D Meson Reconstruction in Au+Au 200 GeV collisions

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# Outline

- Previous issues

  - $D^0/\overline{D^0}$ ratios

  - Misidentification of daughters

- dE/dx cuts

- D^0 and $\overline{D^0}$ results

- D^+ through micro vertexing

- D^+ results

- Plans

Previously

- IPVzl < 10 cm → 20M minbias events

- TPC hits ≥ 15

- SVT hits = 3.0

- Dca Daughters ≤ 200 μm

- 50 ≤ D0 decay length ≤ 300 μm

- D0dcaPV ≤ 300 μm

- lnSigmaPionl < 2.0

- if p_K < 1.0 lnSigmaKaonl < 1.0

- $p_{K,\pi}$ > 150 MeV/c

?

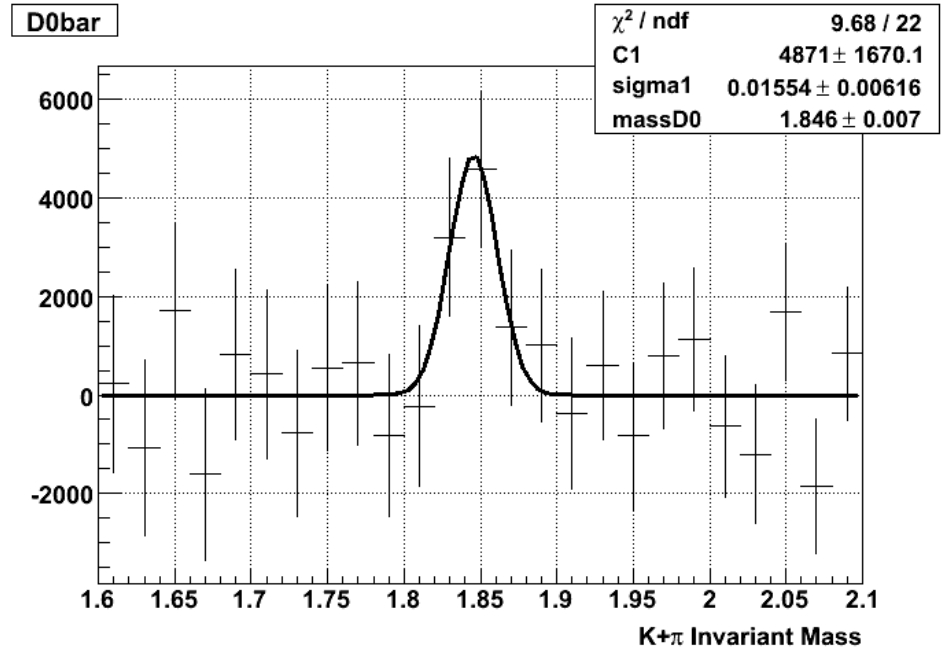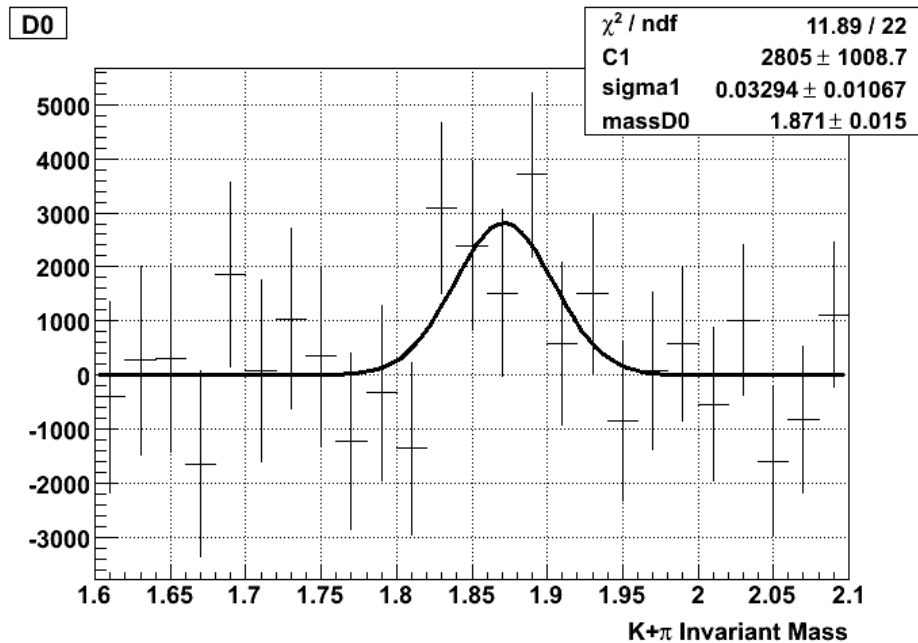- misidentifying daughters?

