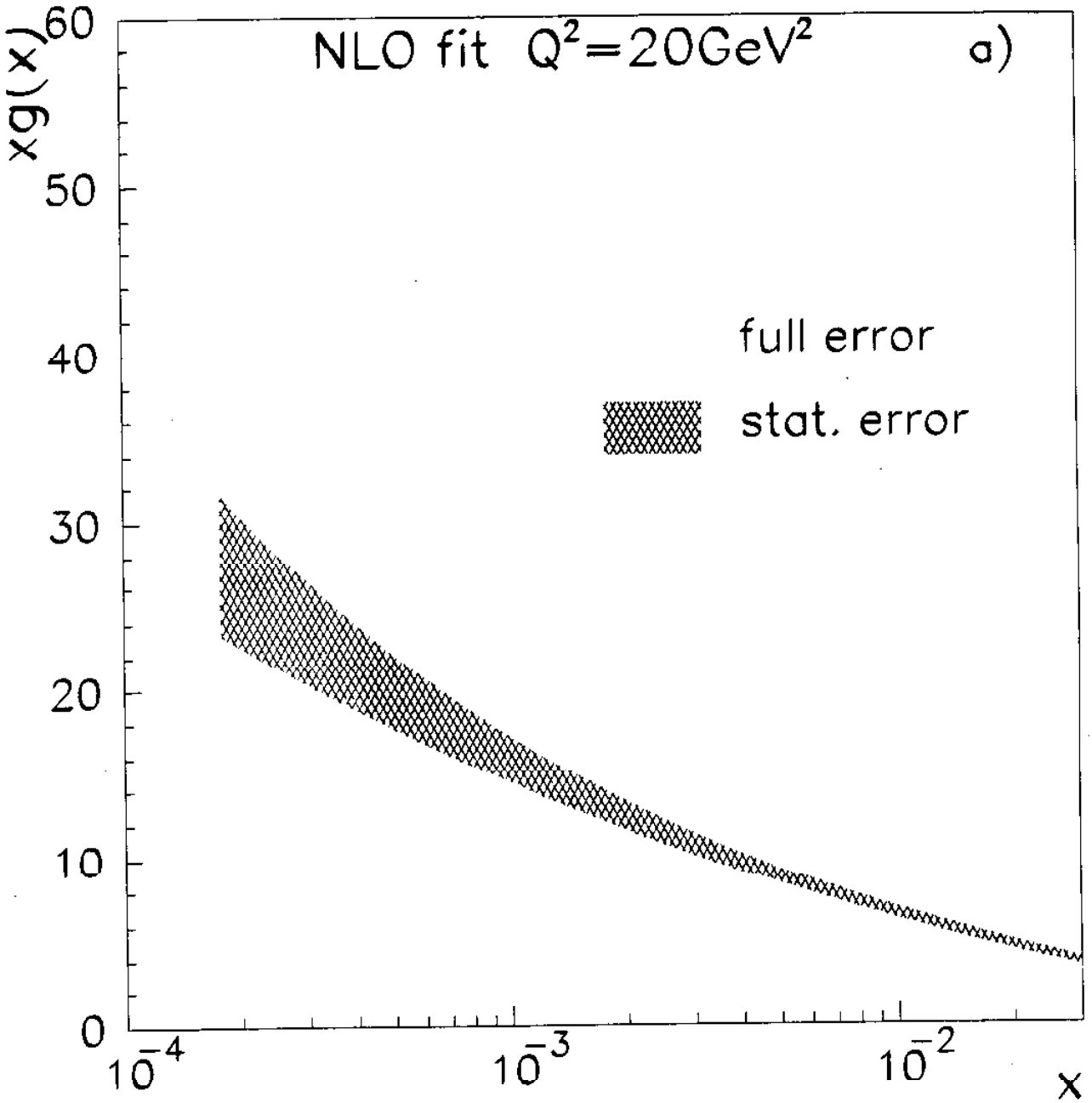
F. Zomer

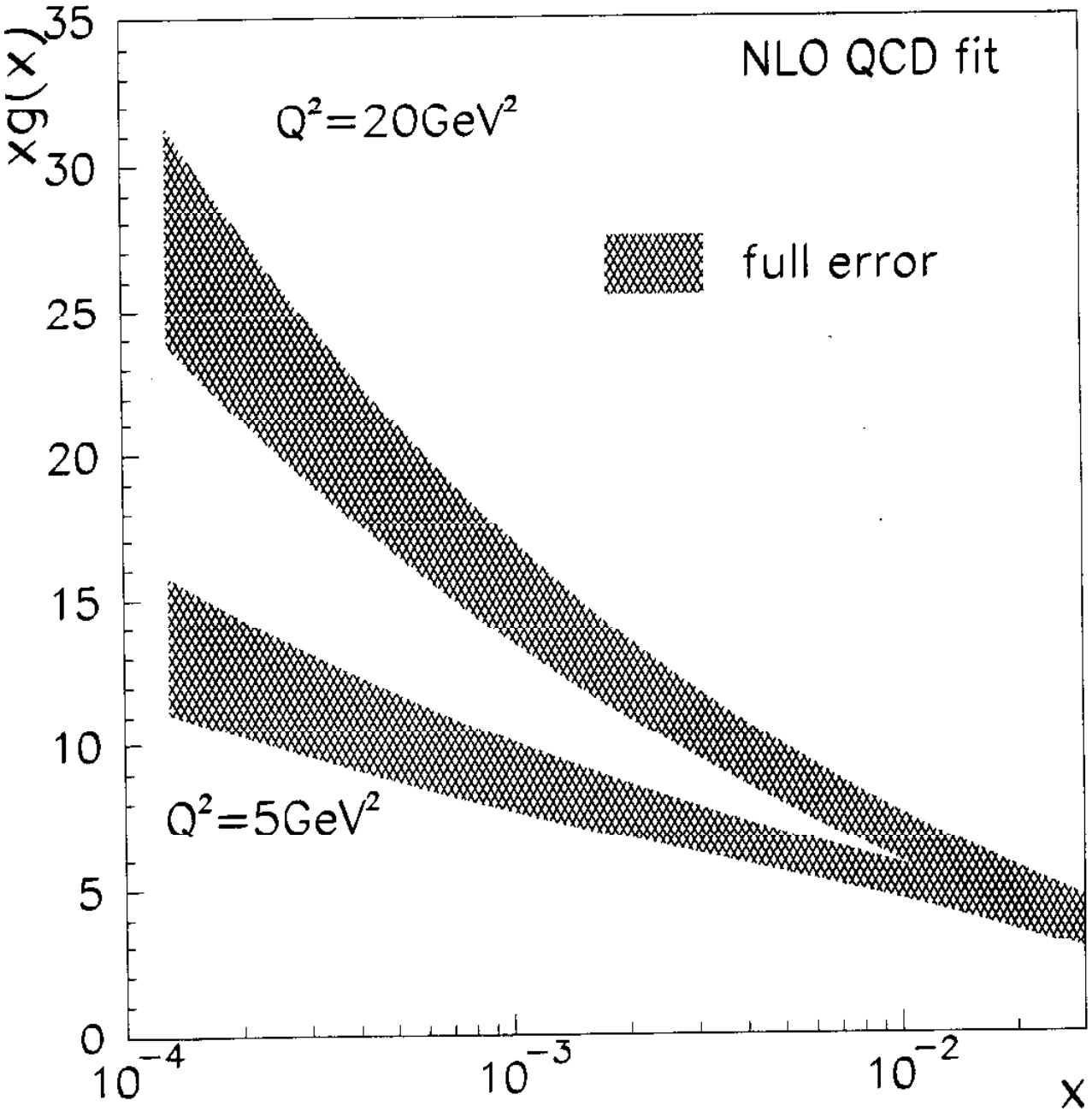
Jet Rate & Q.C.D Fit in H1

- Motivations.
- Fit procedure.
- measurement of the jet rate.
- conclusion

H1 F_2 1993 data analysis



H1 1994 F_2 data analysis



- Question:
  - Can we improve the gluon determinatio within Q.C.D Fit analysis ?

$\Rightarrow$ "Yes" using jet rate observable

- But: "Factorizable" algorithm

$\Rightarrow$ same P.d.f used for F_2 and Jet X-section calculation

$\Rightarrow$ Good candidate: k_t algorithm

$\Rightarrow$ Jet rate measurement at small-x using the k_t alg.

$\Rightarrow$ include this measurement in our Fit procedure

• Fit Procedure •

- Same as in F_2 analysis
  - DGLAP eq. solved
  - $\Rightarrow$ Gluon, Singlet, NoN singlet(s) quark densities
    - using

$$\chi^2_{tot} = \chi^2_{F_2} \underbrace{+ \chi^2_{jet}}_{new}$$

- data entering the Fit:
  - H1-F_2 (1994) + NMC (H & D) + H1 jetrate
- One detail:
