Measurement of the Inclusive DIS Cross Section at Q^2 ~ 1GeV^2

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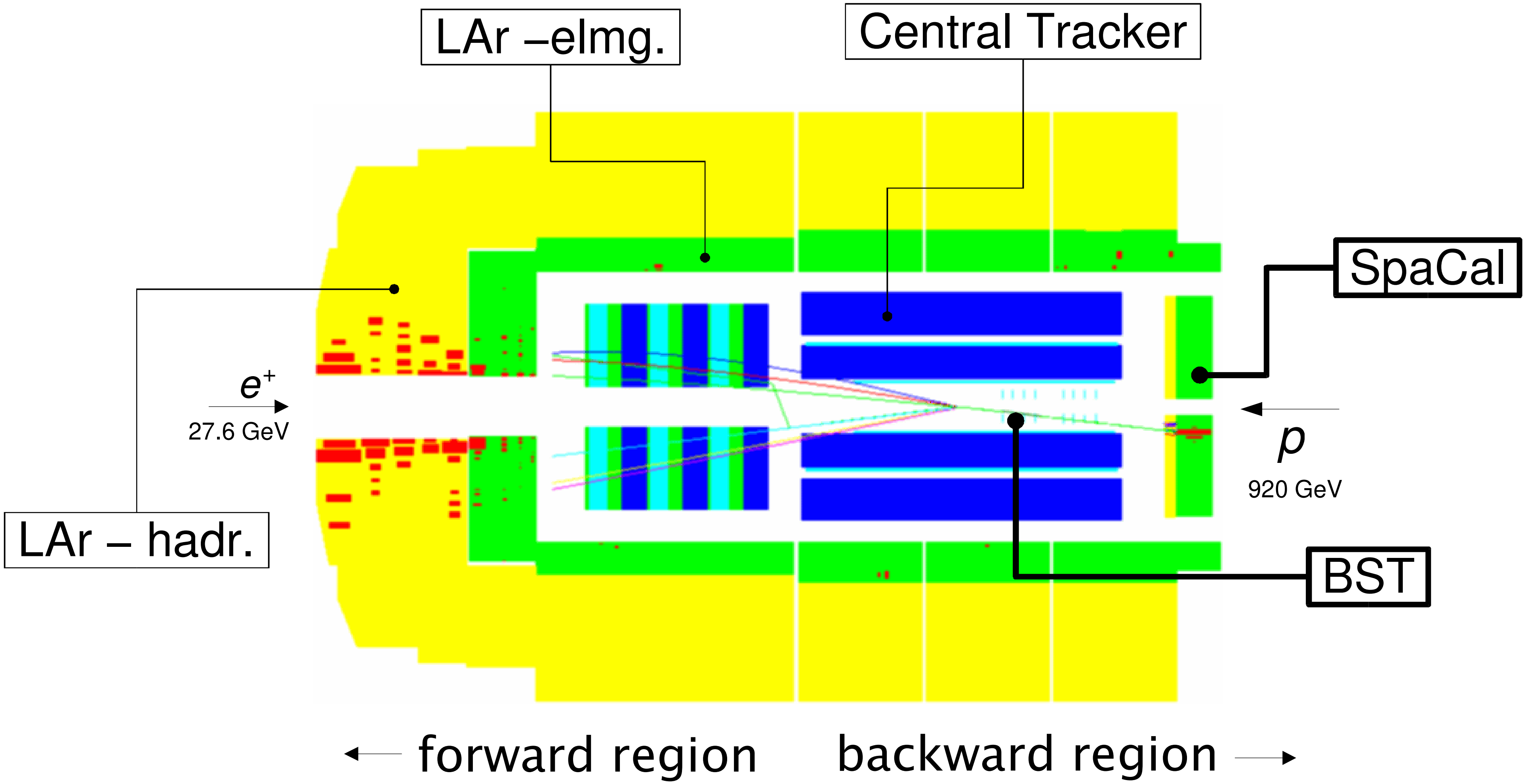
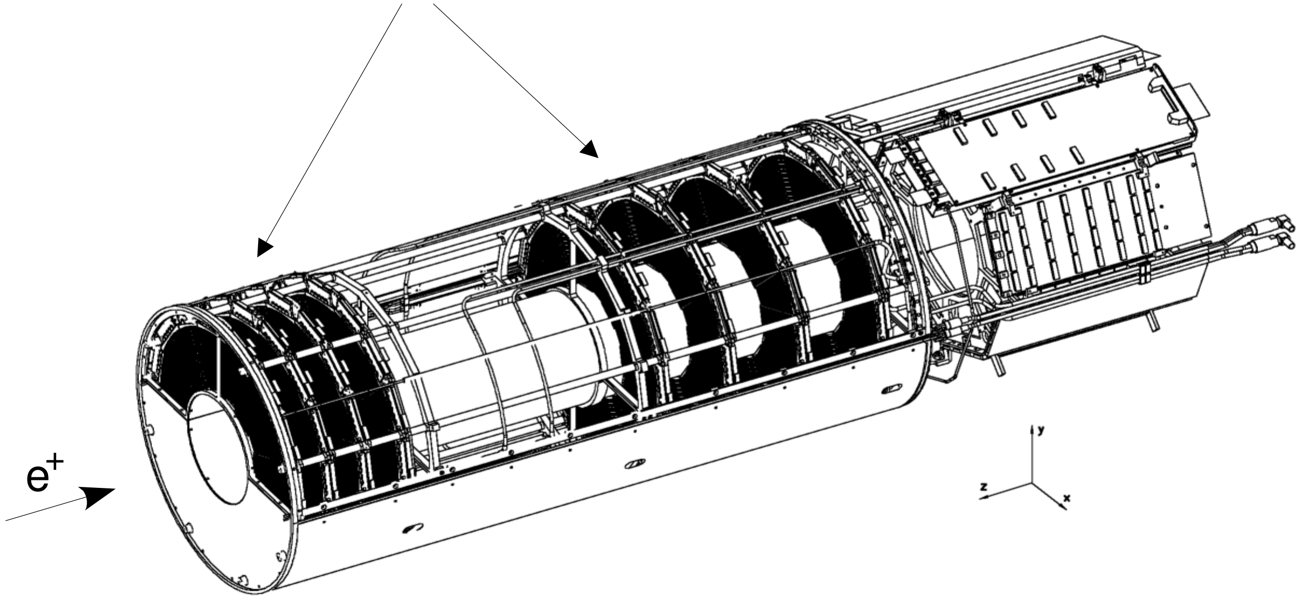
- **H1 detector and its components**
- **'Shifted Vertex' 2000 dataset**
- **Cross–section measurement**
- **The proton structure function F_2**
- **Summary**

