Energy dependence of $\sigma_{TOT}(\gamma p)$ at HERA

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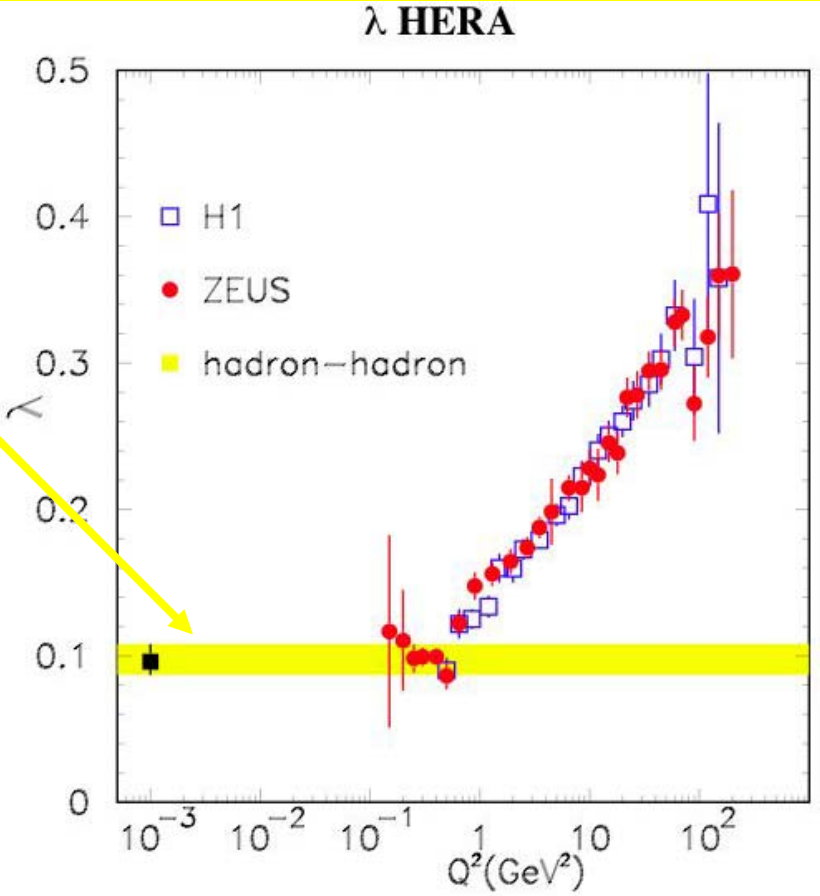
On behalf of the ZEUS collaboration

soft → hard

$\sigma \propto s^{0.096}$

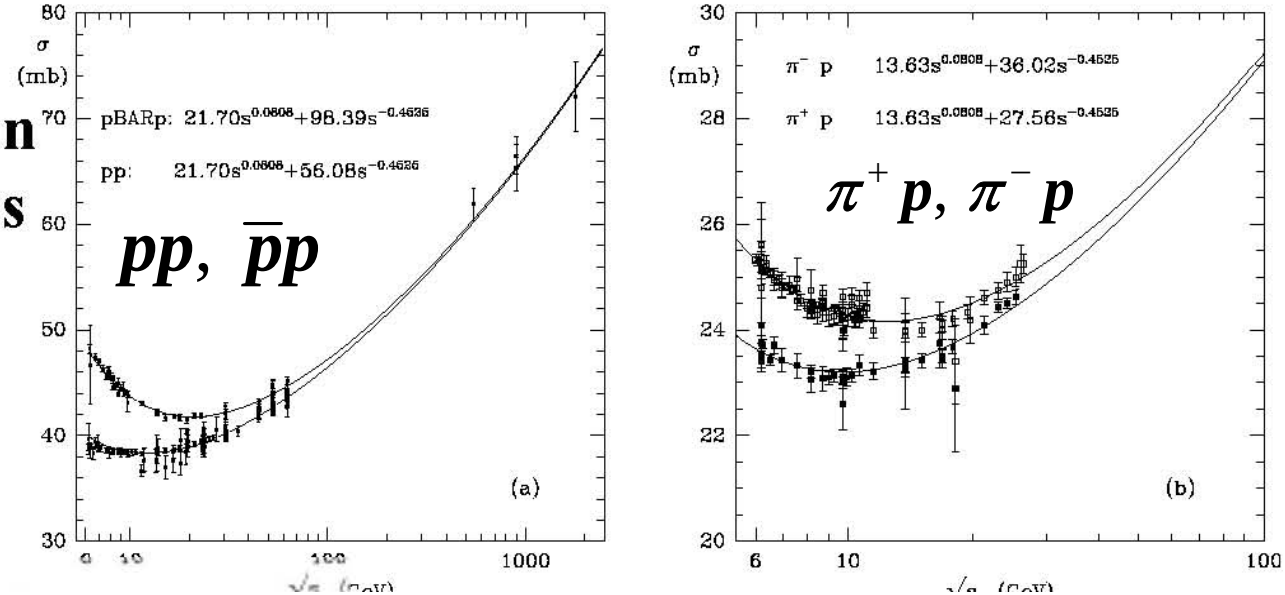


$$F_2 \sim x^{-\lambda(Q^2)}$$

Where exactly is the band? How narrow can one make it? Need to have a precise determination of W dependence of σ_{TOT}.

