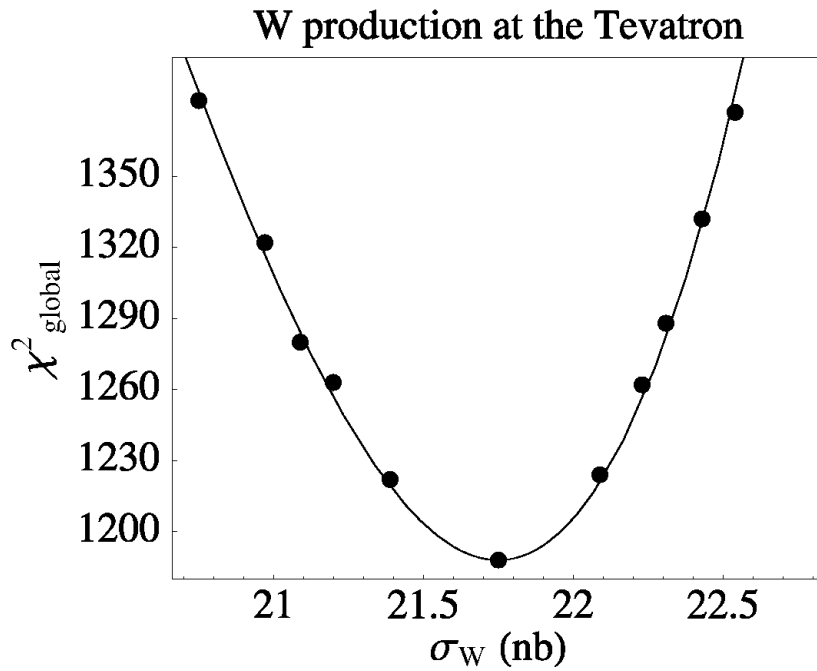


# Uncertainties of Parton Distributions

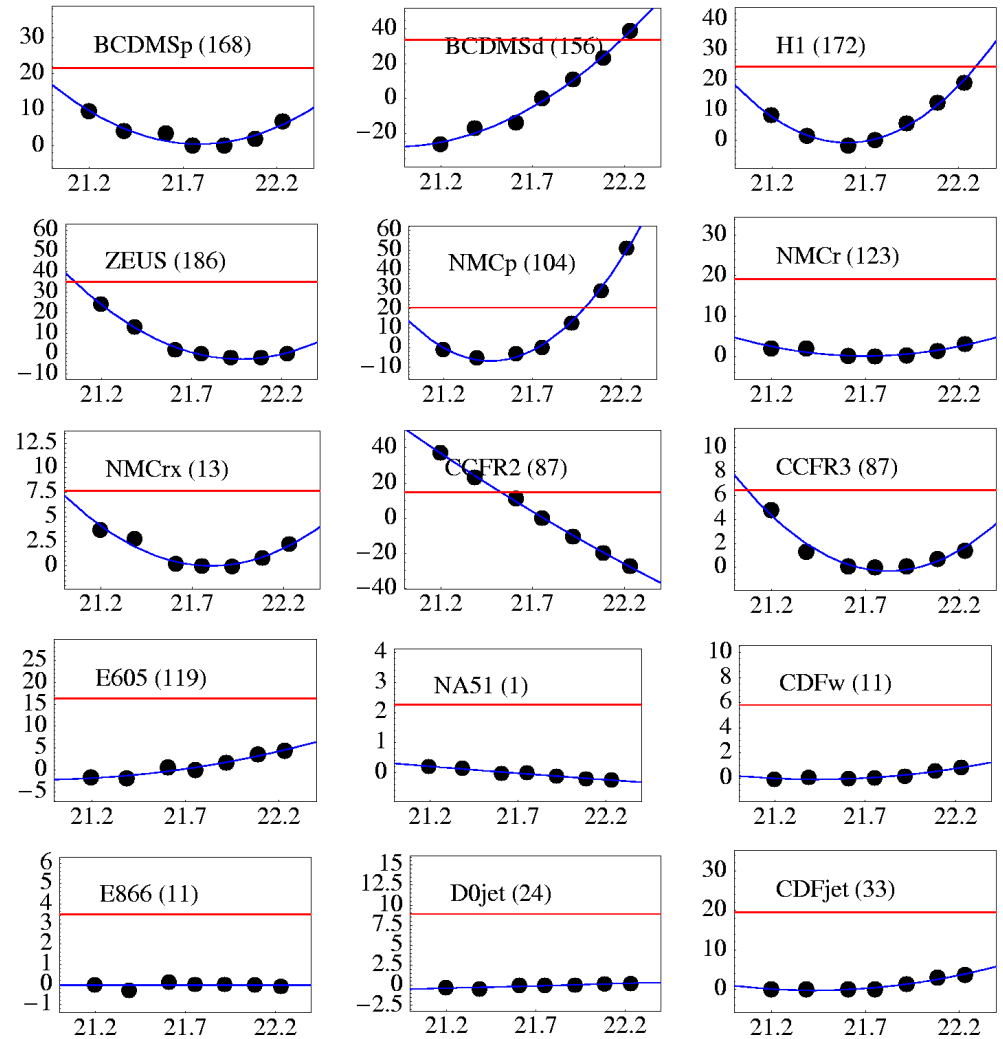
## (II) Results

Estimate the uncertainty on the predicted cross section for  $pp_{\text{bar}} \rightarrow W+X$  at the Tevatron collider.



