# Lattice QCD studies of pseudo-PDFs

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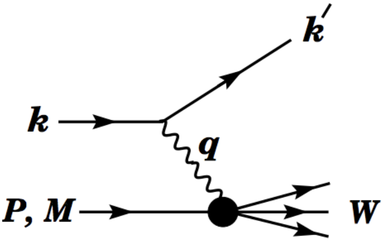
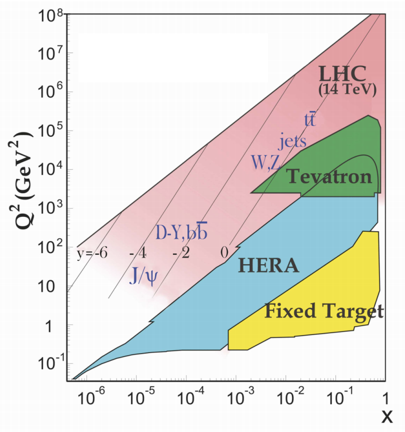
# DIS and collider experiments




Trying to answer questions such as: how fast partons travel and how is momentum distributed within the nucleon

# Factorization

Intuitively, factorization tells us that the same universal non-perturbative objects (the PDFs), representing long distance physics, can be combined with many short-distance calculations in QCD.

- $\sigma = f \otimes H$, where $f$ are the PDFs, $H$ is the hard perturbative part and $\otimes$ is convolution.

# Non-perturbative, let's go lattice

It is natural to think that since the PDFs are non-perturbative quantities, Lattice QCD is the way to proceed. But ...

- PDFs are related to matrix elements of bilocal operators on the light cone, thus not directly implementable on a Euclidean lattice
- calculation of Mellin moments of PDFs through matrix elements of twist$-2$ operators, limited to the first few due to
  - bad signal to noise ratio
  - power-divergent mixing on the lattice

Methods to overcome this, focus on matrix elements with space-like separations that are accessible to the lattice

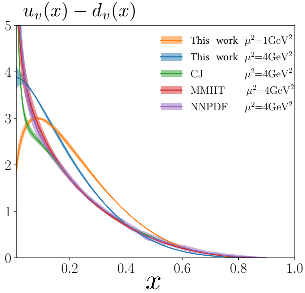
- quasi-PDFs (X. Ji)
- pseudo-PDFs (A. Radyushkin)

# From the matrix element to comparisons with global fits

Starting point is the matrix element for non-singlet parton densities

$$\mathcal{M}^{\alpha}(z,p) \equiv \langle p|\bar{\psi}(0)\,\gamma^{\alpha}\,\hat{E}(0,z;A)\tau_3\psi(z)|p\rangle \ .$$

and after some steps . . .




*Thanks a lot for your attention!!!*