Hadron-hadron: DL

Hadron-hadron scattering cross section versus CM energy



Donnachie and Lanshoff (DL) – universal behavior of total hadron-hadron cross section :

$$\sigma_{tot}(h-h) = As^{\alpha_{IP}(0)-1} + Bs^{\alpha_{IR}(0)-1}$$
$$= As^{0.0808} + Bs^{-0.4525}$$

Hadron-hadron: DL

How was the DL fit done?

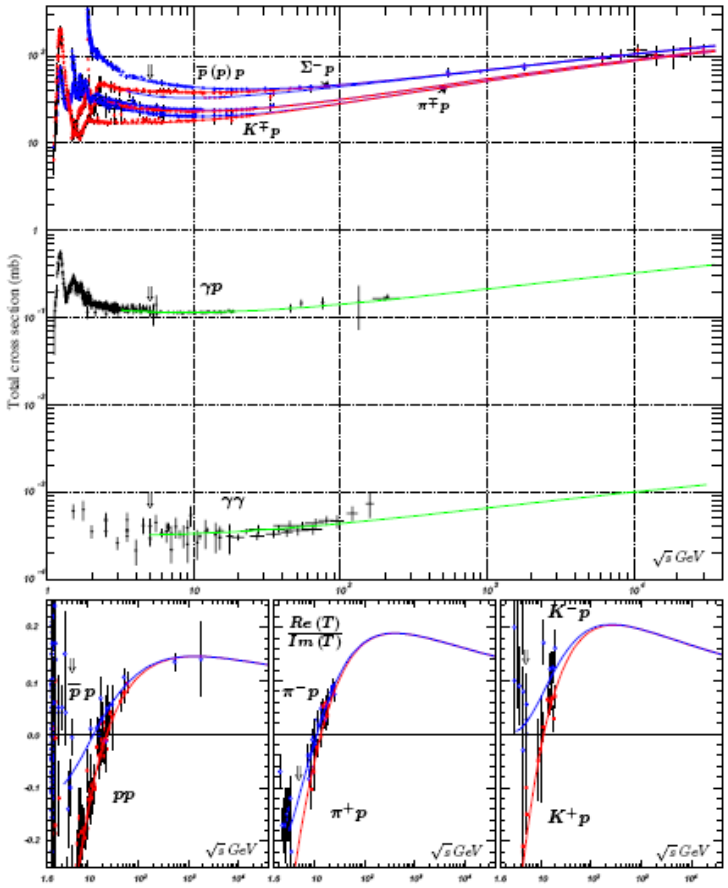
Fit the two powers only from pp and $p\bar{p}$ data above W=10 GeV

Get χ^2/df=410/130=3.16 $\Rightarrow$ do not give uncertainties on parameters

" Notice also that the quality of the data is such that the precise values of our parameters should not be taken too seriously"
(Phys. Lett. B296, 227 (1992))

After fixing the 2 parameters find A, B for other reactions.

Cudell (CKK)



Cudell, Kang, Kim (PL B395, 311 (1997))

Repeat DL analysis, data only if 1σ or 2σ from average. Use also data on ρ (real/imaginary part of amplitude). Add separate intercepts of the C=+ and C=- meson trajectories.

Get:

$$\varepsilon = 0.096^{+0.012}_{-0.009}$$

but

" feel that intercepts as high as 1.11 and as low as 1.07 are possible"

Cudell (CEKLT)