- need to have a very pure kaon
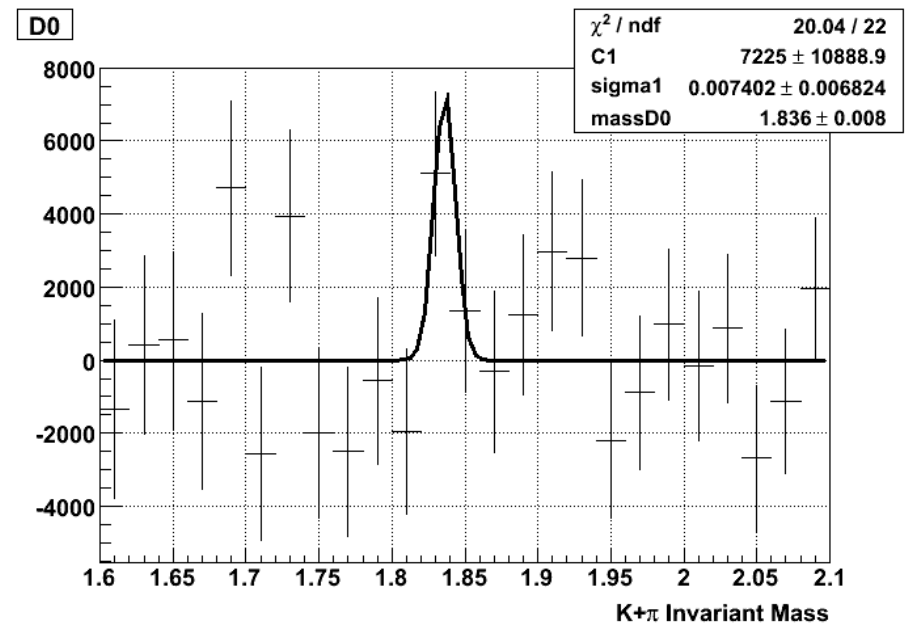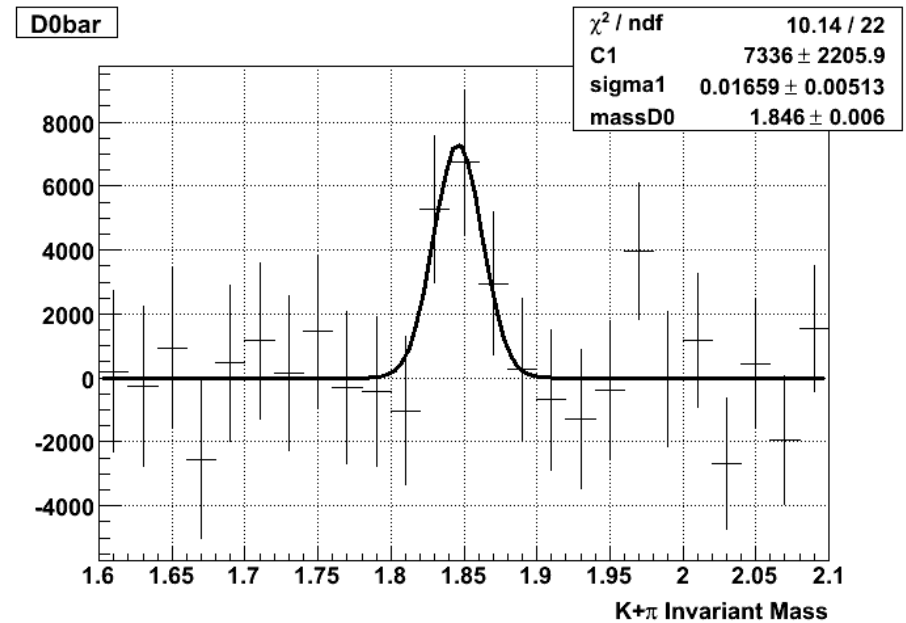
Previously

Positive or Negative track with 3 SVT hits
50 ≤ D0 decay length ≤ 300 μm
-1.0 < nSigmaPion < 2.0
-1.1 < nSigmaKaon < 1.9

