Figure 1: Lowest-order contributions to heavy-quark hadroproduction.
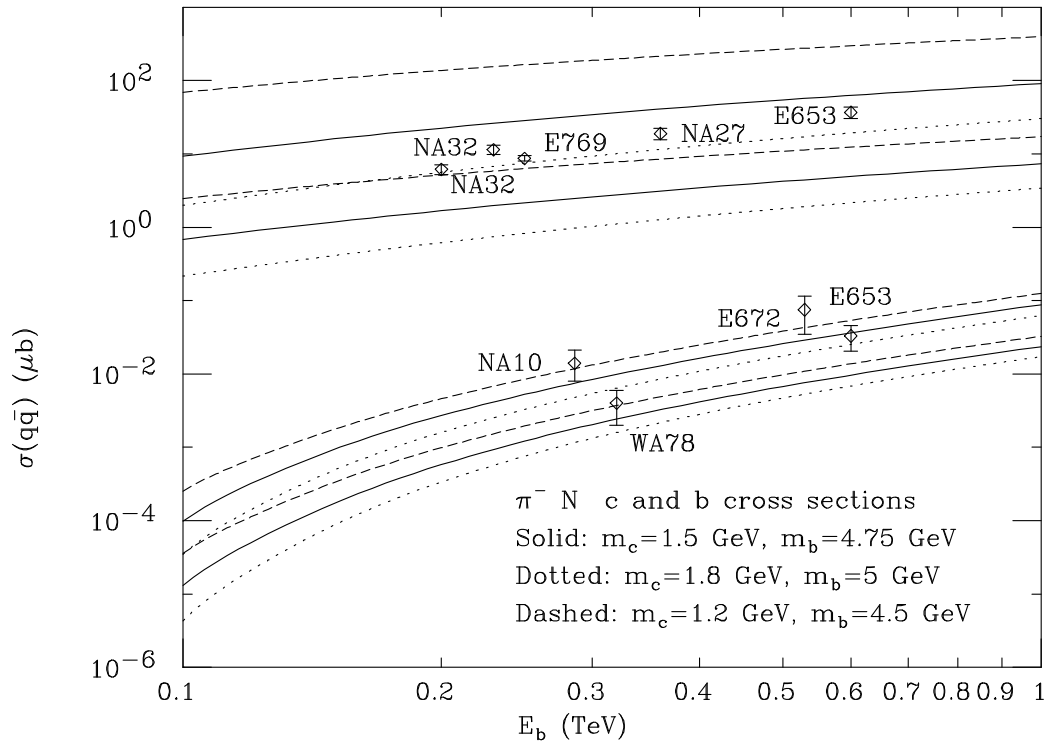


