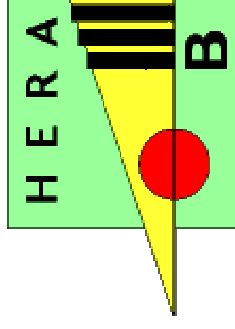


Physics from HERA-B

Torsten Zeuner

Universität Siegen

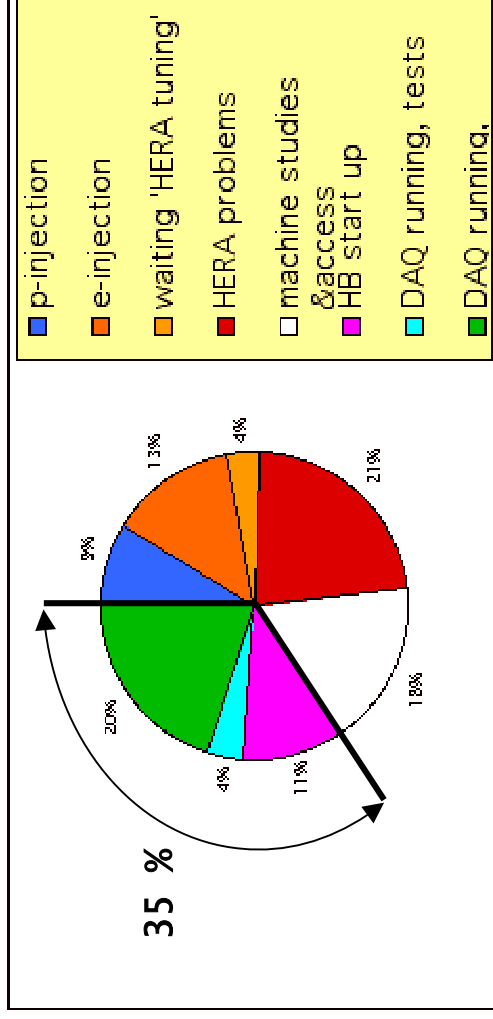
PRC open session 7th May 2003



Data taking 2002/03

Data taking

30. October 2002 -
03. March 2003



~ 35 % running time delivered

~ $150 \cdot 10^6$ dilepton triggered events

~ $210 \cdot 10^6$ minimum bias events

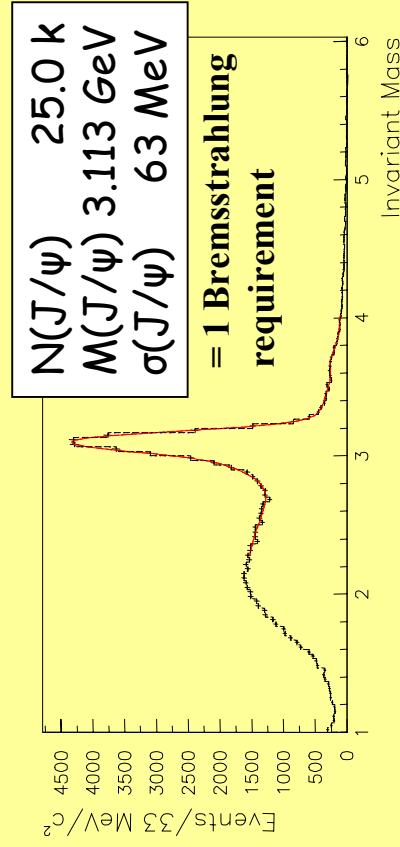
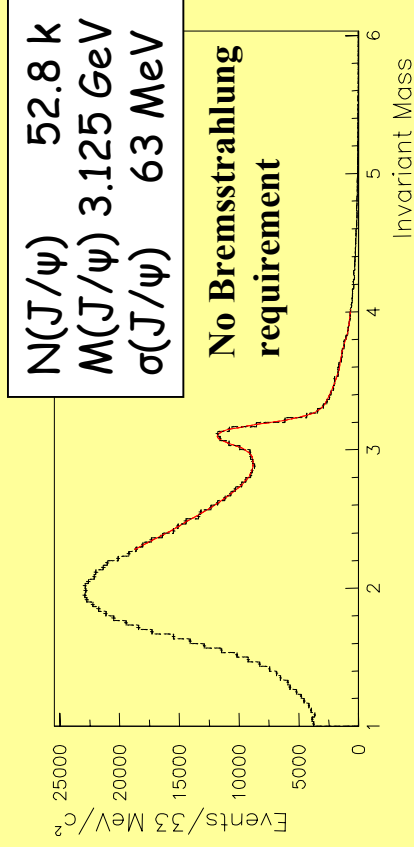
of which ~ 70 % used for data taking