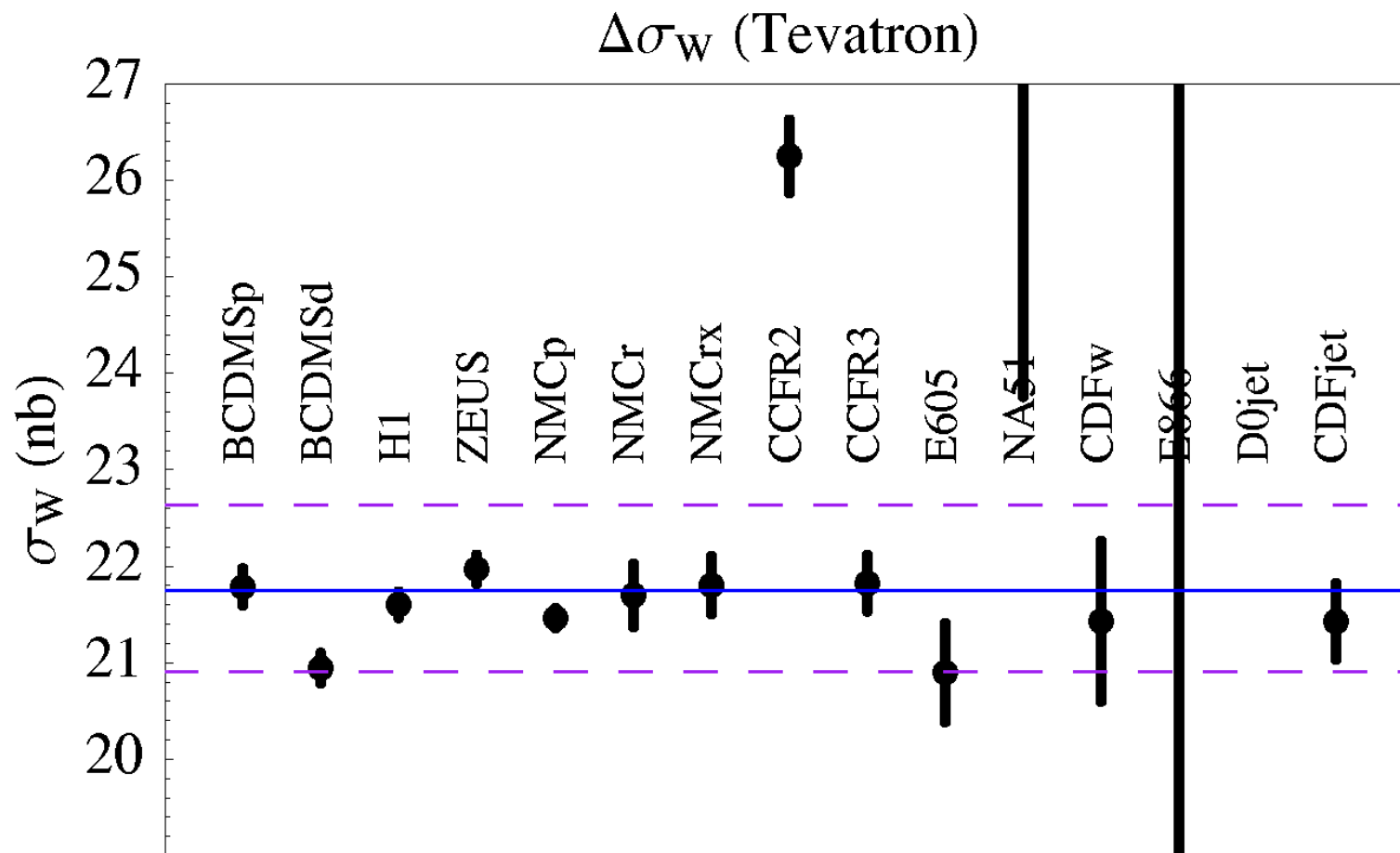
global  $\chi^2$

$\chi^2 - \chi_0^2$  vs  $\sigma_W$  (Tevatron)