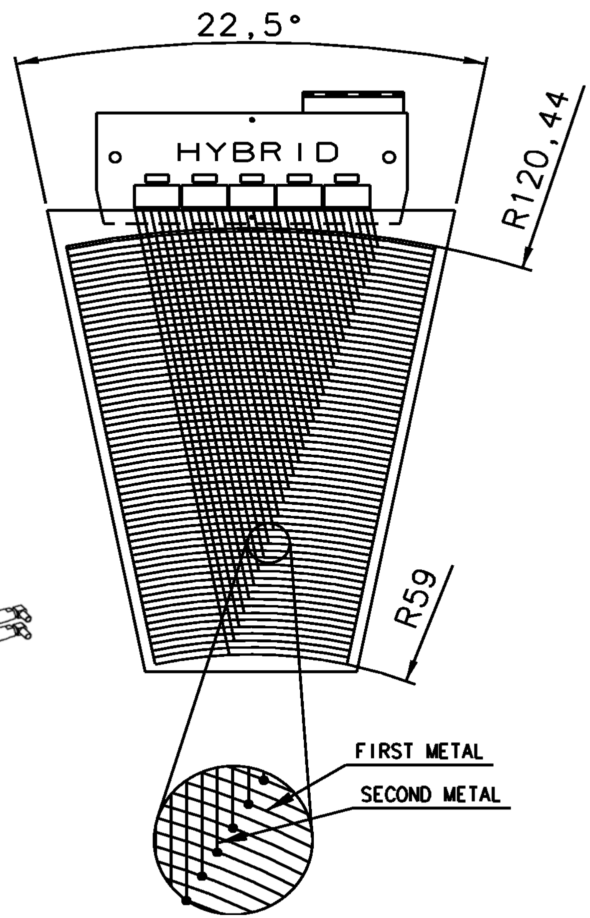
H1 Detector at HERA



Backward Silicon Tracker (BST)

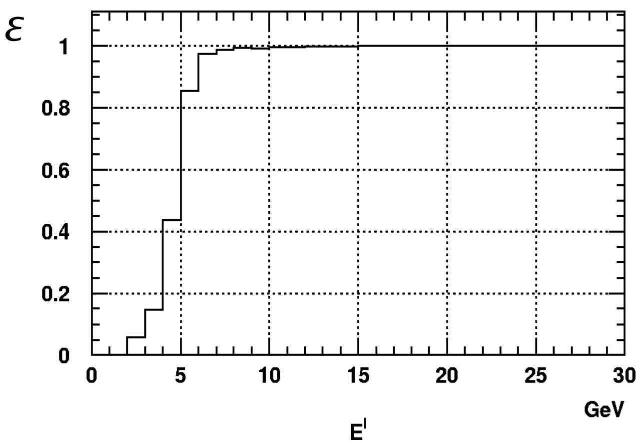
- **BST – silicon strip detector**
  - **positron scattering angle measurement**
  - **track reconstruction efficiency 95%**
  - **resolution ~20 μm**
  - **8 planes x 16 sectors**



