HEAVY FLAVOR PRODUCTION AT THE TEVATRON

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Abstract

We discuss some of the results on the measurements of heavy flavor production at the Tevatron.

1 Introduction

Heavy flavor production can be used to test QCD over a wide range of quark masses ($m_b \sim 4.5$ GeV/c^2 to $m_t = 174.3 \pm 5.1$ GeV/c^2). In addition, it is a background that has to be understood to perform physics measurements in the *top* sector and Higgs searches. The results reported here are performed using the RunI data collected at Tevatron (~ 100 pb^{-1}).

2 *top* production cross section measurements

Top quark has been observed by both detectors at the Tevatron: CDF and DØ. $t\bar{t}$ production cross section has been measured in different decay channels where the different final states are obtained depending on the various decay modes of the W boson. The measured $t\bar{t}$ production cross-sections for a given *top* mass M_{top}[2] are shown in Fig.1 for various analysis. The results are in agreement with NLO theoretical predictions as a function of M_{top} [1, 2].

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[2]CDF refers the cross section measurement for a *top* mass of $M_{top} = 175$ GeV/c^2 while DØ refers to $M_{top} = 172.1$ GeV/c^2.

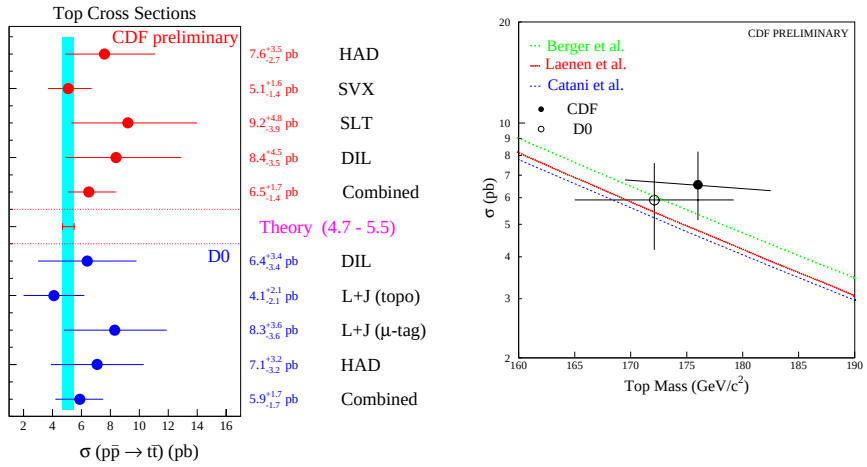

Figure 1: $t\bar{t}$ production cross-section measured by both CDF and DØ using different final states (left). Combined $t\bar{t}$ production cross-section measurements reported with theoretical predictions as a function of M_{top}(right).

3 *b*-quark production

The excess of open beauty production was first found by the experiments at the SPS at CERN in the late 80's. The measured b-quark production cross sections were larger (but still within experimental errors) than those predicted by the NLO analytical calculation [3]. Although it is well known that NLO calculations should be less accurate for the b-quark than those for the top quark, some explanations of this excess at the Tevatron were given in terms of "Physics Beyond the Standard Model" [5]. The inclusive measurements performed at the Tevatron by the DØ and CDF experiments give a larger discrepancy with theoretical productions (up to a factor ~ 2 to ~ 4)[4]. Since the results reported in [4] are expressed in terms of transverse momentum of b-quark some uncertainties could be included. To disentangle from them, the meson $B^{\pm}$ is exclusively reconstructed ($B^{\pm} \to J/\Psi K^{\pm}$) and its production cross section is measured[6] Fig.2. The excess found on the $B^{\pm}$ production cross section has been recently reexamined [7]; it was found that the most striking discrepancies can be reduced by a theoretically careful implementation of perturbative resummation and non-perturbative fragmentation parameter.

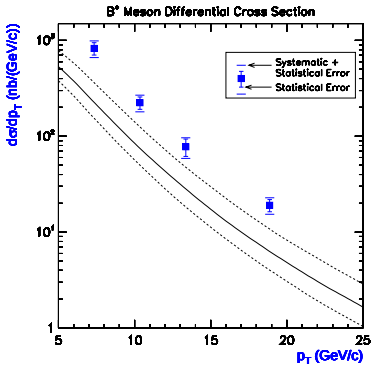

Figure 2: Differential exclusive $d\sigma(B^{\pm})/dP_T(B^{\pm})$. Theory curves: NLO, MRST, $\mu_0/2 < \mu < 2\mu_0$ where $\mu = \sqrt{M_b^2 + P_T^2}$ $0.004 < \epsilon_P < 0.008$, $4.5 < M_b < 5.0\text{GeV}/c^2$.

4 Bound states heavy quark production

Production of charmonium and bottomonium states at high-energy colliders has been the subject of considerable interest during the past few years at both $p\bar{p}$ and ep colliders. At CDF, it has been possible to measure direct charmonium production using the information from silicon vertex tracker detector[9]. Large discrepancies were found using the colour-singlet model. A better agreement is found between measurements and NRQCD theory that includes colour-octet mechanisms Fig.3(left). However, the predicted transverse polarization increase with J/Ψ momentum is not observed Fig.3(right). Similar measurements performed at HERA[8] show some discrepancies with the NRQCD predictions with Color Octet matrice elements extracted from CDF data.

5 Conclusion and Prospects

Both the CDF and DØ detectors are finishing an extensive phase of upgrade to handle the potential of the RunII of Tevatron. It is impossible to condense here the expected improvements on the measurements of heavy flavour production, but we are sure that with the improved detectors our understanding in heavy flavor physics will be increased.

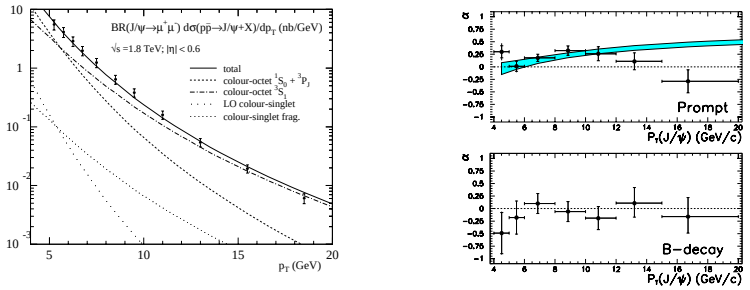

Figure 3: Differential prompt production cross section for J/Ψ (left). Polarization measurement for J/Ψ as a function of P_T, together with the theoretical expectations (right).[9]

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