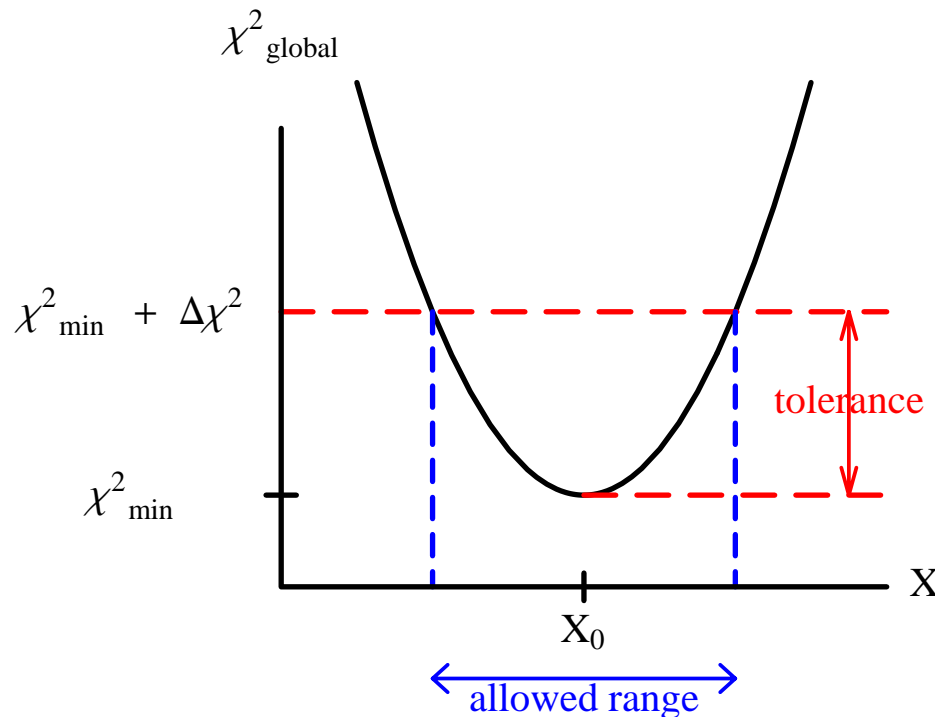


Quantitative Uncertainties of PDF's

Computational tools

- Lagrange Multiplier Method (constrained fitting)
- Hessian Matrix Method (a complete set of allowed variations using the eigenvector basis)

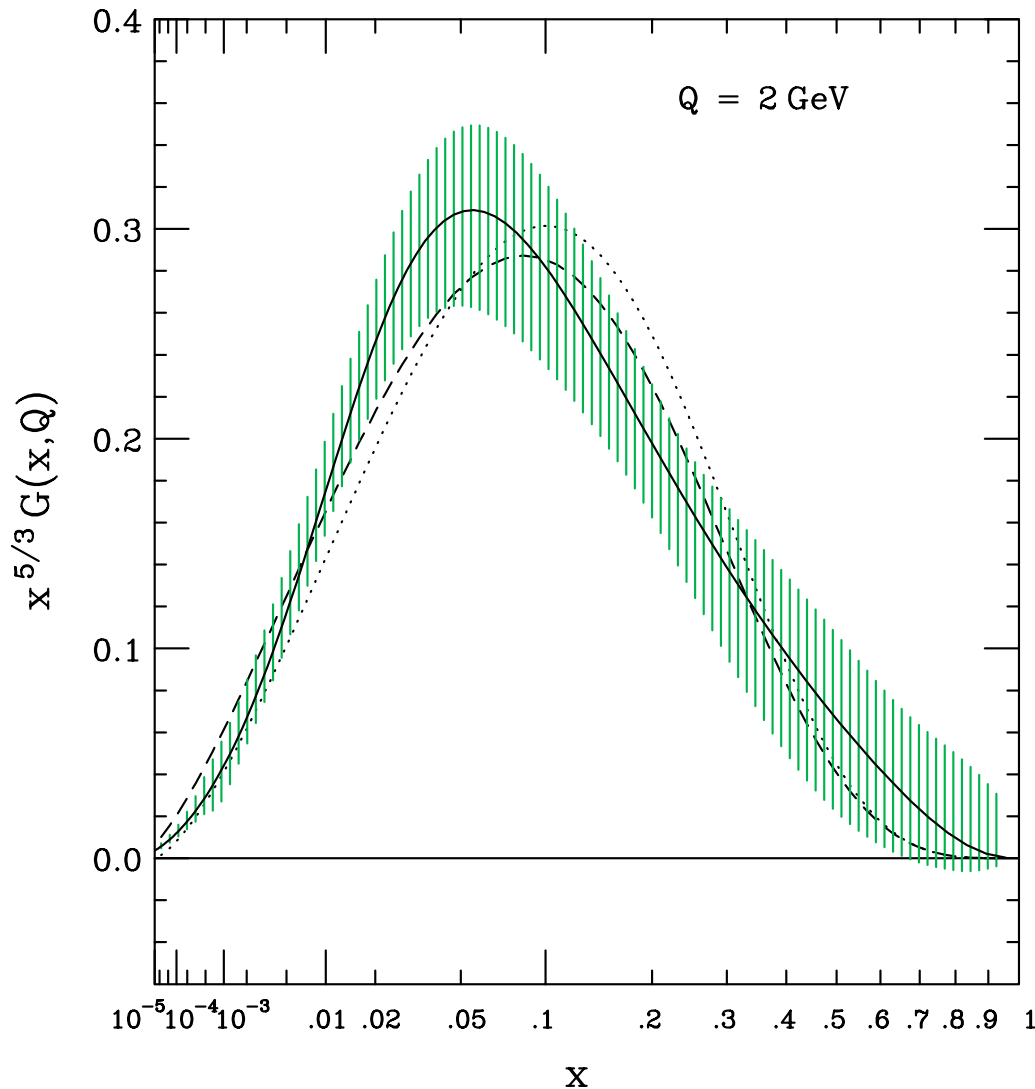
Plot χ^2_{global} versus an observable X .