achieved J/ψ rates: 1200 - 1400 J/ψ per hour

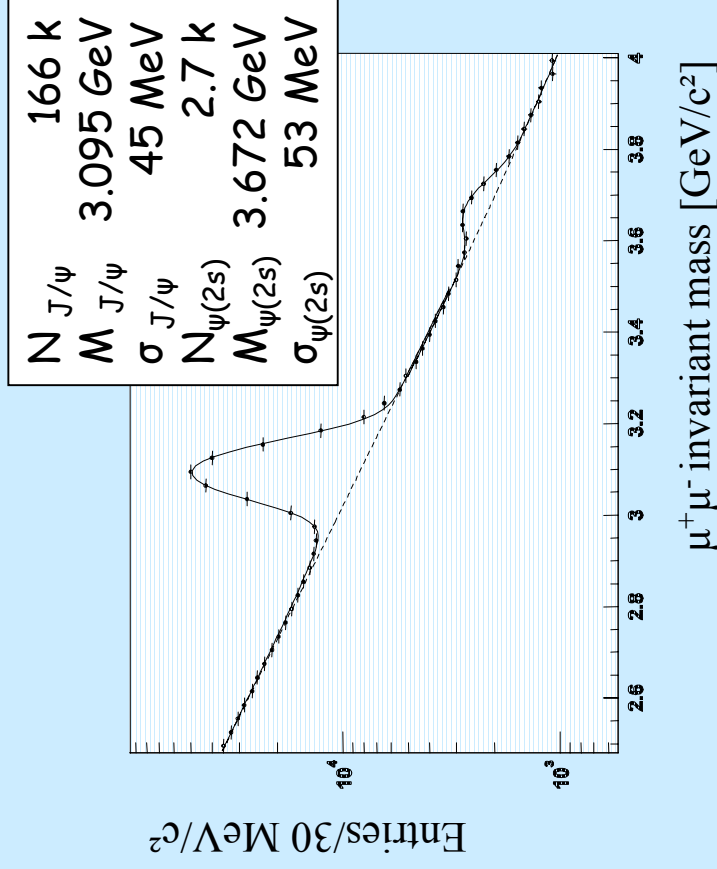
30 - 40 J/ψ per hour (2000)

J/ψ - Statistics

J/ψ? e^+e^- : 40 % of statistics



J/ψ? $\mu^+\mu^-$: full statistics



Analysis in Progress

- Improve pN? $b\bar{b}X$ cross section measurement
 - higher statistics in inclusive analysis : $b? J/? X (J/? ? ee/\mu\mu)$
 - exclusive recon. of b decays ($B^{\pm?} J/? K^{\pm}, B^0? J/? K^{\pm} p^{\pm}, B? J/? K_s, B? J/? KK$)
 - Understand double semileptonic b decays: $b\bar{b}? \mu\mu X$
- Atomic number dependence of charmonium production in pN
 - extend existing Fermilab measurements of $J/? , ?'$ to negative x_F
 - measurement of atomic number dependence of $?_c$
- Minimum Bias physics
 - Open charm production
 - Strangeness production in nuclear matter
 - ? polarization
- Measurement of pA? γ cross section ($ee/\mu\mu$)
- Upper limit on $Br(D^0? \mu^+\mu^-)$
- Direct photons
- ...

bb Cross Section Measurement

Inclusive reaction

$$pA \rightarrow b\bar{b} X,$$

with $b\bar{b} \rightarrow J/\psi X$ ($e^+e^- / \mu^+\mu^-$)

