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Improving parton distribution uncertainties in a W mass measurement at the LHC

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We reexamine the dominant contribution of parton distribution function (PDF) uncertainties to the W mass measurement, and determine their contribution is $\pm 39(30)$ MeV when running the Large Hadron Collider at 7(13) TeV. We find that spurious correlations in older PDF sets led to over-optimistic assumptions regarding normalization to Z observables. In order to understand the origin of the large uncertainties we break down the contribution of the PDF errors into effects at the hard matrix element level, in showering, and in sensitivity to finite detector resolutions.

Using CT10, CT10W, and charm enhanced PDF sets in comparison to older PDF sets, we develop a robust analysis that examines correlations between transverse mass reconstructions of W and Z decays (scaled by $1/\cos \theta_W$) to leptons. We find that central leptons ($|\eta| < 1.3$) from W^- and Z bosons carry the most weight in reducing the PDF uncertainty, and estimate a PDF error of $^{+10}_{-12}$ MeV is achievable in a W mass measurement at the LHC. Further reductions of the W mass uncertainty will require improved fits to the parton distribution functions.

Oral or Poster Presentation

Oral

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