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Electroweak-boson production from small to large collision systems with ALICE at the LHC

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Electroweak W and Z bosons created in hard-scattering processes at the early stage of the collisions are efficient probes of the initial state of the collisions. While the measurements of W and Z bosons in p–Pb and Pb–Pb collisions provide insights on the nuclear modification of the parton distribution functions, the results in pp collisions are a stringent test of perturbative QCD-based calculations and production mechanisms. In pp collisions, W bosons can be produced by pair annihilation but also by higher order processes with additional hadron production. An investigation of these bosons, in relation to the hadrons in the rest of the event, can give insight into multi-parton interactions in high-multiplicity events and the role of color-reconnection mechanisms.

Electroweak bosons are studied with ALICE in pp collisions at $\sqrt{s}$ = 13 TeV, p–Pb collisions at $\sqrt{s_{\rm NN}}$ = 8.16 TeV and Pb–Pb collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV via their leptonic decays in the muon and electron channels at forward rapidity ($-4 < \eta < -2.5$) and midrapidity ($|\eta| < 0.8$), respectively. The observations in p–Pb and Pb–Pb collisions at forward rapidity give access to low Bjorken-x values, a phase-space region poorly constrain by heavy-ion experiments.

A review of the most recent results on the production of W^+, W^- and Z bosons is presented. The results include differential measurements of the normalised production yields, production cross sections and nuclear modification factors as a function of rapidity, transverse momentum, collision centrality and charged-particle multiplicity. The lepton-charge asymmetry measurement is also reported. A particular emphasis will be placed on the new measurement of the production of W bosons in association with hadrons as a function of the charged-particle multiplicity in pp collisions. Comparisons with theoretical model calculations, providing insights on production mechanisms and new constraints for the determination of the nuclear parton distributions functions will also be discussed.

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