Theory and computation highlights in June, 2022
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Reliable estimation of uncertainties in parton distribution functions has become a vital component of modern high-energy scattering data analyses. A new paper [arXiv:2206.10782] by collaborators from the Theory Center and the University of Adelaide reviews methods used to estimate PDF uncertainties. Using a toy model of a PDF, the paper compares uncertainty estimates from the traditional Hessian and data resampling methods, as well as from explicitly Bayesian analyses using nested sampling or hybrid Markov chain Monte Carlo techniques, and neural network approaches. The results show that utilizing a neural network on a simplified example of PDF data can inflate uncertainties due to the cross validation procedure that is used to avoid overfitting data.

A new review article [arXiv:2206.09361] by W. Melnitchouk and collaborators discusses recent applications of nonlocal chiral effective theory to hadron structure studies. Starting from a nonlocal meson-baryon effective chiral Lagrangian, the paper demonstrates how the introduction of a correlation function representing the finite extent of hadrons regularizes the meson loop integrals and introduces momentum dependence in vertex form factors in a gauge invariant manner. The framework is illustrated with applications to nucleon electromagnetic form factors, unpolarized and polarized parton distributions, as well as transverse momentum dependent distributions and generalized parton distributions.