Low-x at TERA:

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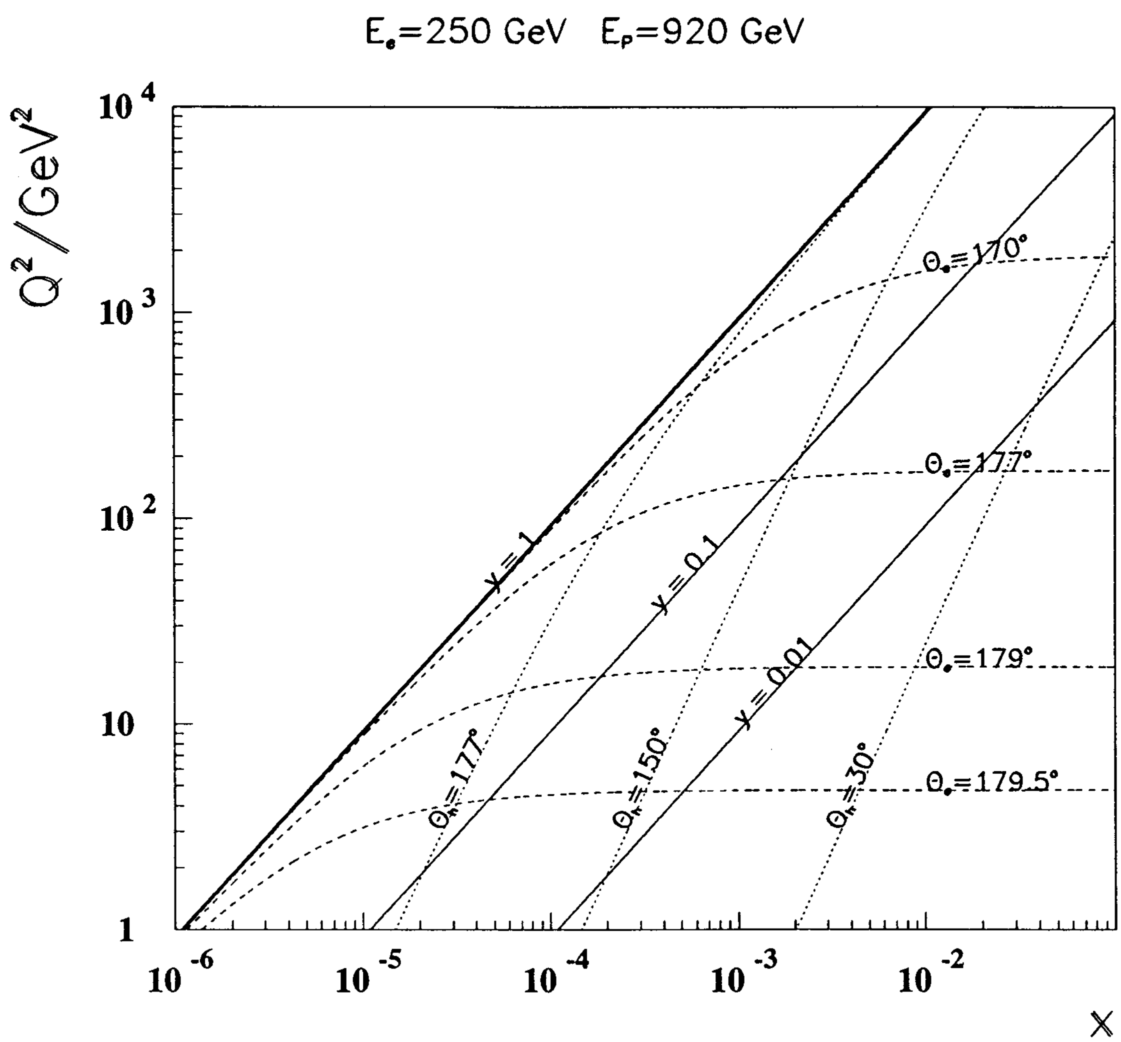
with Genya Levin and Paul Newman
February 9, 2000

- Inclusive DIS at low-x
- Inclusive diffraction at low-x
- Exclusive Vector Meson production at low-x
- Jets at low-x
- Conclusions

Inclusive DIS at low x



- Kinematic extension to low-x - detector dependent

- Need BPC for lower Q^2 detection (around whole beam-pipe)

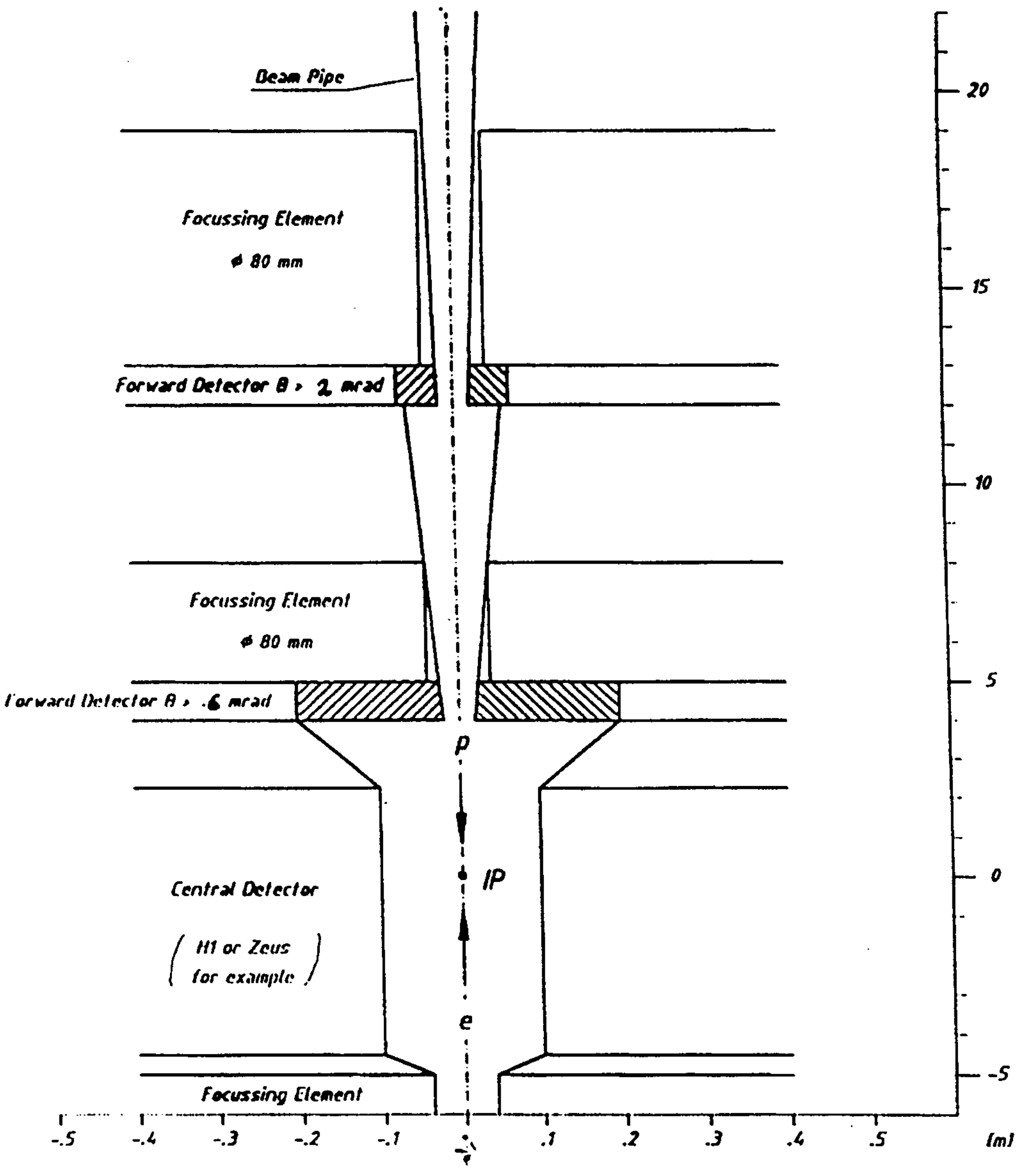
- reach at low x higher Q^2 values
$\rightarrow$ get to pQCD regime at low x

