

# Uncertainties of Parton Distribution Functions

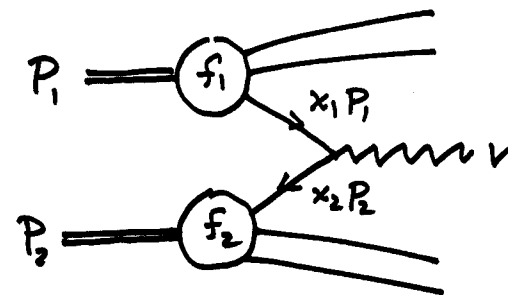
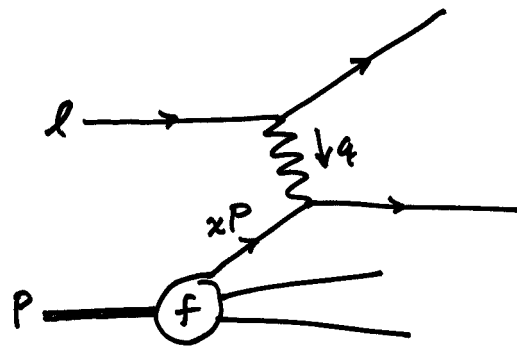
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&  
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High energy particles interact through their quark and gluon constituents – the partons.

**Asymptotic freedom** : the parton cross sections can be approximated by perturbation theory.

**Factorization theorem** : Parton distribution functions in the nucleon are the link between the PQCD theory and measurements on nucleons.



Parton distribution functions are important.

Experiments in high-energy physics may involve high precision measurements at hadron colliders

HERA  $e^- p$   $e^+ p$

Tevatron  $p\bar{p}$

LHC  $pp$

Any experiment with a nucleon in the initial state will require PDF's for the analysis and interpretation of the experiment.

The goals of QCD global analysis are

- to find accurate PDF's;
- to know the uncertainties of the PDF's;
- to enable predictions, including uncertainties.

The systematic study of uncertainties of PDF's developed slowly. Pioneers...

J. Collins and D. Soper, CTEQ Note 94/01, hep-ph/9411214.

C. Pascaud and F. Zomer, LAL-95-05.

M. Botje, Eur. Phys. J. C 14, 285 (2000).

Today many groups and individuals are involved in this research.

## Current research on PDF uncertainties

### CTEQ group

at Michigan State (J. Pumplin, D. Stump, WK. Tung,  
HL. Lai, P. Nadolsky, J. Huston, R. Brock)  
and others (S. Kuhlmann, F. Olness, J. Owens)

MRST group (A. Martin, R. Roberts, J. Stirling, R. Thorne)

Fermilab group (W. Giele, S. Keller, D. Kosower)

S. I. Alekhin

V. Barone, C. Pascaud, F. Zomer; add B. Porthault

### HERA collaborations

ZEUS – S. Chekanov et al; A. Cooper-Sarkar

H1 – C. Adloff et al

## Outline of this talk (*focusing on CTEQ results*)

- General comments; CTEQ6
- Our treatment of experimental systematic errors
- Compatibility of data sets
- Uncertainty analysis
- 2 case studies
  - inclusive jet production in  $pp_{\text{bar}}$  or  $pp$
  - strangeness asymmetry