A quick fix using Stephen's nSigma calibrations from V0s. However, the values chosen were for low multiplicity. This may have led to a misidentification of the daughters
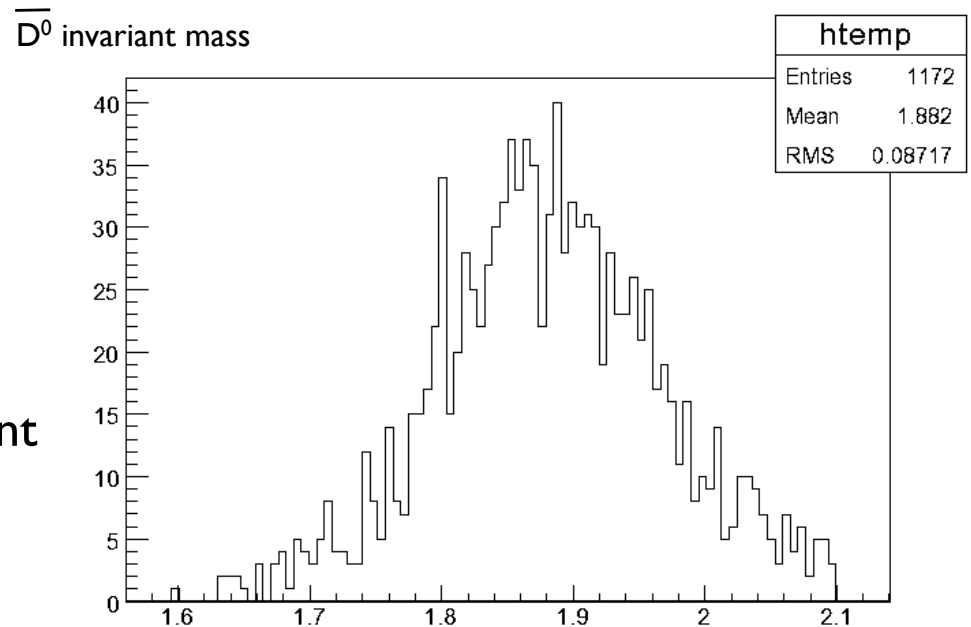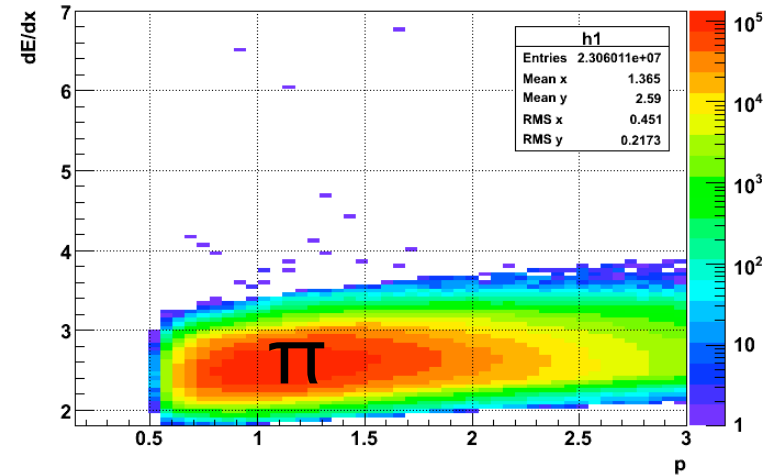