Figure 2: Cross sections for $b$ and $c$ production in $\pi N$ collisions. For details see text (from ref. [8]).
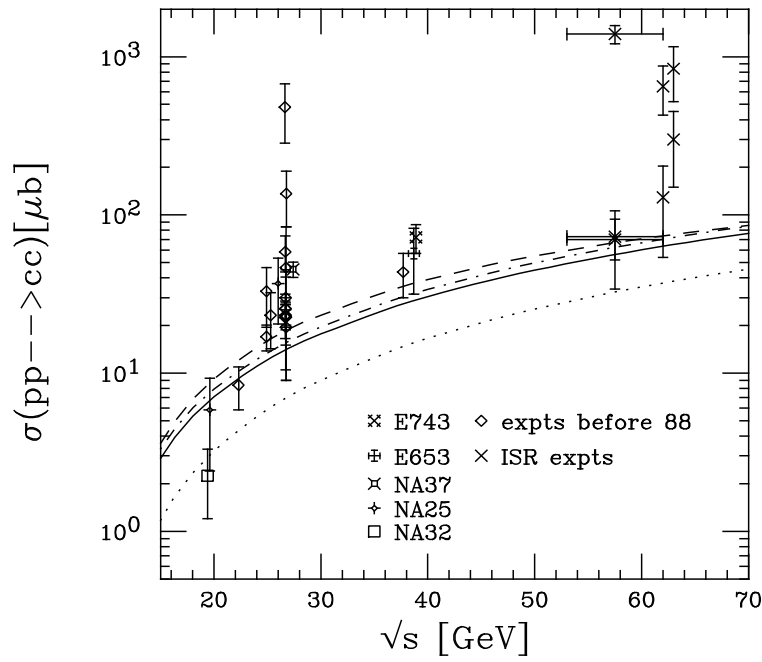
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Figure 3: Total charm production cross sections from $pp$ and $pA$ measurements compared to calculations. The curves are: MRS D$-'$ $m_c = 1.2$ GeV, $\mu = 2m_c$ (solid); MRS D0$'$ $m_c = 1.2$ GeV, $\mu = 2m_c$ (dashed); GRV HO $m_c = 1.3$ GeV, $\mu = m_c$ (dot-dashed); GRV HO $m_c = 1.5$ GeV, $\mu = m_c$ (dotted) (from ref. [10]).
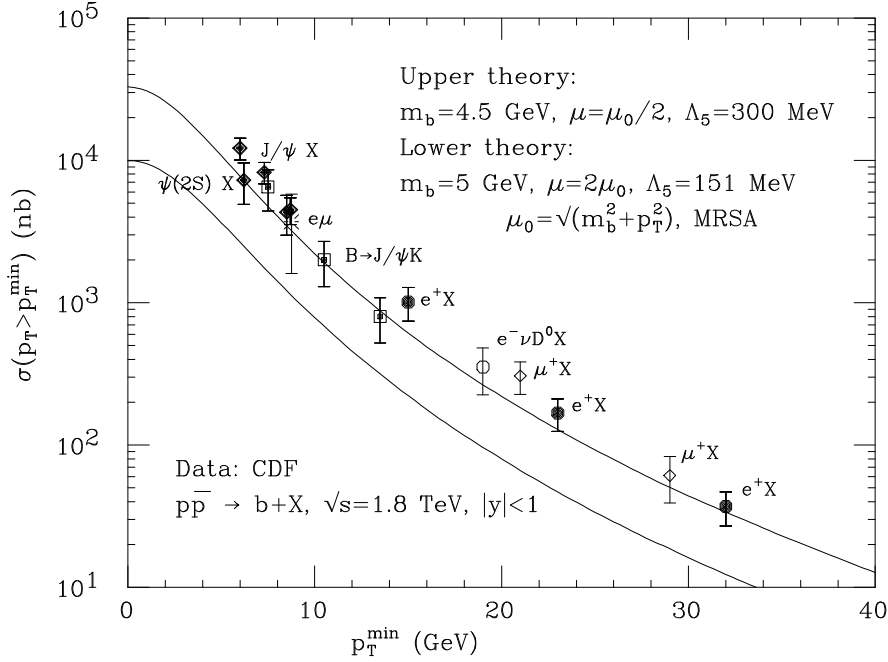


