole}$.

The huge $t\bar{t}$ samples collected at the LHC with ATLAS detector allow the measurement of differential production cross sections $d_{t\bar{t}}/dX$, where X is a kinematical variable of the $t\bar{t}$ system. The full information available in differential cross sections can be exploited for the determination of $m_{t,pole}$ if theoretical calculation for differential $t\bar{t}$ production cross sections are available for different values of $m_{t,pole}$. This technique has been recently applied by D0 experiment at Tevatron. The $t\bar{t}$ samples available at the LHC after collection of 100 fb^{-1} of collision data will allow the measurement of double-differential $t\bar{t}$ production cross sections. Using these distributions to extract $m_{t,pole}$ has the advantage that possible correlations between variables are automatically taken into account.

The comparison between differential cross section measurements corrected at the parton-level and their theoretical calculations for different m_t values will allow to extract $m_{t,pole}$.

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