The question of tolerance

We conclude that a large tolerance ($\Delta\chi^2 \sim 100$ for 1800 data points) is realistic.

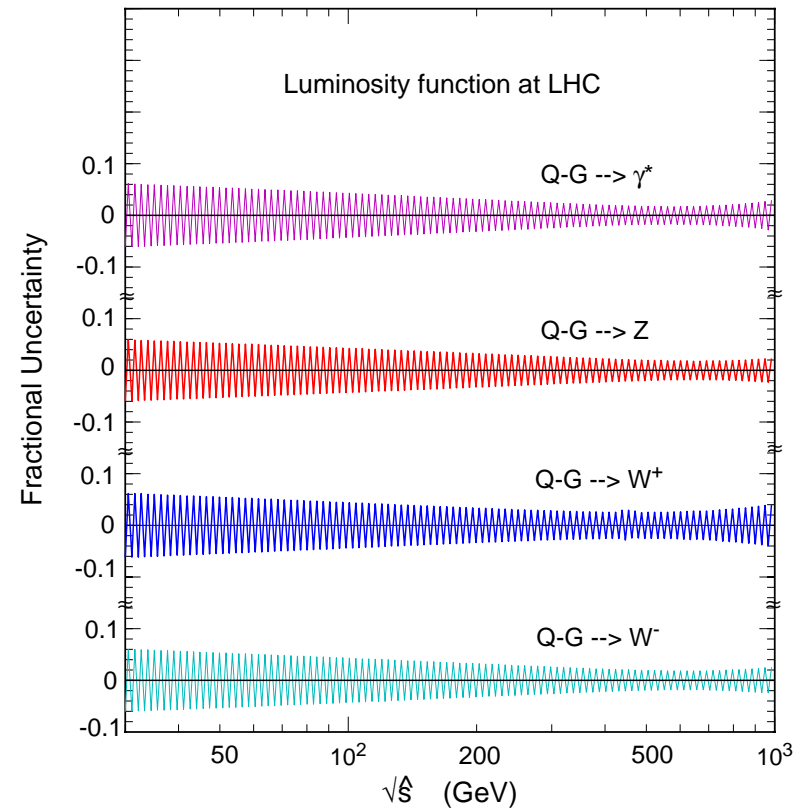
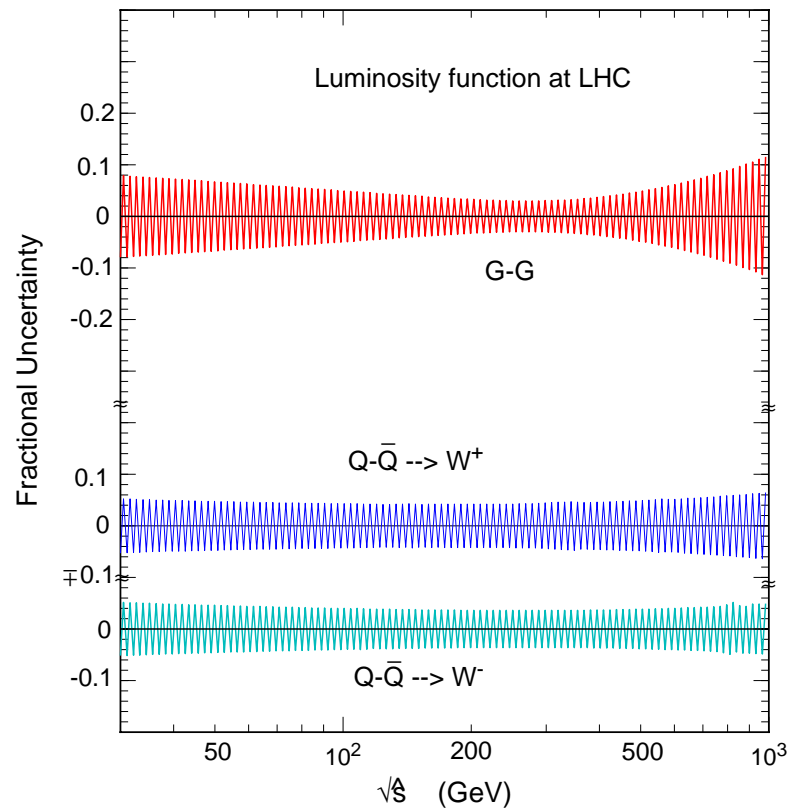
Uncertainty band for the gluon distribution function (at $Q = 2 \text{ GeV}$).