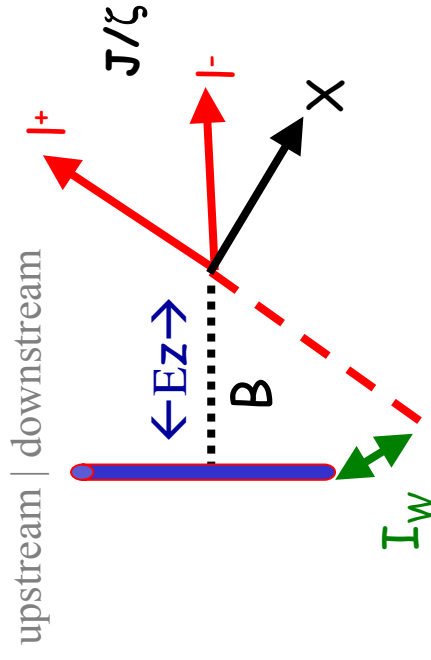
Select $b \rightarrow J/\psi X$ via **detached J/ψ vertices**

Normalization to prompt J/ψ

$\tau(pA \rightarrow J/\psi X)$



Minimize systematic errors



Detached J/ψ Analysis

J/ψ? e^+e^-

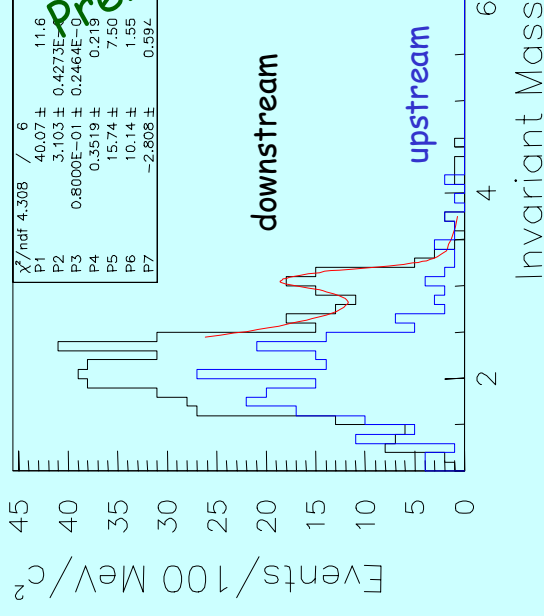
(40 % of statistics)

$\Delta z/\sigma_z > 10$
impact par. cut

No bremsstrahlung
requirement

2000 :

$n_B > 8.6, 3.9$
 3.2



Preliminary

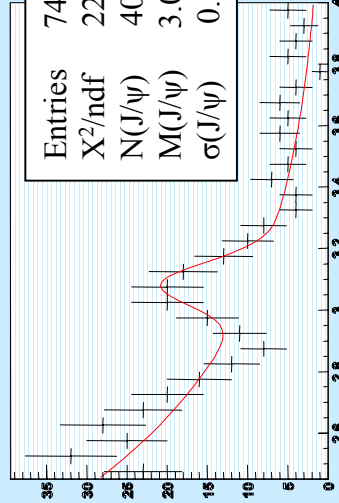
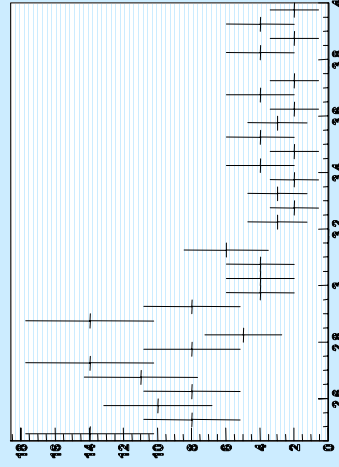
J/ψ? $\mu^+\mu^-$

(60 % of statistics)

$\Delta z < -0.5$ cm

Impact par. cut

$\Delta z > 0.5$ cm



Preliminary

2000 :