Figure 4: The $b$-quark cross sections at CDF. For details see text (from ref. [8]).
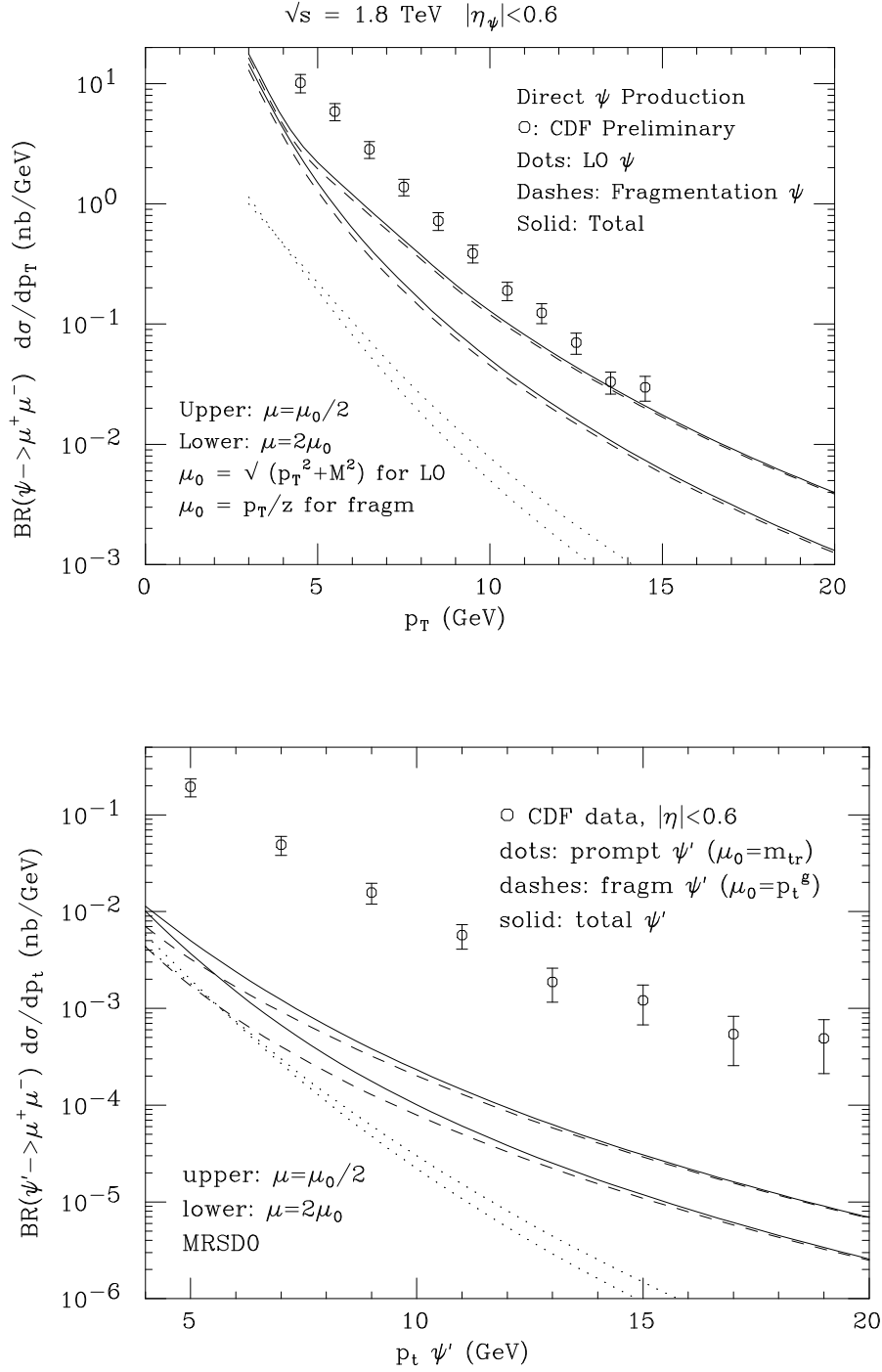
$\sqrt{s} = 1.8$ TeV $|\eta_\psi| < 0.6$

Direct $\psi$ Production
○: CDF Preliminary
Dots: LO $\psi$
Dashes: Fragmentation $\psi$
Solid: Total

Upper: $\mu = \mu_0/2$
Lower: $\mu = 2\mu_0$
$\mu_0 = \sqrt{(p_T^2 + M^2)}$ for LO
$\mu_0 = p_T/z$ for fragm

BR($\psi \to \mu^+\mu^-$) $d\sigma/dp_T$ (nb/GeV)

$p_T$ (GeV)

○ CDF data, $|\eta| < 0.6$
dots: prompt $\psi'$ ($\mu_0 = m_{tr}$)
dashes: fragm $\psi'$ ($\mu_0 = p_t^g$)
solid: total $\psi'$

upper: $\mu = \mu_0/2$
lower: $\mu = 2\mu_0$
MRSD0

BR($\psi' \to \mu^+\mu^-$) $d\sigma/dp_t$ (nb/GeV)

$p_t$ $\psi'$ (GeV)