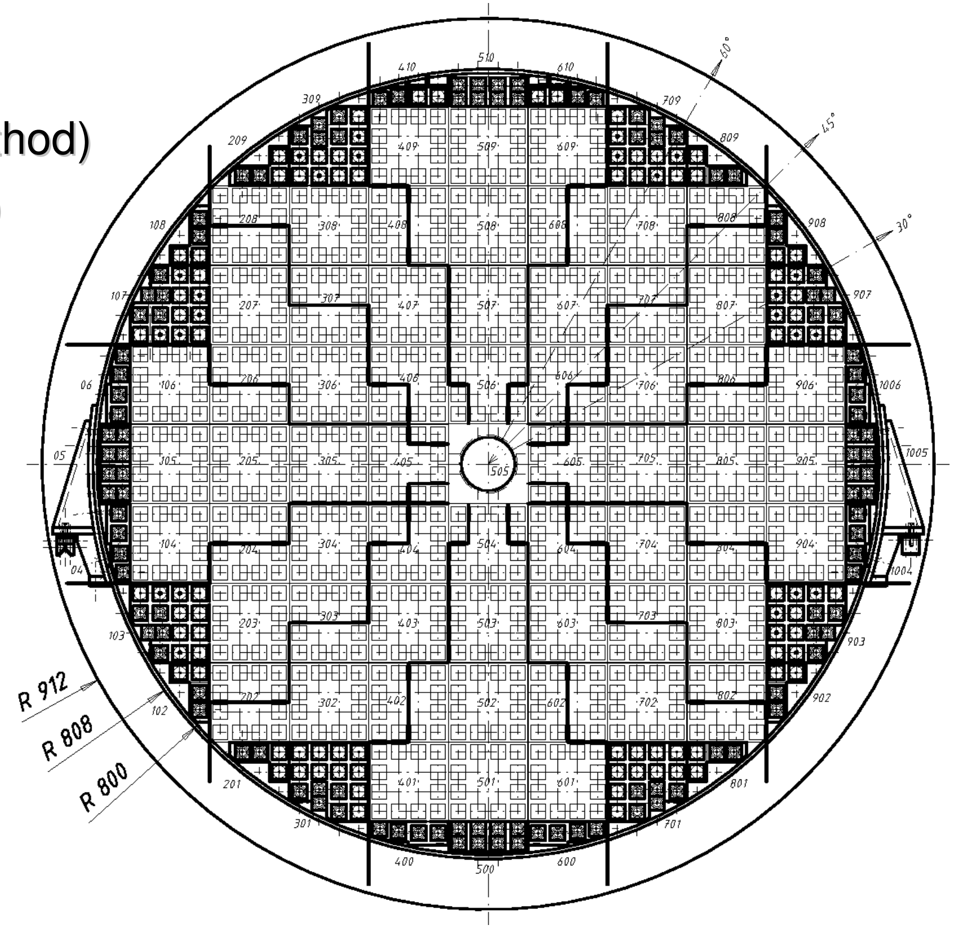


SpaCal Calorimeter

- covers the backward region of the H1 $(Q^2 < 150\ \mathrm{GeV}^2)$
- 1192 square cells
  - lead−scintillating fibres
- Calibration accuracy
  - ~0.3% at 27.6 GeV (double angle method)
  - ~2% at 7 GeV (E/p from Spacal/BST)
- Trigger on positron
  - $\varepsilon > 99\%$ for $E' > 7\mathrm{GeV}$



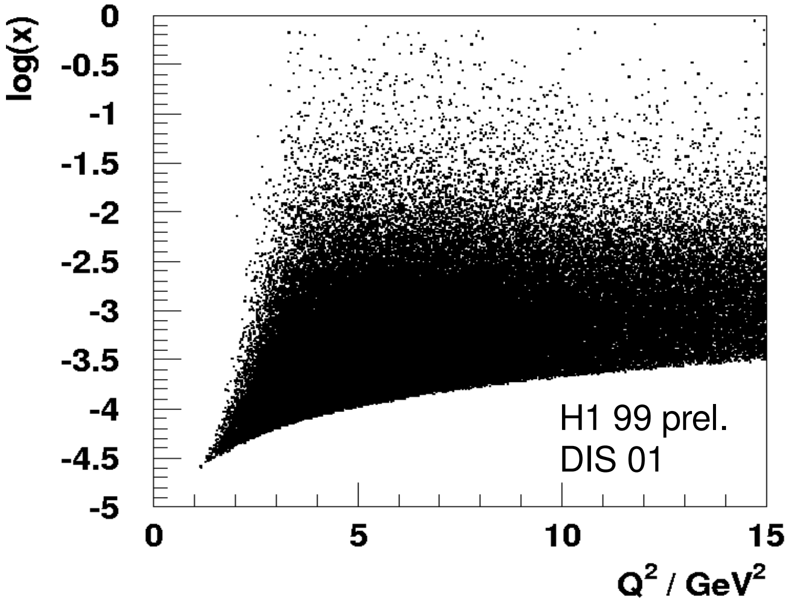
x−y cross−section



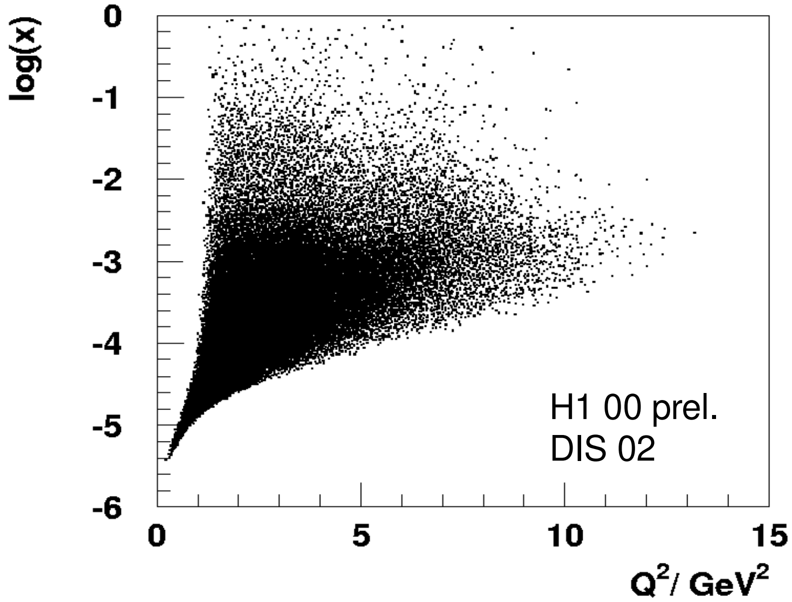
Tomas Lastovicka(H1), DIS2002, Kraków

'Shifted Vertex' 2000 Data

- interaction vertex shifted by +70cm w.r.t. the nominal position -> access to lower values of Q^2
- $L = 607\, nb^{-1}$ (~ 5x more than 1995 shifted vertex data)
- inclusive measurement (vertex determined by positron in BST)
  - diffractive and elastic channels included

