Heavy Flavours 8 Symposium

Onium and b Production at the Tevatron

b quark Production Cross Sections

J/ψ and ψ' production

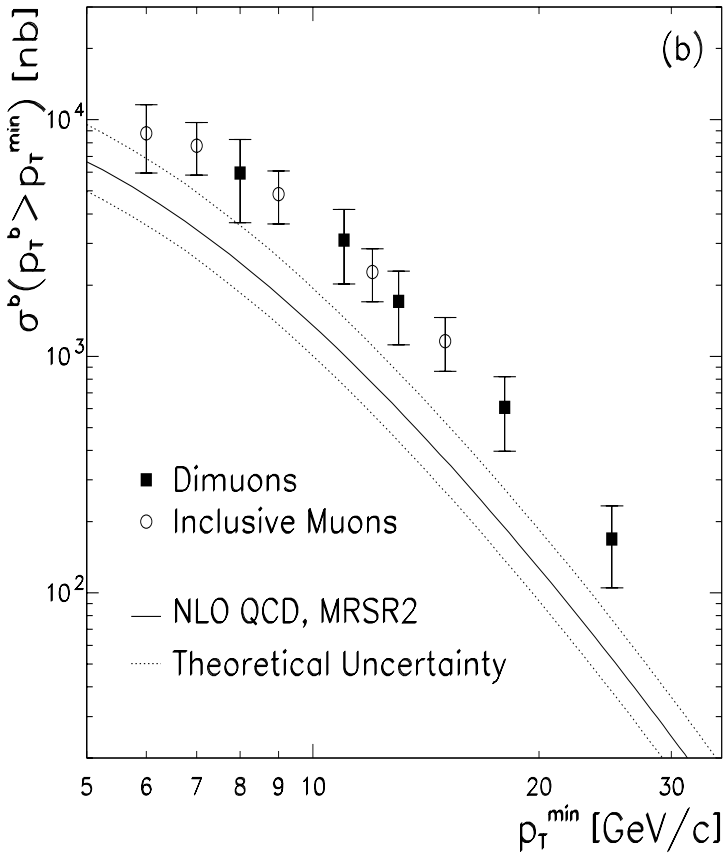
Production Polarization of J/ψ

Production Polarization of ψ'

ϒ Production Measurements

Presented by K. Sumorok MIT

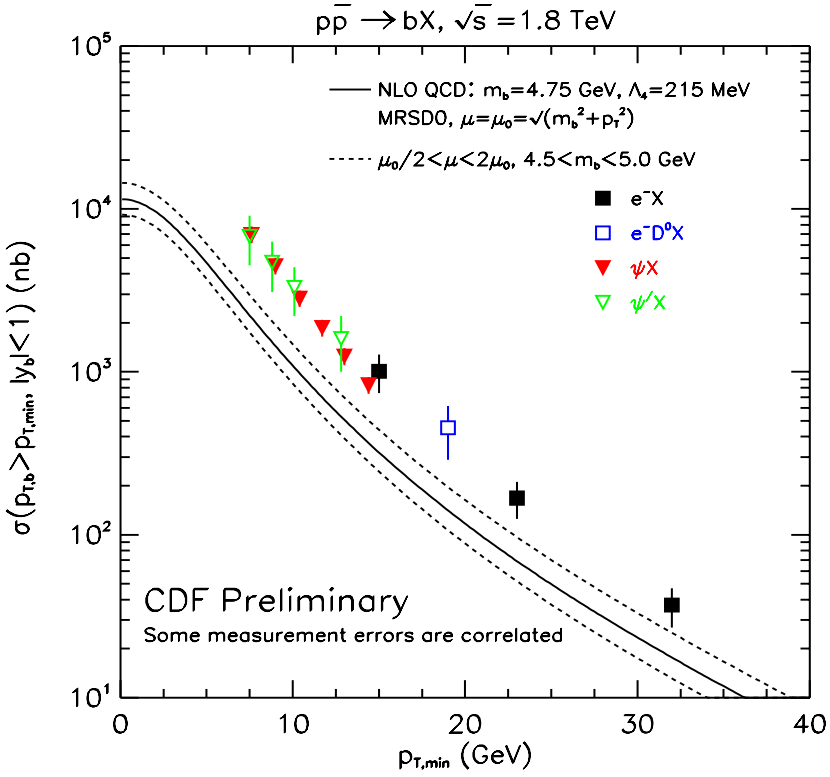
b quark Production Cross Sections



D0 6.5 pb^{-1}

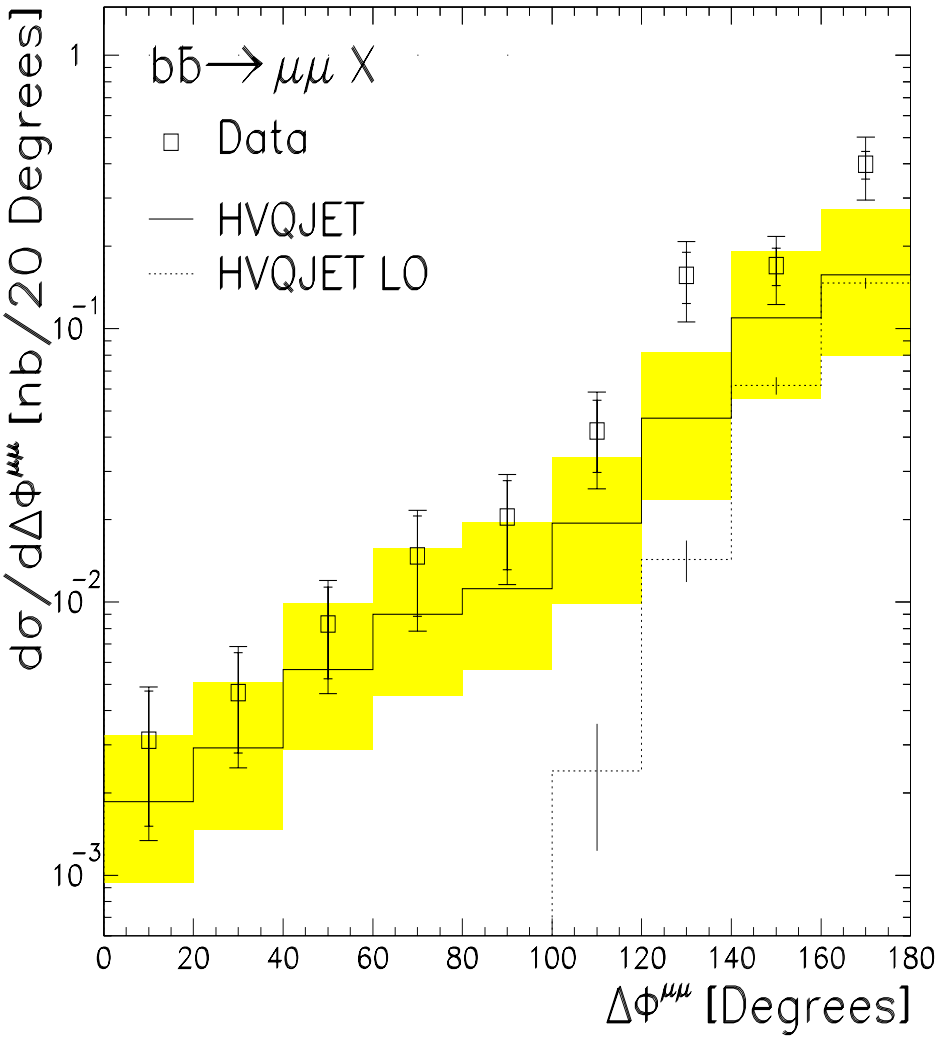
Dimuon and Inclusive muons with jets

Theory MNR Nucl. Phys **B373**, 295 (1992)