$n_B > 1.9, 2.2$
 1.5

No upstream J/ψ

J/ψ = 40 ± 11

Charmonium Production

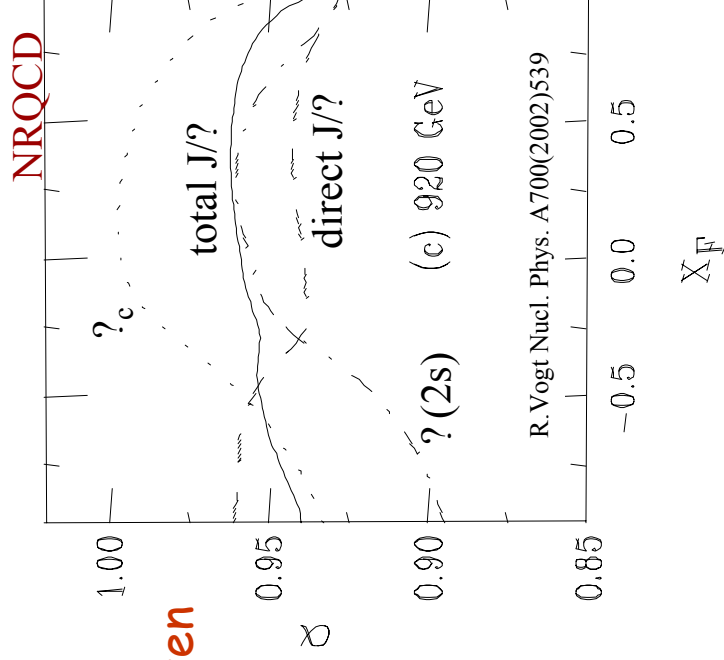
Typical parametrisation of pA cross section

if $a = 1$ for all $x_F, p_T \rightarrow$ no nuclear effects

Measure for J/ψ and ψ_c nuclear dependence vs. x_F, p_T

$$S_{pA} = S_{pN} \cdot A^a$$

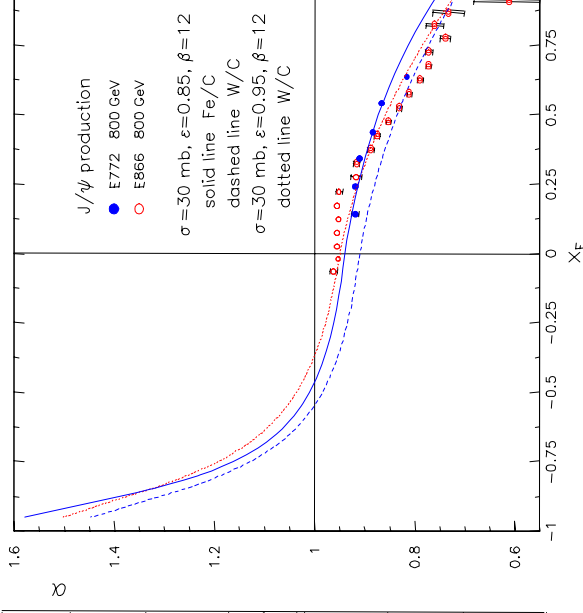
Using Carbon & Tungsten
2-wire sample



Input to test
different models

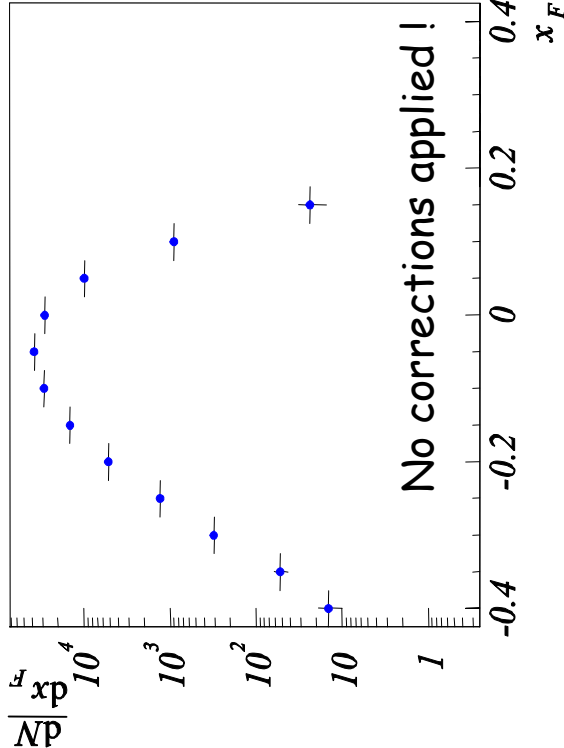
ψ_c production characteristics, nuclear dependence nearly unexplored

