Some studies on High-Q^2 Charged Current events at THERA

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Thera meeting

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1) High-x $d(x, Q^2)$ measurement from e^+p data

2) M_W fit from e^-p Q^2 distribution

3) Single-top production with $d\bar{d}$ (SM!)

1) $d(x, Q^2)$ at large-x

HERA (94-97 e^+p, 48 pb^{-1}, ZEUS)

$x > 0.56$ ⇨ 3 events observed, 1.31 expected.

Supports more 'modern' PDFs than CTEQ4 where d/u is larger at large-x.

Compare HERA upgrade (500 pb^{-1}, e^+p)

with

THERA e^+p 100 pb^{-1} (250 GeV e × 920 GeV P)

DJANGOH MC sample (CTEQ5)

- 1000 events $Q^2 > 100$ GeV^2
- " " , $x > 0.1$
- " " , $x > 0.3$
- " " , $x > 0.5$

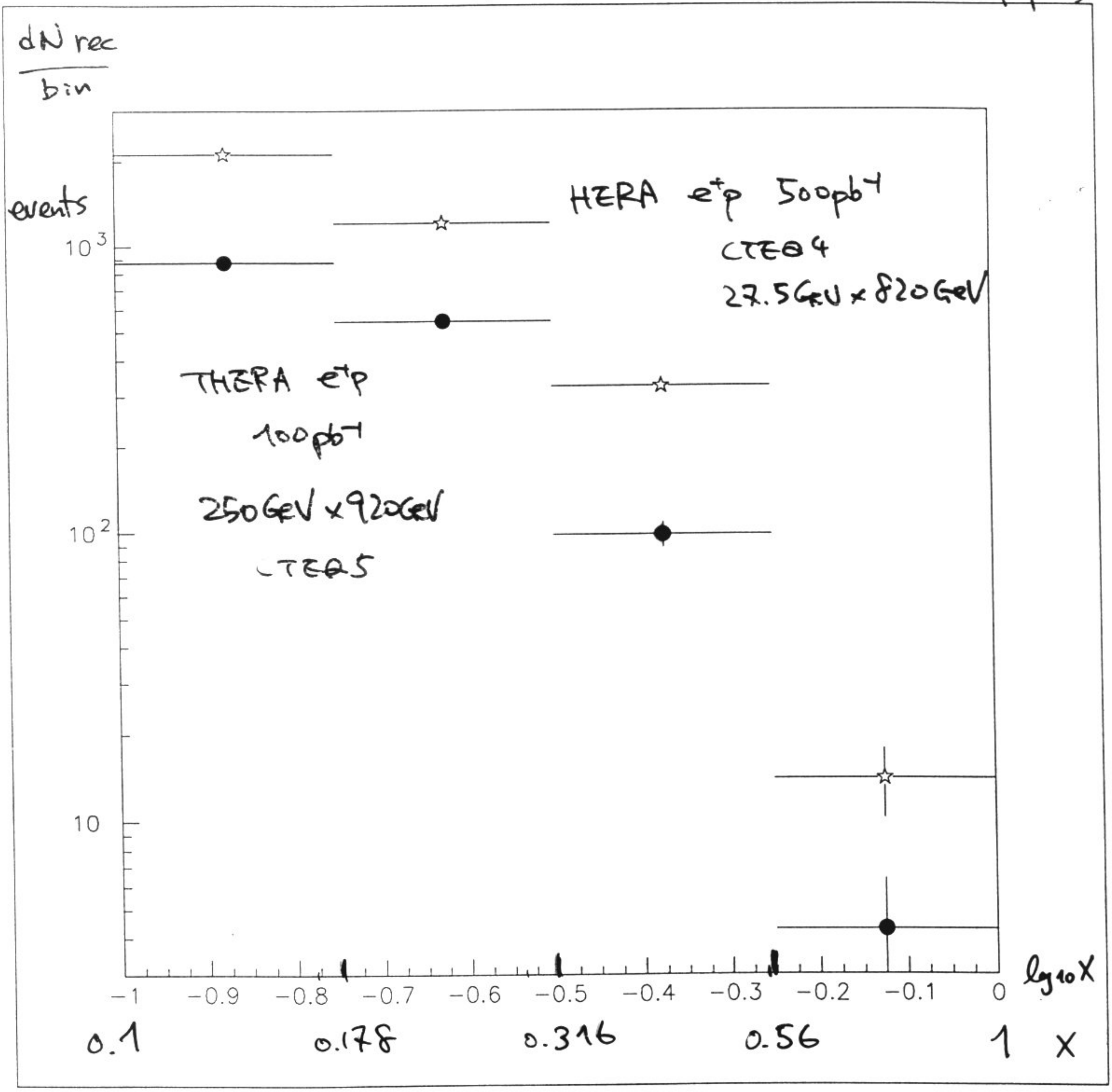
→ ZEUS det. simulation & reconstruction (current cc cuts)