CDF

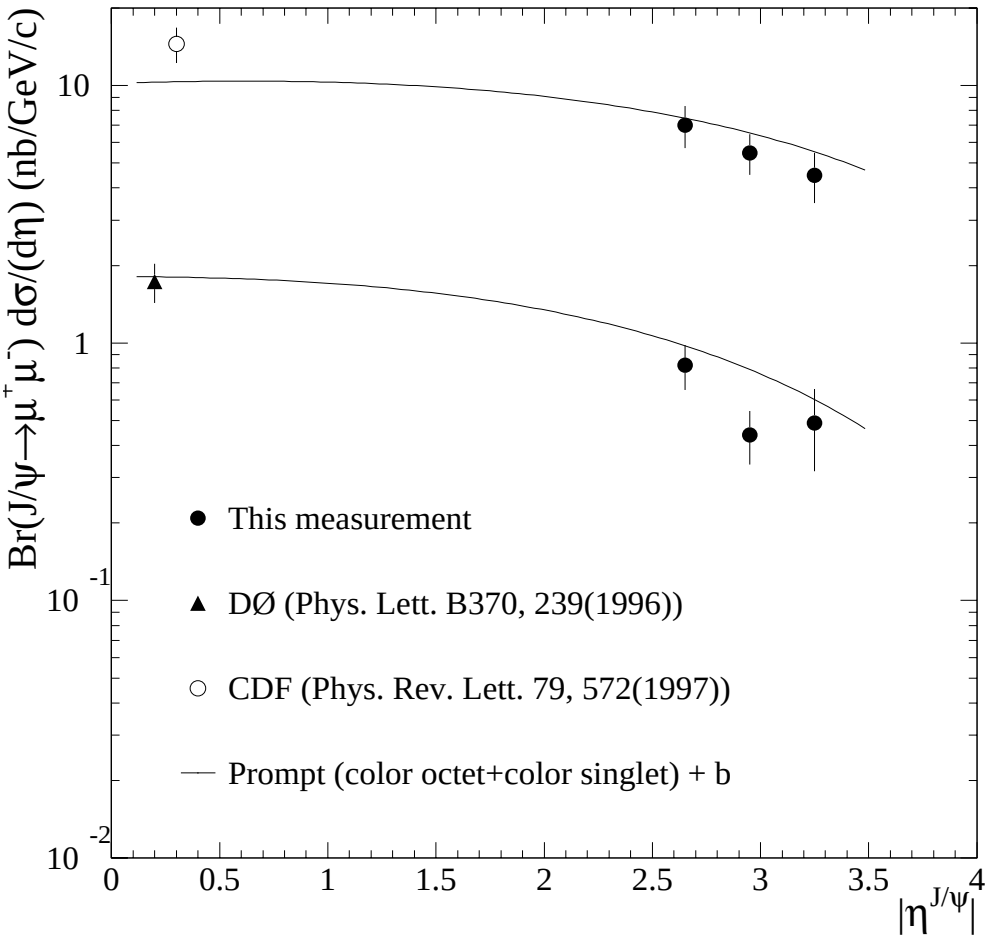
$b\bar{b}$ angular correlations (D0)



LO shape is just back to back jets
NLO shape describes data well

J/ψ Production Cross Sections

New Measurement from D0



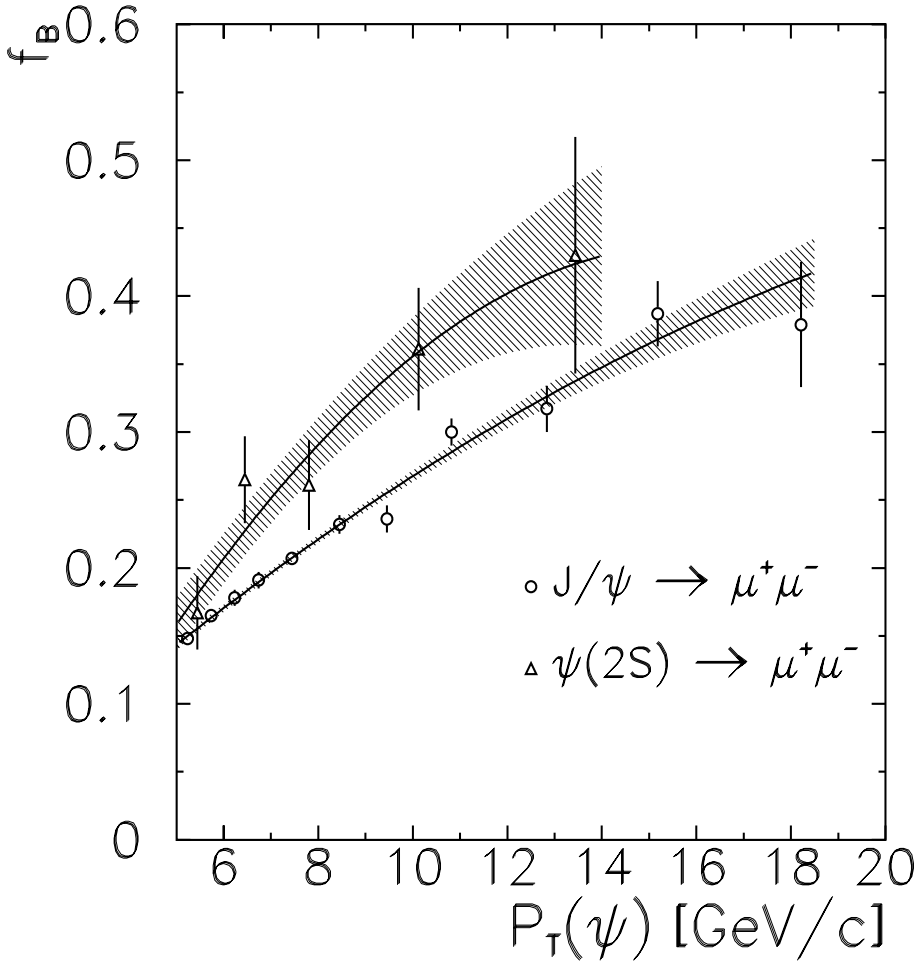
Pt > 5 GeV/c

Pt > 8 GeV/c

J/ψ and ψ' production

CDF using the Silicon Vertex Detector (SVX) can Separate Prompt and B-decay production

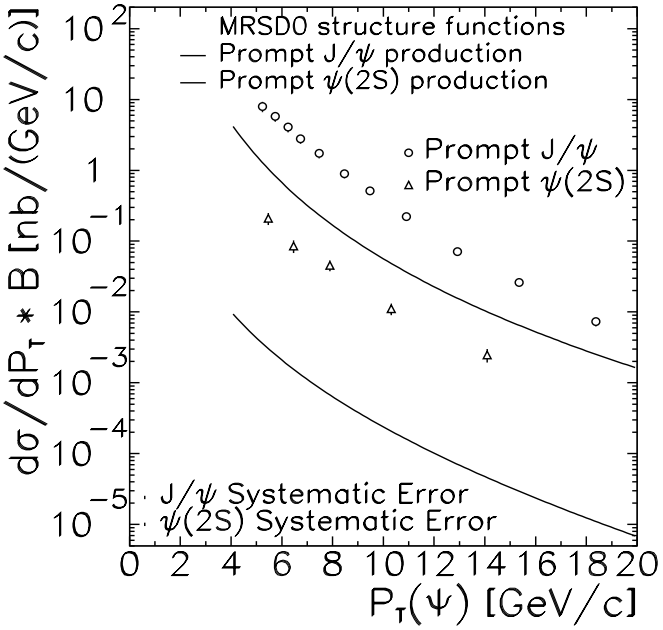
PRL **79**, 572 (1997)



B component gives a longer ct measured with respect to the primary vertex

Prompt Production

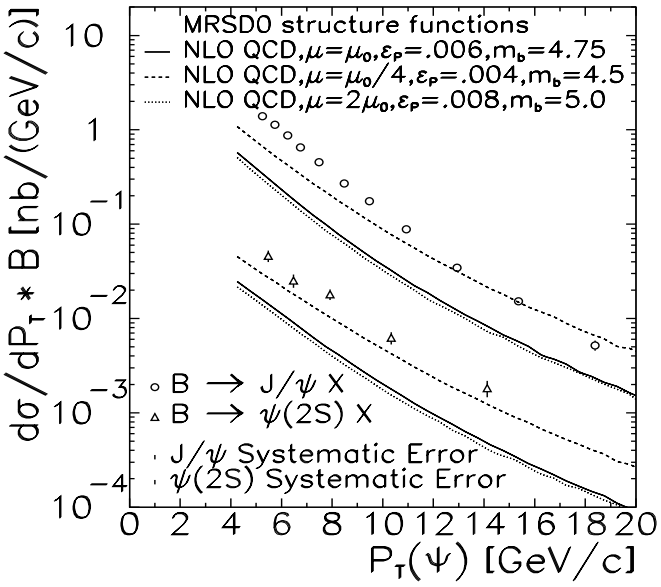
PRL **79**, 572 (1997)