K.G.Boreskov, A.B.Kaidalov hep-ph/0303033



Charmonium Production

x_F distribution

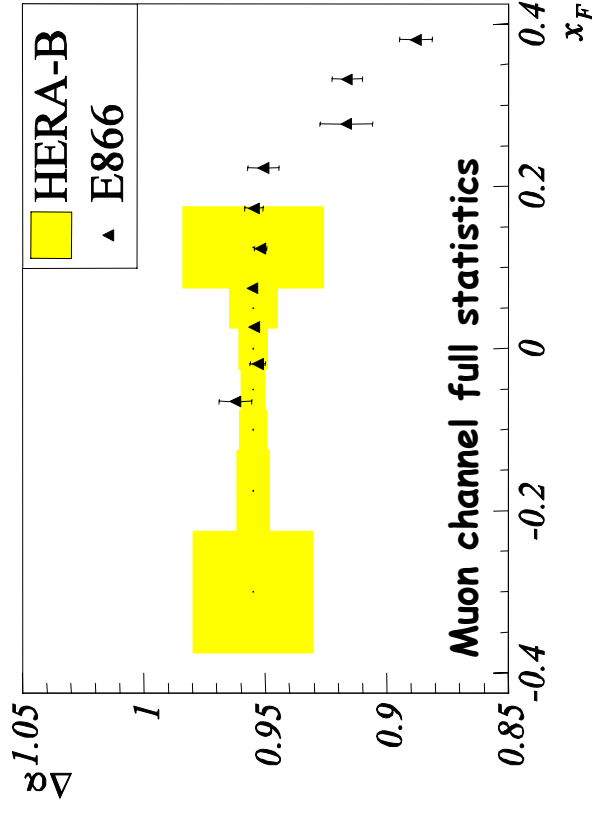


x_F range : [- 0.35, 0.15]

- Statistical error estimation for 2-wire sample (only μ -channel)
- e-channel increases statistics up to factor 2 (depending on particle ID cuts)

$$\beta^{J/\psi} > \frac{1}{\ln(A_W / A_C)} \ln \left[\frac{N_W^{J/\psi} - \phi_C^{J/\psi} - L_C}{N_C^{J/\psi} - \phi_W^{J/\psi} - L_W} \right]$$

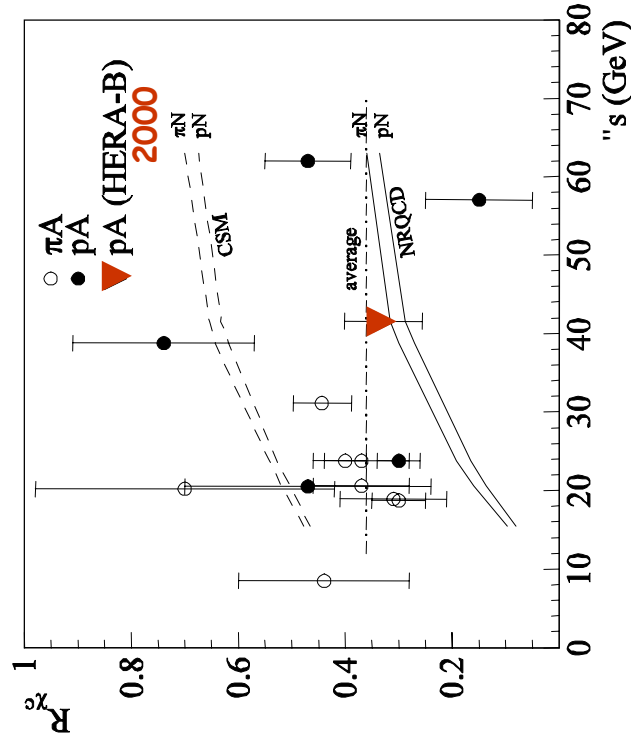
Statistical errors only



Charmonium Production : χ_c

Fraction of J/ψ produced via γ_c

$$R_{\delta_c} > \frac{\sum \tau(\delta_{ci}) \text{Br}(\delta_{ci} \downarrow J/\zeta\eta)}{\tau(J/\zeta)_{\text{tot}}}$$



