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 ($|\eta_l| < 1.3$) 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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