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Type: **Talk**

## MSHT20 Approximate N<sup>3</sup>LO Parton Distribution Functions with Theoretical Uncertainties

*Tuesday 2 August 2022 11:00 (20 minutes)*

The standard for parton distribution function (PDF) fits is at next-to-next-to-leading order (NNLO) in the strong coupling constant ( $\alpha_s$ ). However, as we move into a new era of high precision phenomenology, experimental physics is pushing the need for a robust understanding of theoretical uncertainties to new levels. Due to the perturbative nature of calculations in Quantum Chromodynamics (QCD) with respect to  $\alpha_s$ , the leading theoretical uncertainty in PDFs arises from the truncation of perturbative expansions. We demonstrate how using the currently available knowledge about N<sup>3</sup>LO (an order above the standard NNLO) can provide consistent, justifiable and explainable estimates for missing higher order uncertainties (MHOUs). Using an expanded Hessian procedure from previous MSHT fits, we present the first approximate N<sup>3</sup>LO PDF fit with theoretical uncertainties. The phenomenological impact of using the approximate N<sup>3</sup>LO PDFs is then assessed and compared with NNLO results.

### Preferred track

Hadron Structure

### Subfield

HEP theory

### Attending in-person?

Yes

### On behalf of collaboration?

No

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