(Note. Django σ < Hector σ

0.054 pb   0.078 pb

for $x > 0.562$, $Q^2 > 100$ (leptonic variable) x distribution at high-x

Same cuts as (ZEUS 94-97 paper)



Result: only a few events reconstructed

< HERA upgrade.

Why?

My qualitative guess:

More symmetric E_e / E_p:

CC jet points to central detector at high-x

<u>IF</u> at the same y.

$\hookrightarrow$ $Q^2 = sxy$ is 10 times larger than HERA case

$\rightarrow$ $\left(\frac{M_W^2}{M_W^2 + Q^2}\right)^2 \sim 1/Q^4$ like NC

so, additional xsec is very small in extended Q^2 range $\frac{d\sigma}{dx} = \int_0^{Q^2_{max}} \frac{d\sigma}{dx dQ^2} dQ^2$

$\rightarrow$ enhanced acceptance does not help much.

(what you gain is events from very low-y region, where jet is again very forward)

Actually y distribution is very steeply falling, like NC events.

2) M_W fit from e^-p Q^2 distribution

HERA MC (e^-p, 27.5 GeV × 920 GeV, CTEQ4)

500 pb^{-1} ← (no polarization)

vs ↙

THERA MC (e^-p, 250 GeV × 920 GeV, CTEQ5)

100 pb^{-1}

DJANGOH
($Q^2 > 100$ GeV^2 1k events
($Q^2 > 20000$ "

ZEUS simulation + reconstruction

→ fit to $\left(\frac{M_W^2}{M_W^2+Q^2}\right)^2$ for $Q^2 > 400$ GeV^2

with G_F fixed (1-param fit, log-likelihood on $\frac{dN}{dQ^2}$)

Result:

HERA upgrade ΔM_W (stat) = 370 MeV

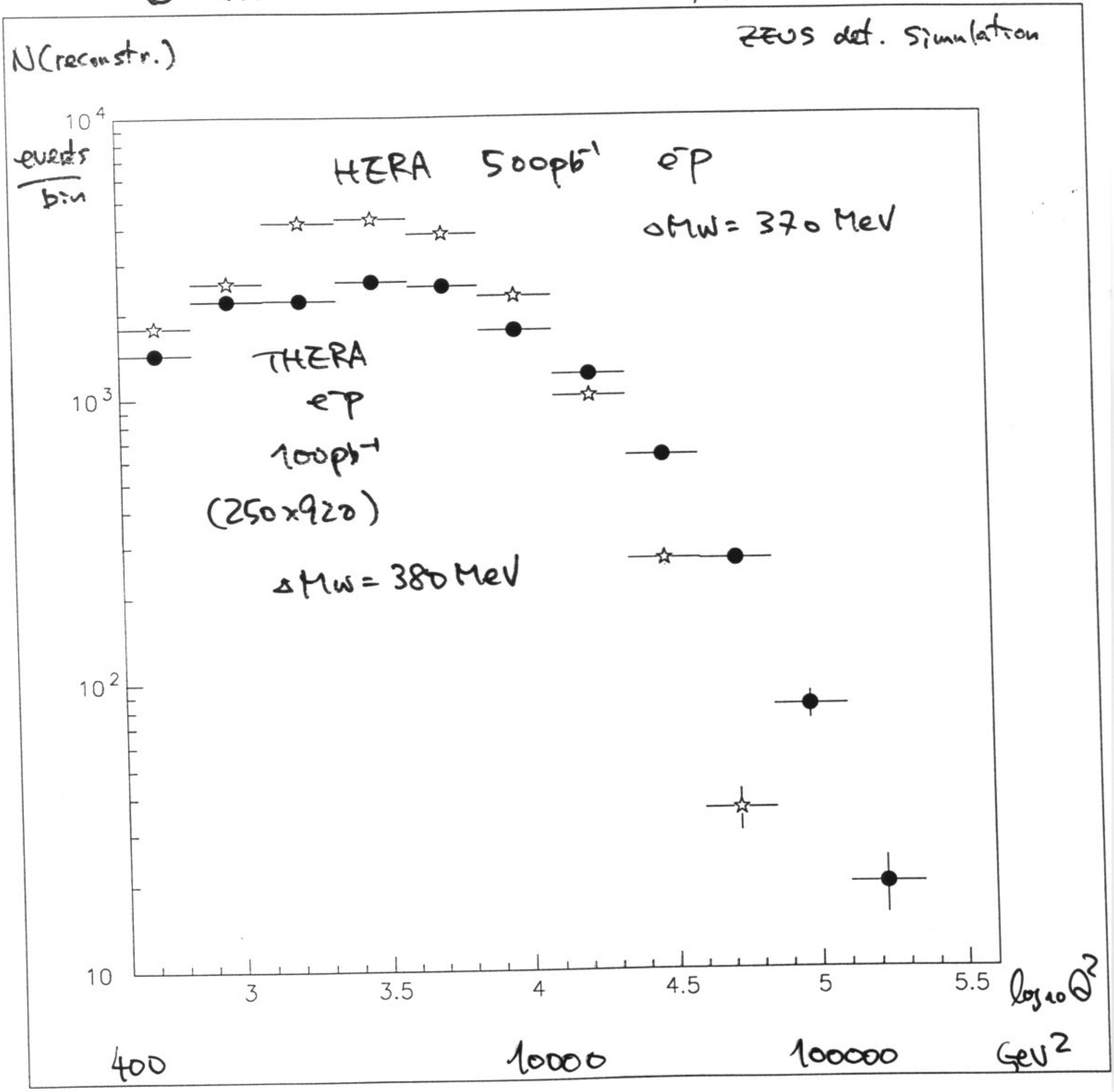
THERA ΔM_W (stat) = 380 MeV

almost the same.

#(THERA) < #(HERA) for $Q^2 < 10000$

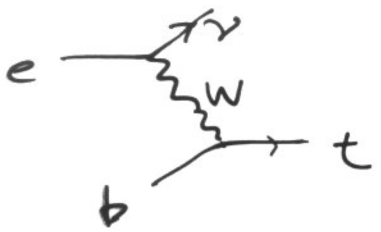
$>$ $Q^2 > 10000$

Q^2 distribution and Mw fit



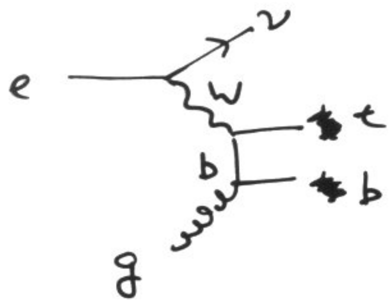
3) Single-top production in ℓℓ

A)



LO (+ $s \to t$ with $|V_{st}|$
$d \to t$ $|V_{dt}|$)

B)



W^*–gluon fusion

Which program?

HERACLES / DJANGO → not implemented
(H. Spiesberger)

AROMA → gave too high cross section
for c–s production (L. Gladilin
April meeting)

HERWIG → reasonable result for c–s (")

Used HERWIG 5.9

A) not possible since $m_q = 0$ $\forall q$

B) σ (250 GeV e^- × 920 GeV p) = 0.47 pb

(IPROC = 19144)
CTEQ4

P_t min = 2 GeV , $Q^2 > 100$ GeV^2

Generated 1000 events and passed ZEUS sim.
recon. eff. = 55% ⇒ ~25 events
(background is another issue!)

↓

Old literature (top search)

Ingelman. Schuler Z. Phys. C40 (1988) 299

Baur, van der Bij Nucl. Phys. B304 (1988) 451

→ σ_{tot} ($ep \to \nu t X$) ~ 1 pb* at THERA 250.

cf. 1.4 pb
for 500 GeV e
×
920 GeV p

(0.35 fb
at HERA!)