- Need electron tagger for photoproduction

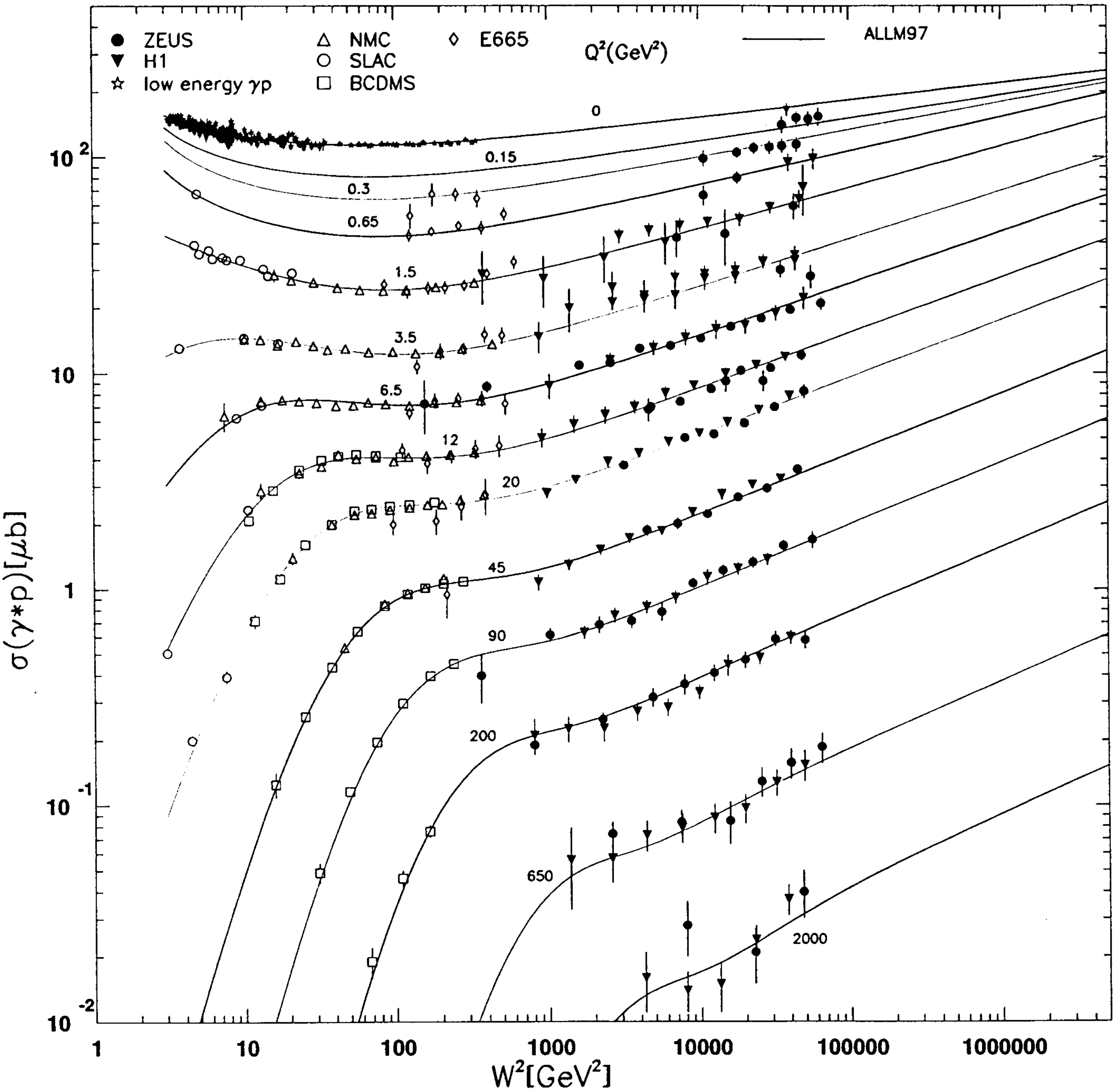
A. De Roeck, DESY 97-250

Tesla - Hera p - Collider

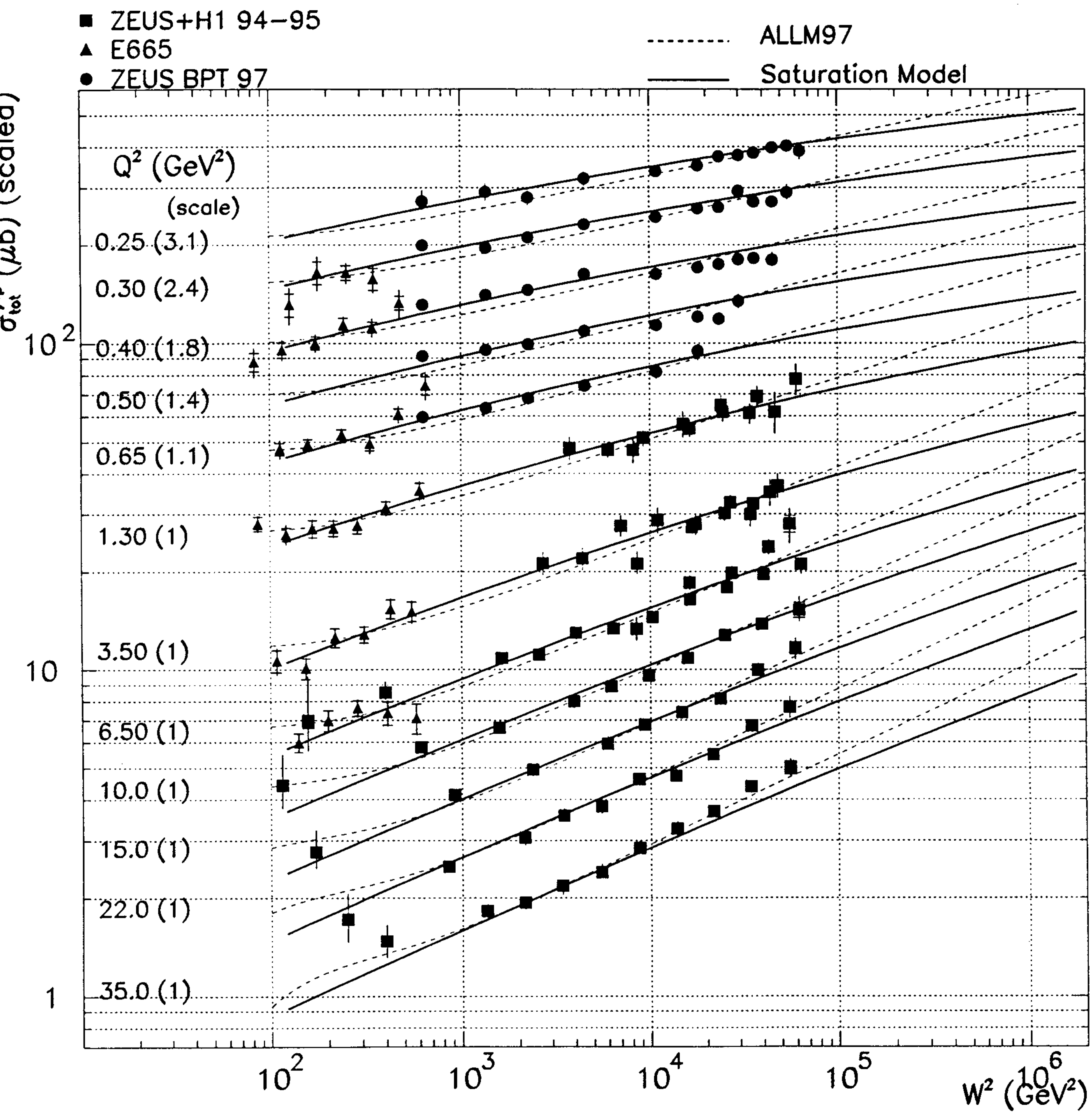
Sketch of the Forward Electron Detection