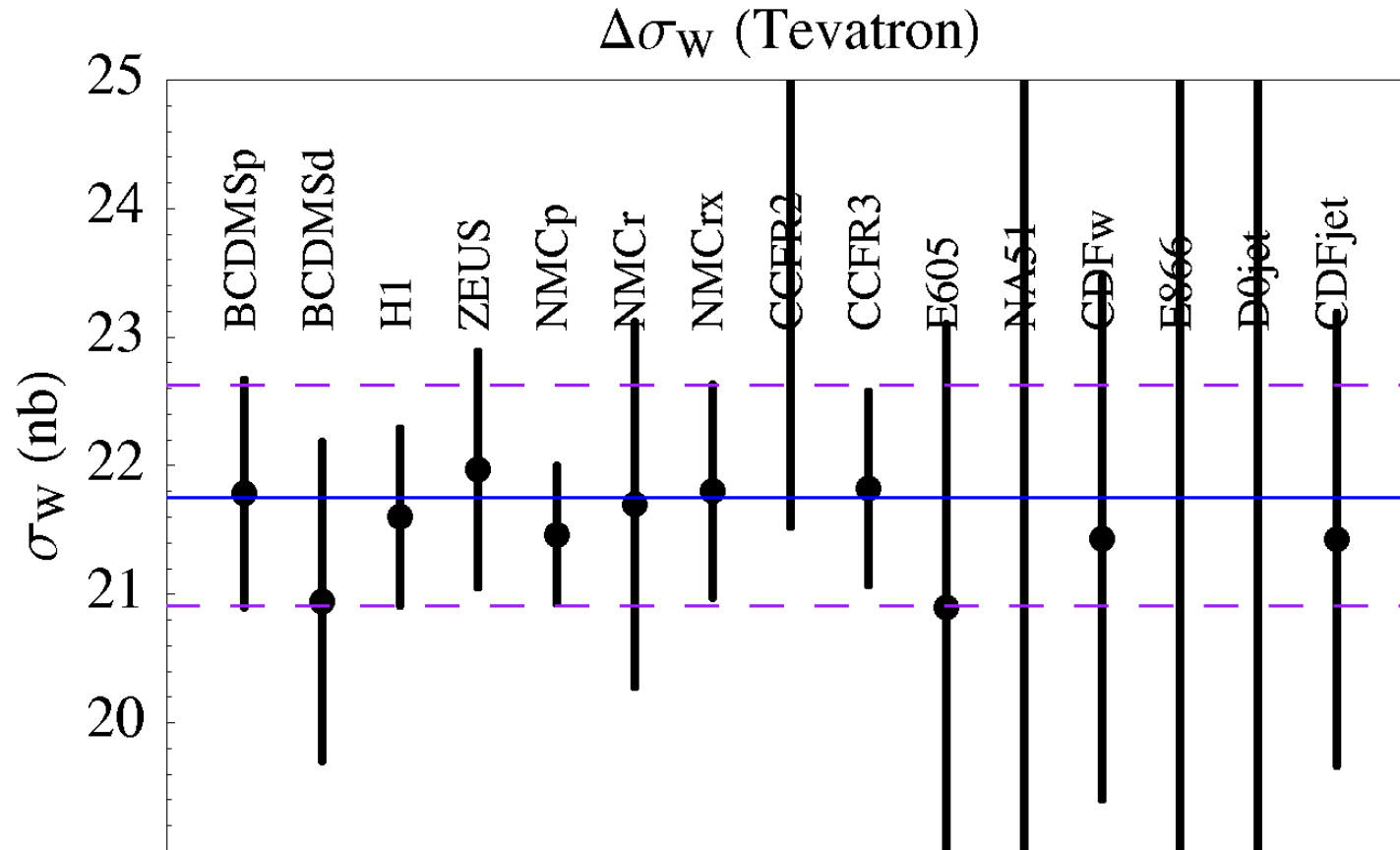


local  $\chi^2$ 's

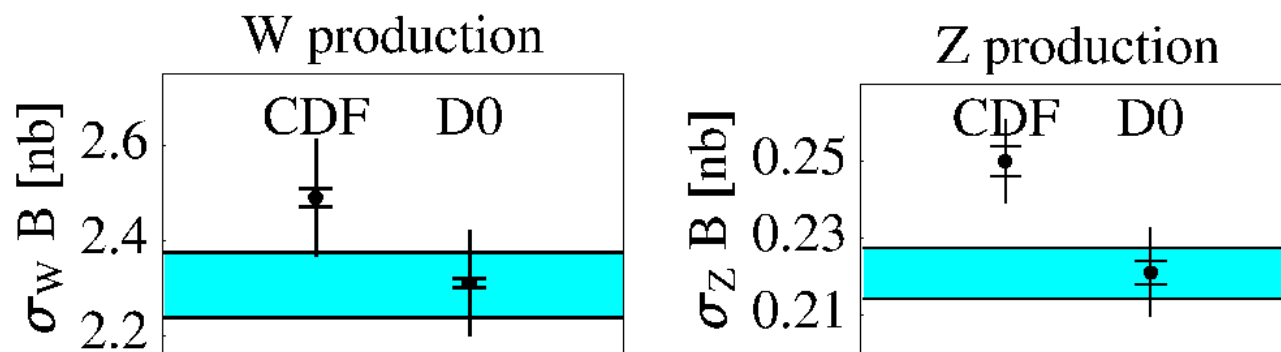
Each experiment defines a “prediction” and a “range”.  
 This figure shows the  $\Delta\chi^2 = 1$  ranges.



This figure shows broader ranges for each experiment based on the “90% confidence level” (cumulative distribution function of the rescaled  $\chi^2$ ).



The final result is an uncertainty range for the prediction of  $\sigma_W$ .