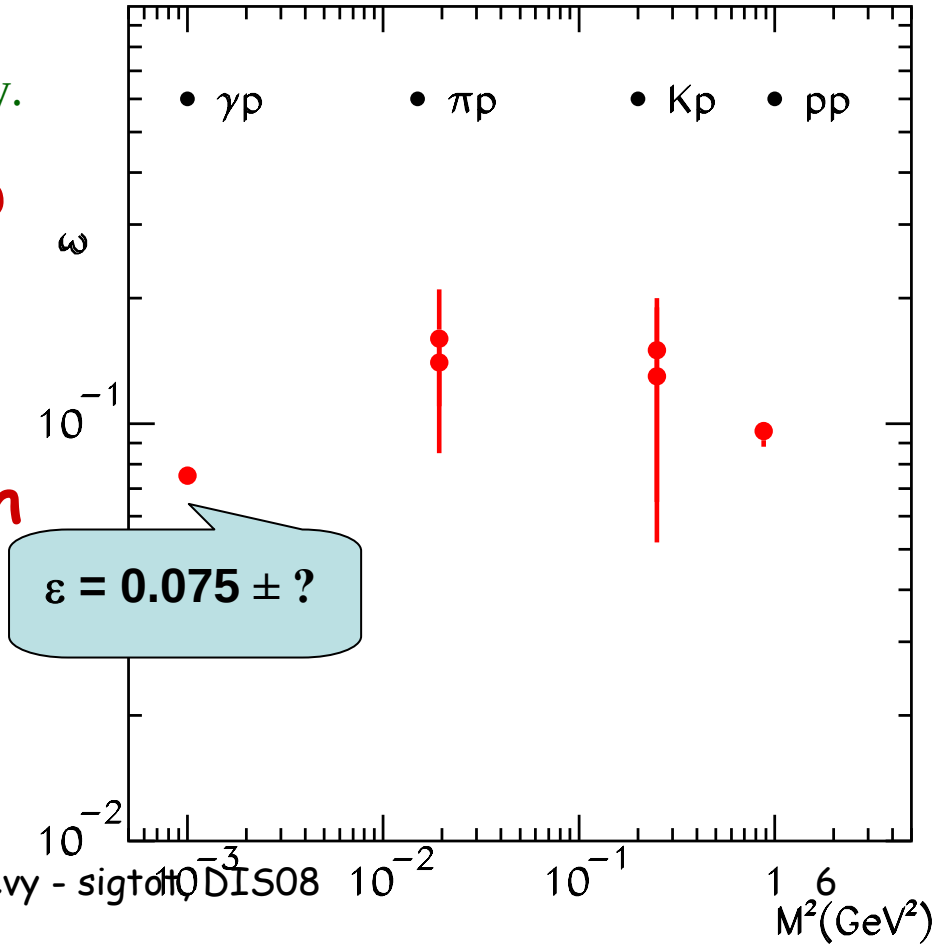
Cudell, Ezhela, Kang, Lugovsky, Tkachenko PR D61, 034019 (2000)
Repeat CKK with W_{min}=9 GeV

Get: ε = **0.093** $\pm$ **0.002** - mainly from pp, $\bar{p}p$

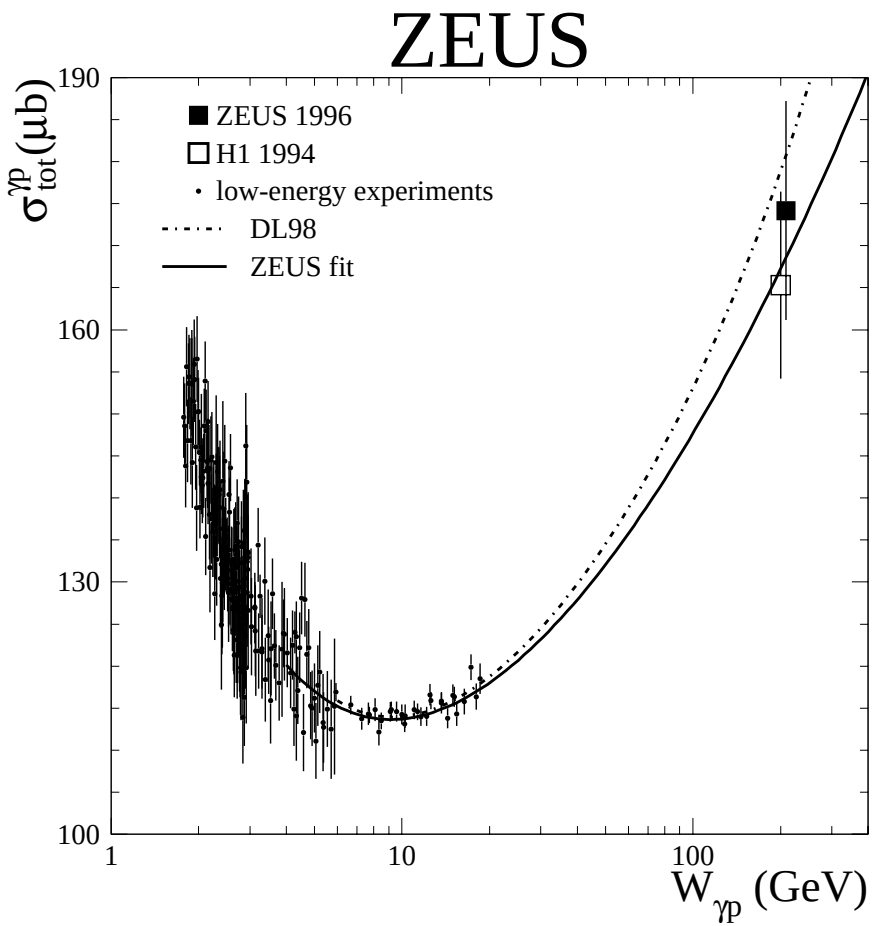
"Furthermore, the parameters of the C=+1 trajectory are highly correlated to those of the Pomeron."