Measurement 2000 based on

$380 \pm 74 \chi_c$

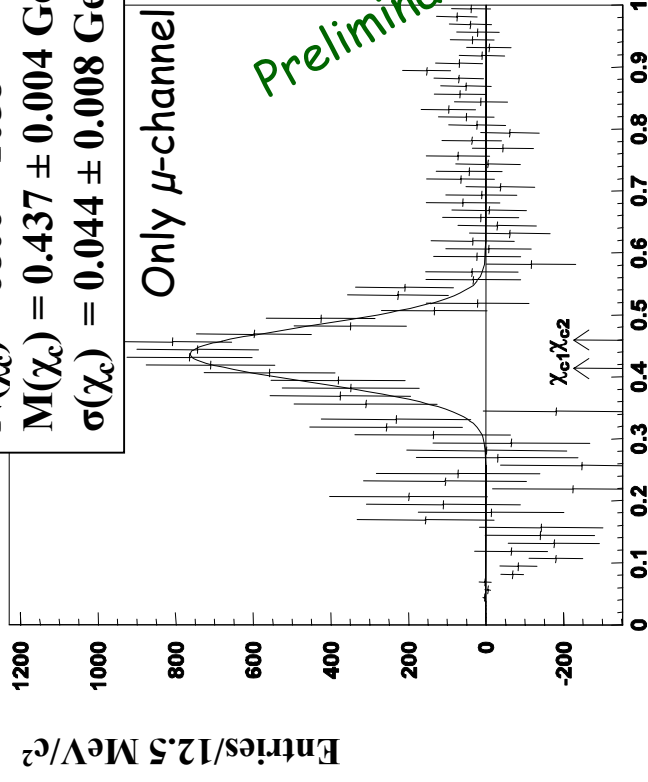
$R_{\gamma_c} = 0.32 \pm 0.06_{\text{stat}} \pm 0.04_{\text{sys}}$

$? M = M(J/\psi) - M(J/\psi?)$

background subtracted

$N(\chi_c) = 6806 \pm 1058$
 $M(\chi_c) = 0.437 \pm 0.004 \text{ GeV}$
 $\sigma(\chi_c) = 0.044 \pm 0.008 \text{ GeV}$

Only μ -channel

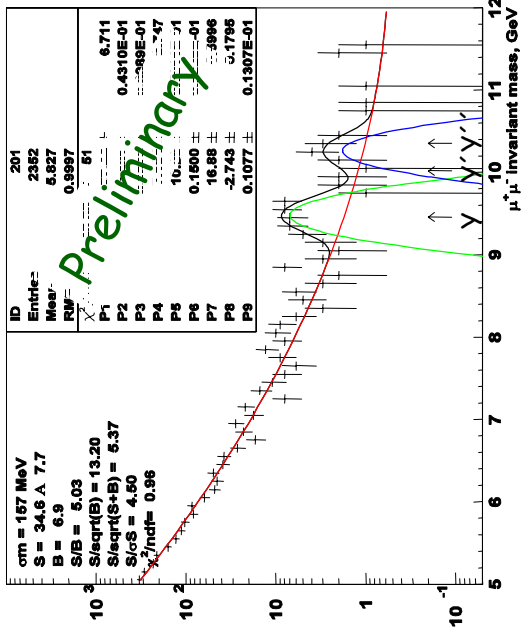


$\Delta M [\text{GeV}/c^2]$

First measurement of χ_c suppression in nuclear matter possible!