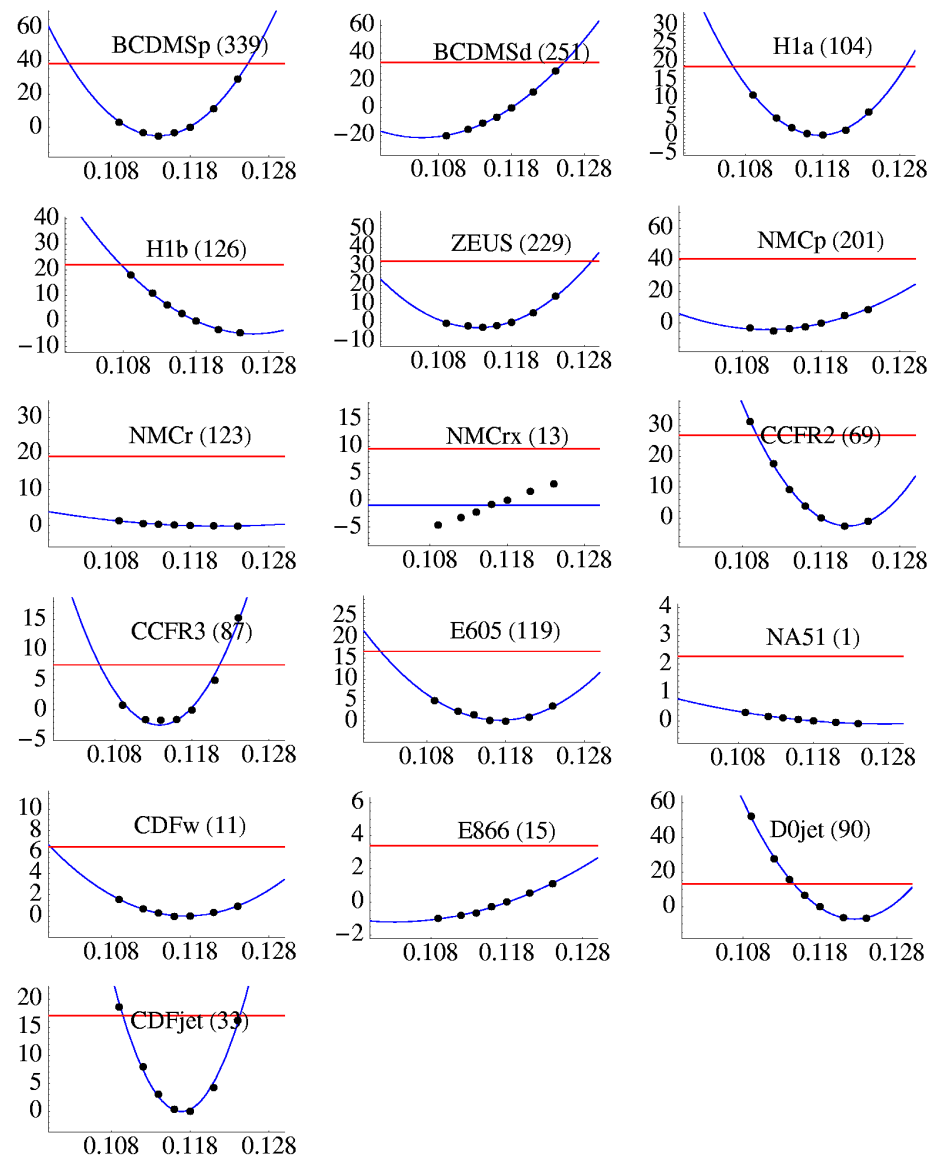


Survey of  $\sigma_w \times B_{l\nu}$  predictions (by R. Thorne) ...

PDF set	energy	$\sigma_w \times B_{l\nu}$ [nb]	PDF uncert
Alekhin	Tevatron	2.73	$\pm 0.05$
MRST2002	Tevatron	2.59	$\pm 0.03$
CTEQ6	Tevatron	2.54	$\pm 0.10$
Alekhin	LHC	215.	$\pm 6.$
MRST2002	LHC	204.	$\pm 4.$
CTEQ6	LHC	205.	$\pm 8.$

How well can we determine the value of  $\alpha_S(M_Z)$  from Global Analysis?

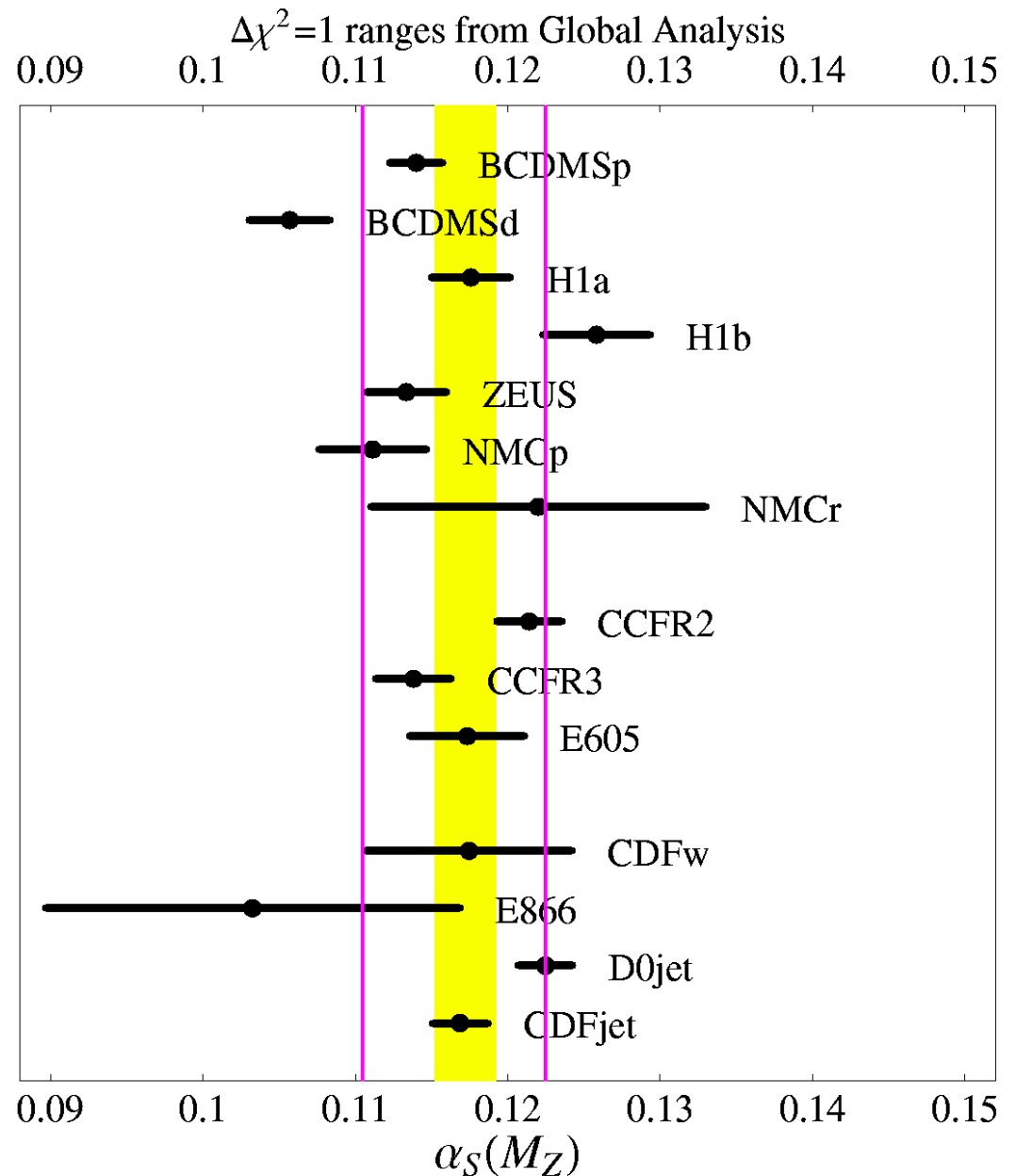
For each value of  $\alpha_S$ , find the best global fit. Then look at the  $\chi^2$  value for each experiment as a function of  $\alpha_S$ .