Both have ~ 10,000 entries
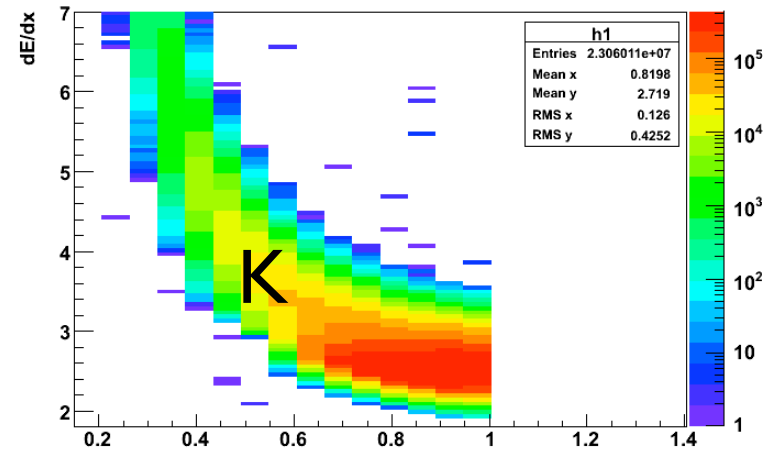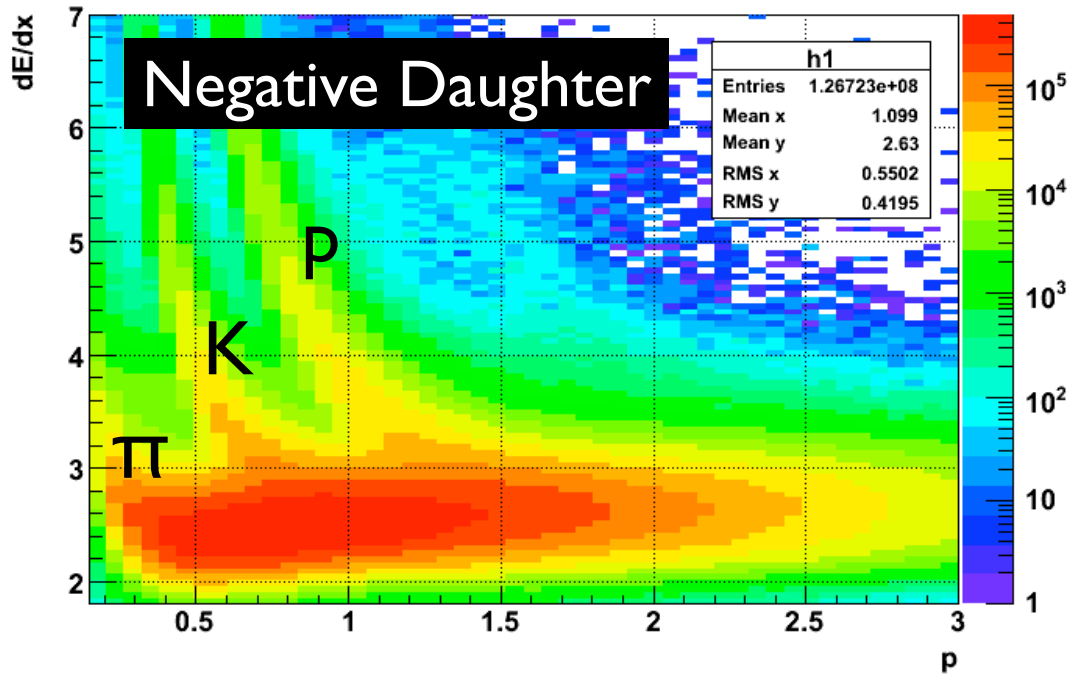
Misidentification

Ran D^0bar finder on PYTHIA D^0 sample that contains 1 D^0/evt

The K and π from the D^0 decay can reconstruct to a D^0, although the invariant mass distribution is is widened.
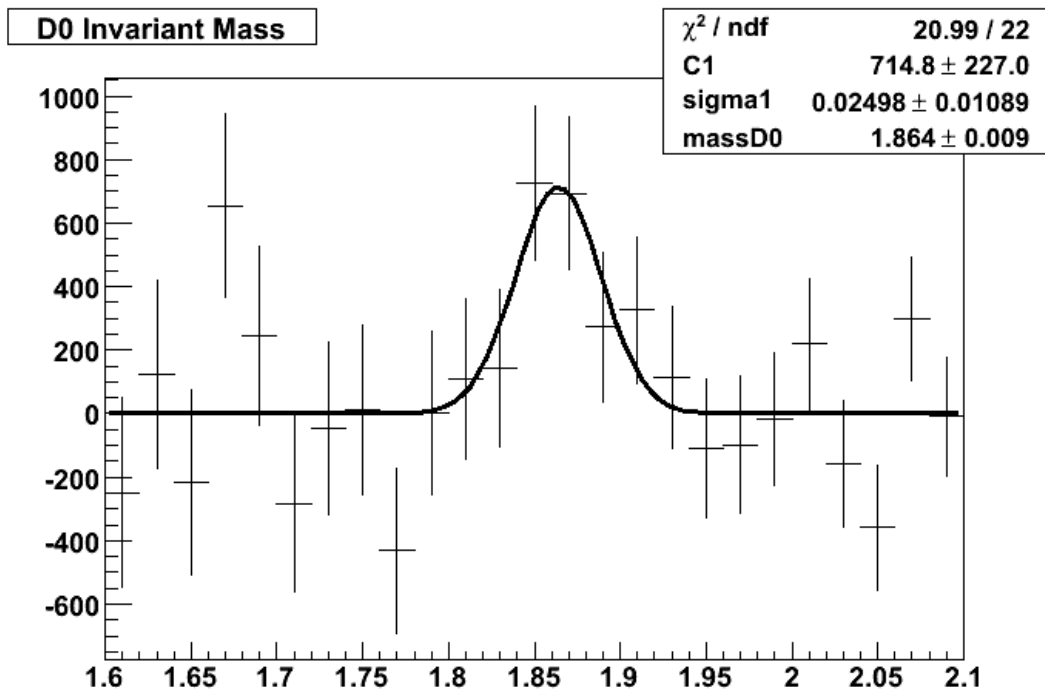
$\overline{D^0}$ invariant mass

