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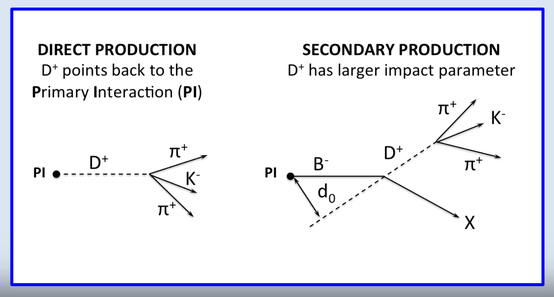
MEASUREMENT OF LOW-P_T CHARM-MESON PRODUCTION CROSS-SECTION AT CDF

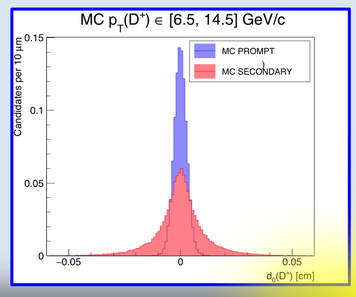
ABSTRACT

We report a measurement of the low-p_T D^+-meson production cross section produced in proton-antiproton collisions at 1.96 TeV center-of-mass energy, using the data set collected by the CDF experiment at the Tevatron collider during RUN II. The measurement is performed in a previously unexplored low-transverse-momentum range 1.5 to 14.5 GeV/*c*. In this range a perturbative expansion of the strong coupling constant in not appropriate. Experimental results are crucial to test new QCD models refining the actual knowledge.

SIGNAL AND BACKGROUND

The channel of interest is $D^+ \longrightarrow K^-\pi^+\pi^+$ (and its charge-conjugate decay). The signal of interest is D^+ mesons produced directly at the point where the primary interaction occurred, the **primary** component. Some D^+ can originate from decays of B mesons. They constitute a **secondary**-decay background component which is characterized by a wider impact-parameter distribution than the prompt component. Three unrelated tracks with an effective mass near the D^+ peak value in the invariant-mass distribution form a **combinatoric** background.



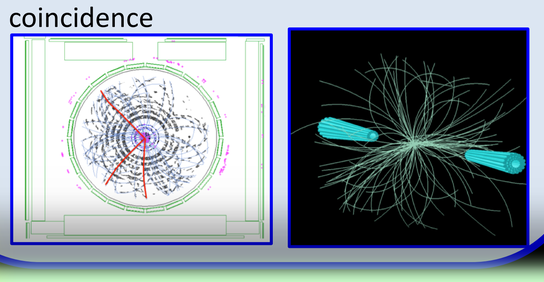


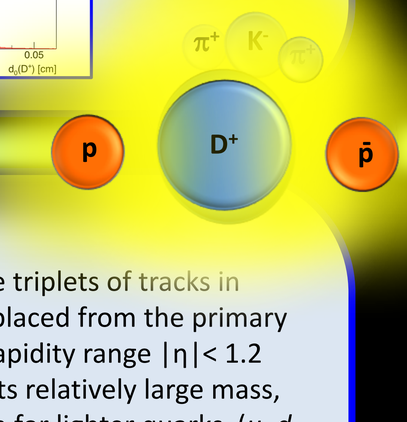
DATA SELECTION

Data are collected by two triggers:

Zero **B**ias - Rate ≈ 1.6 events/s
- Events collected every bunch crossing whether or not collisions occur

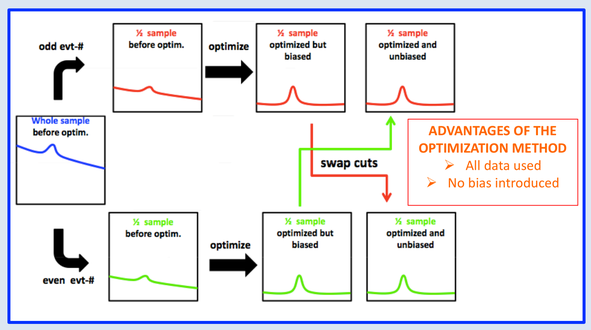
Minimum **B**ias - Rate ≈ 1 events/s
- At least one inelastic $p\bar{p}$ collision occurred
- Cherenkov Luminosity Counters signal coincidence





D^+ CANDIDATES

In each event, the D^+ candidates are reconstructed by combining all possible triplets of tracks in kinematics fits. If a fit returns a possible common origin for the three tracks displaced from the primary interaction, a D^+ candidate is defined. Tracks are selected only in the pseudorapidity range $|\eta| < 1.2$ where the reconstruction of the tracking system is highly efficient. Because of its relatively large mass, the *c*-quark production cross-section is several orders of magnitude smaller than for lighter quarks (*u*, *d* and *s*). A data-driven optimization is introduced in a way that leads to unbiased sample selection: data are divided into two subsamples, EVEN-numbered and ODD-numbered events. The optimization strategy is performed independently in each p_T (D^+)-bin.



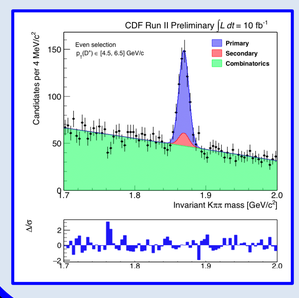
- How many selection configurations?

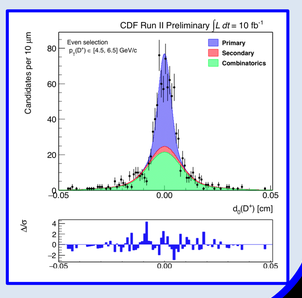
2 Subsamples • **5** $p(D^+)$-bins •**10** •**10**•**10** Variables cuts

10^4 SELECTIONS

FITTING PROCEDURE

To find the D^+ yields, a two-dimensional unbinned likelihood fit to the invariant -$K^-\pi^+\pi^+$-mass distribution and to the impact-parameter distribution Is performed. It is assumed that in the signal region there are three components: prompt D^+, secondary D^+ and combinatorics. For each component, the distribution in mass and impact-parameter are uncorrelated.

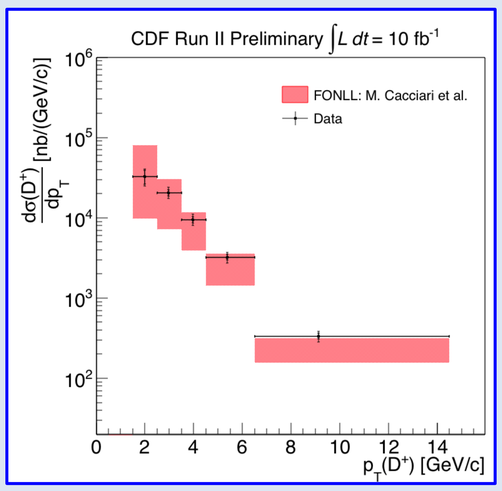




CROSS SECTION

- In order to measure the production cross section, we need to evaluate the trigger and reconstruction efficiency. The trigger efficiency is determined to be (98.8±0.4)%. All offline efficiencies are reproduced accurately by the simulation.

- Putting all the pieces together, the D^+- production cross section as a function of the transverse-momentum at CDF is measured.



REFERENCES

- The CDF coll., D.Acosta, *et all., Phys. Rev. Lett.*, **91:241804** (2003).
- L. Marchese, Master's thesis, University of Naples "Federico II", **FERMILAB-MASTERS-2014-01** (2014).

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