

First simultaneous measurement of single and pair-production of top quarks in association with a Z boson

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In the years 2016-2018 the CMS Experiment at CERN's Large Hadron Collider (LHC) recorded a large amount of proton-proton collision data at a centre of mass energy of 13 TeV, corresponding to an integrated luminosity of 138 fb^{-1} . With this large dataset, the associated production of top quarks with the Z boson has been measured precisely and differentially. However, background processes were always assumed to follow the expectations of the Standard Model (SM). In this measurement, for the first time, $t\bar{t}Z$, tWZ and tZq are measured simultaneously and differentially. The measurement will therefore be more sensitive to new physics, and particularly suitable for effective field theory interpretations. Due to the large overlap between $t\bar{t}Z$ and tWZ , separating the two processes is extremely challenging both theoretically and experimentally, therefore their sum is reported in the results.

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