# *Short About PROFFIT*

Prepared by Albert for the
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# About PROFFIT

- Based on the same principle as PROFESSOR.
- Originally developed for fitting uPDFs
- Written in Fortran – reads hbook-files –
  Several HERA analyses good for fitting (u)PDF – exist already coded in HZTOOL
- Singular Value Decomposition used to determine the polynomial describing the MC grid.
  If few parameters are fitted a 4th order polynomial can be used to described the MC grid.
  However, while a 3rd order poly is a clear improvement over 2nd order, the 4th order do
  usually nor improve the Chi2(MC - Poly).
- The fit of the MC parameters (in the polynomial) to the data is done by Minuit (MIGRAD)
- Currently equidistant MC grids has been used (PROFESSOR use randomized grids(?))

# *Error treatment in PROFFIT*



- **The statistical errors of the MC is propagated to the coefficients of the polynomial. A co-variance matrix for the coefficients are calculated.**

- **The CTEQ error calculation is used to take the correlated errors in the data into consideration. Basically the Chi2 is differently calculated.**

- **In the fit of the MC parameters to the data the uncorrelated errors and the different correlated errors are treated separately according to:**

$$\chi^2 = \Sigma \frac{(X_{Data} - X_{Polynomial})^2}{\alpha^2} - \Sigma_j \Sigma_{j'} B_j (A^{-1})_{jj'} B_{j'}$$

$\alpha^2 =$ **Sum of uncorrelated errors (data and polynomial)**

$\Sigma_j \Sigma_{j'} B_j (A^{-1})_{jj'} B_{j'} =$ **Term related to the correlated systematic errors (vector *B*), and their correlations (matrix *A*)**

(From the CTEQ group, hep/ph/0101051,
code from Federico von Samson-Himmelstjerna)

# Fitting the x dependence to the proton structure - F2

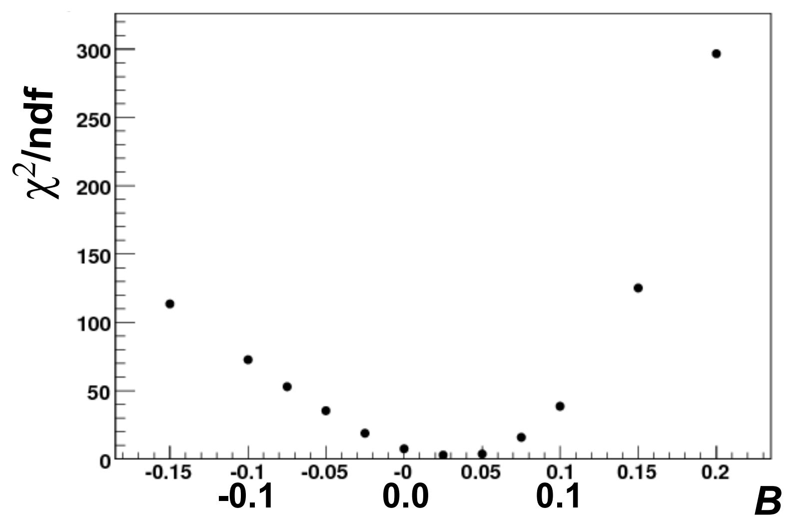
$$xA_0(x, k_T, \bar{q}_0) = N \cdot x^{-B} \cdot (1-x)^C \cdot exp(-\frac{(k_T - \mu)^2}{2\sigma^2})$$

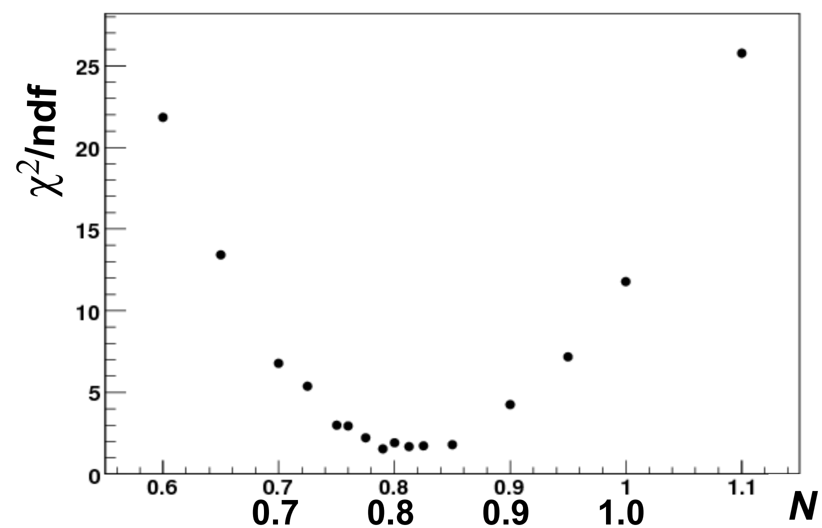
**Fitting F2 in the range x < 0.005, Q2>4.5,**
**gives:**

**<u>Minimum</u>**
**N = 0.807 +/- 0.016**
**B = 0.029 +/- 0.004**
**Chi2/ndf=1.2**

This is a good fit which reconstructs the parameter values in an already existing uPDF tuned to F2 within the same kinematic range... (Good validation of the method.)

$\chi^2$ - profiles as for the fitted parameters:



# Some fitting results



**However if we open up the phase space and fit all the F2 data points in the measurement, we obtain the minimum:**

$$xA_0(x,k_T,\bar{q}_0) = N \cdot x^{-B} \cdot (1-x)^C \cdot exp(-\frac{(k_T-\mu)^2}{2\sigma^2})$$

**Minimum**
**N = 0.767 +/- 0.001**
**B = 0.028 +/- 0.000**
**Chi2/ndf = 5.4**

**Inspired by the CTEQ people we added an extra factor in the starting distribution**

$$xA_0(x,k_T,\bar{q}_0) = N \cdot x^{-B} \cdot (1-x)^C \cdot (1-Dx) \cdot G(k_T)$$

Fitting F2 over the full range in x gives a slightly different gluon then before.
uPDF allowed to be more pronounced at low and high x:

**Minimum**
**N = 0.487 +/- 0.007**
**B = 0.097 +/- 0.003**
**D = -5.10 +/- 0.35**
**Chi2/ndf = 2.8**
**(Before: Chi2/ndf = 5.4)**