J/ψ theoretical curve includes χ_c component

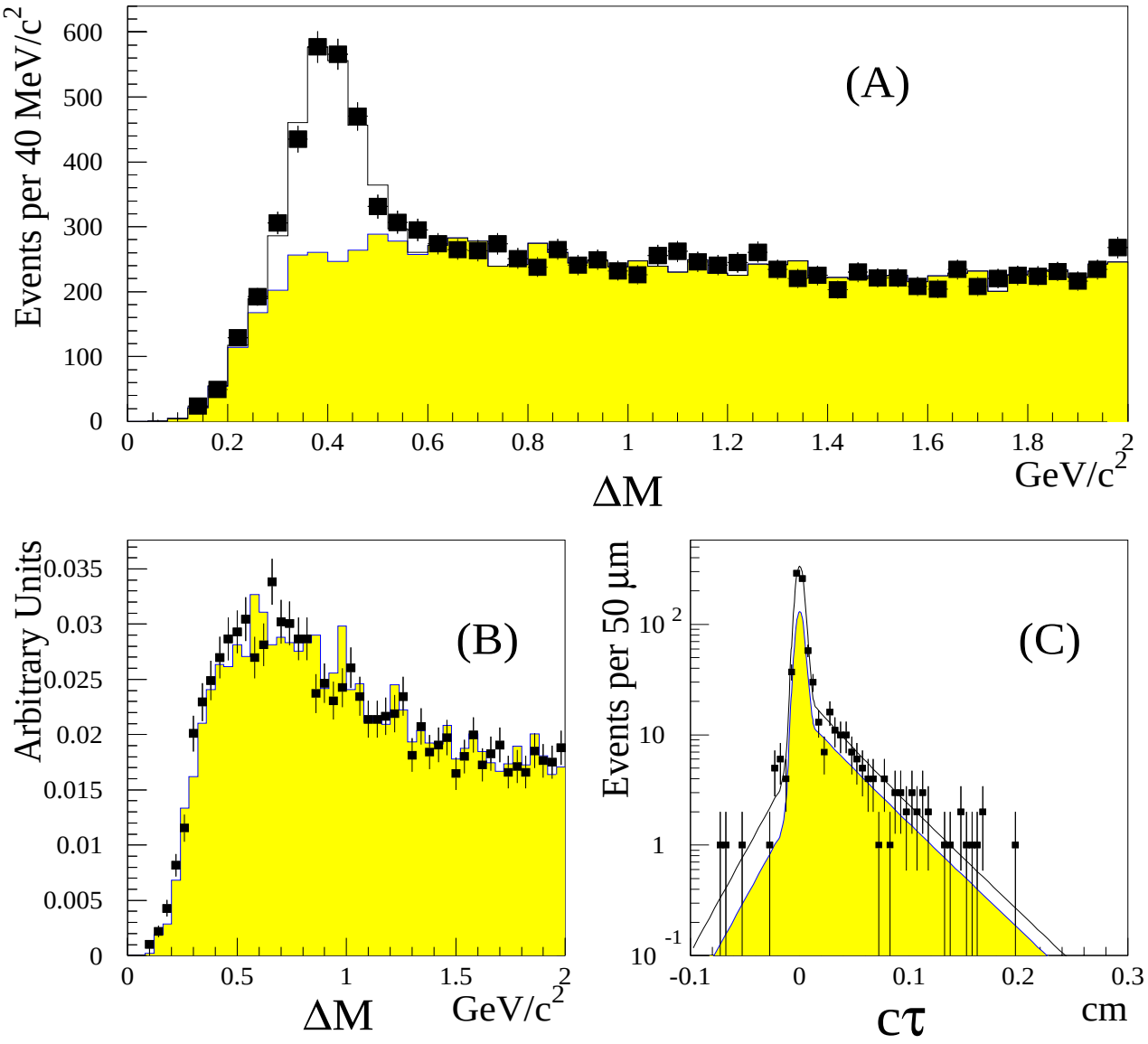
ψ' component ~50 times colour singlet model predictions

B-decay production



b component 3-4 times theoretical predictions

Observation of J/ψ from χ_c Decays in CDF

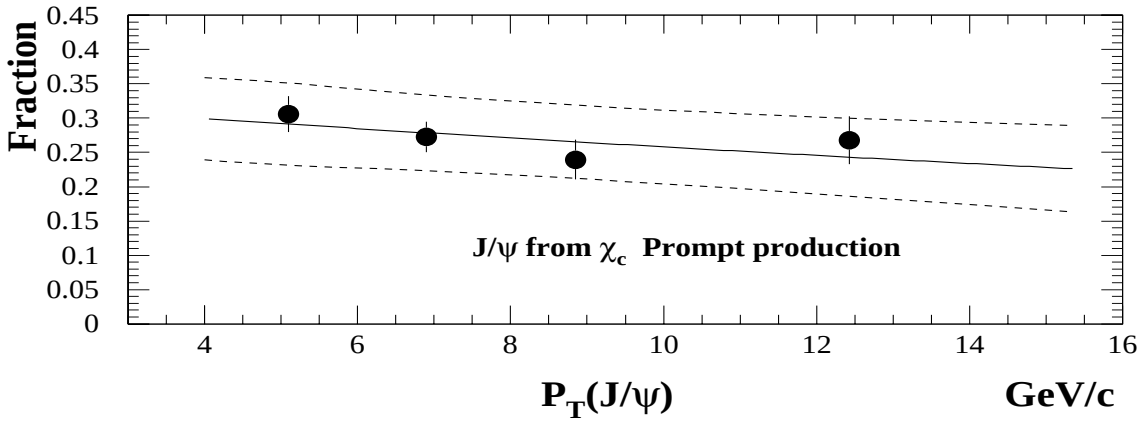


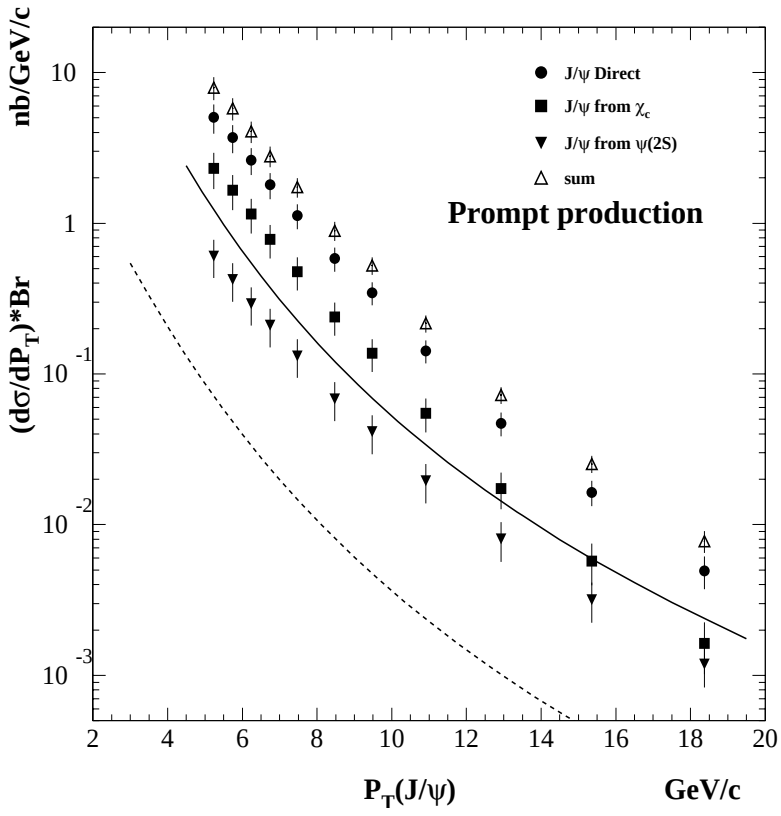
$\Delta M = M(\mu^+\mu^-\gamma) - M(\mu^+\mu^-)$

$c\tau$ proper decay length measured in SVX

Fraction of J/ψ coming from χ_c Decays

PRL **79**, 578 (1997)