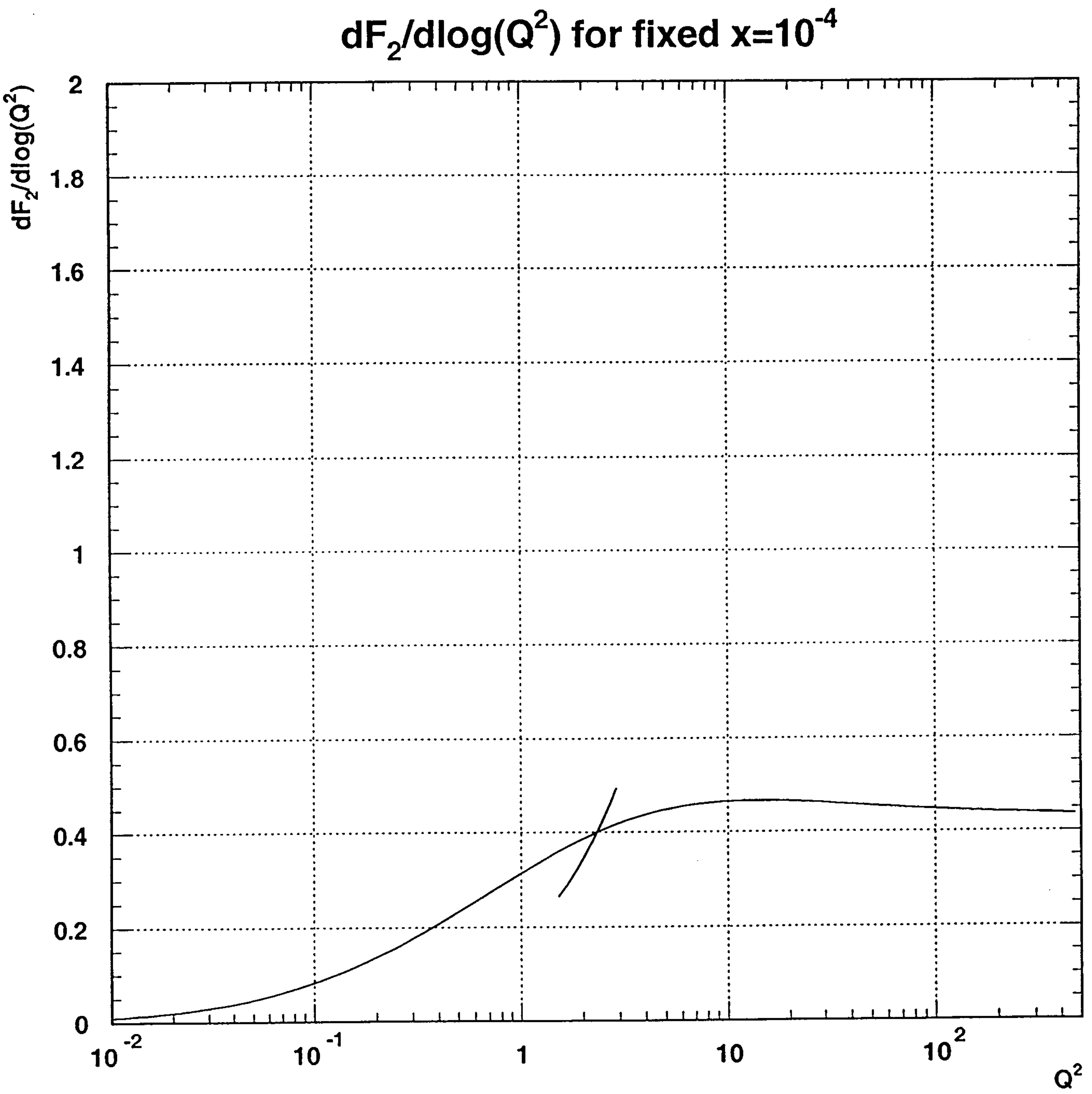
• Expected cross section values at TERA



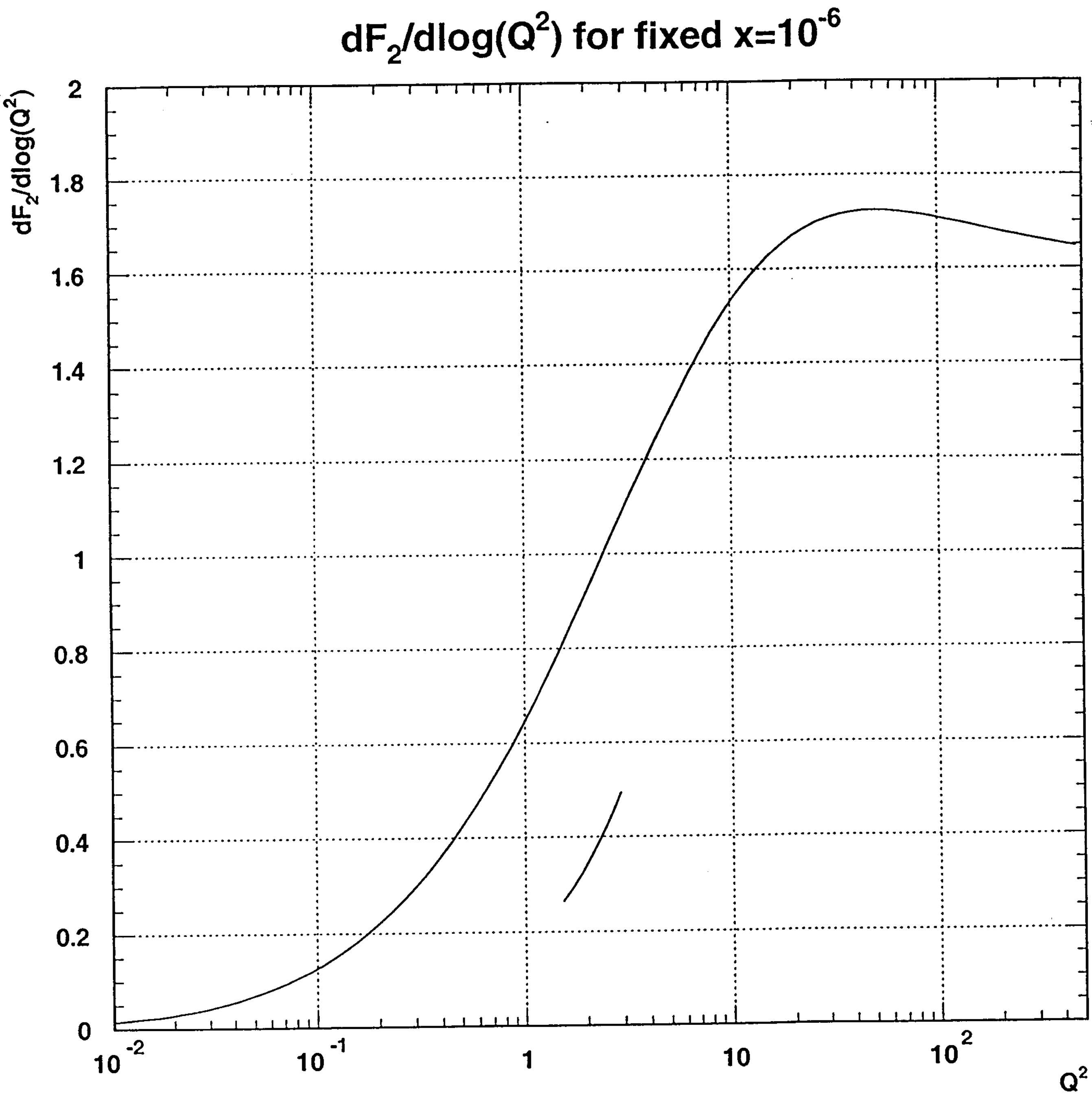
• look for saturation



• DGLAP vs BFKL



$dF_2/d\log(Q^2)$ for fixed $x=10^{-4}$
$dF_2/d\log(Q^2)$
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
10^{-2}
10^{-1}
1
10
10^{2}
Q^2



dF2/dlog(Q2) for fixed x=10-6
dF2/dlog(Q2)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
10-2
10-1
1
10
102
Q2