curves \equiv
solid : CTEQ6M
dashed : CTEQ5M1
dotted : MRST 2001

Uncertainty band \equiv
envelope of allowed
variations

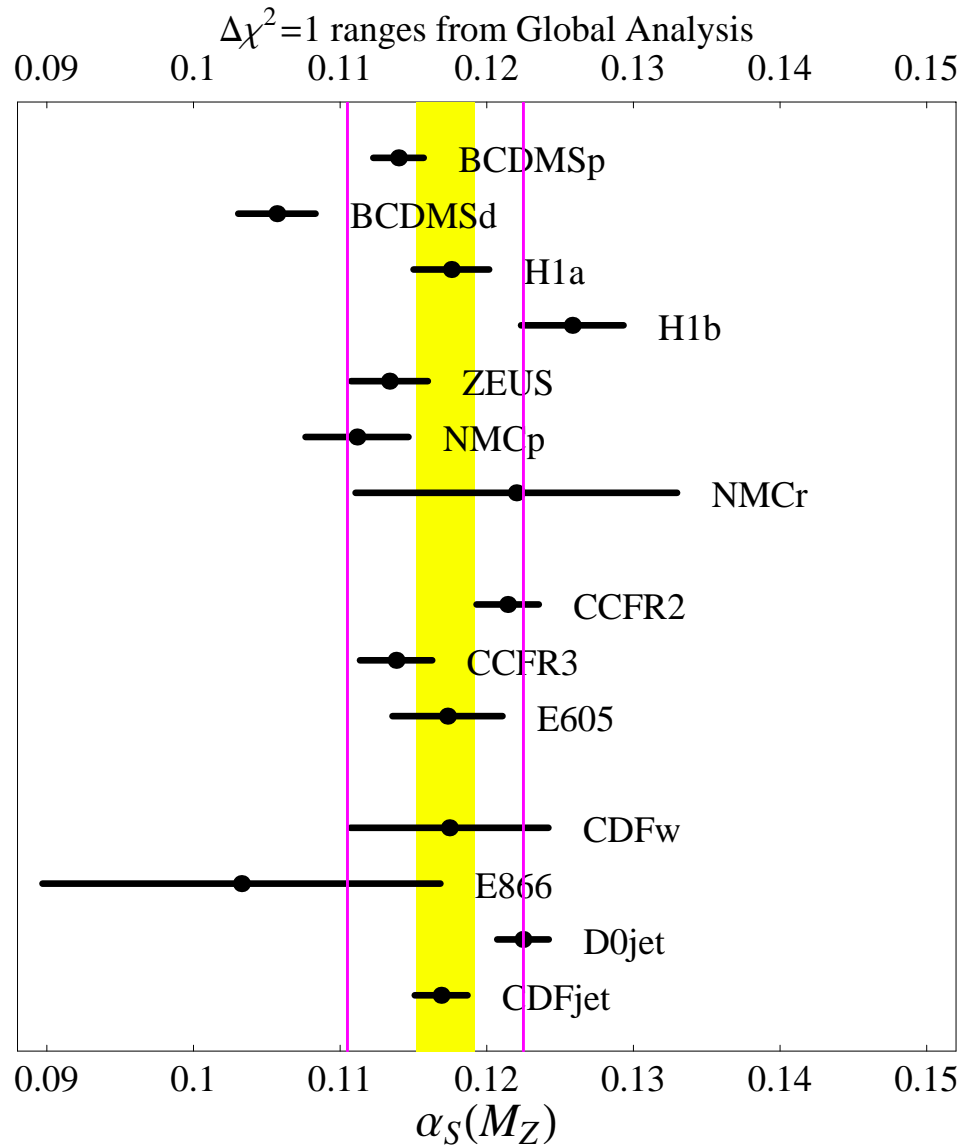
Uncertainties of LHC parton-parton luminosities



$$\mathcal{L}(\hat{s}) = \sum_{i,j} C_{ij} \int f_i(x_1) f_j(x_2) \delta(\hat{s} - x_1 x_2 s) dx_1 dx_2$$

provides simple estimates of PDF uncertainties at the LHC.

Example $\alpha_S(M_Z)$ from the CTEQ6 global analysis



Each data set gives a **best value of α_S** (from min. χ^2) and an **"allowed range" of α_S** (from $\Delta\chi^2 \leq 1$).

Particle Data Group (shaded strip) is 0.117 ± 0.002 .

The fluctuations are larger than expected for normal statistics. The vertical lines have $\Delta\chi^2_{\text{global}} = 100$,

$$\alpha_S(M_Z) = 0.1165 \pm 0.0065$$

Determination of α_S from the CTEQ global fit ...

Plot χ^2 versus α_S for
the individual data
sets.

