EPPS16: FIRST NUCLEAR PARTON DISTRIBUTIONS WITH LHC DATA

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Cross sections of inclusive large-interaction-scale processes, "hard" processes, in high-energy hadron and nuclear collisions are computable from perturbative QCD and collinear factorization once the quark- and gluon structure of the colliding hadrons/nuclei is known. This structure, the universal process-independent parton distribution functions (PDFs), is not yet obtainable from first principles of QCD. Instead, the PDFs have to be extracted simultaneously from various types of collider data through a "global" fit analysis which involves the computation of the corresponding hard-process cross sections, DGLAP scale-evolution of the PDFs, and statistical error analysis of the obtained best-fit PDFs.

We report on EPPS16 - the very first global analysis of next-to-leading order nuclear PDFs where LHC data (Z, W, dijets) from proton-lead collisions have been directly used as a constraint [1]. In comparison to our previous global fit EPS09 [2] which has defined the state-of-the art for the nuclear PDFs already for many years, also data from neutrino-nucleus deep-inelastic scattering and pion-nucleus Drell-Yan process are now included. Much of the theory framework has also been updated from EPS09, including a consistent treatment of heavy quarks in deep-inelastic scattering. However, the most notable change is that we no longer assume parton-type-blind nuclear modifications for valence and sea quarks. This significantly reduces the theoretical bias in the error estimates. All the analysed data are well reproduced and the analysis thereby - importantly - supports the validity of collinear factorization in high-energy nuclear collisions in the kinematical region studied. However, as discussed in the talk, flavour by flavour the nuclear PDF uncertainties are still rather large. The released EPPS16 nuclear PDF set, which again includes error sets for public use (e.g. by the LHC experiments), is intended as a new world standard of the nuclear PDFs.

[1] K. J. Eskola, P. Paakkinen, H. Paukkunen and C. A. Salgado,
arXiv:1612.05741 [hep-ph], to appear in Eur. Phys. J. C.
[2] K. J. Eskola, H. Paukkunen and C. A. Salgado, JHEP 0904 (2009) 065.