DIFFRACTIVE DIS : F_2^D

T(H)ER(R)A OFFERS CONSIDERABLE EXTENSIONS IN $\beta / x_{I\!P}$ COVERAGE COMPARED TO HERA :-

... $\lesssim 1$ ORDER OF MAGNITUDE LOWER IN $x_{I\!P}$ AT FIXED β

$\lesssim 1$ ORDER OF MAGNITUDE LOWER IN β AT FIXED $x_{I\!P}$

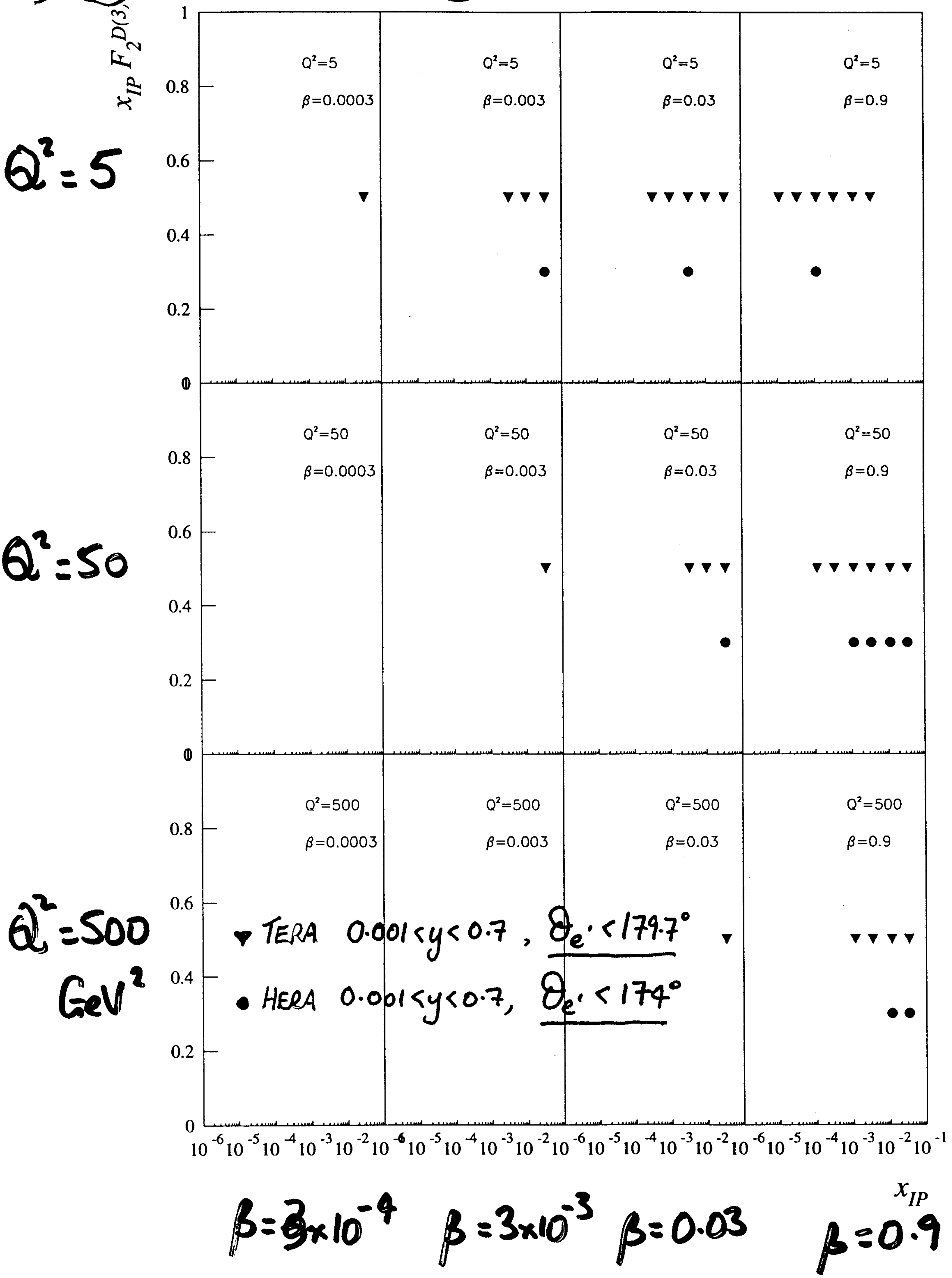
<u>BUT!</u>

TO REACH THE NEW REGION, NEED....

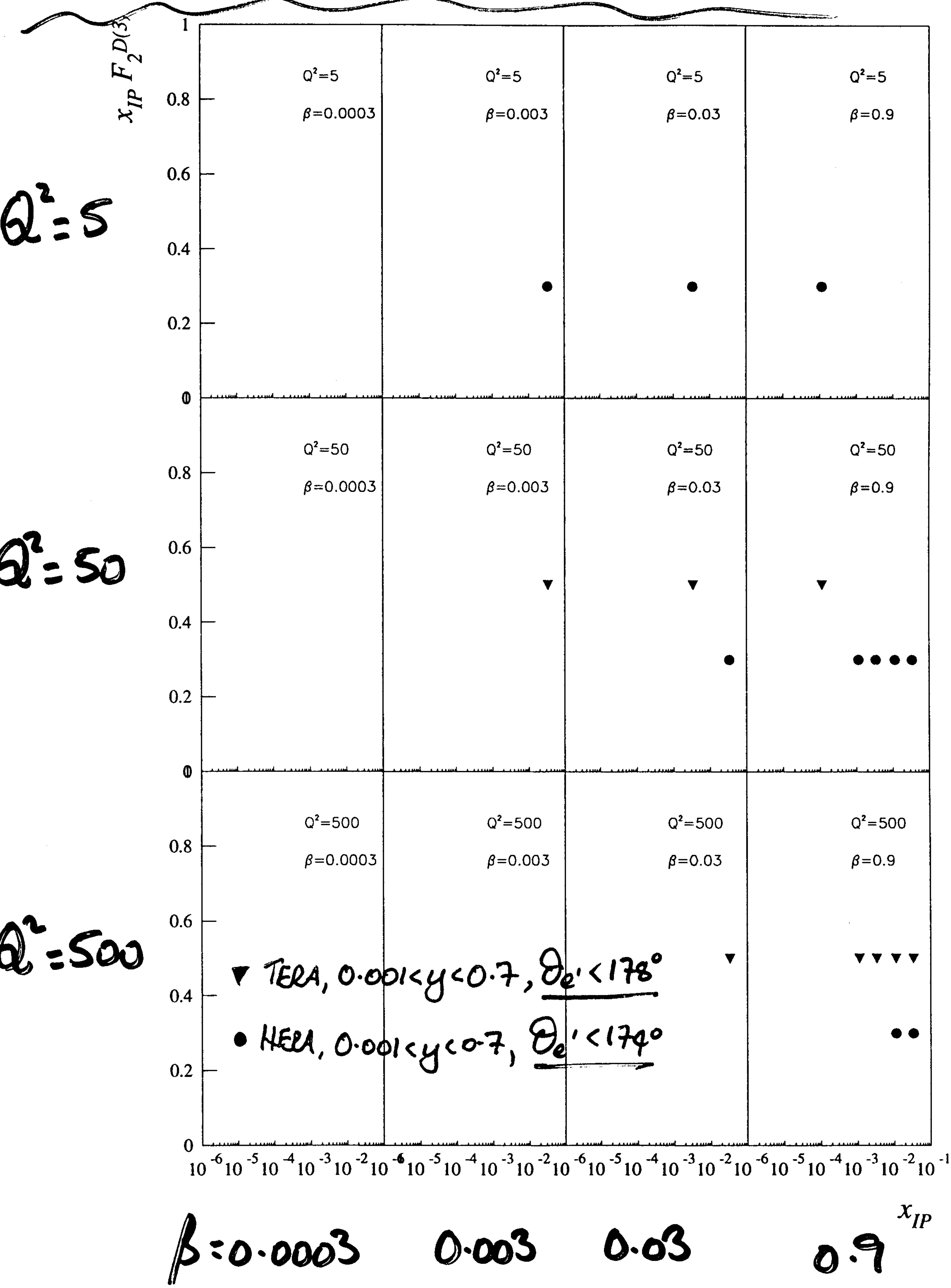
1) VERY LOW ANGLE ELECTRON TAGGERS ($\theta \lesssim 179.5{+}{+}^\circ$)
2) GOOD BACKWARD HADRON MEASUREMENT (OR PROTON SPECTROMETER)
3) REACH TO VERY LOW y.

