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(I) Measurements of Z boson production in association with two jets using the ATLAS Run-II dataset

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The electroweak production of a Z boson in association with two jets is measured using the full Run-II dataset of the ATLAS experiment. This EW-Zjj process is a fundamental process of the Standard Model (SM), it is sensitive to vector boson fusion Z boson production via the WWZ triple gauge vertex. The process is difficult to study, so an advanced methodology is employed to measure the EW-Zjj signal by exploiting topological features. This methodology and the large dataset collected during Run-II have made it possible to measure the cross section of EW-Zjj differentially for the first time. The cross section is measured as a function of four observables: the invariant mass of the two jet system, the rapidity interval spanned by the two jets, the signed azimuthal angle between the two jets, and the transverse momentum of the Z boson. The observed total fiducial cross section of EW-Zjj is 37.14 ± 3.47 (stat.) ± 5.79 (syst.) fb.

The techniques developed for this analysis can be applied to the measurement of other electroweak processes such as vector boson fusion Higgs production. EW-Zjj is also an important background for vector boson scattering processes that are of growing interest for searches of deviations from the SM. The differential cross sections themselves provide two avenues for testing the SM. First, the measurements are sufficiently precise as to distinguish between different state-of-the-art theoretical predictions. Knowledge gained here is applicable to other areas, such as Higgs physics. Second, the differential cross sections are used to test deviations from the SM attributed to higher order corrections in the WWZ vertex by exploiting the sensitivity of a parity-odd observable with an effective field theory approach.

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