  - massless quark prescription is used: $\nexists$ NLO calculation Program for jets including m

- χ^2_{jet} Definition

- Goal: Perform NLO analysis

  ⇒ Avoid parton level of M.C.

  ⇒ jet rate at hadron level

- Choice:

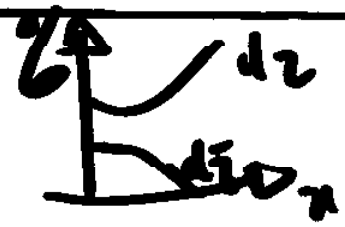
  - Use uncorrected data

    ⇒ Fold calculations with detector response functions

- $$\chi^2_{jet} = \sum_j \frac{\left[R^{det}(j) - R^{data}(j)\right]^2}{\sigma^2_{stat}}$$

  $j \equiv \text{bin}\left\{\Delta x_j, \Delta Q^2_j\right\}$

$$R^{det}_{(j)} = \frac{\sum_i d_2(i,j)\,\sigma^{2+1}_{(i)} + d_{\bar{2}}(i,j)\left[\sigma^{Tot}_{(i)} - \sigma^{2+1}_{(i)}\right]}{\sum_i d(i,j)\,\sigma^{Tot}_{(i)}}$$



- $d_2(i,j)$: 2 jets at had. Level
  $\longrightarrow$ 2 jets at det. Level

- $d_{\bar{2}}(i,j)$: NOT 2 jets at had. Level
  $\longrightarrow$ 2 jets at det. Level

- $$\sigma^{2+1}_{(i)} = \iint_{\Delta x_i\,\Delta Q^2_i} dx\,dQ^2 \left\{ \left(\frac{d\sigma^{2+1}}{dx\,dQ^2}\right)_{Pert.} + \Delta\sigma^{2+1}_{(x,Q^2)} \right\}$$