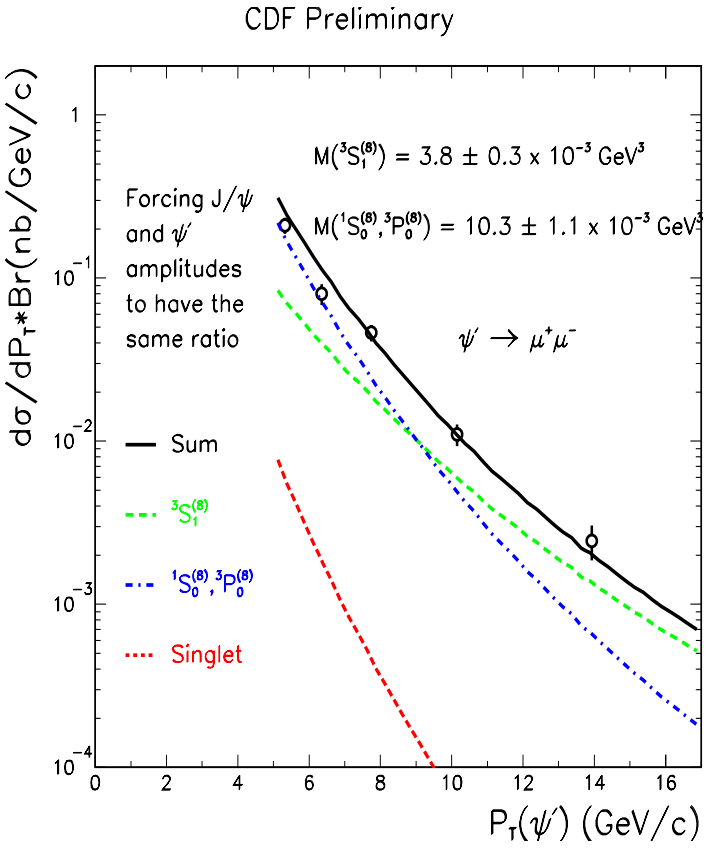


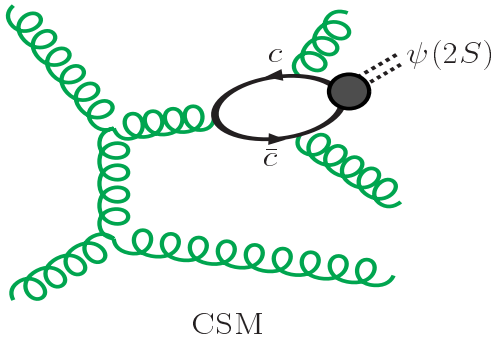


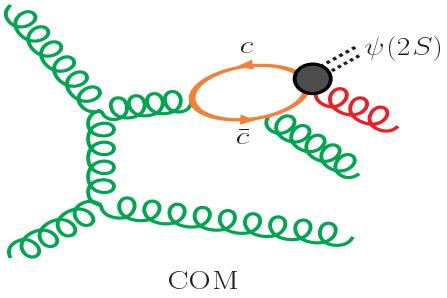
Solid curve χ_c –>J/ψ γ

Prompt J/ψ component ~50 times colour singlet model predictions

Colour Octet model can fit the prompt ψ' production





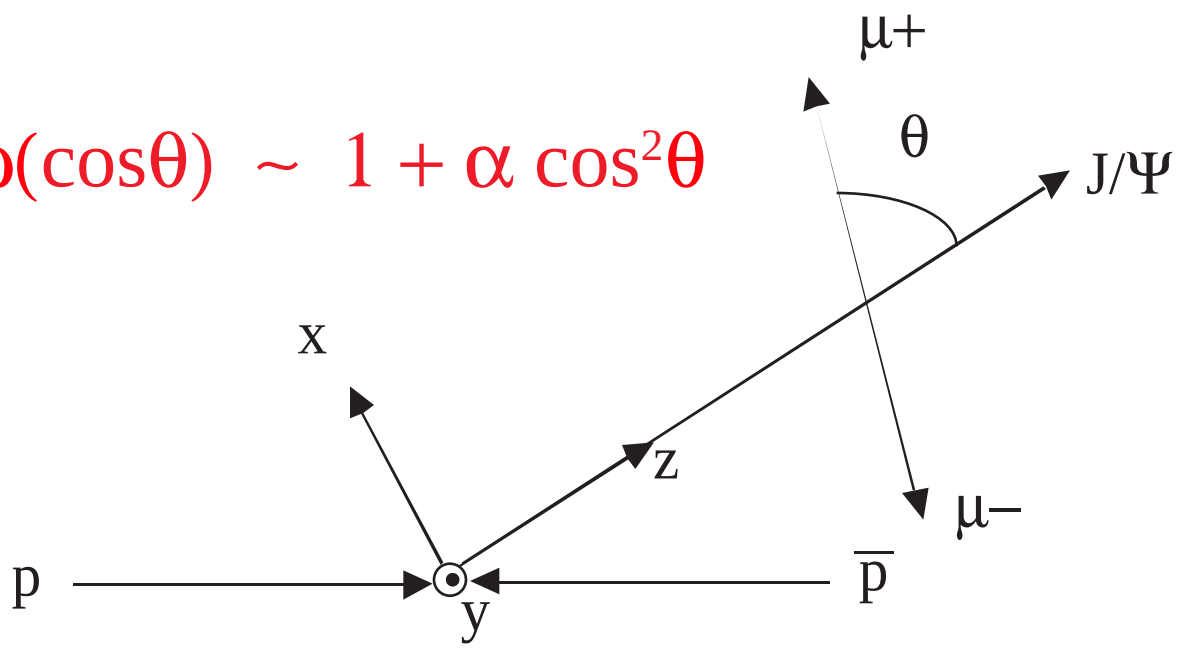


$^3S_1^{(8)}$ term from a single gluon seen to dominate at high Pt

This leads to prediction of transverse polarization of J/ψ and ψ' at high Pt

Measurement of Production Polarization of J/ψ, ψ', ϒ

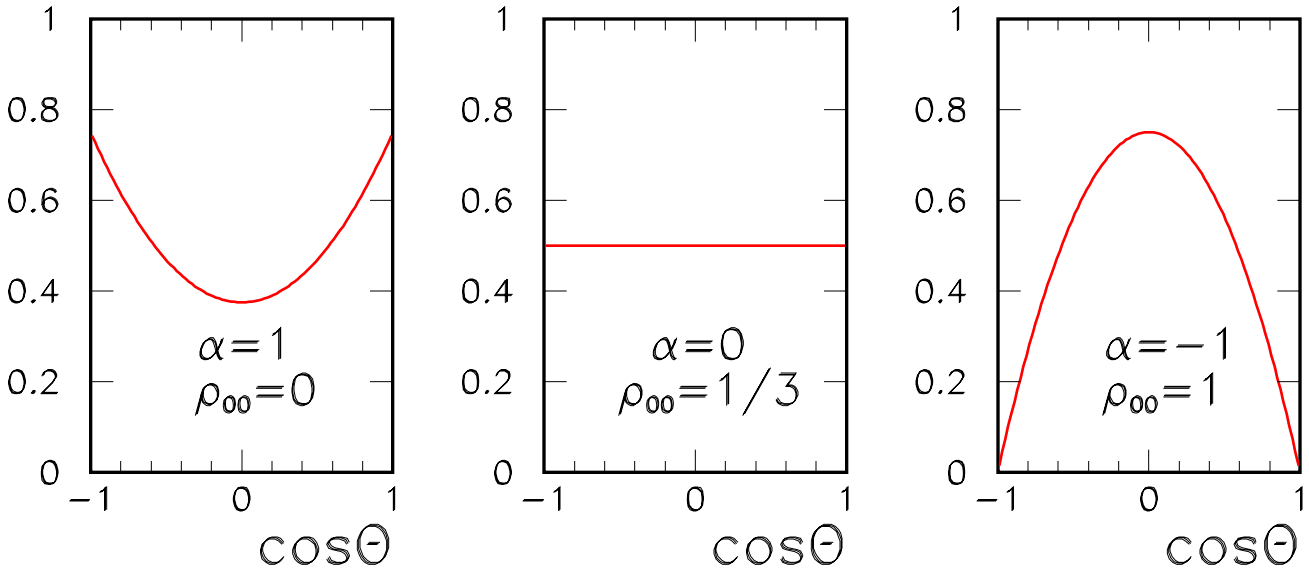
$\omega(\cos\theta) \sim 1 + \alpha \cos^2\theta$



$\alpha = +1$ transversely polarized

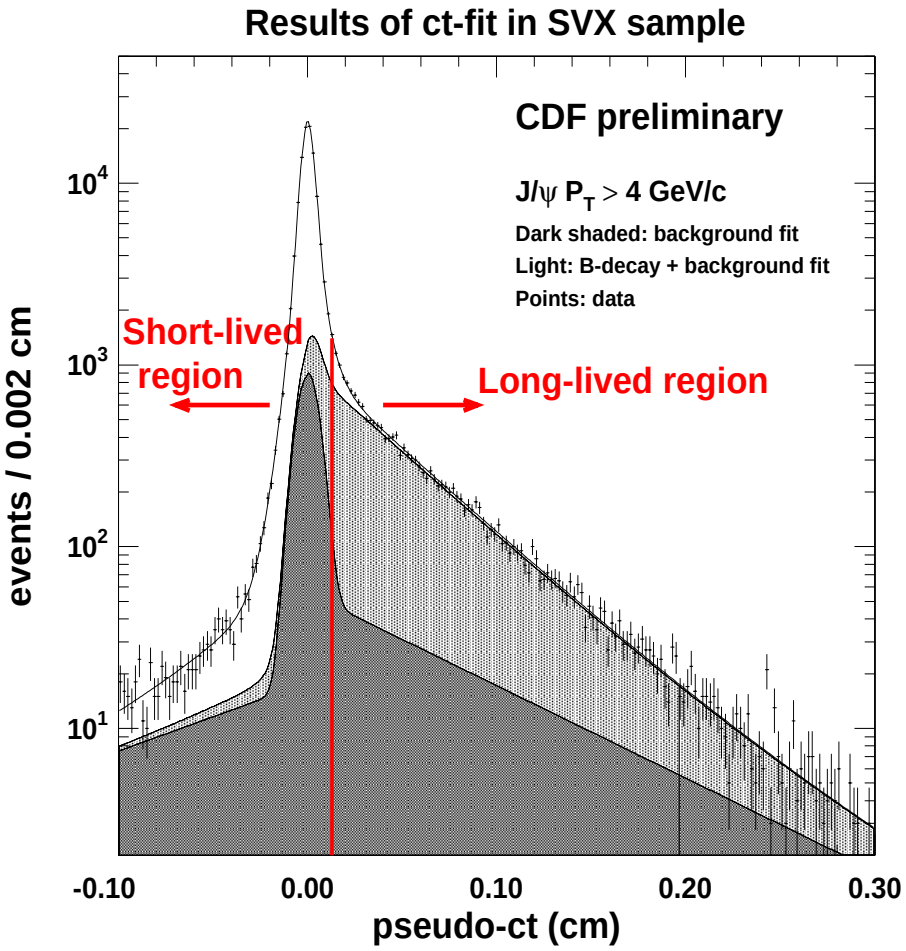
$\alpha = 0$ unpolarized

$\alpha = -1$ longitudinaly polarized



Measurement of Production Polarization of J/ψ

J/ψ sample size ~180,000 $\mu^+\mu^-$ decays (110 pb^{-1})
Pt J/ψ > 4 GeV/c
Separate into Prompt and B-decay components using the ct measured in the SVX