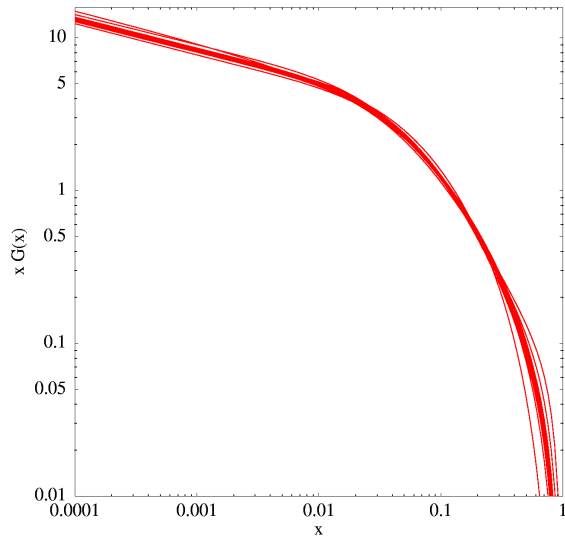


Each experiment defines a “prediction” and a “range”. This figure shows the  $\Delta\chi^2 = 1$  ranges.

Particle data group (shaded strip) is  $0.117 \pm 0.002$ .

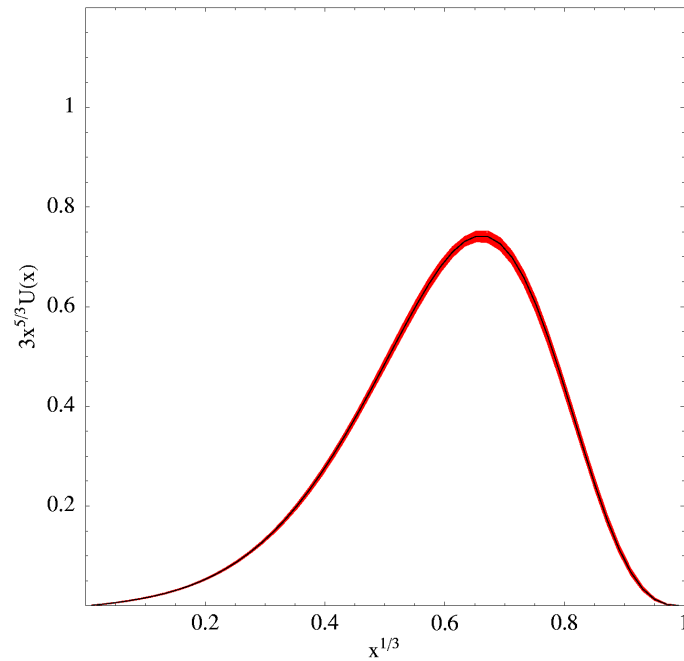
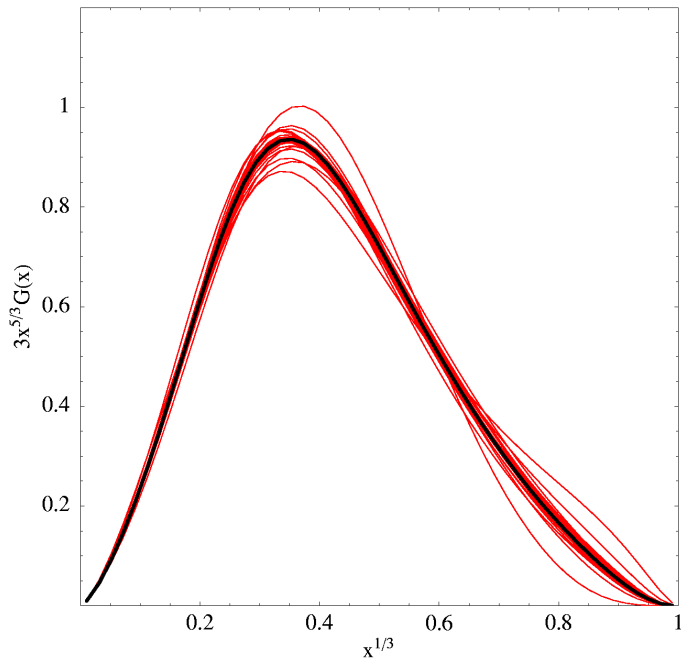
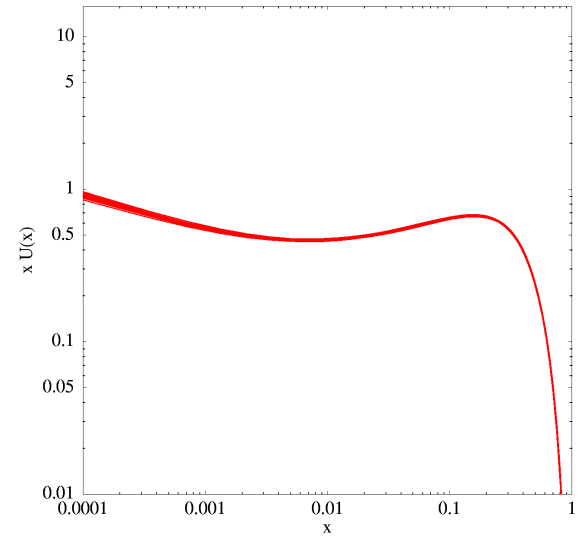
The fluctuations are larger than expected for normal statistics. The vertical lines have  $\Delta\chi^2_{\text{global}} = 100$ ,  
 $\alpha_s(M_Z) = 0.1165 \pm 0.0065$