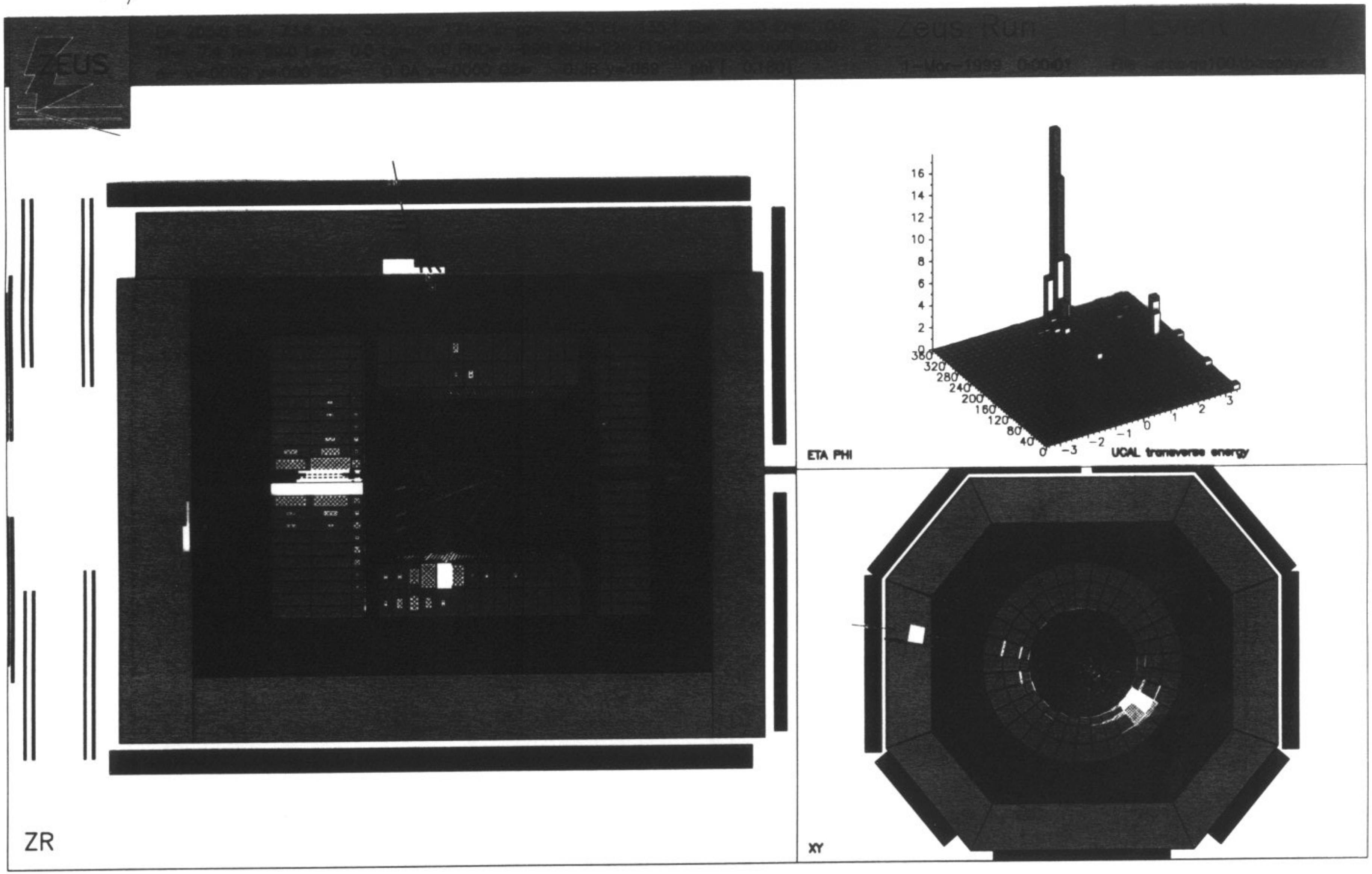
$W^* g \to t b$, $t \to bW \to b \mu \nu$

$P(\mu) = 60$ GeV, p_T (CAL) $= 55$ GeV

THERA CC

250 GeV e^- × 920 GeV p

$\sigma \sim 0.5$ pb



Conclusions so far.

1) For d/u at high-x.

higher $\sqrt{s}$ does not help much.
E_e

(Personally I think HERA with low E_p is more suited)

2) similar sensitivity on $sin^2\theta_W$ as HERA upg.

Q^2 reach extends → maybe higher sensitivity on W', W_R ?

3) Produces $\mathcal{O}(50)$ single-Top SM events.

(background not yet studied)

Q: what do we learn from it?

$b(x, Q^2)$ or $g(x, Q^2)$ or ?

K. Long

T HERA Reduced NC Cross Section