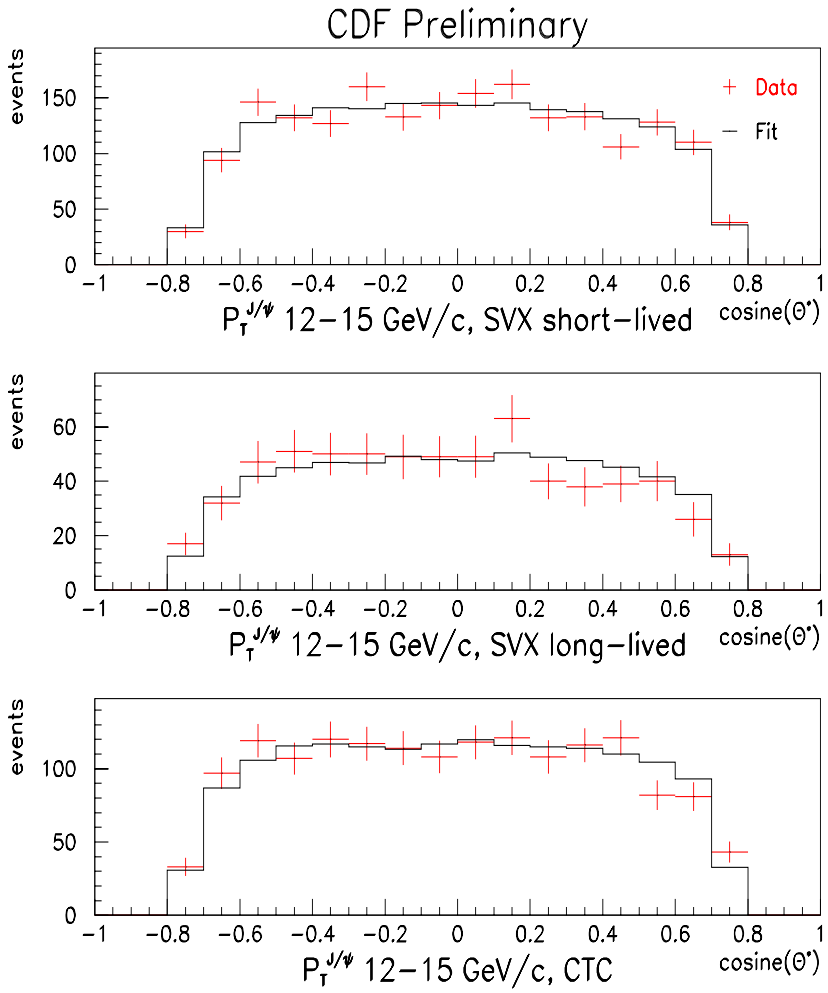


From ct fit, fraction of prompt and B-decay is measured in each short-lived and long-lived region. Total B-decay fraction also measured.

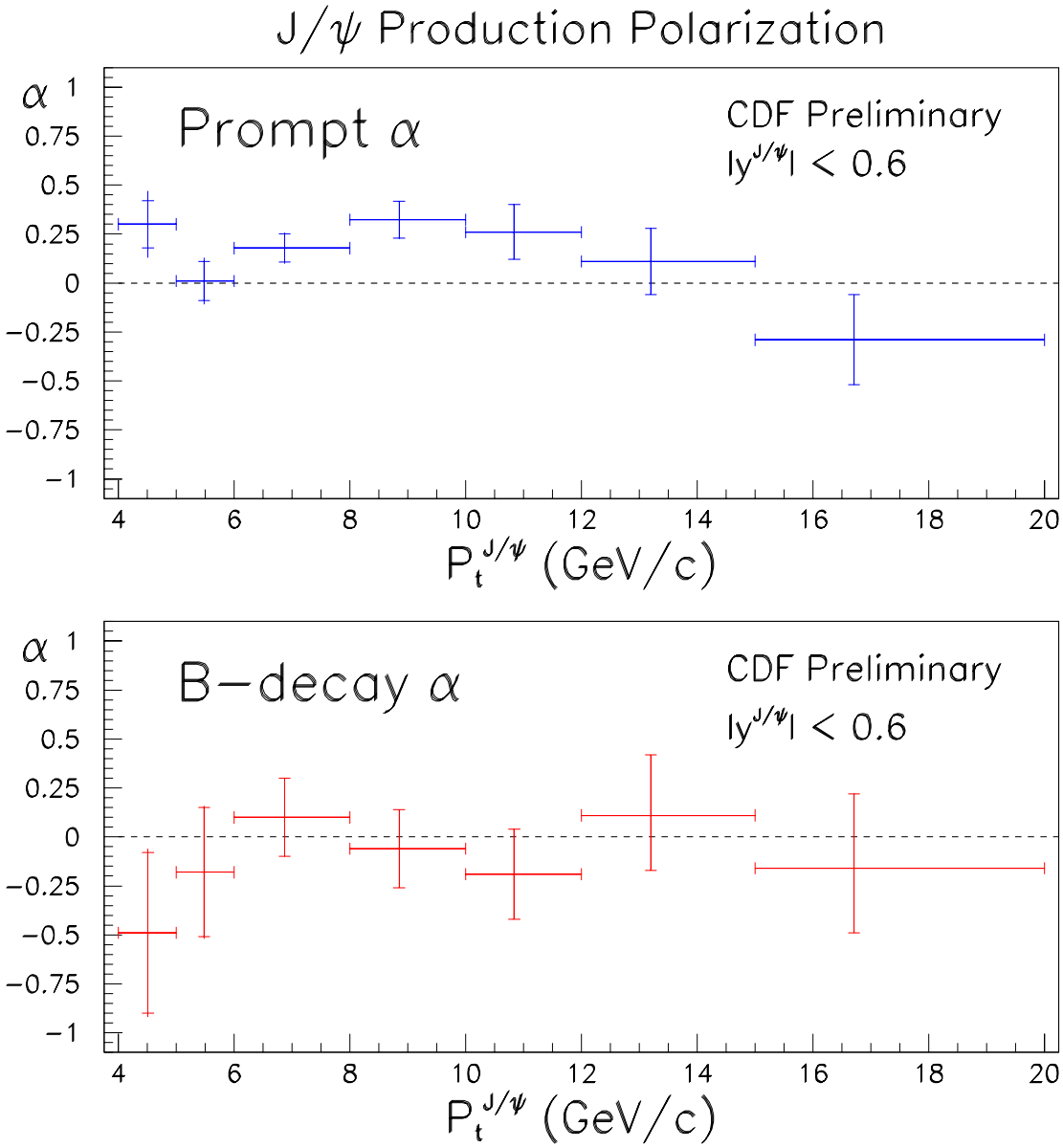
Data divided into 3 subsamples and 7 Pt bins

1. SVX short-lived -0.1<ct<0.013 cm
2. SVX long-lived 0.013<ct<0.3 cm
3. CTC (Central Tracking Chamber)
 (SVX information missing,
 Total B-decay fraction used)

Angular distributions are strongly cut by the acceptance. Monte Carlo events with detector acceptance used to normalize.