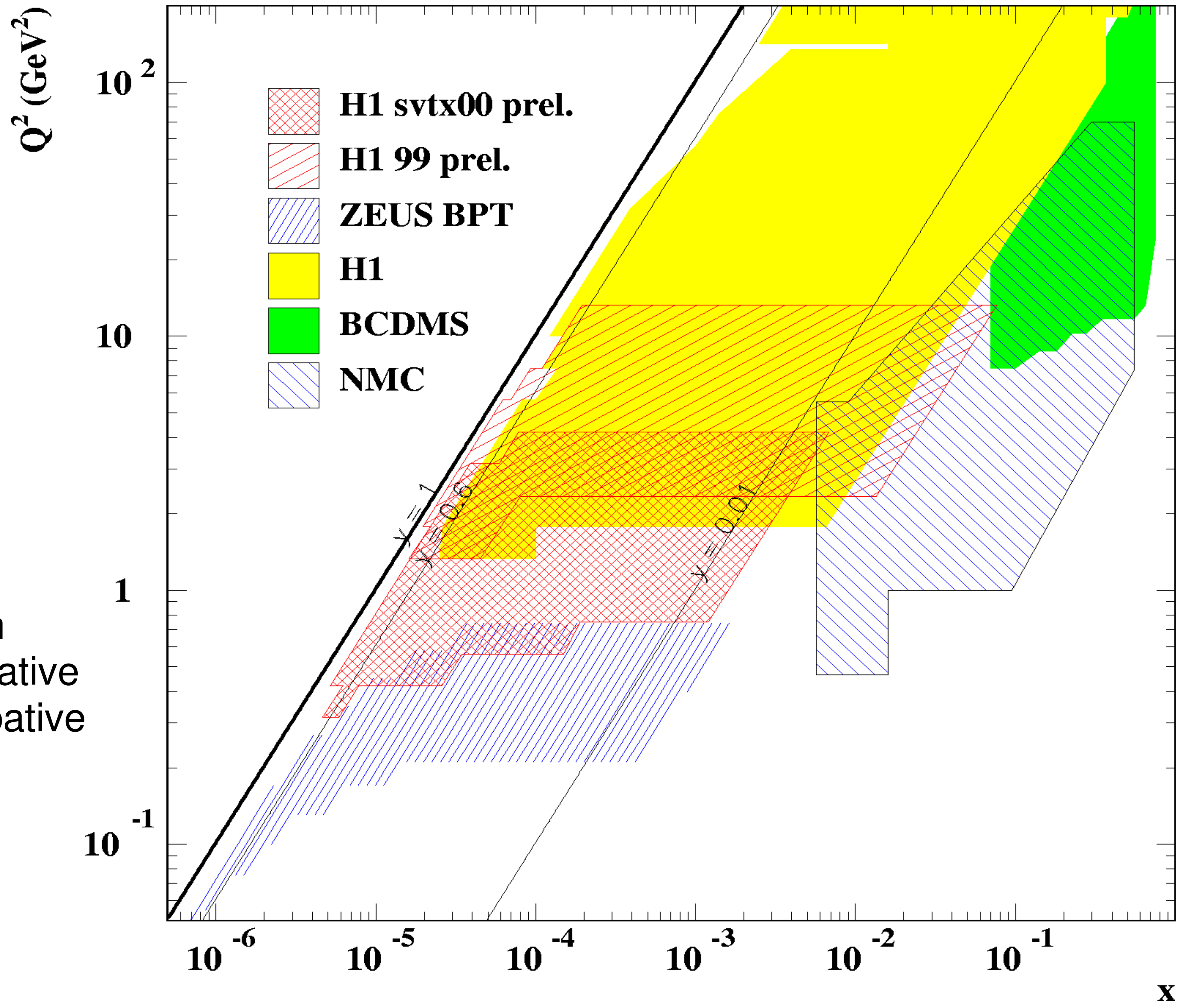


Nominal vertex position



Shifted vertex position

Kinematic plane coverage



Overlap with nominal vertex H1 data

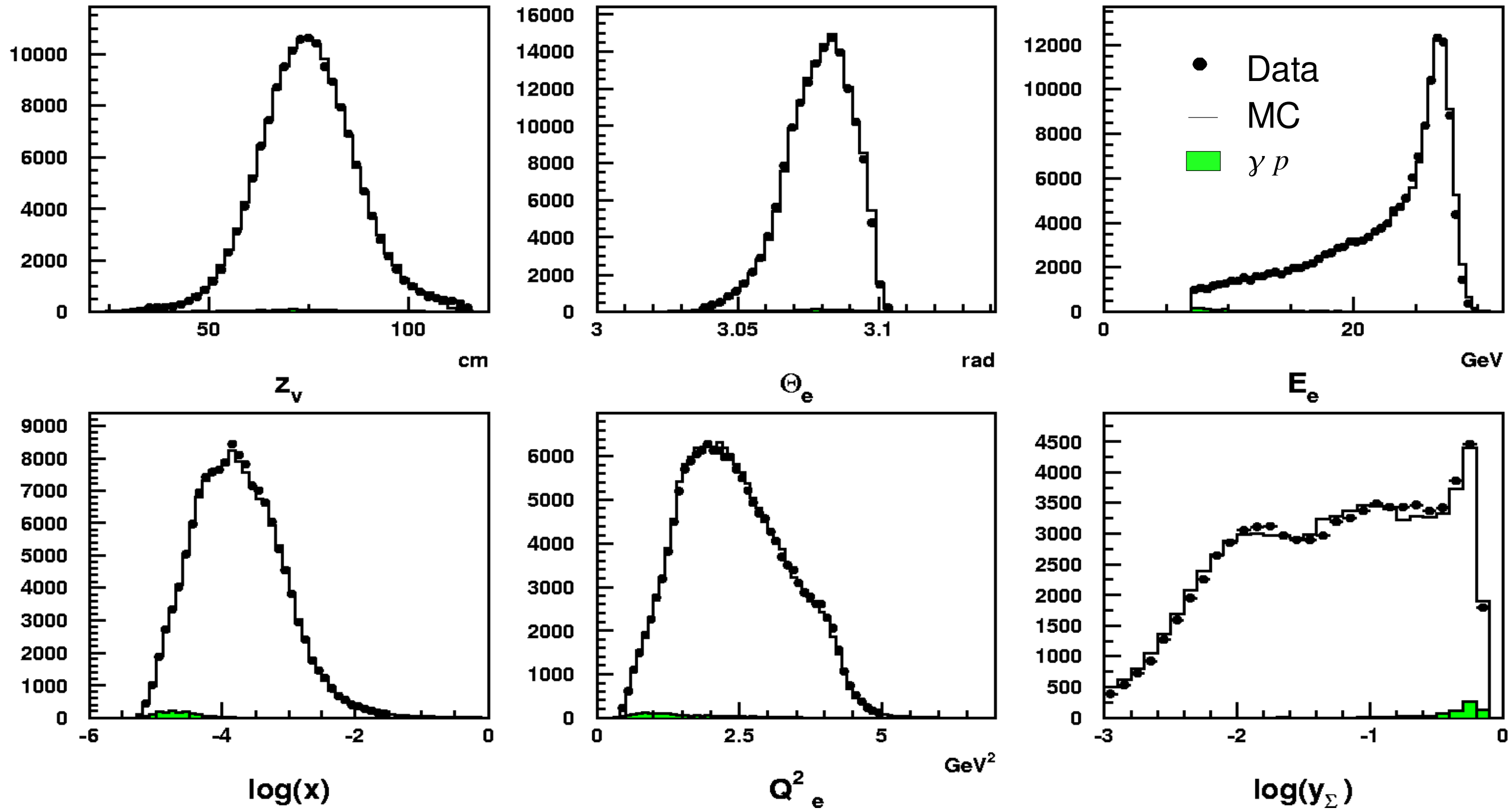
Transition region between perturbative and non−perturbative kinematic range