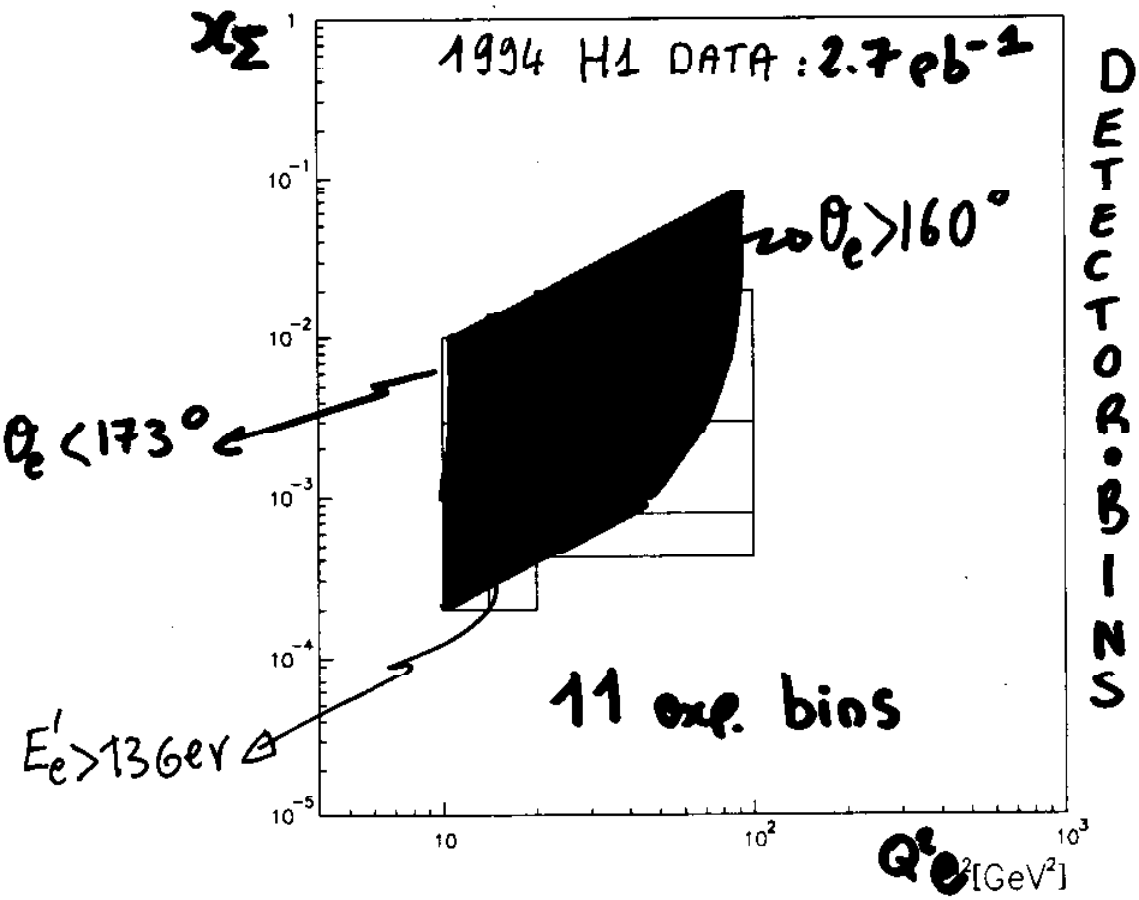
computed using Disent M.C coeff. (NLO) (extracted for basis functions*) convoluted with P.d.F evolved in the Fit program

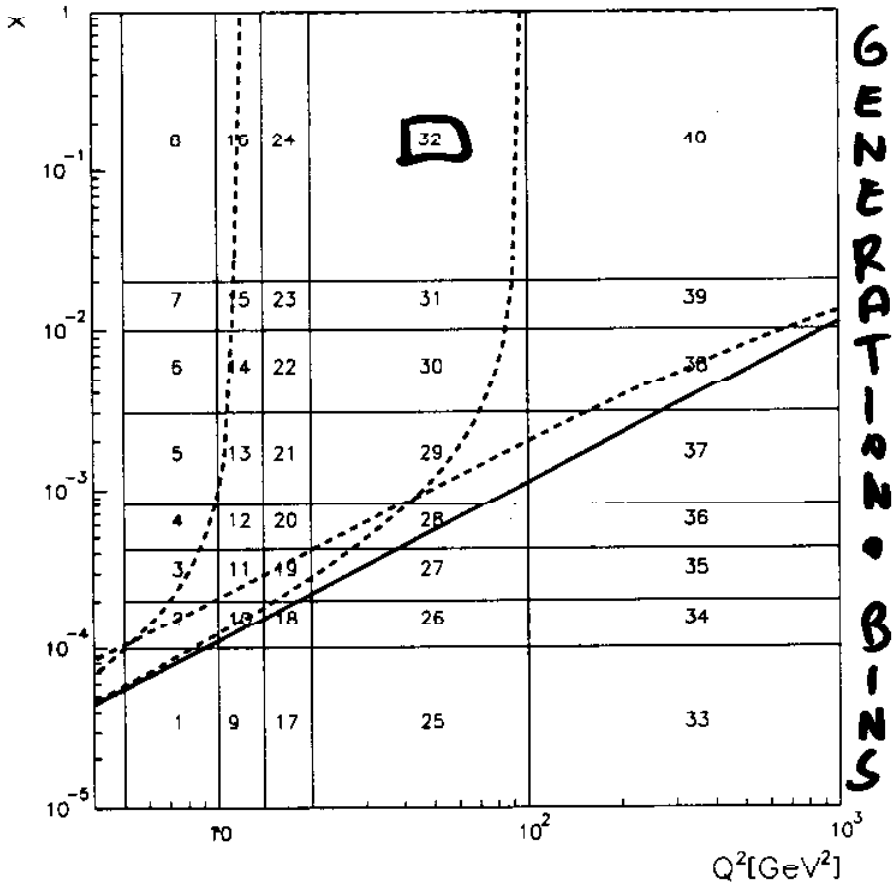
Power corr. : $\sim \frac{A}{Q^2} + B\,\frac{\ln Q^2}{Q^2}$

A-Priori ...

*G. Lobo: Proceeding of the last HERA workshop.

• DATA ANALYSIS •





- Jet Rate measured
  - $10 < Q^2 < 100\ \mathrm{GeV}^2$
  - $2\,10^{-4} < x < 2\,10^{-2}$