Upsilon Production : $s(pA? \gamma)$

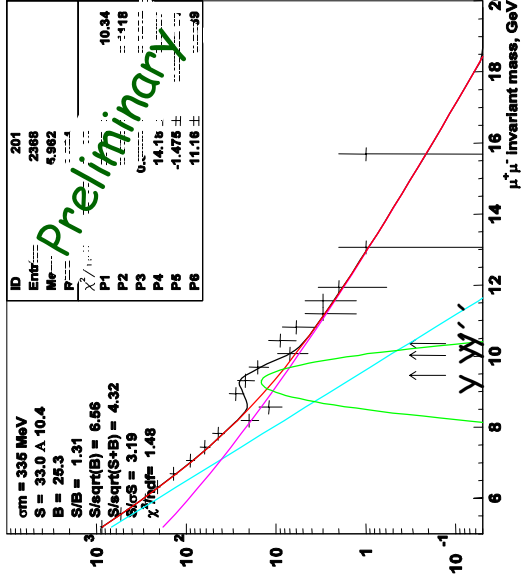
?? $\mu^+\mu^-$



γ events 35 ± 8
Width 157 MeV

Width : in agreement with MC

$\gamma?$ e^+e^-



γ events 33 ± 10
Width 335 MeV

Existing measurements by

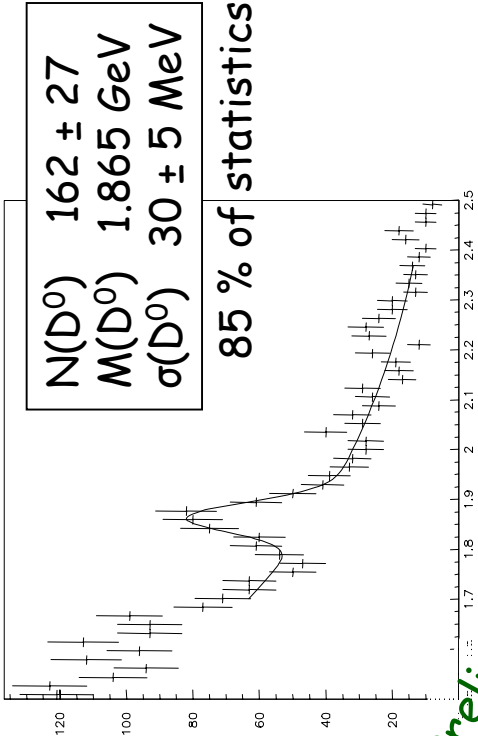
E605, E771

contradictory

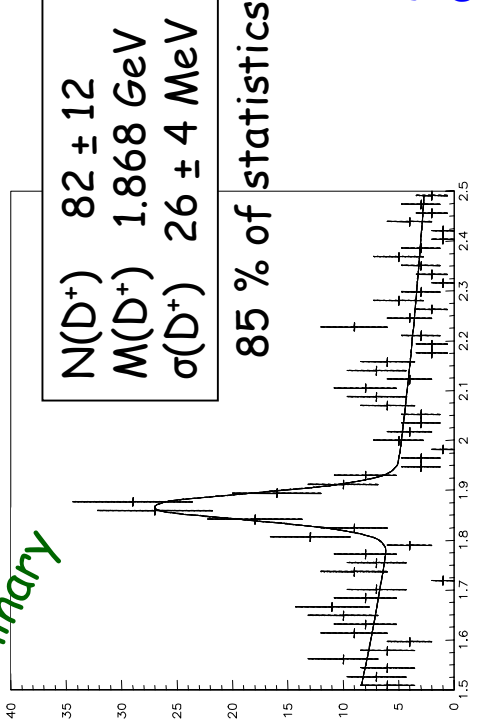
Measurement of the γ production cross section is feasible
may help to distinguish between Fermilab measurements

Minimum Bias Data sample

Open charm signals



Preliminary



~210 · 10⁶ events recorded on Carbon, Tungsten and Titanium wire

K_s^0	2.8 M	} ~ factor 300 to 2000 statistics
M^0	620 k	
\overline{M}^0	310 k	
Ψ	10 k	
$\Psi^{\#}$	6.2 k	
$\Psi^0(1530)$	1.5 k	
Ξ^-	500	
Ξ^+	460	
$K^{*0} + \overline{K}^{*0}$	1.1 M	
Γ	63 k	

Measurements of differential cross sections, atomic number dependence

Measurement of ratio (D^+/D^0)

Summary

- HERA-B detector & trigger in good shape
 - Data taking : 30.October 2002 - 3.March 2003
 - 1200-1400 J/ ψ per hour, 70% of available beam time used
 - $\sim 300,000$ triggered J/ ψ ($e^+e^-/\mu^+\mu^-$)
 - $\sim 210 \cdot 10^6$ Minimum bias events
- Analysis of 2002/03 data in progress
 - Quality of recorded data looks good, first preliminary results promising

Expect preliminary results for summer conferences.