F_2^D: MEASURABLE REGION

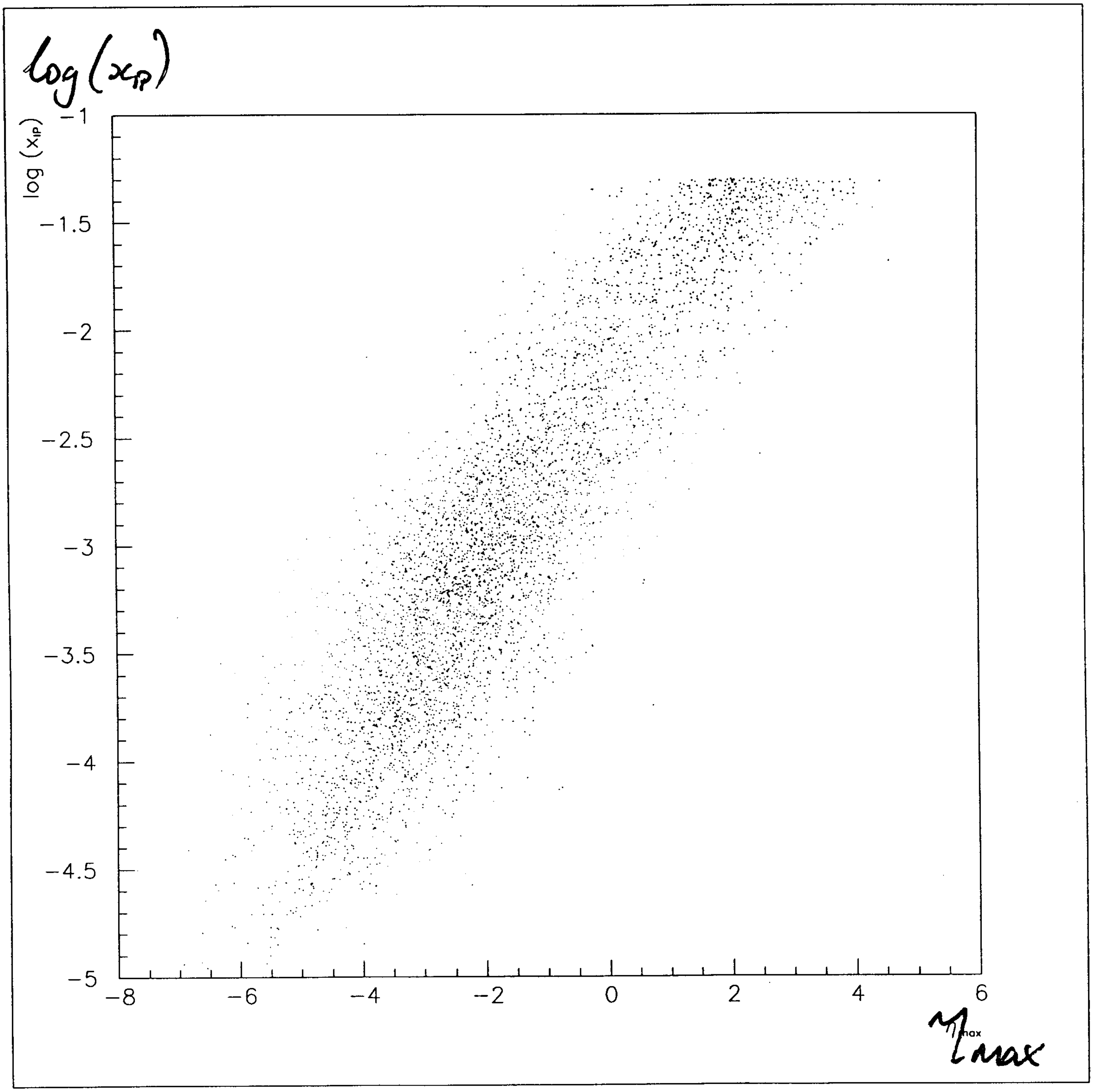
$E_e = 250$ GeV
$E_p = 920$ GeV



REDUCE $\theta_{e'}$ COVERAGE



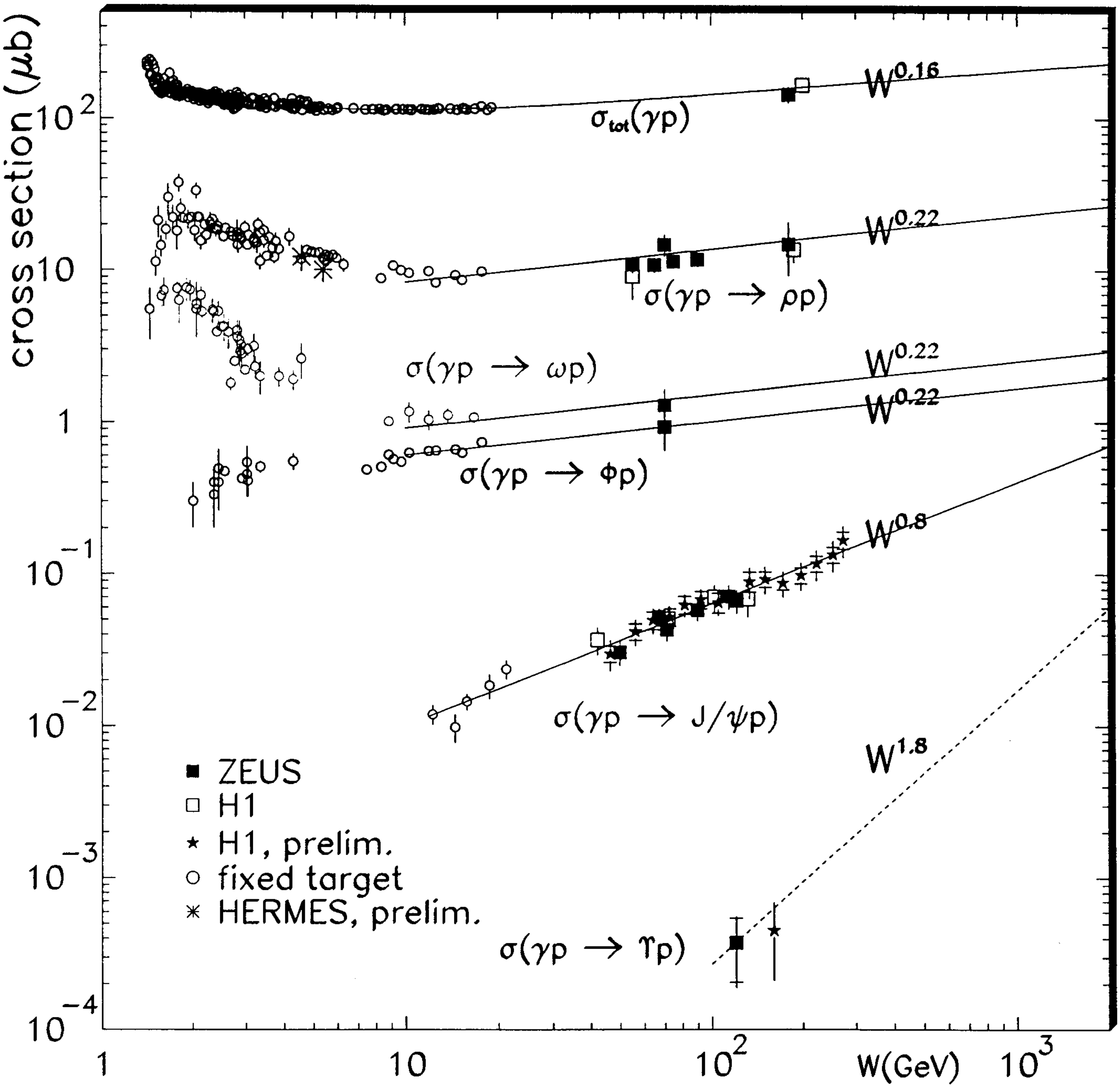
x_{IP} v η_{max} CORRELATION



→ SIMILAR TO HERA, BUT HIGHER M_X REACHED @ FIXED x_{IP}

→ LOW x_{IP} / M_X SYSTEMS VERY BACKWARD ($\eta_{max} \sim -5$!)