No rise in Prompt α at high Pt

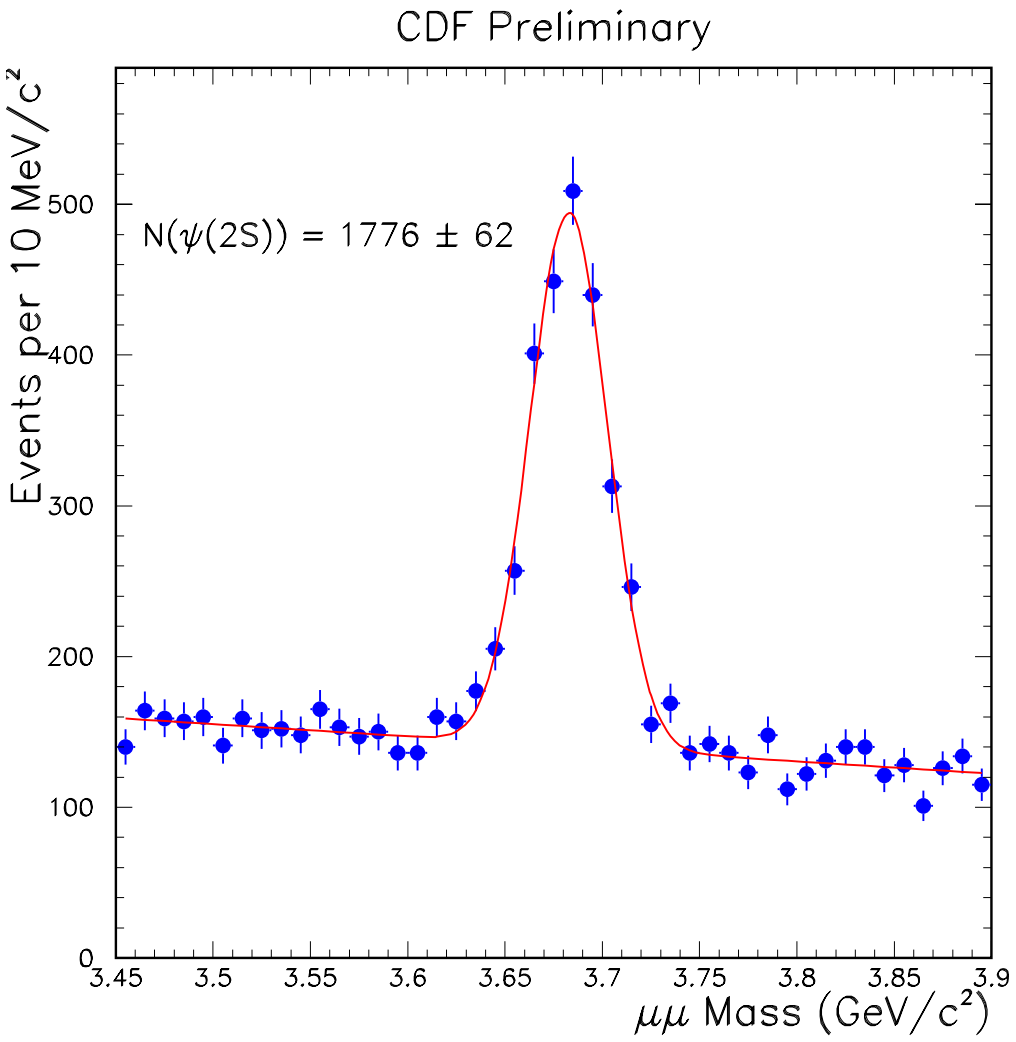


B-decay α consistant with zero

Fraction of directly produced J/ψ in Prompt sample is 64% (rest is from χ_c and ψ')

Measurement of Production Polarization of ψ'

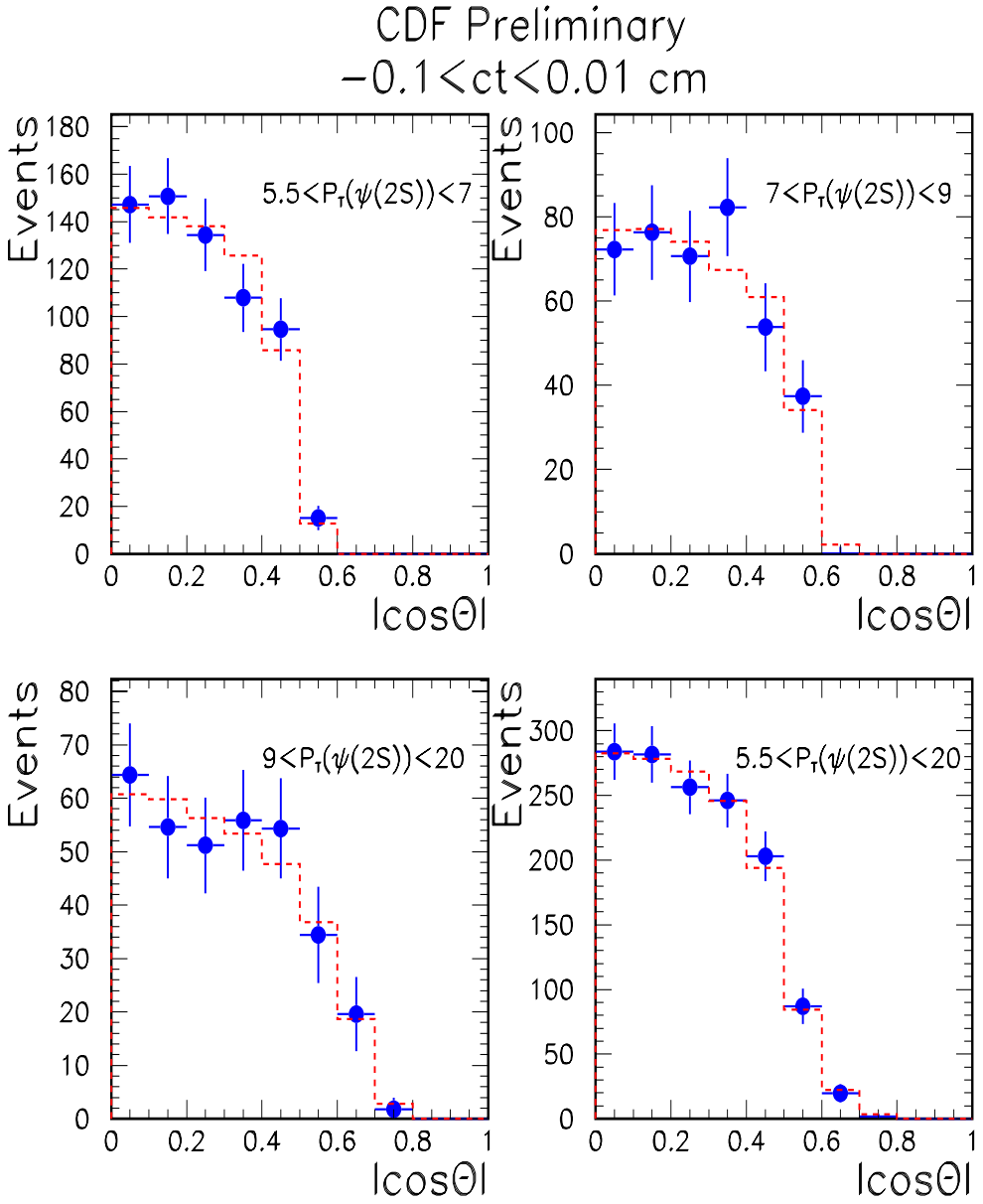
Data Selection (110 pb^{-1})
Pt > 5.5 GeV/c
Both Muons in SVX



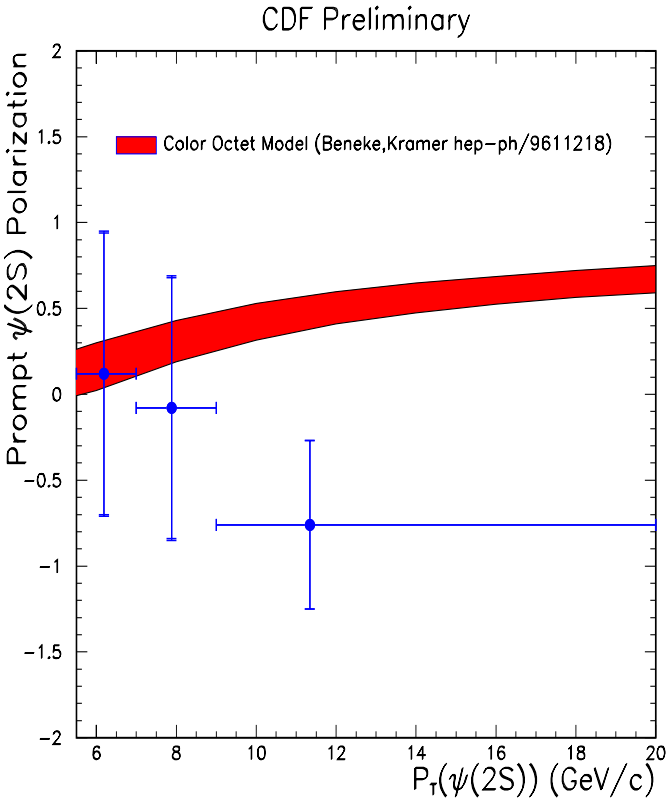
From ct lifetime fit, fraction of prompt and B-decay is measured in each short-lived and long-lived region.