Figure 5: Preliminary CDF data for prompt $J/\psi$ and $\psi'$ production compared with theoretical predictions of the total fragmentation contribution (solid curves) and the total leading-order contribution (dashed curves) (from ref. [26]).
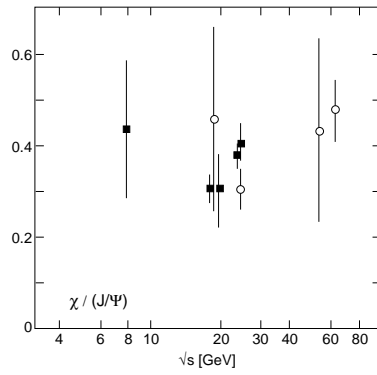
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Figure 6: The ratio of $(\chi_{c1} + \chi_{c2}) \to J/\psi$ to total $J/\psi$ production as a function of c.m. energy $\sqrt{s}$, by proton (open symbols) and pion beams (solid symbols) (from ref. [30]).
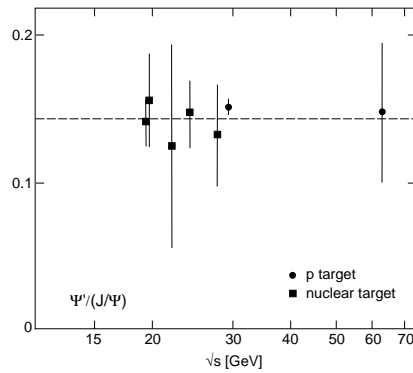


Figure 7: The ratio of $\psi'$ to $J/\psi$ production as a function of c.m. energy $\sqrt{s}$, on proton (circles) and nuclear targets (squares) (from ref. [30]).
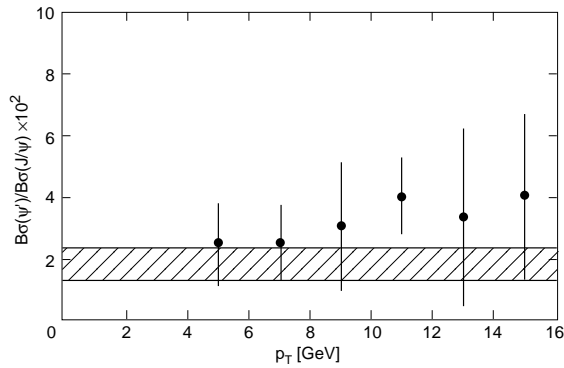


Figure 8: The ratio of $\psi'$ to $J/\psi$ production as a function of transverse momentum; the shaded strip shows the average value of Fig. 7 (from ref. [30]).
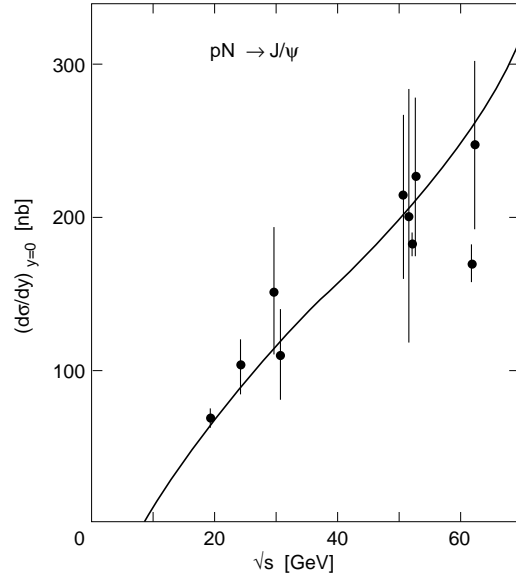
Figure 9: The differential $J/\psi$ production cross section $(d\sigma[pN \to J/\psi X]/dy) = 2.5 \times 10^{-2} \ (d\tilde{\sigma}[c\bar{c}]/dy)$ at $y = 0$, calculated with MRS D$-'$ PDF, compared with data (from ref. [30]).
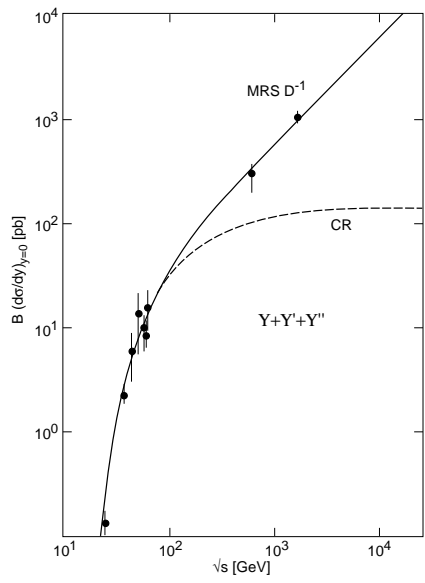