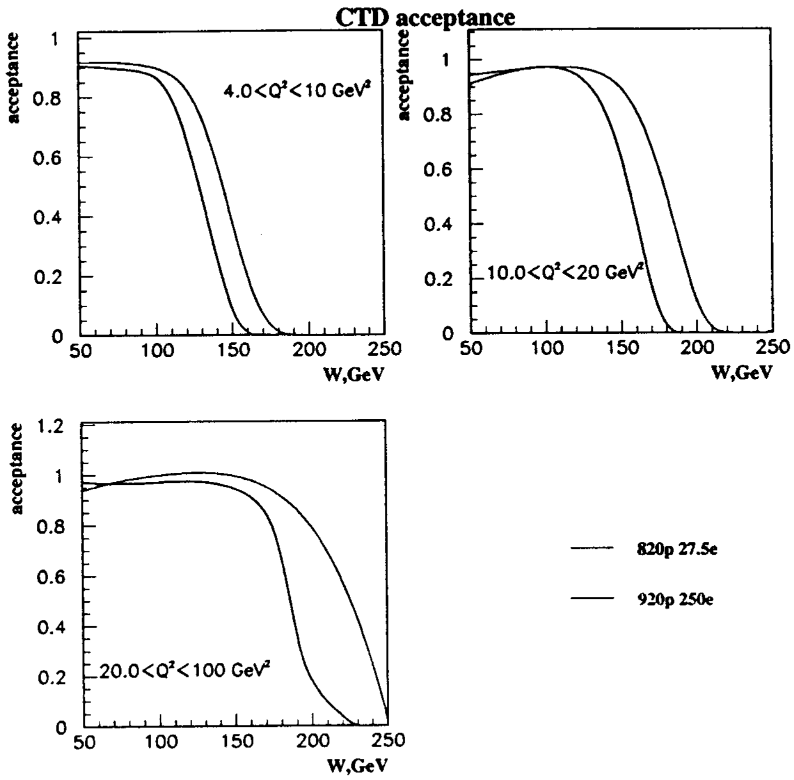
Exclusive VM at low x

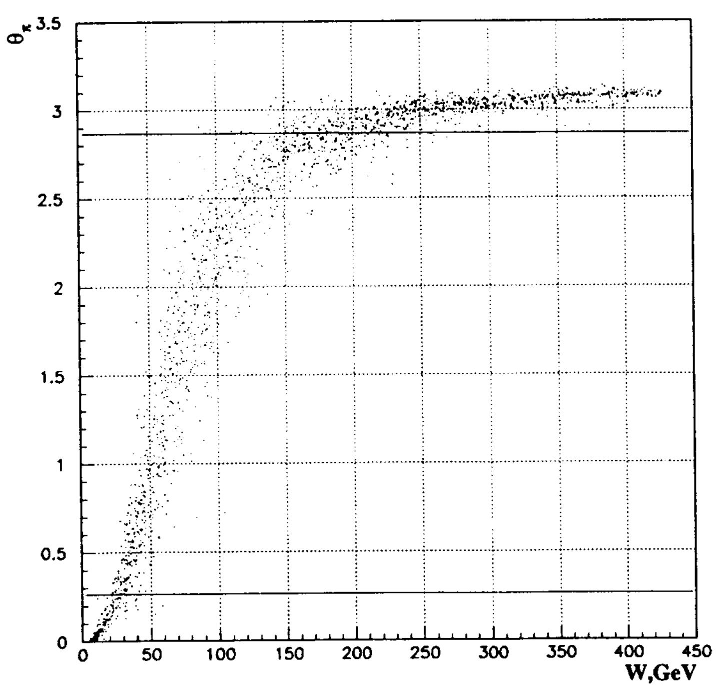


- Learn more about Υ?

Sasha Proskuryakov

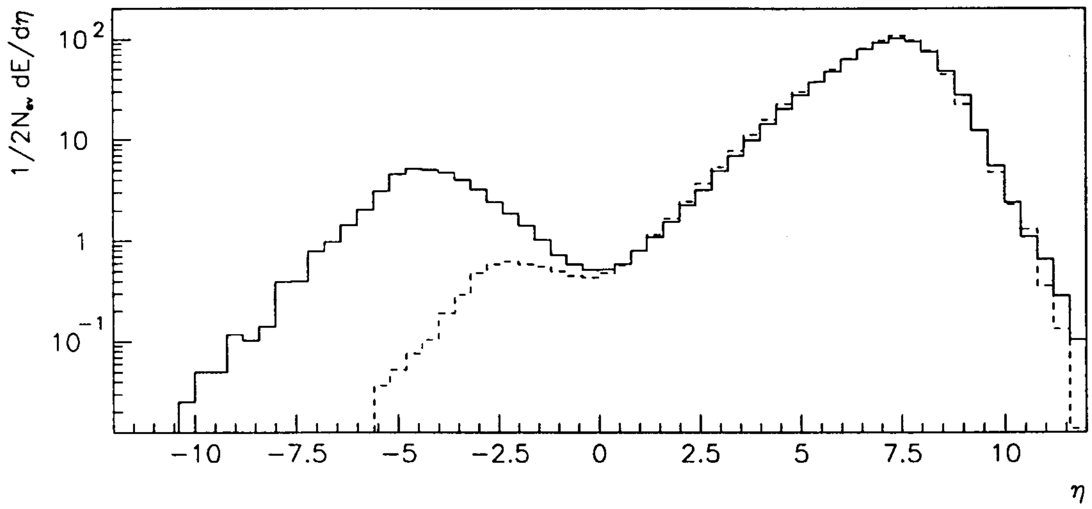
- Example: $\gamma p \to \rho^0 p$.

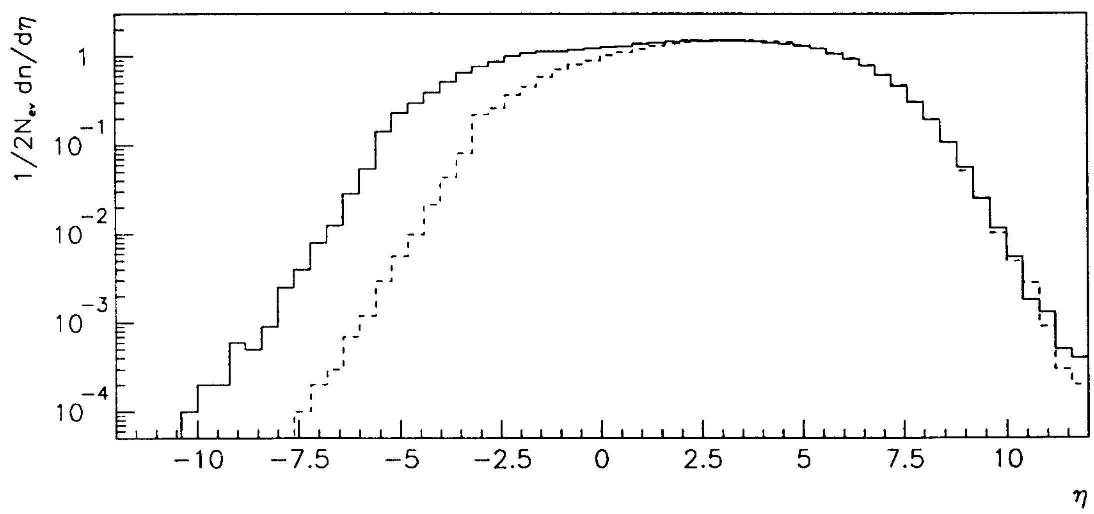




Need very forward trackers, or reconstruct mass from CAL

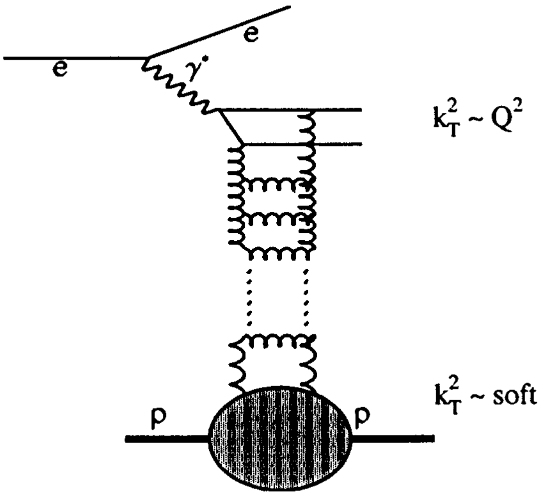
• Can we learn more about proton dissociation?