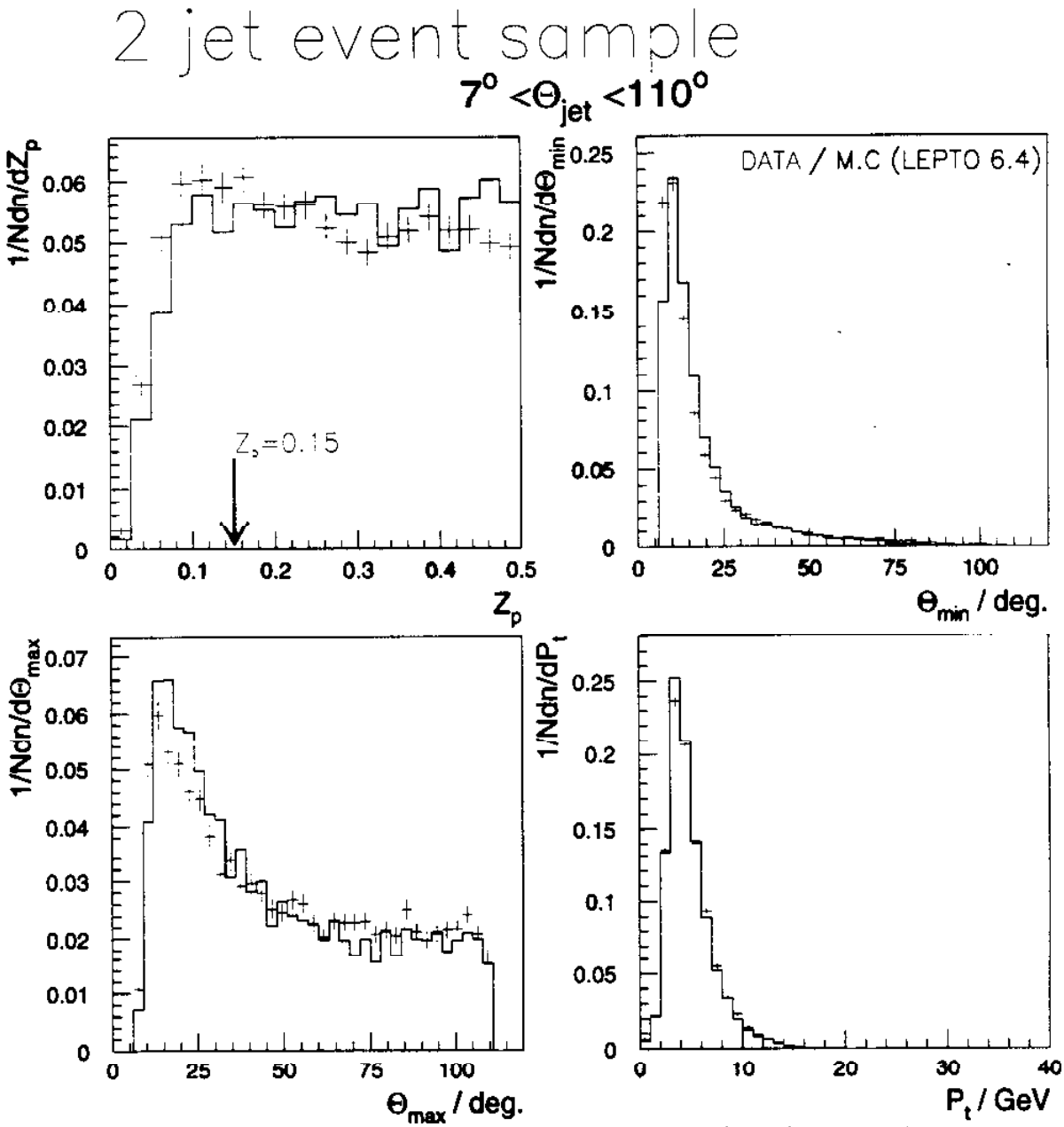
  } 11 bins

- k_t algorithm performed
  - in the Breit-Frame $(2x\vec{p} + \vec{q} = \vec{0})$
  - using calorimeter clusters
  - Resolution scale : Q^2
  - Resolution parameter: $y_c = 0.5$

⇒ θ_{jet} cuts:

- $\theta_{jet} > 7^\circ$ to avoid beam pipe
- $\theta_{jet} < 110^\circ$ to avoid backward calorimeter

• shape comparison •
(<=> histos normelized to 1)



$Z_s = \min[E_1(1-\cos\Theta_1), E_2(1-\cos\Theta_2)] / [E_1(1-\cos\Theta_1) + E_2(1-\cos\Theta_2)]$

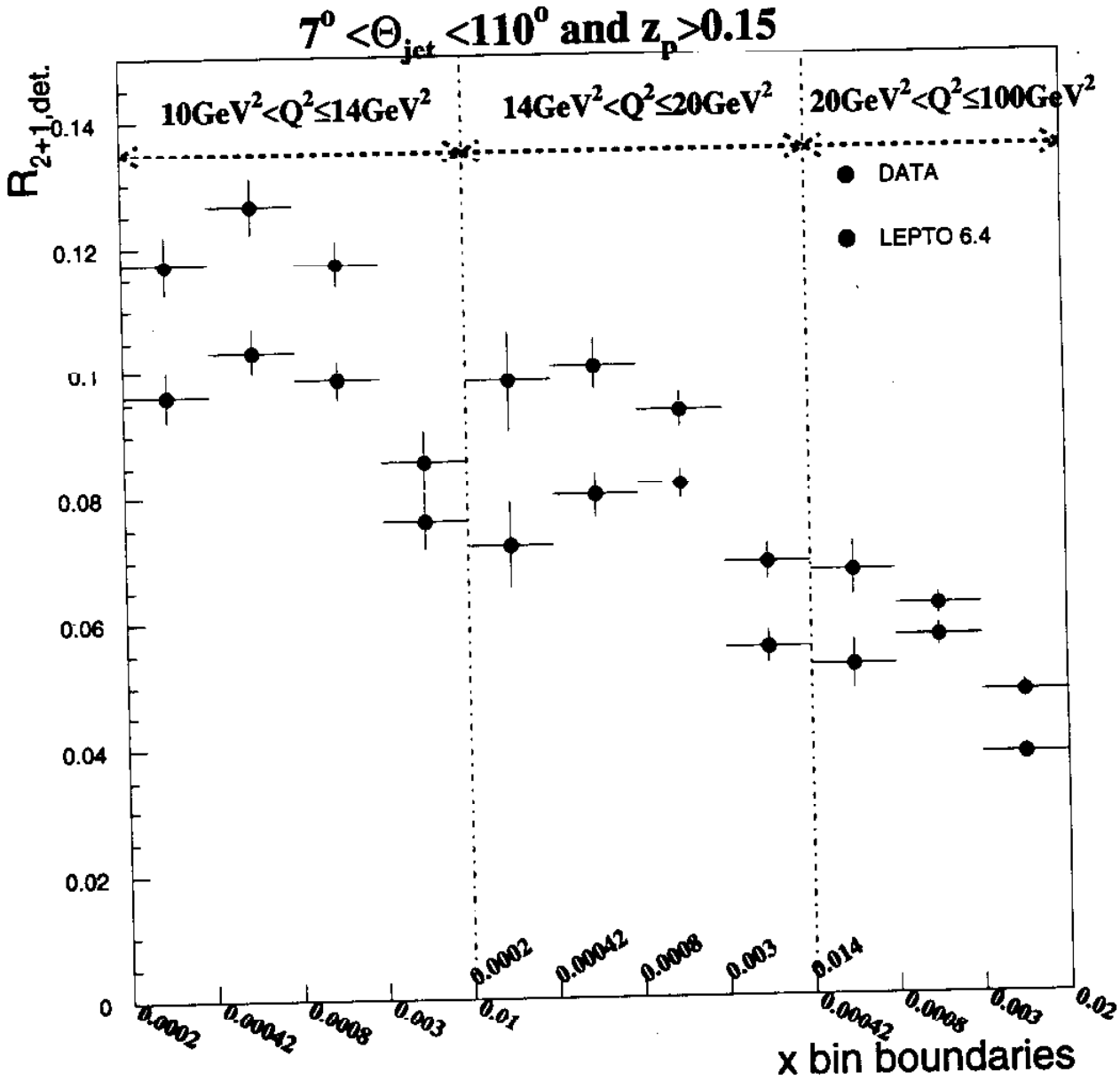
- QED rad. corr. $< 1\%$ (Django M.C)