Event Selection

- **inclusive SpaCal trigger**
- **electromagnetic SpaCal energy: $E_e > 7$ GeV**
- **lateral cluster size: $R_{cl} < 4$ cm**
- **BST validated track**
- **BST–SpaCal matching: $\delta r < 2$ cm**
- ***z* vertex position: abs ($z_v - 70$) < 40 cm**
- **energy momentum conservation: $E - p_z > 35$ GeV**

Kinematic Distributions

- DIS simulation: DJANGO generated with MRST (3.75 PDF), reweighted to fractal F_2 parametrisation and dipole F_L
- $\gamma\, p$: PHOJET normalised to data (el. tagged events), suppressed by BST and $E-p_z$
- Kinematics reconstructed with electron (e) and sigma (e,h) methods



Contributions to Cross-Section Uncertainties

Data statistics	~2 %
MC statistics (comparable with data)	
Trigger eff.	0.5 %
BST eff.	2 %
E'_e (0.3–2 %)	0.5 %
E_{had} (2 %)	1 %
ϑ_e (0.3 mrad)	0.5 %
LAr noise	4 % at low y
γp background	~2 % at high y
Radiative corr.	1 %

total error: 3–4% typically

- Luminosity measurement 1.8 % (not included in the total errors)

$\boxed{\sigma_r}$

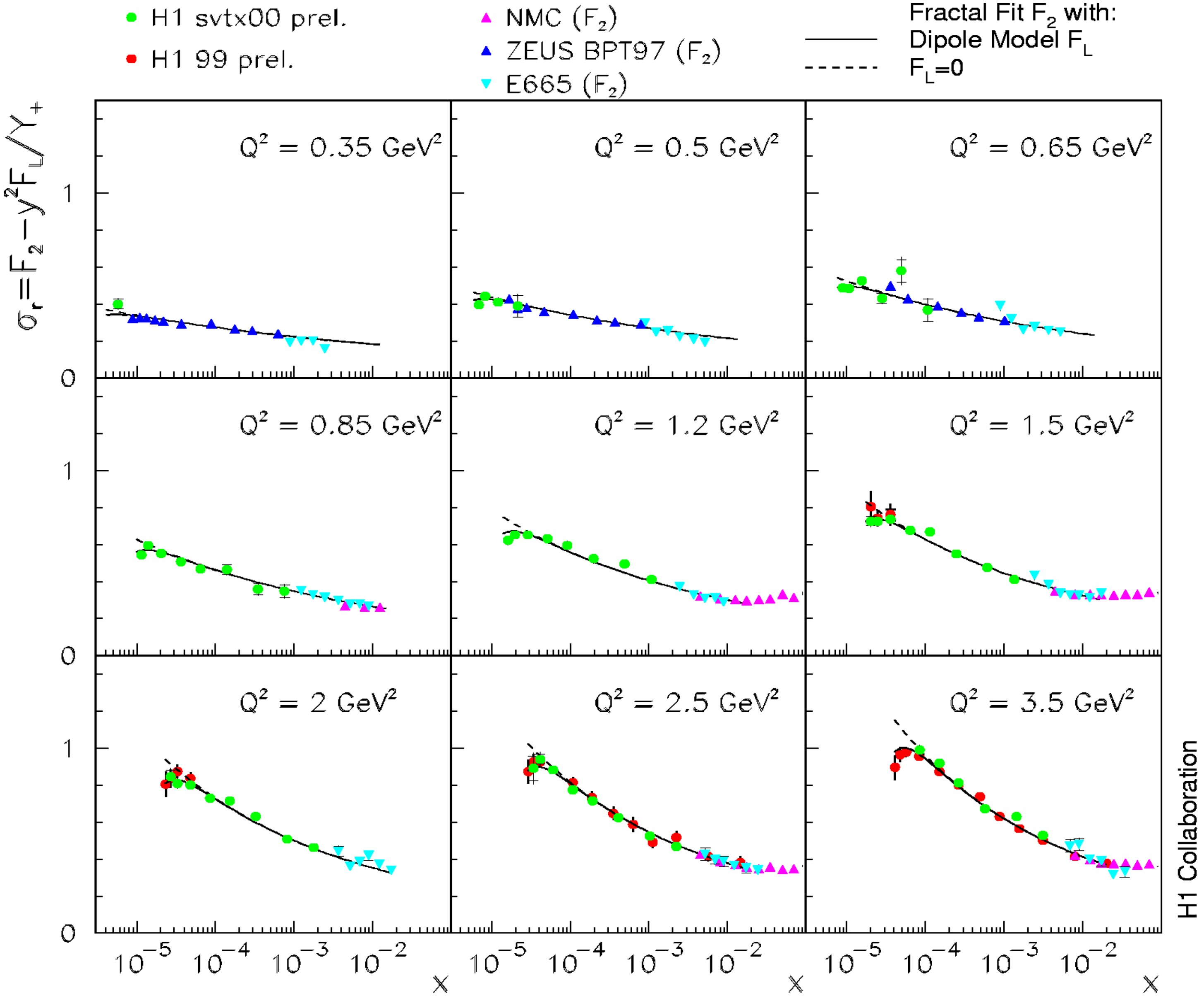
compatible with the previous measurements

