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# Production of $W$ , $Z$ , and charged hadrons in Pb+Pb collisions with the ATLAS detector

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Measurements of  $W^\pm$ ,  $Z$ , and charged-hadron production in Pb+Pb collisions at  $\sqrt{s_{NN}} = 5.02$  TeV are presented using data recorded by the ATLAS experiment at the LHC in 2015 corresponding to a total integrated luminosity of  $0.49 \text{ nb}^{-1}$ .

The electro-weak (EW) bosons are reconstructed in both the electron and muon decay channels.

The EW boson yields measured in Pb+Pb collisions, normalised by the total number of minimum-bias events and the mean nuclear thickness function, are compared with similar measurements made in pp collisions at the same centre-of-mass energy.

The results are compared with predictions based on next-to-leading-order calculations with CT14 parton distribution functions as well as with nuclear modifications to PDFs implemented in EPPS16.

The central and mid-central collisions are consistent with the calculations and a small excess above the calculations is observed in the peripheral collisions.

The inclusive charge-hadron yield in Pb+Pb, Xe+Xe and p+Pb collisions is also normalized by the mean nuclear thickness function and is also compared against the yields of charged hadrons in pp collisions.

The comparison of the nuclear modification of EW bosons and charged particles in central and peripheral Pb+Pb collisions will provide constraints on the relative importance of initial- and final-state effects in these measurements.

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