- Syst. error:

  - Dominated by hadronic energy scale in Calorimeters.

  - effect on jet rate: Between 3% and 13%.
    $\Rightarrow$ Fully correlated

- Systematic taken into account within the χ^2 expression. (see F-Z talk of yesterday)


$7^0 < \Theta_{jet} < 110^0$ and $z_p > 0.15$
$R_{2+1,det.}$
$10GeV^2 < Q^2 \leq 14GeV^2$
$14GeV^2 < Q^2 \leq 20GeV^2$
$20GeV^2 < Q^2 \leq 100GeV^2$
DATA
LEPTO 6.4
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0.0002
0.00042
0.0008
0.003
0.01
0.014
0.02
x bin boundaries

• Fit Resuts •

- Starting Fit
  - No jet data: H1-F_2 ; NMC(F_2^p, F_2^D)
  - $\Lambda^4_{\overline{MS}} = 250$ MeV

    $\Rightarrow$ xg, Singlet, 2 non-singlet PdF are evolved From $Q_0^2 = 10$ GeV^2

- Jet Rate introduced

  $\Rightarrow$ REFIT

  $\Downarrow$

  - no significant changes of the PdF
  - using $\frac{A}{Q^2} + B\frac{\ln Q^2}{Q^2}$ For Power correction & Fitting A, B

    $\Rightarrow$ $\chi^2_{jet} > 200$ For 11 points!

⇒ ask "theoretician"

- non pert. corr. are x-dependent.

⇒ Simple empirical x function is introduced:

$$\Delta\sigma^{2+1}_{(x,Q^2)} \overset{\text{no Pert.}}{=} \frac{h(x)}{Q^2}$$

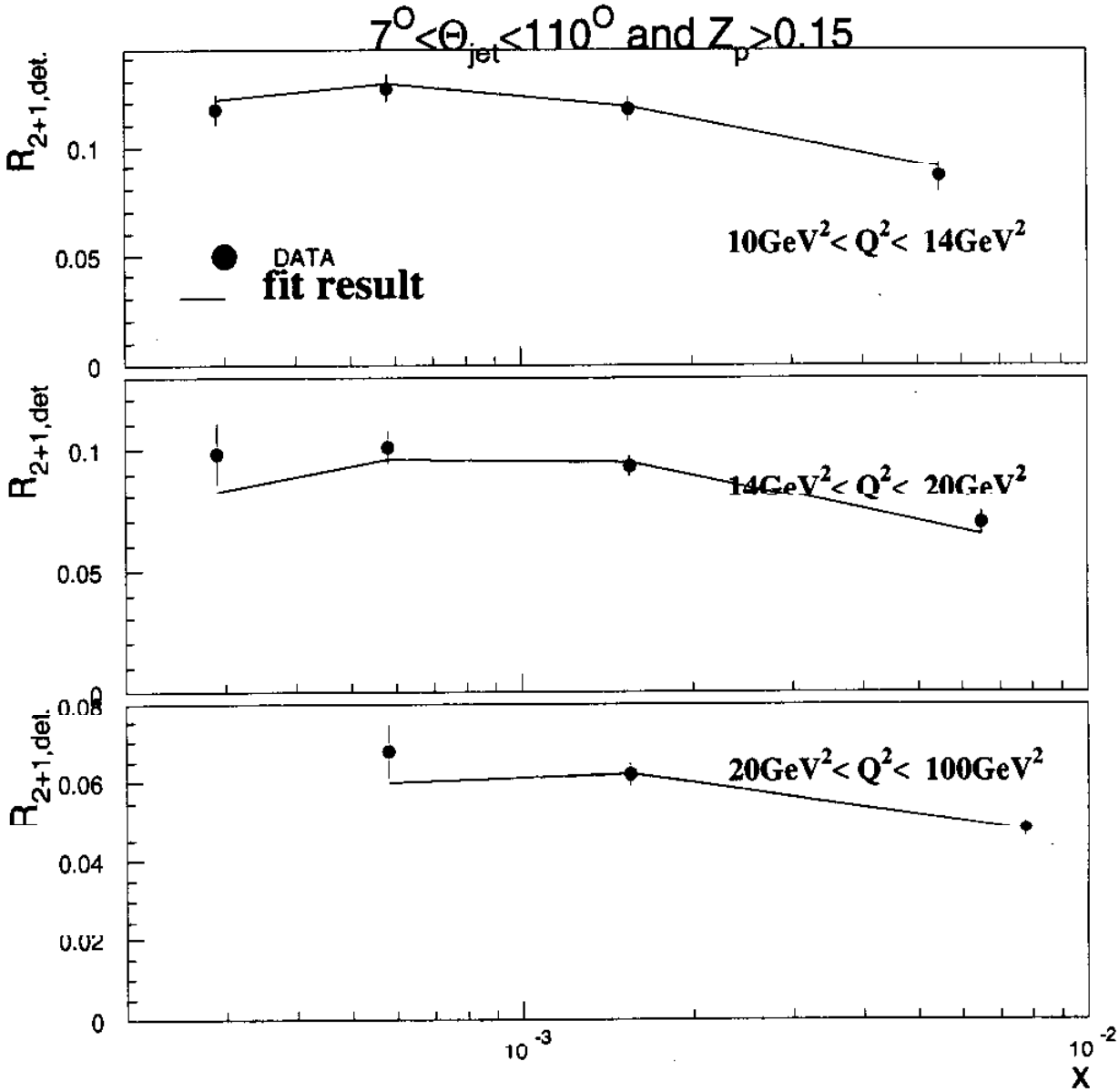
[we found: $\frac{\ln Q^2}{Q^2}$ not necessary]