*Uncertainties of the PDF's themselves (only interesting to the model builders)*

Gluon and U quark  
at  $Q^2 = 10 \text{ GeV}^2$ .

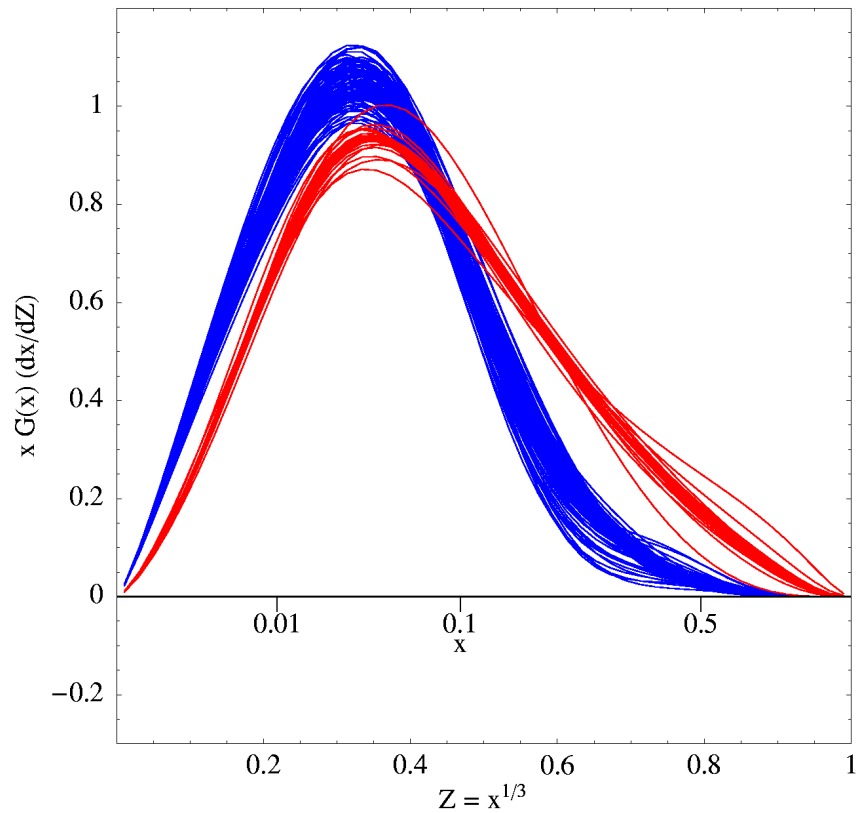


# Comparing “alternate sets”

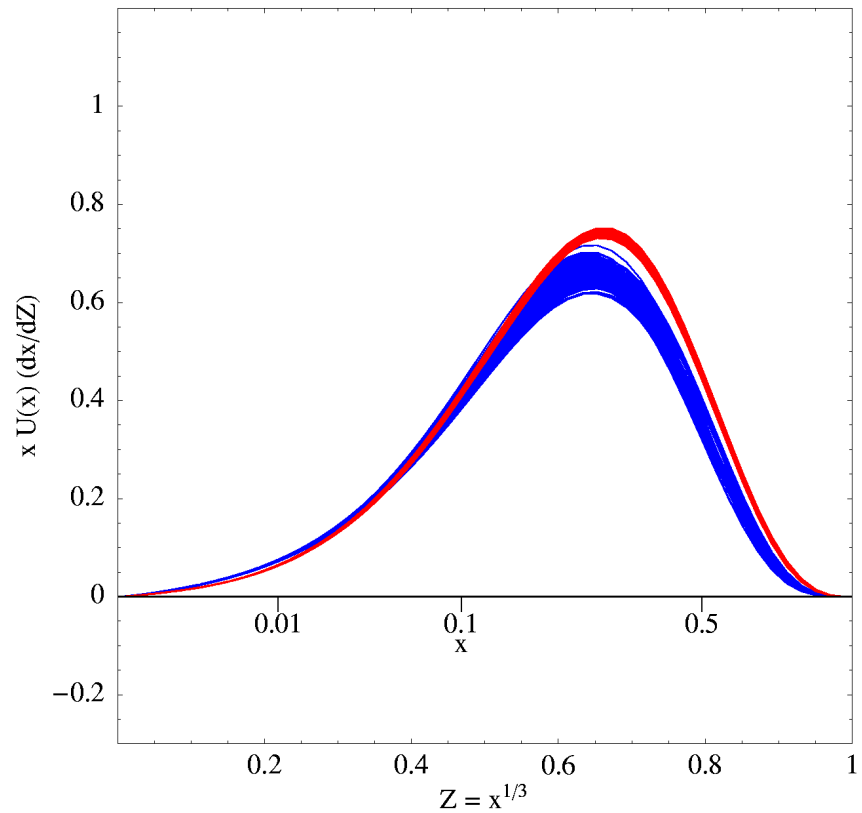
red – CTEQ6.1

blue – Fermi2002 (H1, BCDMS, E665)