Figure 10: Energy dependence of $\Upsilon$ production in $pN$ collisions using the MRS D$-'$ PDF. Also shown (CR) is a phenomenological low-energy fit (from ref. [30]).
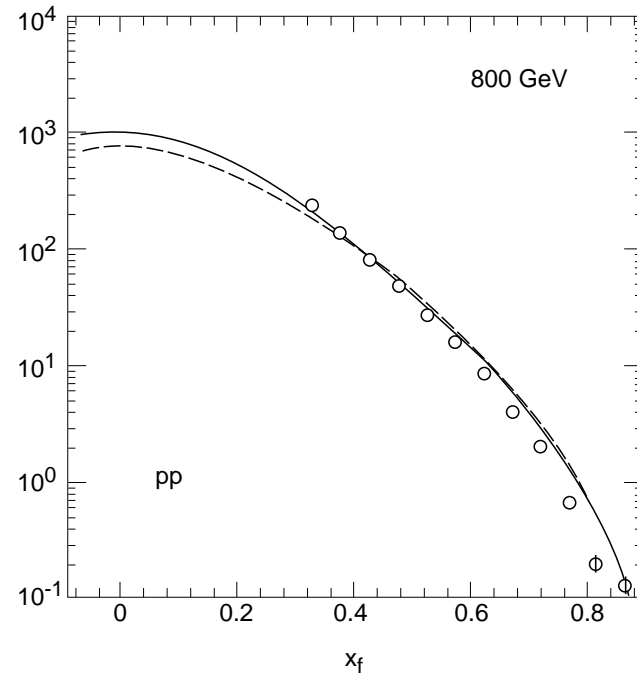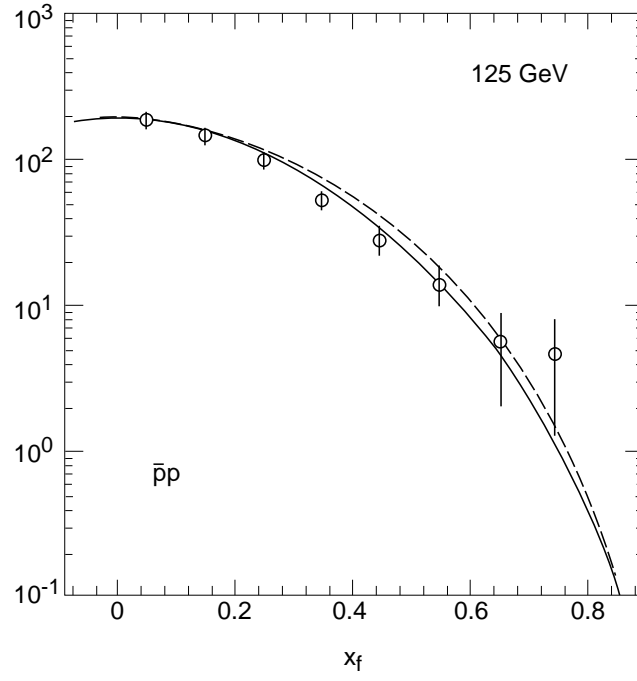
Figure 11: The $J/\psi$ longitudinal momentum distributions compared with $\bar{p}N$ (top) and $pN$ (bottom) data using two parametrizations of the PDF, MRS D$-'$ (solid) and GRV (dashed) (from ref. [30]).