Fix meson intercepts, fit reactions separately.

" We have not included the γp data, as there is some uncertainty regarding these. They would lead to an intercept of order 0.075 with large error bars"



$\sigma_{TOT}(\gamma p)$ at HERA



At HERA:

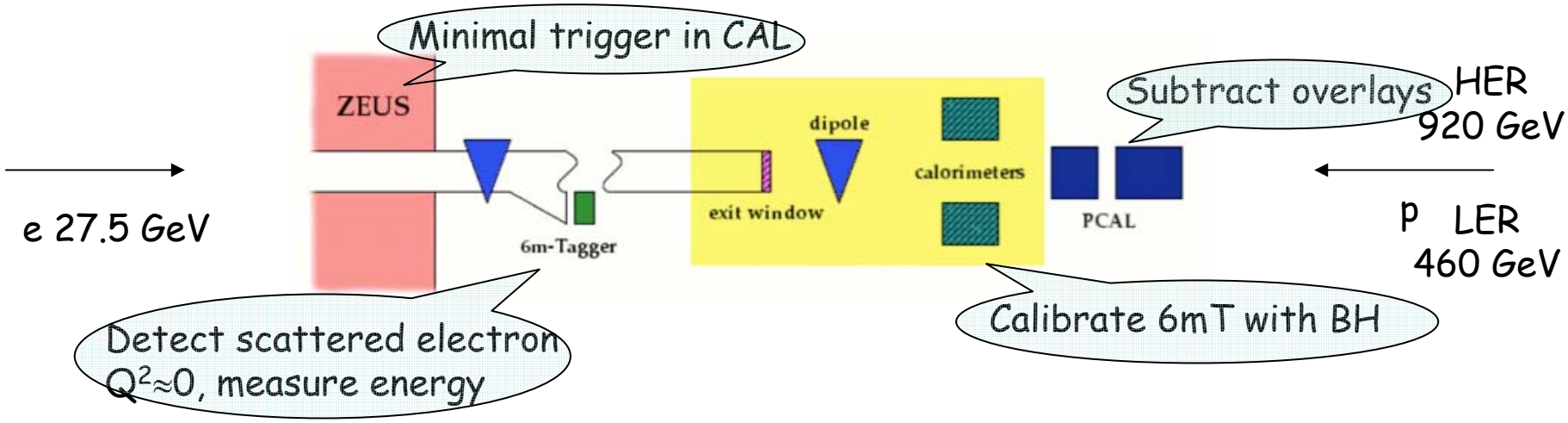
H1 (W=200 GeV), 165 ± 2 ± 11 μb

ZEUS (W=209 GeV), 174 ± 1 ± 13 μb

Large systematic uncertainties from 35m tagger acceptance and Calorimeter acceptance.

Want to reduce the large systematic error on total cross section by measuring ratios at different W.

W dependence of $\sigma_{tot}(\gamma p)$



Expect CAL acceptances at different W to be same – (checked with PYTHIA). Tagger acceptance under control – practically 100%.

W dependence of $\sigma_{tot}(\gamma p)$

ZEUS preliminary

$$R = \frac{\sigma^{\gamma p}_{HER}}{\sigma^{\gamma p}_{LER}} = \frac{N^{HER}_{evt}}{N^{LER}_{evt}} \cdot \frac{L_{LER}}{L_{HER}} \cdot \frac{f_{LER}}{f_{HER}}$$

Uncertainties: $\pm 0.52\%(\text{stat.}) \pm 1.05(\text{sys.}) \pm 1\% \pm 3.5\%$

from: signal measurement LUMI tag6 (to be improved)

$$\varepsilon = 0.070 \pm 0.007(\text{stat.}) \pm 0.021(\text{syst.}) \pm 0.050(6\text{mT})$$

Comments

- Result preliminary –

  shows that the principle works

- Can improve –

  reduce systematic uncertainty

- Will use also data

  from intermediate run (E_p = 575 GeV)