- with

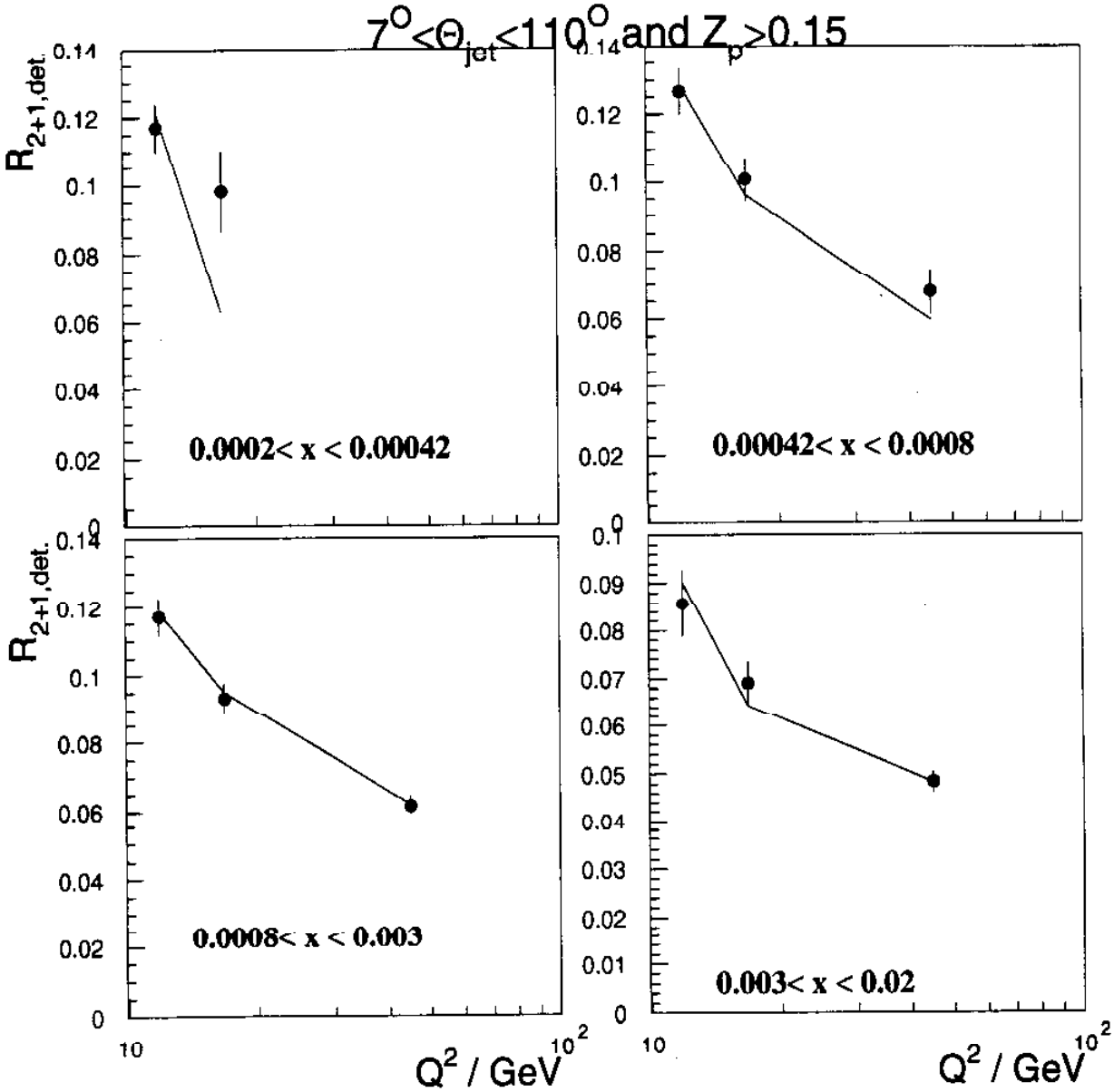
$$h(x) = \alpha + \beta \ln\frac{x}{x_0} + \gamma \ln^2\frac{x}{x_0} + \delta \ln^3\frac{x}{x_0}$$

- $\alpha, \beta, \gamma, \delta$: free parameter

(- $x_0 = 10^{-4}$)