$$\sigma_r = F_2 - \frac{y^2}{Y_+} F_L$$

$$Y_+ = 1 + (1-y)^2$$

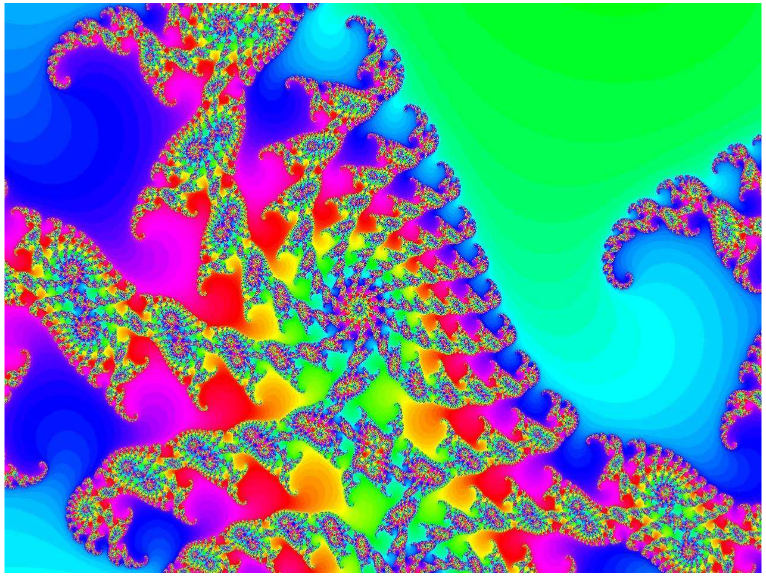
<u>low y</u> : $\sigma_r \simeq F_2$

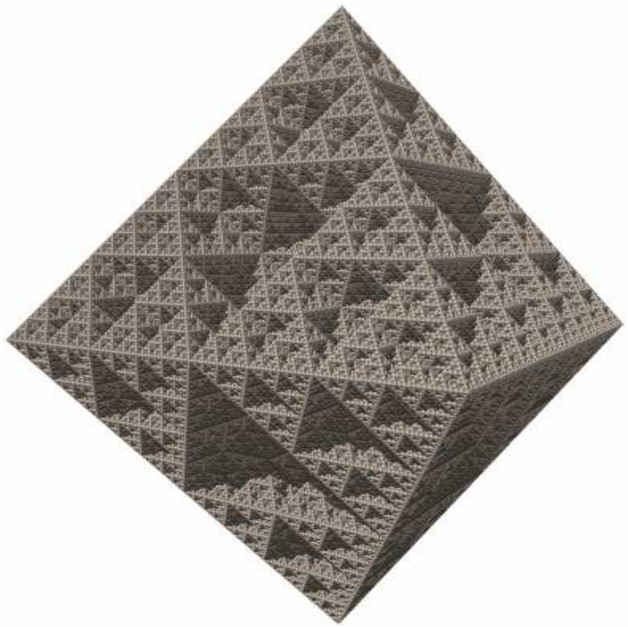
<u>high y</u> : F_L contribution is noticeable



Fractal Fit to F_2

- phenomenological parametrisation based on model where proton at low x is described as a self−similar object using fractal dimension concept [hep−ph/0203260]
- in the presented analysis it was fit to H1 96/97 and ZEUS BPT 97 data and used for reweighting of cross−section together with dipole F_L
- for details: talk at joint session (diffraction + structure functions)

