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Measurement of a single top quark production in association with a Z boson in ATLAS

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The total cross-section of a single top quark production in association with a Z boson is measured in proton-proton collision data at a center-of-mass energy of 13 TeV recorded by the ATLAS experiment at LHC. The full Run II dataset (2015-2018) which corresponds to an integrated luminosity of 139 fb^{-1} is analysed. In this production mechanism, the top quark is produced via the t-channel and the Z boson is either radiated off from one of the participating quarks or produced via W boson fusion, leading to a signature of a single top quark, a Z boson and an additional quark. Events are selected based on the presence of three leptons (electrons or muons), two or three jets (one identified as coming from a b-quark), and substantial missing transverse energy. The three leptons come from leptonic Z boson decay and semi-leptonic top quark decay. Major backgrounds come from diboson, $t\bar{t}V$, Z+jets and $t\bar{t}$. The non-prompt leptons background processes which are difficult to simulate are studied by implementing different isolation criteria. A python based (tensorflow) neural network algorithm is trained in order to separate the signal and background distributions. A simultaneous binned maximum-likelihood fit of the signal regions and control regions is performed and from the fit cross-section is extracted. The extracted cross-section of tllq is $\sigma(pp \rightarrow tZq \rightarrow Wbl^{+}l^{-}q)$ = 132 ± 12 (stat) ± 17 (syst) fb with the SM prediction of 102 fb under the assumption of a top-quark mass of m_t = 172.5 GeV.

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