Probably only with more spectrometers close to the beam in the proton direction.

Interplay of 'soft' and 'hard' $\rightarrow$
in each QCD calculation need a non-perturbative part.
Why? Gribov diffusion



Is diffusion always present?
In Regge picture, $\alpha(t) = \alpha(0) + \alpha' t$, slope of trajectory

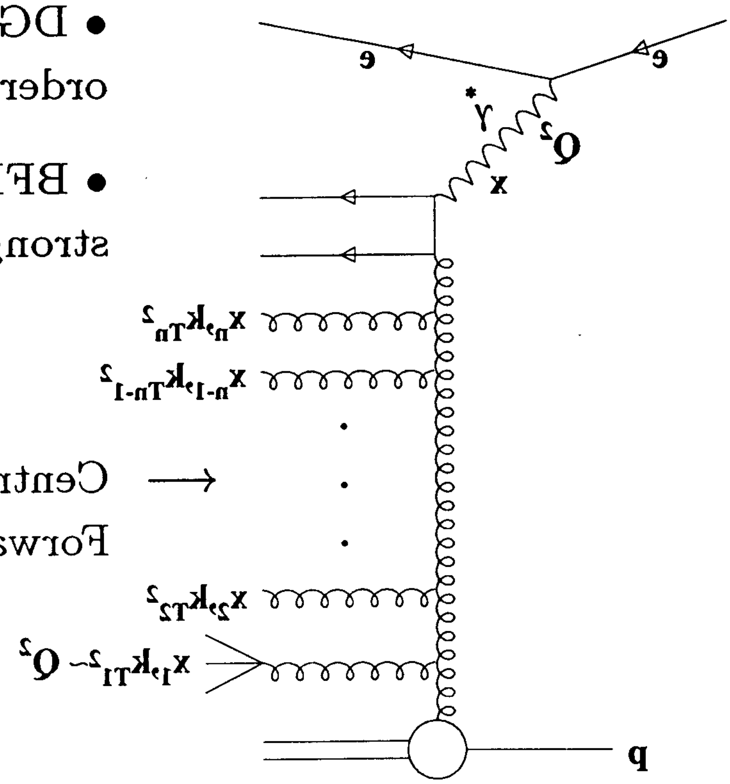
$$\alpha' \sim 1/ < k_T >$$

If $\alpha' \sim 0$, $\rightarrow$ diffusion suppressed, $\rightarrow$ all 'hard', $\rightarrow$ calculable in pQCD.

At HERA, in $\gamma p \rightarrow J/\psi p$, $\alpha' \approx 0$. What about α' at TERA? Will nature of interaction change?

BFKL Searches in the Final State

- DGLAP evolution implies k_t ordering of partons along ladder
- BFKL evolution imposes no strong k_t ordering



← Central rapidity in $\gamma^* p$ lies in Forward (outgoing proton) region in HERA lab frame.

BFKL → enhanced forward high p_t particle production.

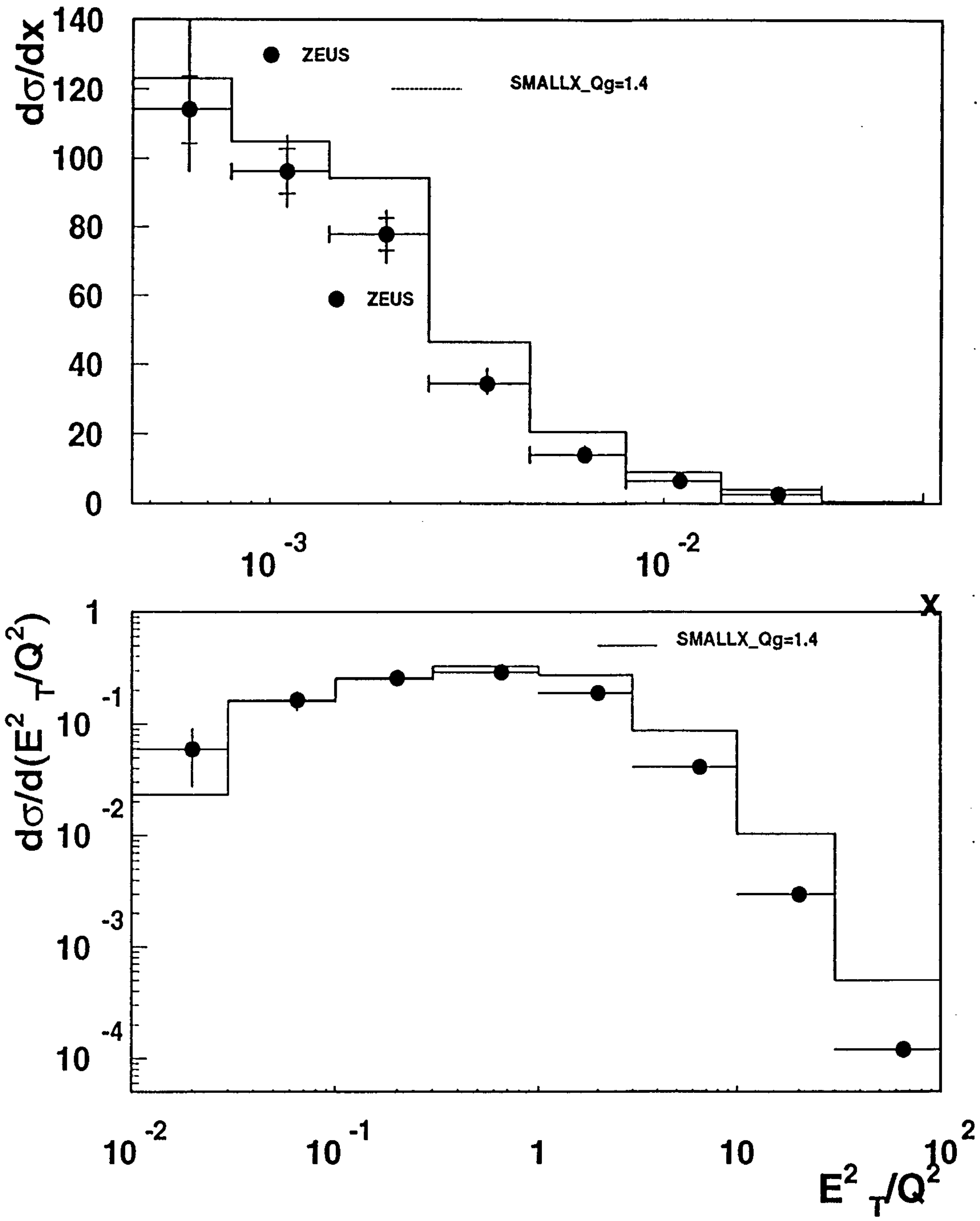
TERA - Proton fragmentation region similar to HERA - Forward jets still forward!

TERA - Photon fragmentation phase space enlarged - More rapidity units between γ^* and forward jet

Improved sensitivity?