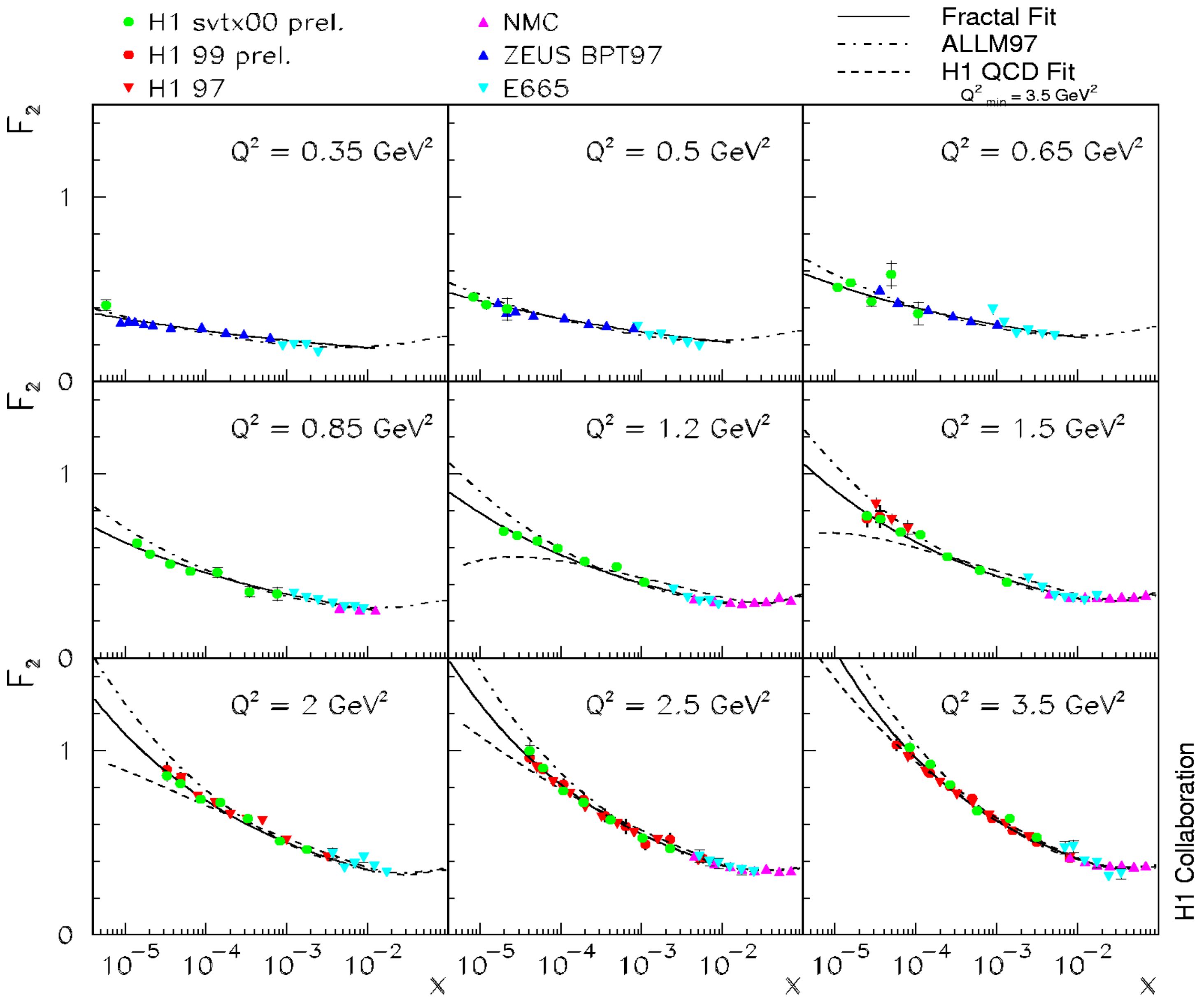




F_2

from σ_r for y<0.6 with F_L dipole

rise towards low x observed also at low Q^2



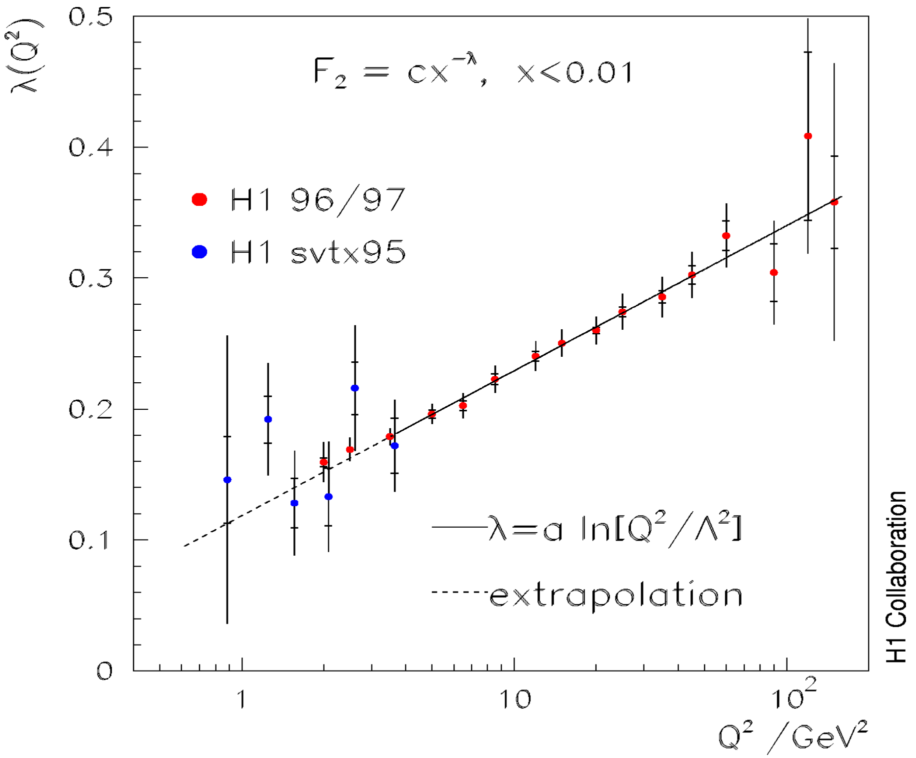
λ

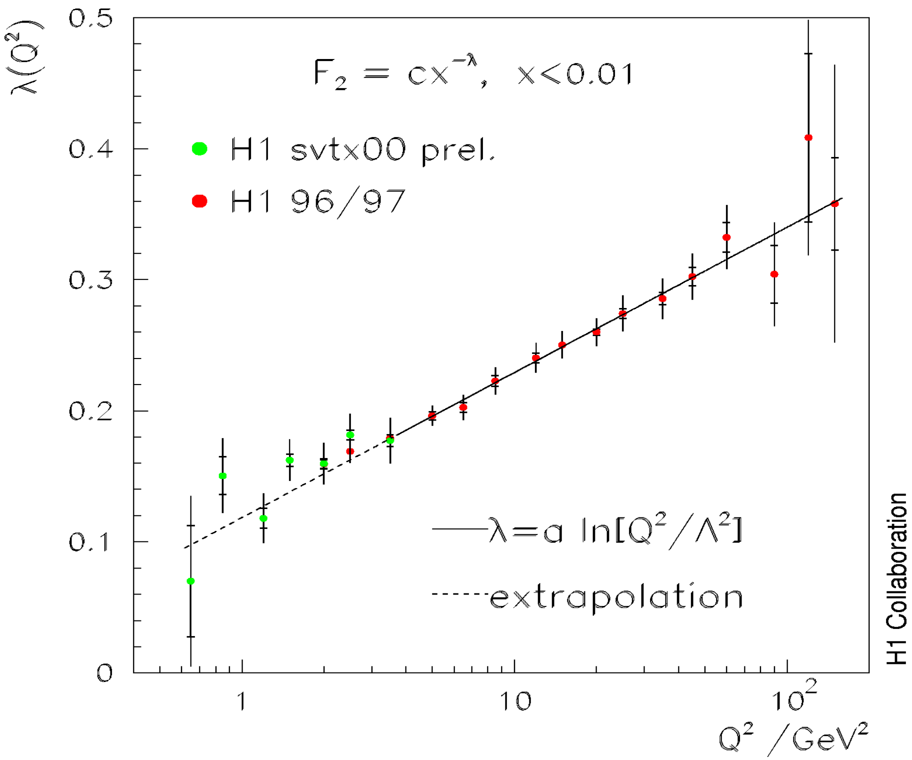
power–law behaviour of F_2 at fixed Q^2: $F_2 \propto x^{-\lambda(Q^2)}$

