Robust Low-pt Charm \(D \rightarrow eX\)

1) remove Dalitz e, DCA cut
2) or fit DCA distribution folded with resolution

\[\Rightarrow\] charm yield low \(p_{T,D}\)

\[\Rightarrow\] reduce systematic error of existing charm result

PRL 88:192303, 2002
High-pt Charm

- High-pt heavy-quarks may lose less energy in the plasma
  - Kharzeev et al. predict reduced gluon Bremsstrahlung
- High-pt charm not possible via semi-leptonic decay
  - dominated by beauty decays
Open Charm via Specific Channels

- Observe specific D-mesons,
  - $D^0 \Rightarrow K^- \pi^+ (4\%)$, $D^+ \Rightarrow K^- \pi^+ \pi^+ (9\%)$, …
  - reconstruct invariant mass of $D$,
  - extract signal over background etc.
  - measure pt spectra, yields of $D^0$, $D^+$, $D^-$
    » high-pt helps in multiple-scattering and acceptance

- Problems with simulation in LOI, $D^+ \Rightarrow K^- \pi^+ \pi^+$
  - $B=0$, straight-line DCA
  - no Phenix acceptance, perfect PID…..

- Summer ’03 (Hua Pei) restart
  - not as much progress as we would like…..
Strategy Options

1) Full B-field in PISA to get $\pi$, K, acceptance, decays
   - Kalman tracker using Si hits $\Rightarrow$ DCA
     » EDA summer ’04

2) B=0
   - Fit Si hits with a line, calculate DCA to collision
   - use fast filter to see if $\pi$, K in PHENIX acceptance

3) Full B-field in PISA to get $\pi$, K, acceptance, decays
   - Fit Si hits with a circle
     » assumes ~ uniform B-field in vtx region
   - calculate DCA of circular track to collision (c.f. above)
Work Plan (done = ✓)

✓ <ncoll> * D from pythia, π, K from min.bias Au+Au EXODUS
✓ pt > 1 GeV/c on π, K (primary and daughters)
   – selects > 2 GeV/c D’s
✓ Kaon into acceptance of TOF or aerogel
   – goal of PID cut is to reduce S/B
   § S/B vs DCA cut
   § Use Tony’s #events collected in a Au+Au run
      – significance of signal over fluctuating background

\[
\text{significance} = \frac{S}{\sqrt{(\sigma_S)^2 + (\sigma_B)^2}} = \frac{S}{\sqrt{B}}
\]

– increases with sqrt(nevents)
– plot significance vs DCA cut
backups
**aerogel**

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<th>0.5</th>
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<th>3.5</th>
<th>4.5</th>
<th>5.5</th>
<th>6.5</th>
<th>7.5</th>
<th>~10.5 (Momentum Limit)</th>
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</table>

**PHENIX Detector**

- Particle tracks
- z-direction
- r-direction
- Beam line
- West Beam View East
- ACC
- RICH
- BB
- MVD
- PC3
- PC2
- PbSc
- PbGl
Bz values in field map vary < 1%
(histogram of points in map)

-12 < z < 12
and
4 < r < 10 cm
A review of fast circle and helix fitting
R. Fruhwirth

http://acat02.sinp.msu.ru/presentations/fruehwirth/talk.pdf
High-pt: Flavor Dependence Energy-loss

- @ higher pt, e and $\mu$ decay channels dominated by beauty
  - hadronic decay for high-pt charm spectra
    ▶ multiple-scattering, small acceptance less problematic

\[ D^+ \rightarrow K^- \pi^+ \pi^+ \text{ (BR 9\%)} \]

\[ p+p \text{ 30k/year} \]

\[ \text{Au+Au 10K/year} \]

Au+Au 4 blue-book luminosity, 50 full days/year, yield Au+Au = AA*(yield p+p)
electrons from non-photonic sources in min. bias Au+Au collisions

PHENIX preliminary

\[ \left( \frac{e^+ + e^-}{2} \right) @ \sqrt{s_{NN}} = 200 \text{ GeV} \]

\[ \left( \frac{e^+ + e^-}{2} \right) @ \sqrt{s_{NN}} = 130 \text{ GeV} \]

(PHENIX: PRL 88(2002)192303)

\[ \text{sys. error @ } \sqrt{s_{NN}} = 200 \text{ GeV} \]

PYTHIA: pp @ \sqrt{s} = 130/200 \text{ GeV}

\[ \left( \frac{e^+ + e^-}{2} \right) \text{ from charm with binary scaling from pp to Au+Au} \]
Electron pt Spectra from D

electrons from D pt=4.0-4.4 GeV
electrons from D pt=2.4-2.8 GeV
electrons from D pt=0.8-1.2 GeV
Signal/background of invariant mass peak
(2002 plots)

\[
\frac{S}{B} = \frac{(D^0 \times \text{Branching Ratio} \times \text{Survive Pt cut})}{(K^- \times \text{Survive Pt cut})(\pi^+ \times \text{Survive Pt cut})} \times \text{rejection}
\]

Kapton beam-pipe
Be beam-pipe

\[\frac{S}{B} \sim 0.1\% \text{ for dca cut } = 150\mu\text{m}\]

Assumed per event
1 \(D^0\), 150 \(K^-\), 1000 \(\pi^+\)
DCA of K/Pion from D0 comparing with DCA of primary K/Pion (no pt cut)