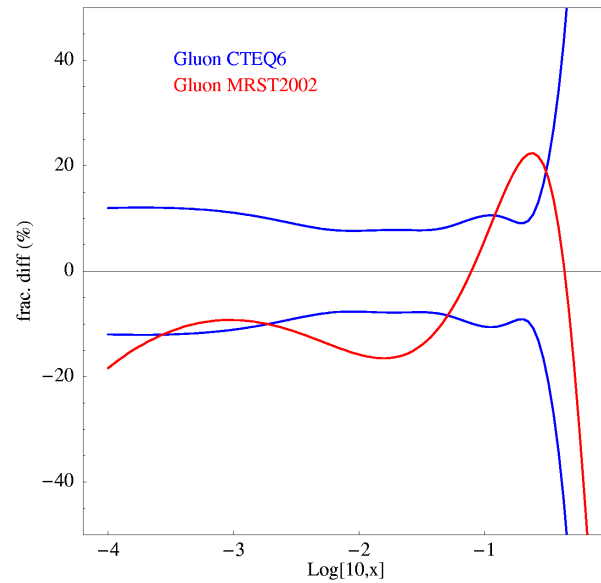
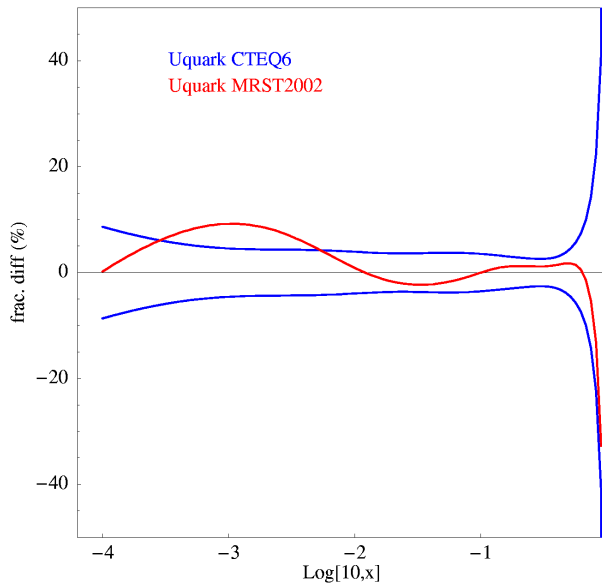
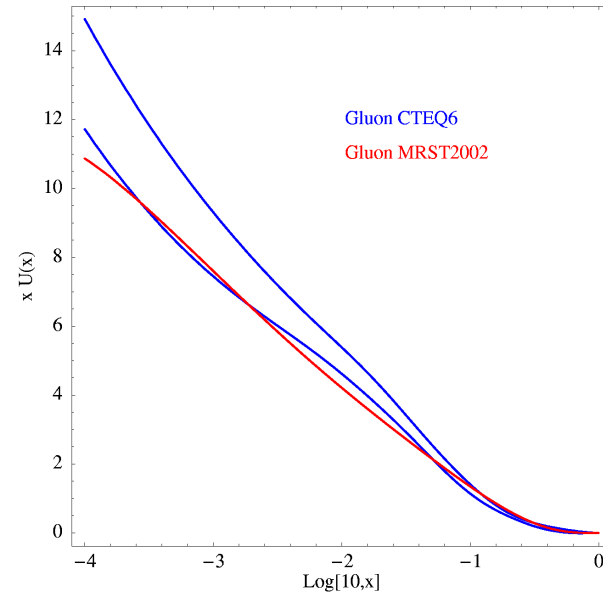
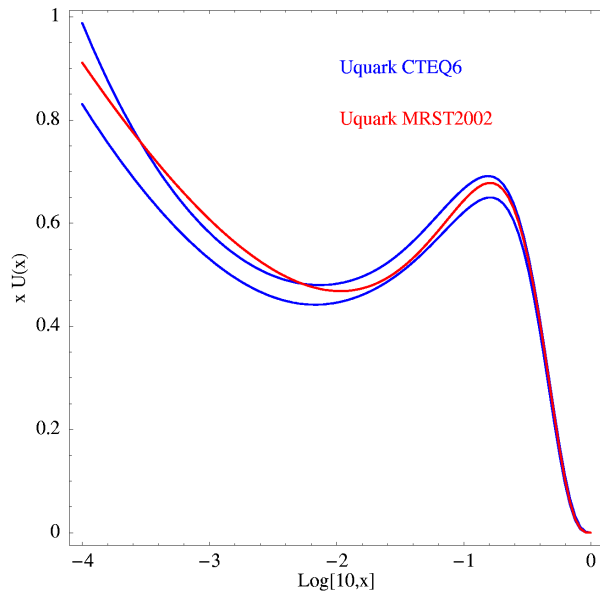
### Gluon at $Q^2 = 10 \text{ GeV}^2$