Data divided into 2 subsamples and 3 Pt bins

1. SVX short-lived -0.1<ct<0.01 cm
2. SVX long-lived 0.01<ct<0.3 cm

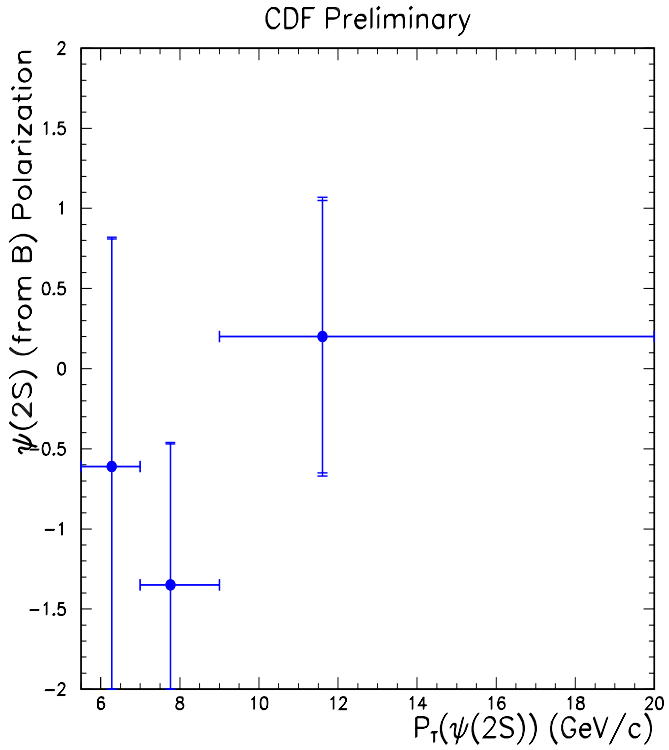


Polarization results on ψ'



prompt α

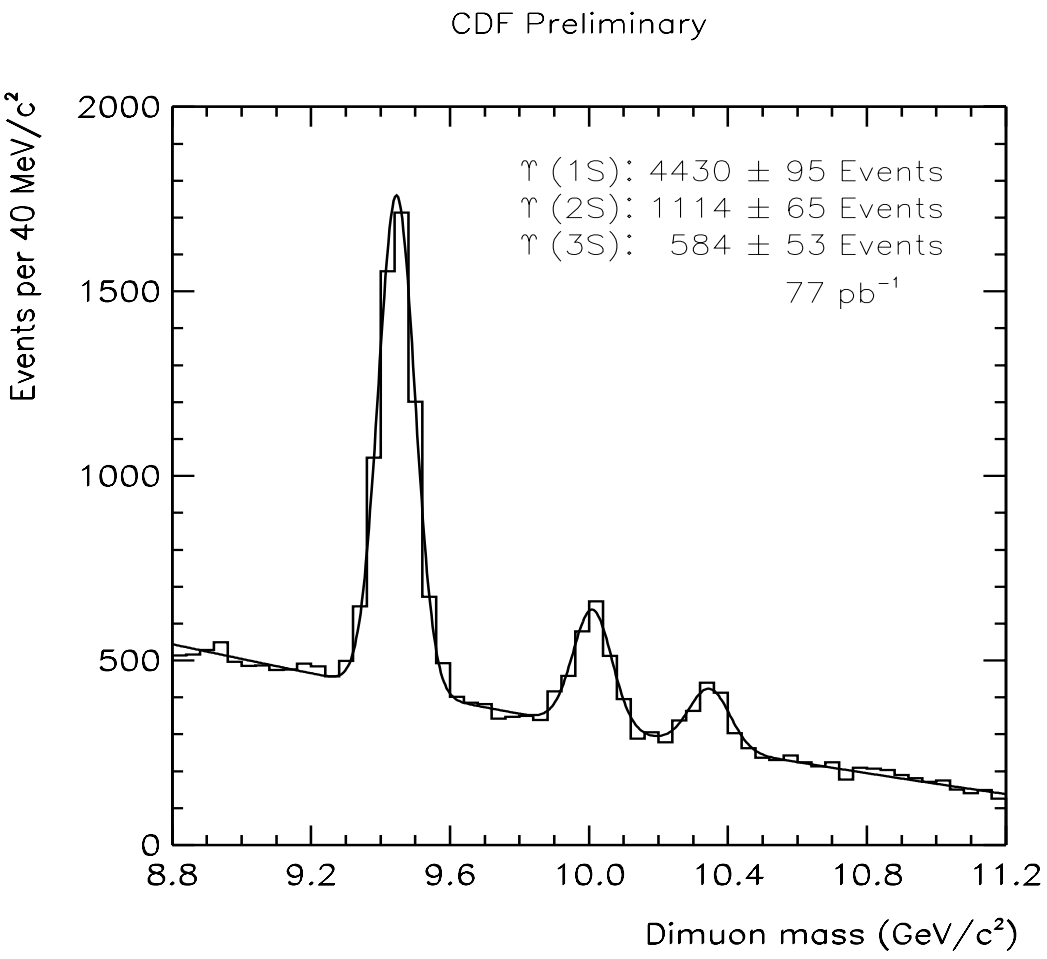
Polarization does not appear to rise at high Pt



