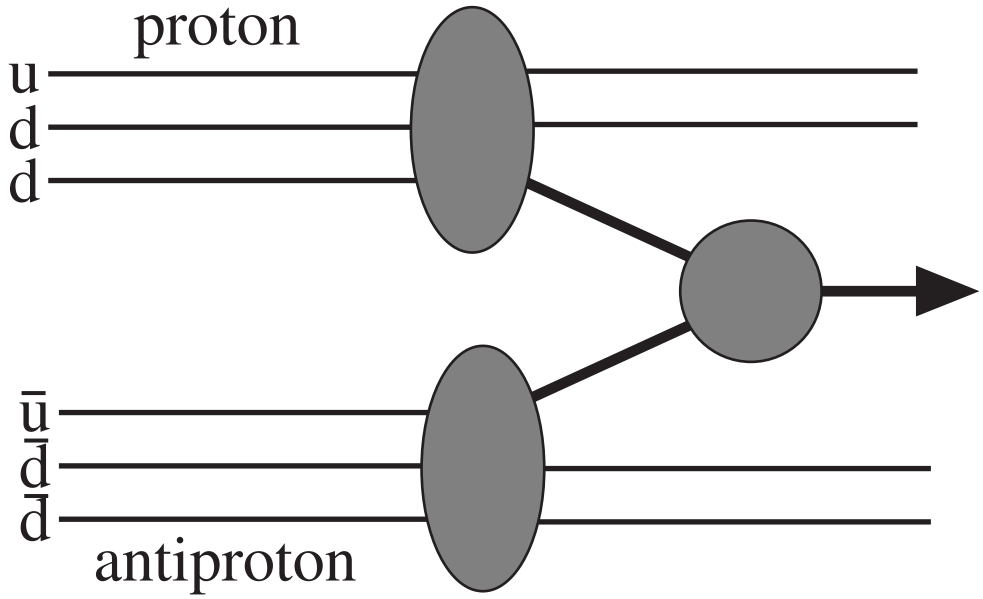
Introduction: Proton-Antiproton Scattering

The proton is a complex object

- Consists of valence quarks (uud), sea quarks and gluons
- each type of parton has momentum distribution function
- p beam is really "broad-band" beam of quarks and gluons
- $\bar{p}$ is primarily beam of anti-quarks and gluons

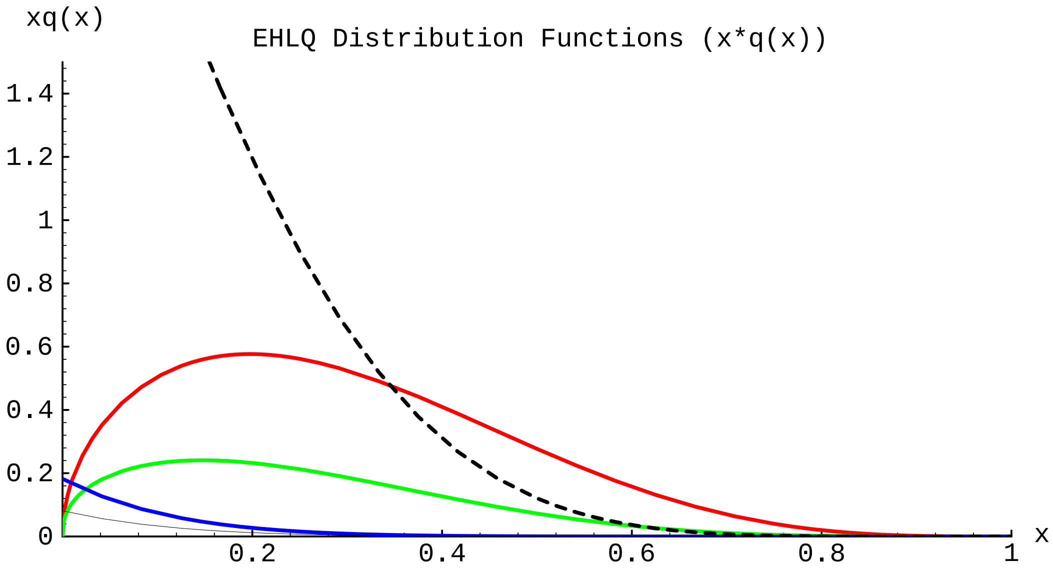


Interested mostly in "hard scattering"

- Characterised by high p_T of interaction

Parton Distribution Functions

Fraction of momentum carried by parton given by pdf's



- Example is EHLQ (Set I) at $Q^2 = 5$ GeV^2
- Derived from deep inelastic scattering
- Note large non-valence quark contribution
  - Largest uncertainty comes from gluon contribution

QCD predicts these PDF's to evolve with Q^2

- Get "softer" as $\hat{s}$ increases
- Best measurements come from neutrino and DIS
- Raison d'etres for several experiments

Evolution of PDF's

QCD predicts that $f_q(x, Q^2)$ will evolve as Q^2 increases

- Valence quark distributions become softer
- Sea quark and gluon distributions increase in size
- Evolution predicted by the Altarelli-Parisi equations

As example, Duke-Owens I evolution

- Red is $x\,u(x, Q^2)$ and blue is $x\,d(x, Q^2)$
- Plotted for $Q^2 = 4$ and $Q^2 = 5000$ GeV^2