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## NNLO QCD predictions of charge asymmetry distributions for inclusive W-boson hadroproduction

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Higher-order QCD predictions of charge asymmetry distributions are presented for inclusive  $W_{\pm}+X \rightarrow l_{\pm}+v+X$  production in proton-proton (pp) collisions at 8, 13, and 14 TeV center-of-mass energies. The W boson or the decay lepton charge asymmetries constitute a direct probe of the relative u and d quark distributions in the proton as functions of the initial-state parton momentum fractions. The predictions for the charge asymmetry distributions are acquired at next-to-next-to-leading order (NNLO) accuracy in the perturbative QCD domain, exploiting several parton distribution function (PDF) models. The predicted lepton charge asymmetry distributions are justified with the 8 TeV measurements by the LHC experiments in both central and forward acceptance regions of the lepton pseudorapidities  $0 \leq |\eta| \leq 2.4$  and  $2.0 \leq |\eta| \leq 4.25$ , and are provided thoroughly for both the regions at 13 and 14 TeV pp collisions energies. Additionally, the impact of various lepton transverse momentum  $p_{\perp}^l$  thresholds on the lepton (or the W boson) charge asymmetry predictions at NNLO accuracy are presented in the fiducial region encompassing both central and forward detector acceptances of the lepton pseudorapidity  $0 \leq |\eta| \leq 4.5$ . The lepton and W boson charge asymmetry distributions are assessed to be in close correlation with the  $p_{\perp}^l$  threshold, where the distributions are particularly observed to be more correlated at a higher- $p_{\perp}^l$  threshold. The W boson asymmetry distribution as a function of the W boson transverse momentum  $p_{\perp}^W$  is also presented with improved accuracy by matching the NNLO predictions to resummed logarithmic corrections. Overall, the predicted results represent a substantial contribution in the context of the high-precision phenomenological studies.

**Primary author(s)** : OCALAN, Kadir (Necmettin Erbakan University, Konya, Turkey)

**Presenter(s)** : OCALAN, Kadir (Necmettin Erbakan University, Konya, Turkey)

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