fit performed in bins of Q^2

$x < 0.01$ – below the valence quark region

$y < 0.6$ – F_L contribution reduced





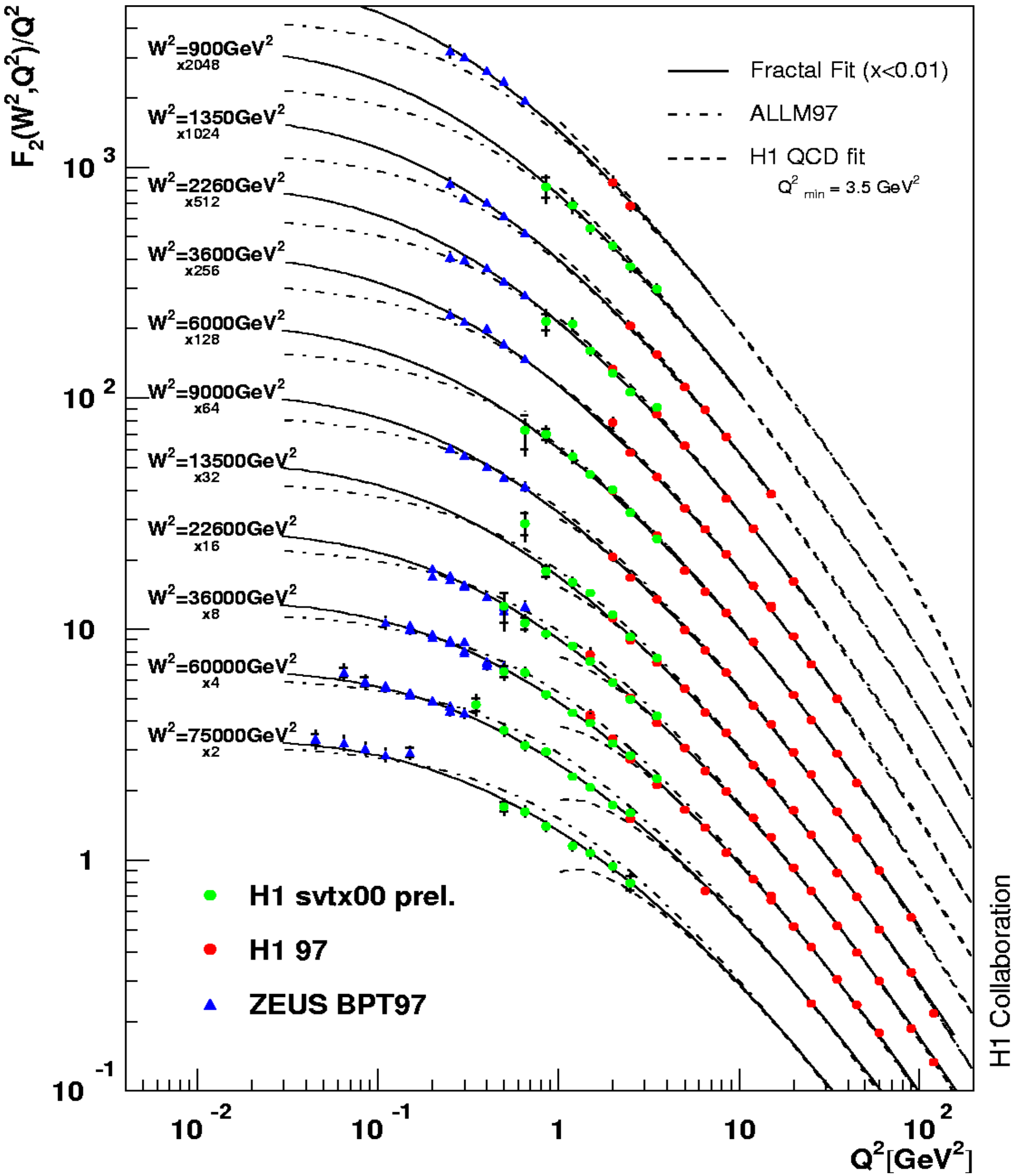
→ see Joerg Gayler's talk on rise of F_2

Photoproduction cross–section in the limit $Q^2 \to 0$:

$$\sigma_{\gamma^* p} \propto F_2/Q^2$$

The new H1 data cover the transition region to non−perturbative domain, $Q^2 \sim 1\,\mathrm{GeV}^2$, with precision measurement.

$$W^2 = \frac{Q^2(1-x)}{x} + M_p^2 \approx y \cdot s$$



Summary

- H1 has obtained precision data in the region of $Q^2 \sim 1\, GeV^2$ from a special shifted vertex run in August 2000.
- This measurement extends the H1 precision σ_r /F_2 determination into the transition region to the non–perturbative domain.
- The rise of the proton structure function F_2 persists at low Q^2, x.
- At lowest x an indication of F_L is observed in the cross–section behaviour.