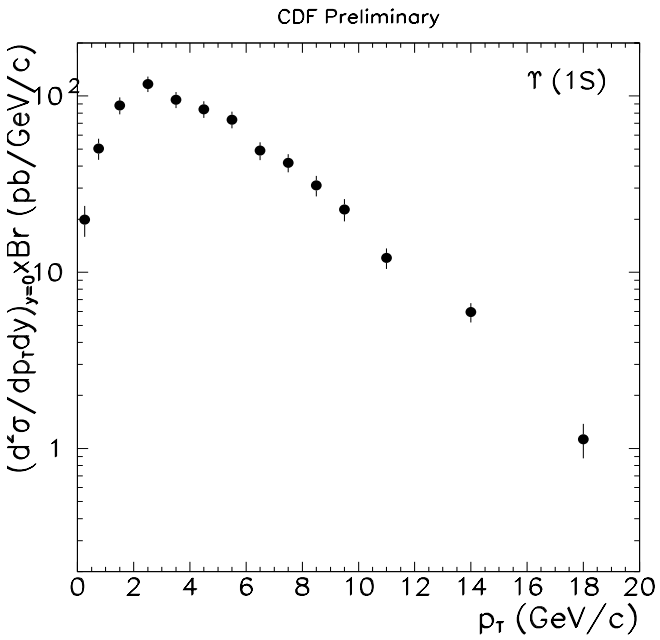
B-decay α

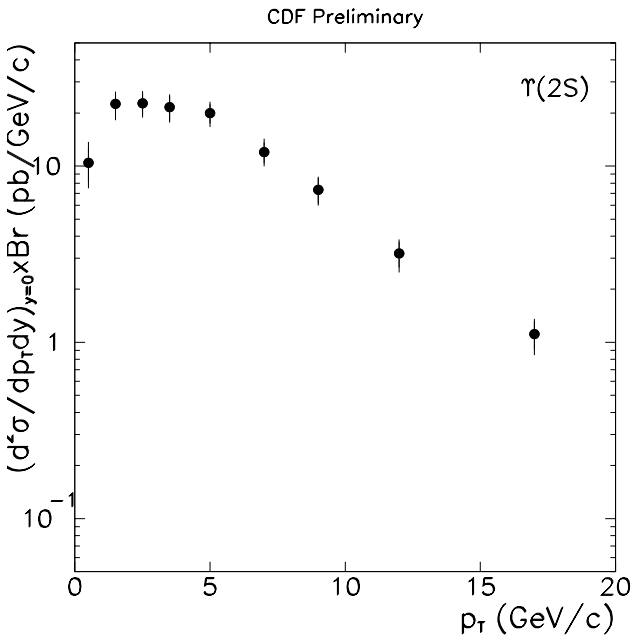
ϒ Production Measurements

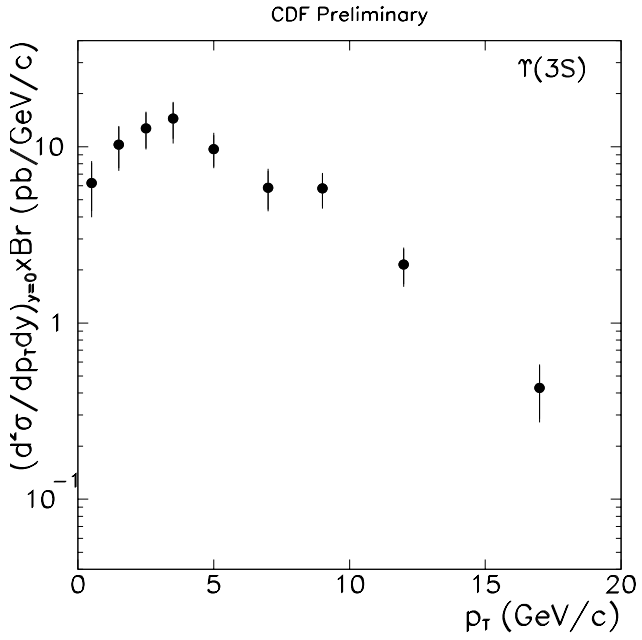
Data ϒ-->$\mu^+\mu^-$ 77 pb^{-1}

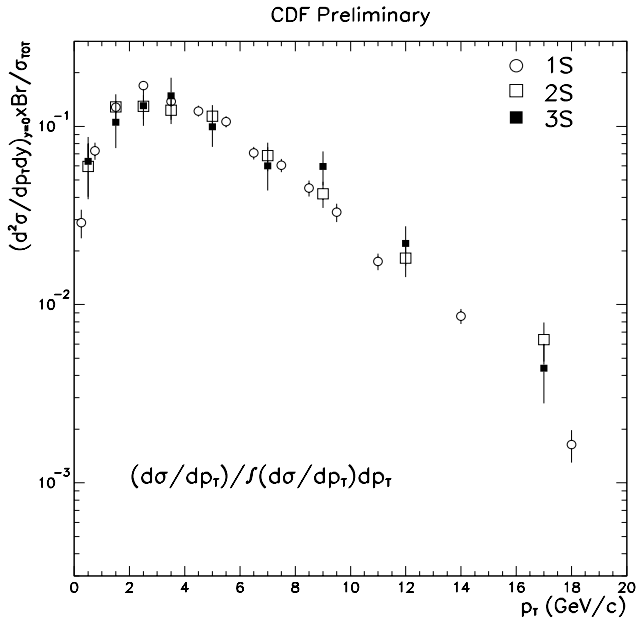


Υ(1S), Υ(2S) and Υ(3S) Production Cross Sections

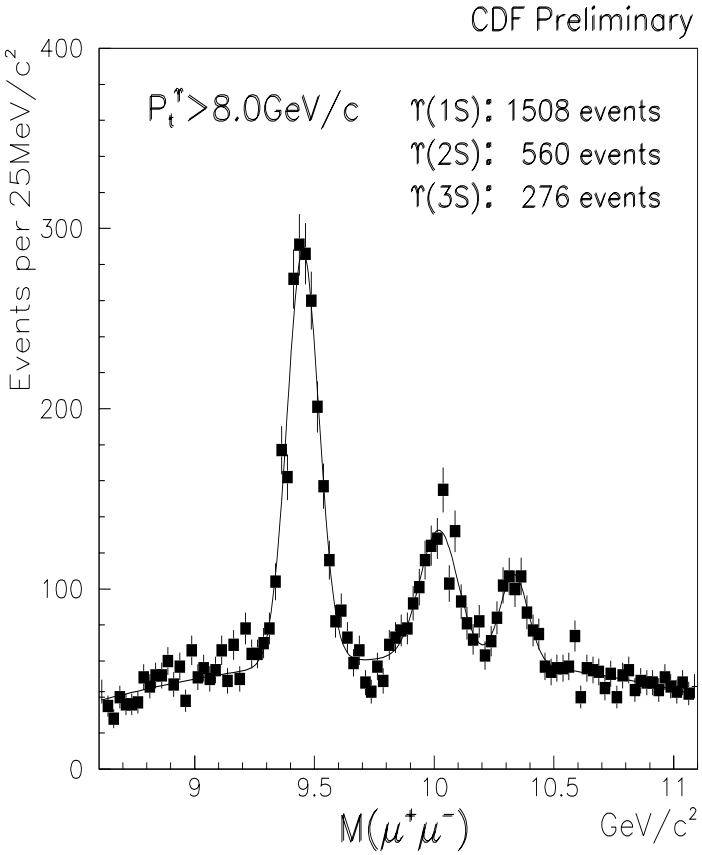








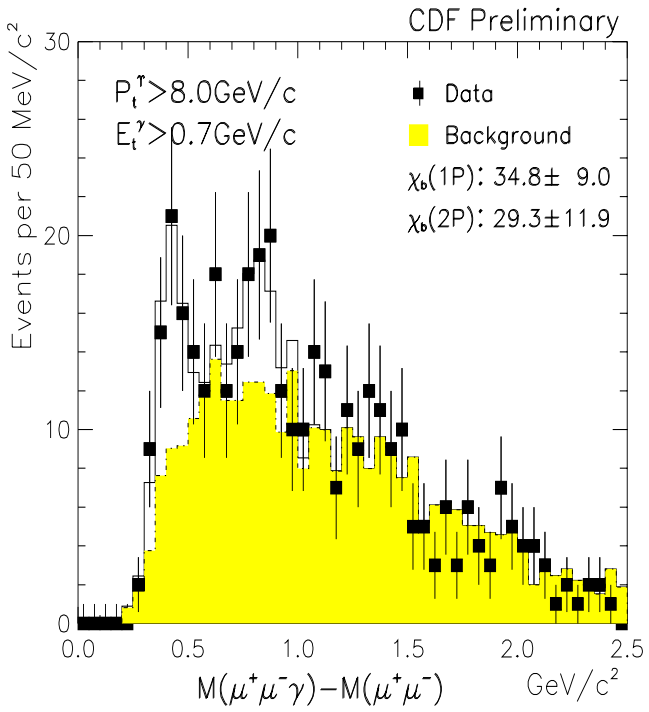
Fraction of $\Upsilon(1S)$ from χ_b decays



Pt Υ > 8 GeV/c

Eγ > 0.7 GeV

$\chi_b \Rightarrow \Upsilon(1S)\,\gamma$



$F^{\Upsilon}\chi_b(1P) = (26.7\pm6.9\pm4.3)\%$

$F^{\Upsilon}\chi_b(2P) = (10.8\pm4.4\pm1.3)\%$

$F(\Upsilon(1S))$ from
$\Upsilon(2S)\rightarrow\Upsilon(1S)\pi\pi = (10.7\pm2.5)\%$

F(direct) = (51.8±8.2)%

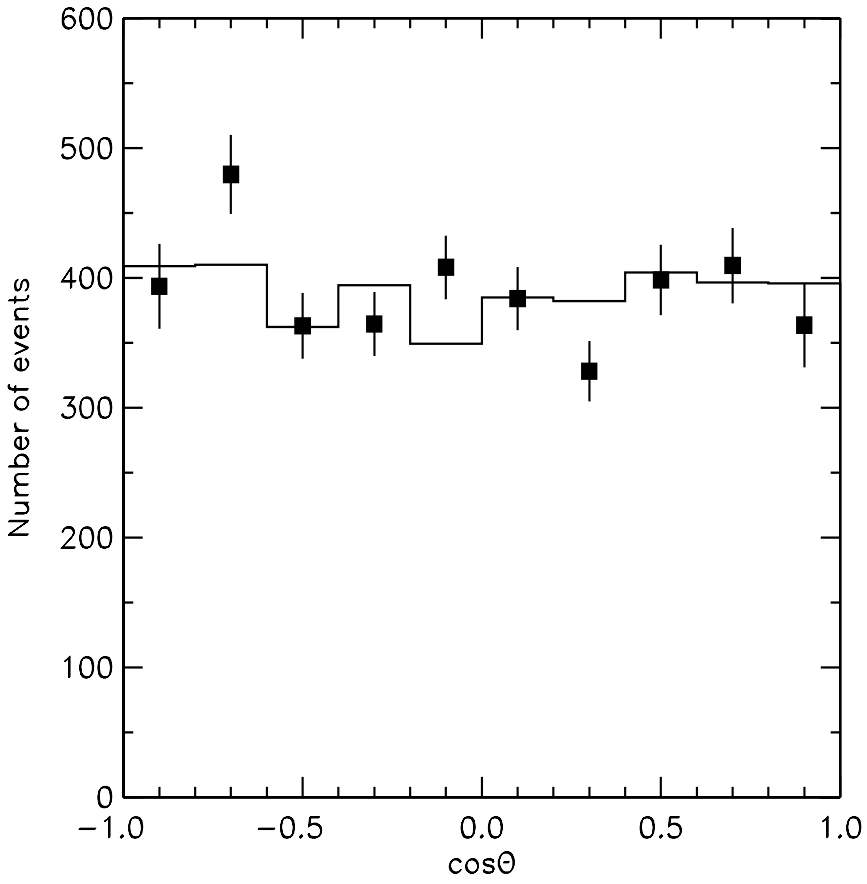
Polarization of Υ(1S) Production

$\Upsilon \Rightarrow \mu^+\mu^-$

$|y(\Upsilon)| < 0.4$

$2\ \text{GeV/c} < Pt(\Upsilon) < 20\ \text{GeV/c}$

No cut on ct



$\Gamma_L/\Gamma = (1-\alpha)/(3+\alpha) = 0.37 \pm 0.04$

$(\alpha = 0.08 \pm 0.09)$

Unpolarized Production

Conclusions

-D0 and CDF b cross section data 3-4 times theory

-Shape of angular jet correlations well described by NLO

-b production components of J/ψ and ψ' 3-4 times theory

-Prompt components of J/ψ and ψ' ~50 times CSM theory

-65% Prompt J/ψ direct (35% from χ_c and ψ' decays)

-COM predicts polarized onium production at high Pt

-No rise in J/ψ polarization seen at high Pt

-Polarization of ψ' does not appear to rise at high Pt

-New ϒ(1S),ϒ(2S) and ϒ(3S) cross sections similar shape

-51.8±8.2% ϒ(1S) prompt production direct

–ϒ(1S) unpolarized 2-20 GeV/c