### U quark at $Q^2 = 10 \text{ GeV}^2$

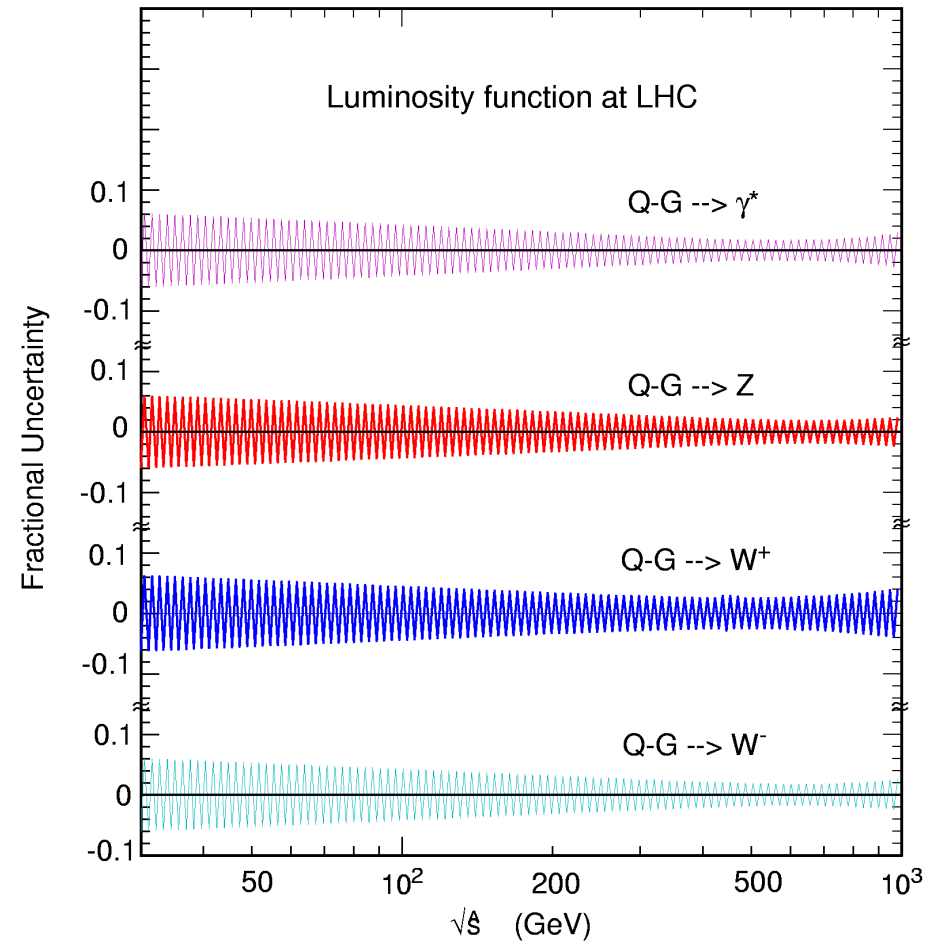
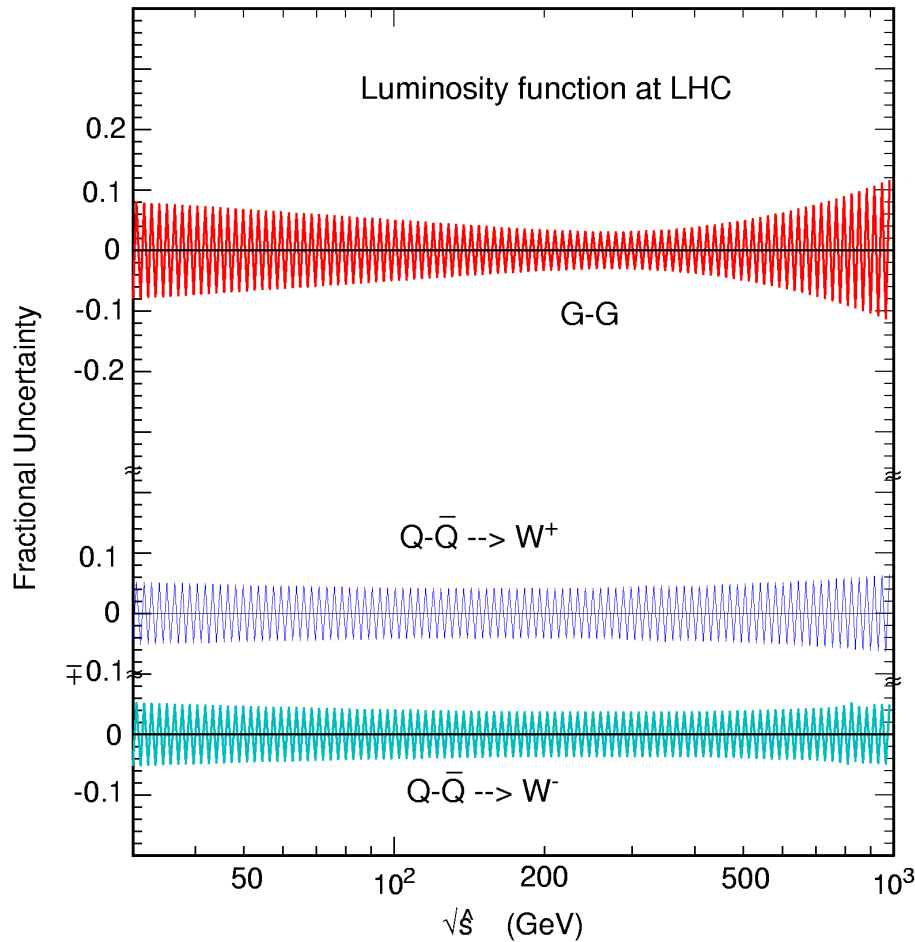


# CTEQ error band with MRST2002 superimposed



$\tilde{Q}_2 = 10 \text{ GeV}^2$

# Uncertainties of LHC parton-parton luminosities



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

Provides simple estimates of PDF uncertainties at the LHC.