

Updates on D Mesons at SPD

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D Meson Decay Channels of Interest

① $D^0 \rightarrow \pi^+ + K^-$

② $D^+ \rightarrow \pi^+ + \pi^+ + K^-$

D Meson Production at SPD

- We want to estimate expected statistics of D meson cross-section and asymmetry measurements at SPD using Pythia8 event generator + SpdRoot detector Geant4
- We test event generator by comparing with theoretical estimates
- Anton Karpishkoff calculated inclusive D^0/\bar{D}^0 and D^+/D^- cross-sections
- 3 Billion open charm events at $\sqrt{s} = 27$ GeV (gg2ccbar+qqbar2ccbar) in PYHTIA8 using default (NNPDF23 LO) PDF : total process cross-section 1.514×10^{-3} mb for $\hat{p}_{T\min} = 1$
- 1 Million open charm events at $\sqrt{s} = 10$ GeV : process cross section 2.254×10^{-5} mb for $\hat{p}_{T\min} = 1$

Partonic Kinematic Range in D : 10 GeV

For open charm events with two detected D mesons :

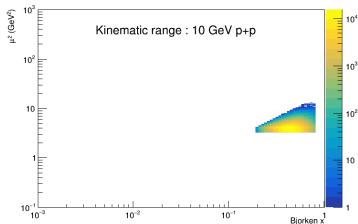


Figure 1: Partonic kinematic coverage for 10 GeV $p + p$ collision at SPD

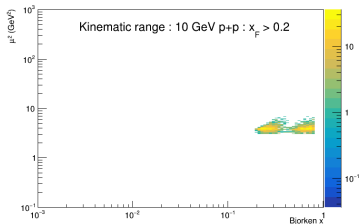


Figure 2: Partonic kinematic coverage for 10 GeV $p + p$ collision at SPD with D mesons above $x_F = 0.2$

energy scale μ^2 is the same as renormalization/factorization scale.
 $\mu^2 = \Sigma m_i^2 + p_{T_i}^2$ for scattered partons i

Partonic Kinematic Range in D : 27 GeV

For open charm events with two detected D mesons :

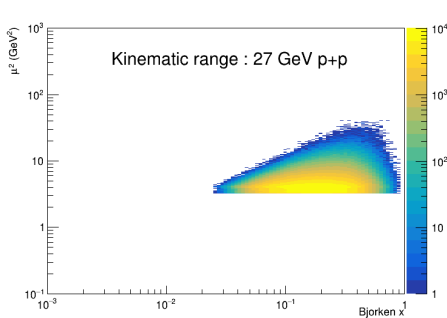


Figure 3: Partonic kinematic coverage for 27 GeV $p + p$ collision at SPD

energy scale μ^2 is the same as renormalization/factorization scale.

$$\mu^2 = \sum m_i^2 + p_{T_i}^2 \text{ for scattered partons } i$$

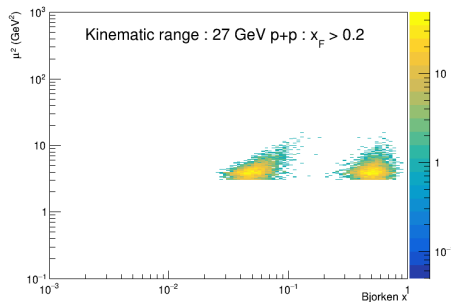


Figure 4: Partonic kinematic coverage for 27 GeV $p + p$ collision at SPD with D mesons above $x_F = 0.2$

D Meson Detection at SPD

- Looking at D meson detection at SPD using decays into pions and kaons
- $D^0 \rightarrow \pi^+ K^-$
- $D^+ \rightarrow \pi^+ \pi^+ K^-$
- SpdRoot simulation : version 4.1.3
- SpdRCKFpartV0Finder for secondary vertex
- Signal : 'gg2ccbar + qqbar2ccbar' : Pythia8
- Background : 'SoftQCD' except 'elastic'

D Mesons : Background Invariant Mass

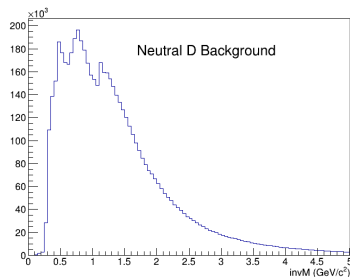


Figure 5: Background for neutral D from all possible combinations of +ve and -ve charged particles

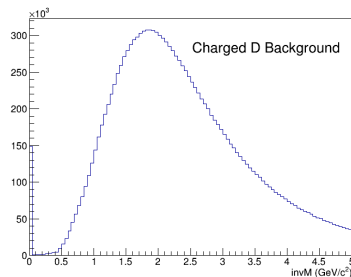


Figure 6: Background for charged D from all possible combinations of +ve and -ve charged particles

Neutral D Mesons : Signal and Background

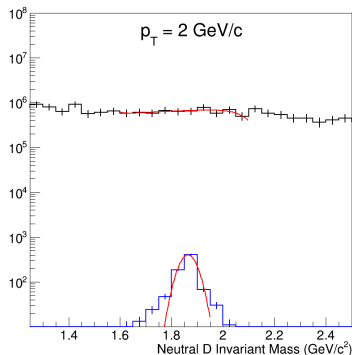


Figure 7: $S/B = 1.37 \times 10^{-4}$

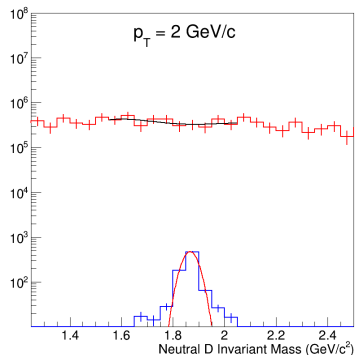


Figure 8: $S/B = 2.41 \times 10^{-4}$

D Meson Cross-Sections at SPD

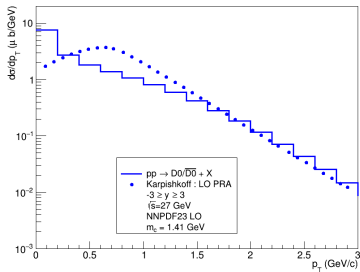


Figure 9: Transverse momentum distributions of inclusive neutral D mesons

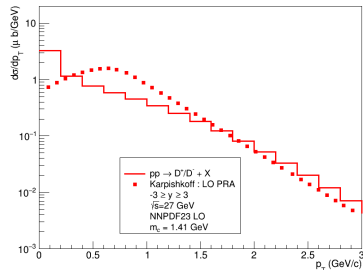


Figure 10: Feynman- x distributions of inclusive charged D mesons

Summary and Outlook

- We look at the kinematic range of detected D mesons that will be probed in measurements at SPD
- We looked at attempts at fit of signal and background in extracting D mesons
- I was not sure if counts from such fits are good enough for error estimates, so I stopped short of error bars of asymmetries
- I may have overestimated background by using all possible charged hadron combinations

Thank You