H. Jung

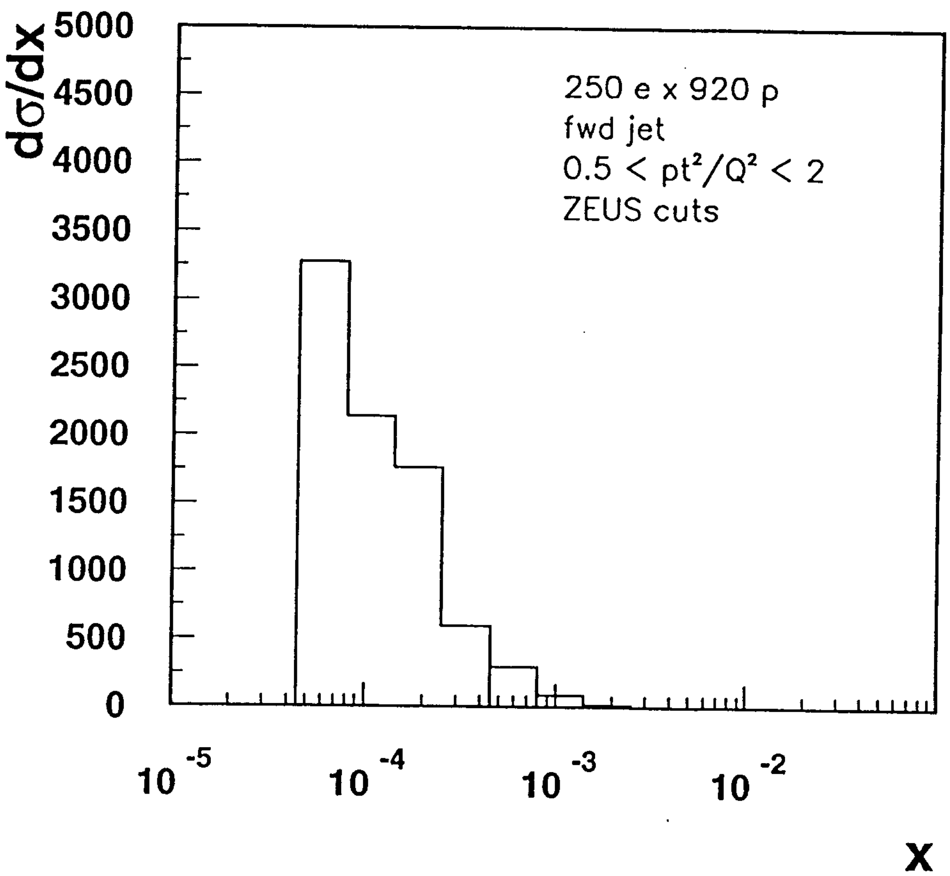
CCFM



dσ/dx
ZEUS
SMALLX_Qg=1.4
ZEUS
140
120
100
80
60
40
20
0
10 -3
10 -2
x
dσ/d(E²_T/Q²)
SMALLX_Qg=1.4
1
10 -1
10 -2
10 -3
10 -4
10 -2
10 -1
1
10
10 2
E² _T/Q²

H. Jung

CCFM



dσ/dx
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
250 e x 920 p
fwd jet
0.5 < pt²/Q² < 2
ZEUS cuts
10 -5
10 -4
10 -3
10 -2
x

DIFFRACTIVE FINAL STATES

→ DIFFRACTIVE DIJETS / CHARM VERY IMPORTANT
... DIRECT ACCESS TO GLUON DYNAMICS.

→ INCREASED DIJET / CHARM PHASE SPACE AT TERA.

e.g. TYPICALLY AT FIXED $x_{I\!P}$,

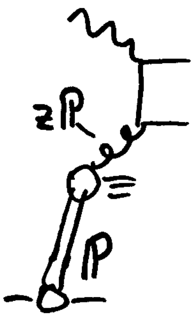
$$M_x \text{ (TERA)} \sim 3\, M_x \text{ (HERA)}$$

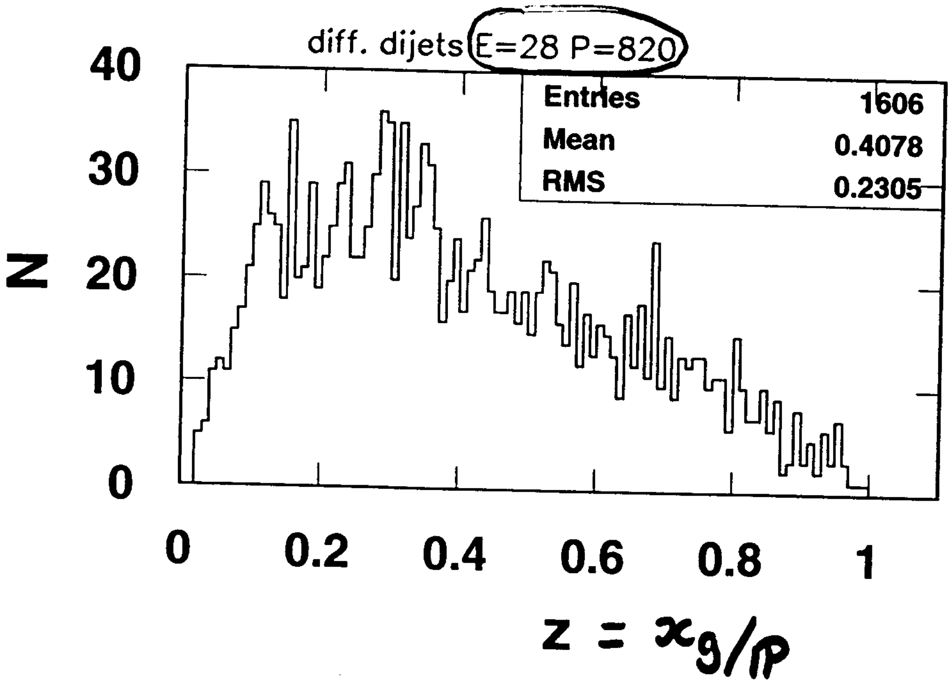
⇒ SIGNIFICANTLY INCREASED DIJET / CHARM YIELD

⇒ ACCESS TO GLUON / IPOMERON AT LOW β ?

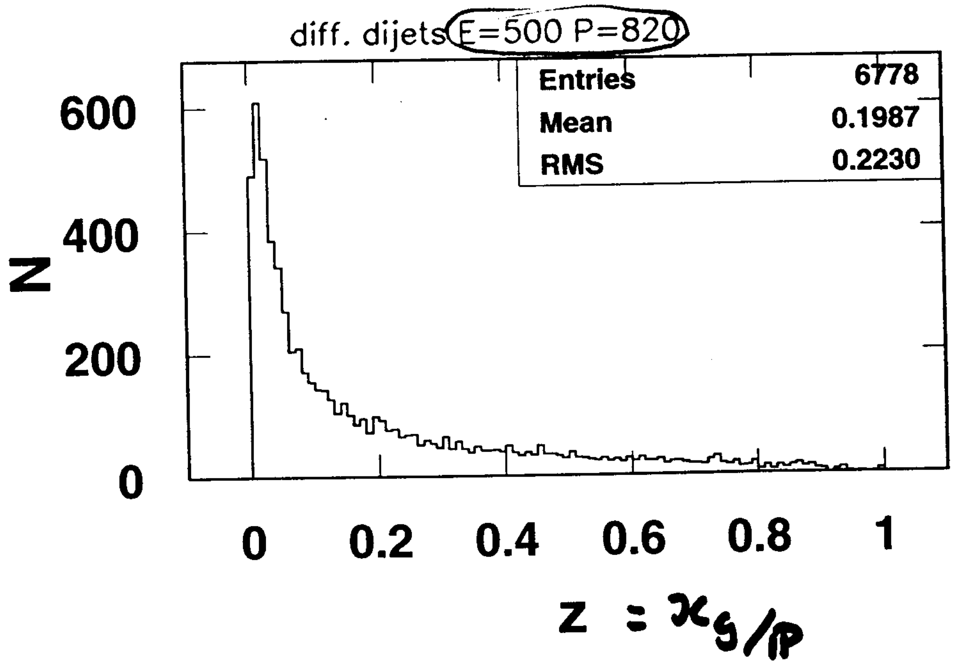
H. Jung

DIFFRACTIVE DIJETS





HERA



TERA

REQUIREMENTS OF :- $p_t^{jet} > 5$ GeV, CENTRALITY, $x_{I\!P} < 0.05$.

Conclusions

- Low-x at TERA can enrich our understanding of QCD.

- Lots to do for April meeting.