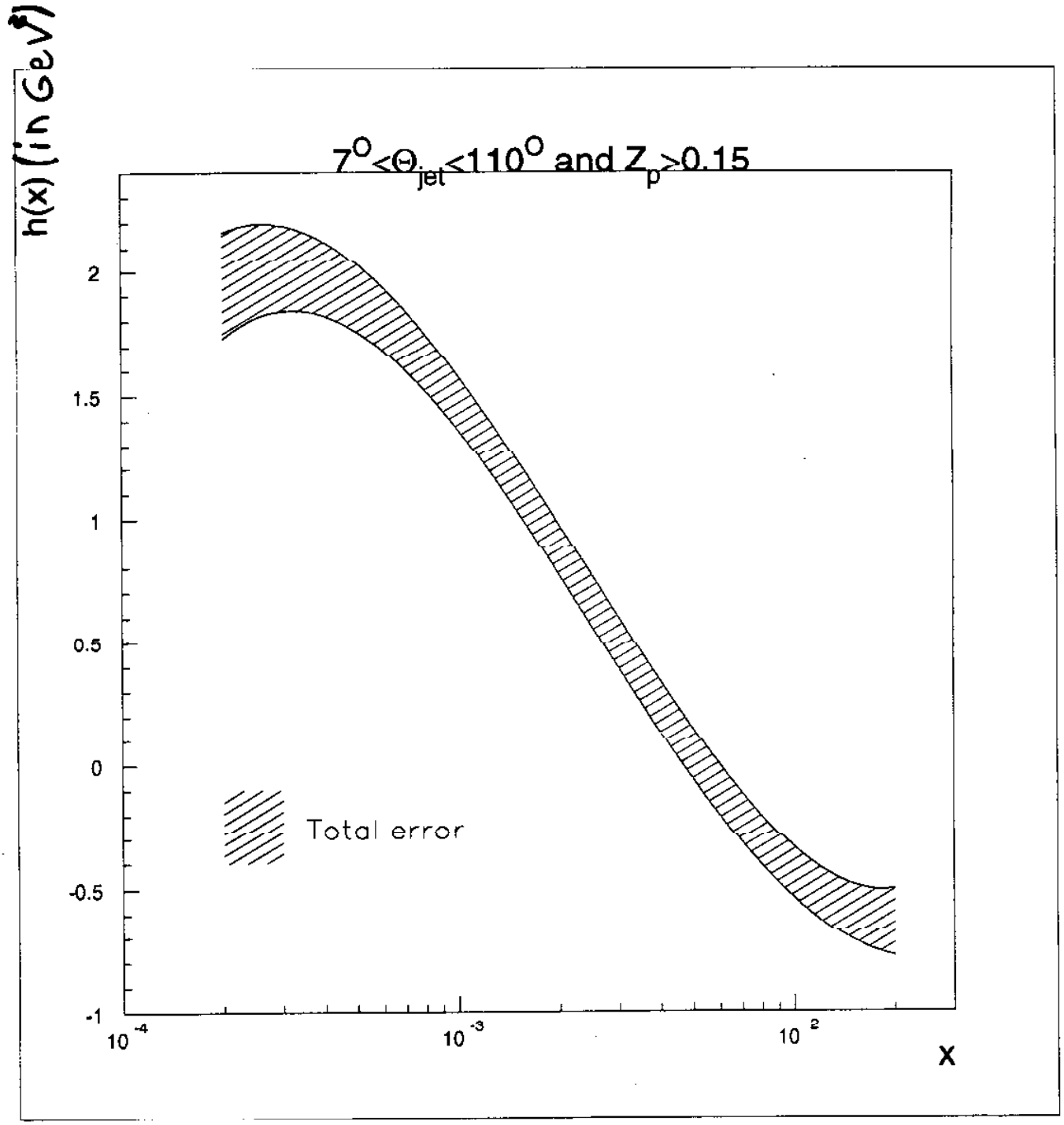


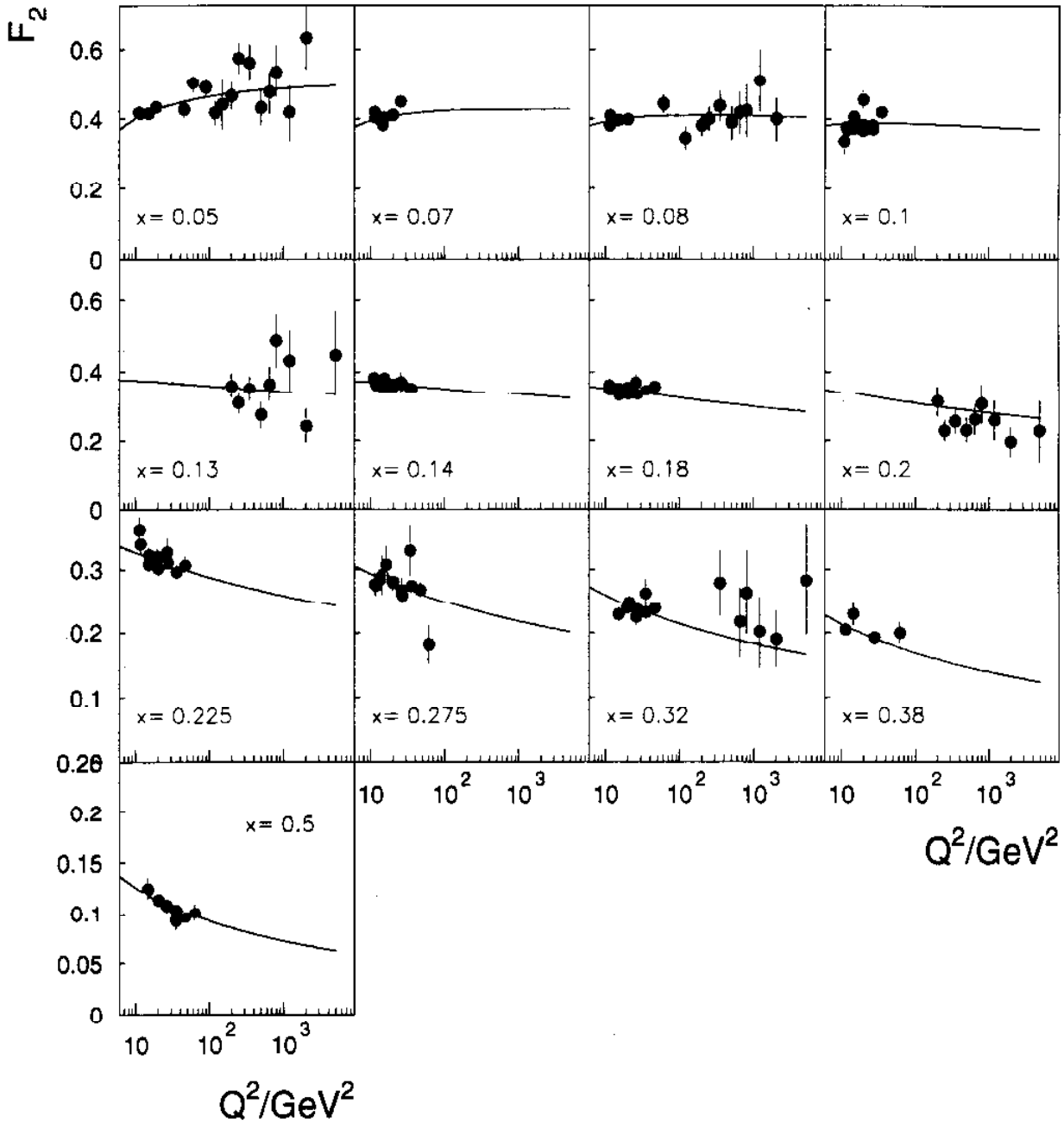
ZOMER@DICE2, AFR11/11:09



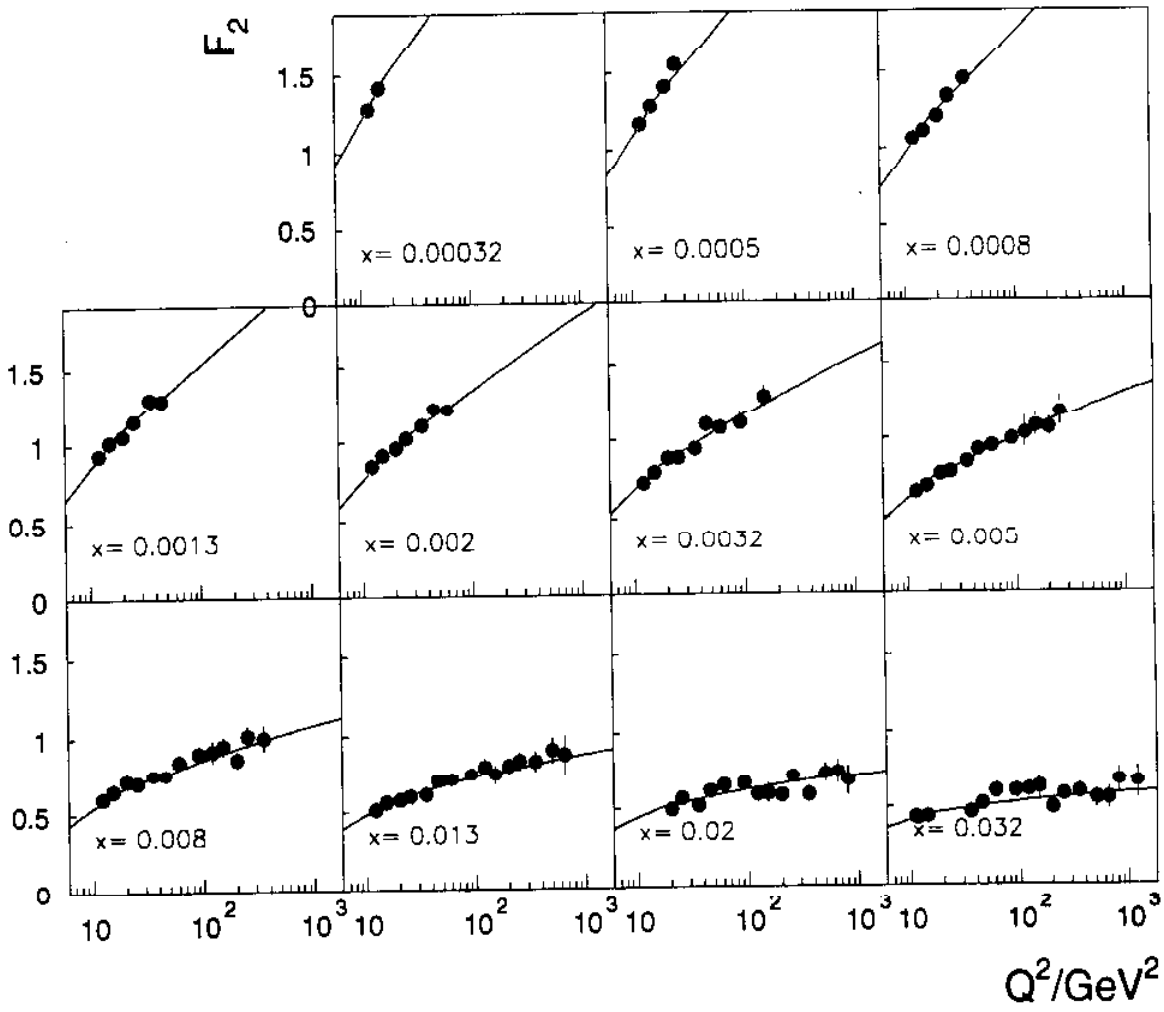
ZOMER@DKCE2, APR11/11:09

- RESULT
  - Good χ^2 : $\chi^2_{jet} < 10$ (For 11 points)
  - Still : no significant modification of p.d.f
  - Very little improvement of the gluon error band.
  - But : extraction of non perturbative function $h(x)$ with error band


h(x) (in GeV²)
7°<Θjet<110° and Zp>0.15
2
1.5
1
0.5
0
-0.5
-1
10⁻⁴
10⁻³
10⁻²
X
Total error


F_2
x= 0.05
x= 0.07
x= 0.08
x= 0.1
x= 0.13
x= 0.14
x= 0.18
x= 0.2
x= 0.225
x= 0.275
x= 0.32
x= 0.38
x= 0.5
Q^2/GeV^2
Q^2/GeV^2

H1 & NMC F_2 fit result



• conclusion •

- Using k_t alg. with scale Q^2 does not "help" F_2 to determine xg

BUT

- Fitting simultaneously F_2 & jet-rate

  ⇒ extraction of the non perturbative contribution to σ^{2+1} : $\frac{h(x)}{Q^2}$

  ⇒ experimental error band for $h(x)$

- A frame to study jet rate using QCD at NLO is provided

  ⇒ what algorithm should we use? (to do a proper job)