htemp	
Entries	1172
Mean	1.882
RMS	0.08717

- We need reliable particle identificaiton
- Clean Kaon sample

dE/dx

Negative Daughter

h1	
Entries	1.26723e+08
Mean x	1.099
Mean y	2.63
RMS x	0.5502
RMS y	0.4195

h1	
Entries	2.306011e+07
Mean x	0.8198
Mean y	2.719
RMS x	0.126
RMS y	0.4252

h1	
Entries	2.306011e+07
Mean x	1.365
Mean y	2.59
RMS x	0.451
RMS y	0.2173

- require $p_K < 1.0$ GeV/c

- positive daughter: require $|n\sigma_\pi| < 2.0$
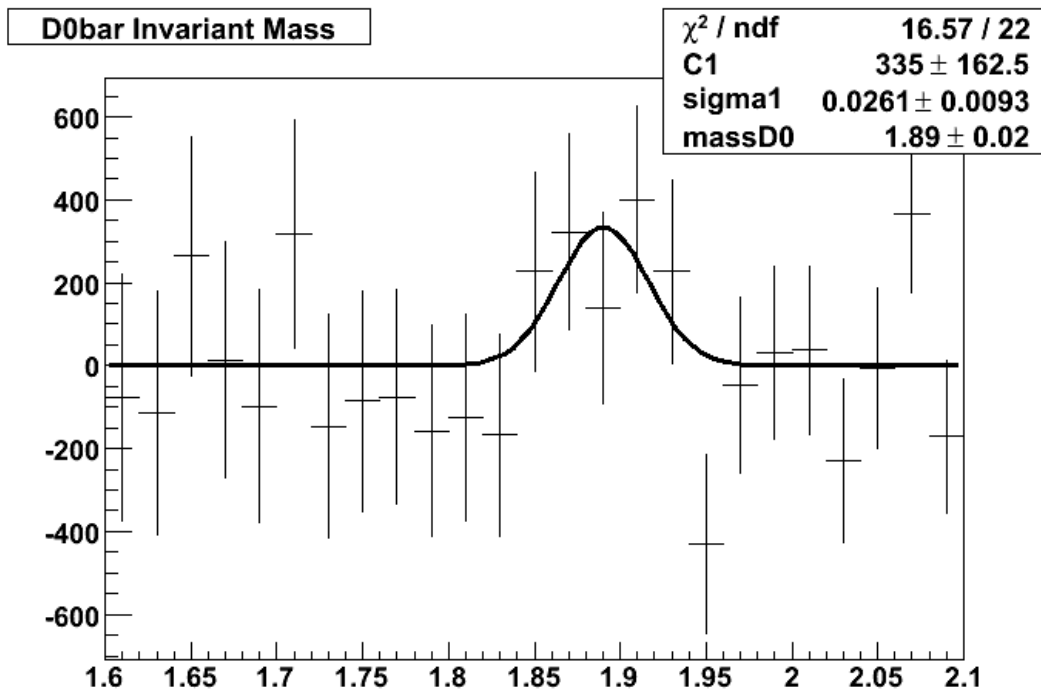
- negative track: $|n\sigma_K| < 2.0$, if $p_K < 0.6$ require $|n\sigma_\pi| > 2.0$

D^0 Invariant Mass

D0 Invariant Mass	
χ^2 / ndf	20.99 / 22
C1	714.8 ± 227.0
sigma1	0.02498 ± 0.01089
massD0	1.864 ± 0.009

s ~ 2240 ± 1200

- 4.4 M minimum bias Au+Au events in |pvZ| < 10 cm

- SVT hits = 3

- TPV > 15

- D0dcaPV < 300 µm

- D0 decay length < 350 µm

- Dca Daughters < 200 µm

- dE/dx cuts (previous slide)
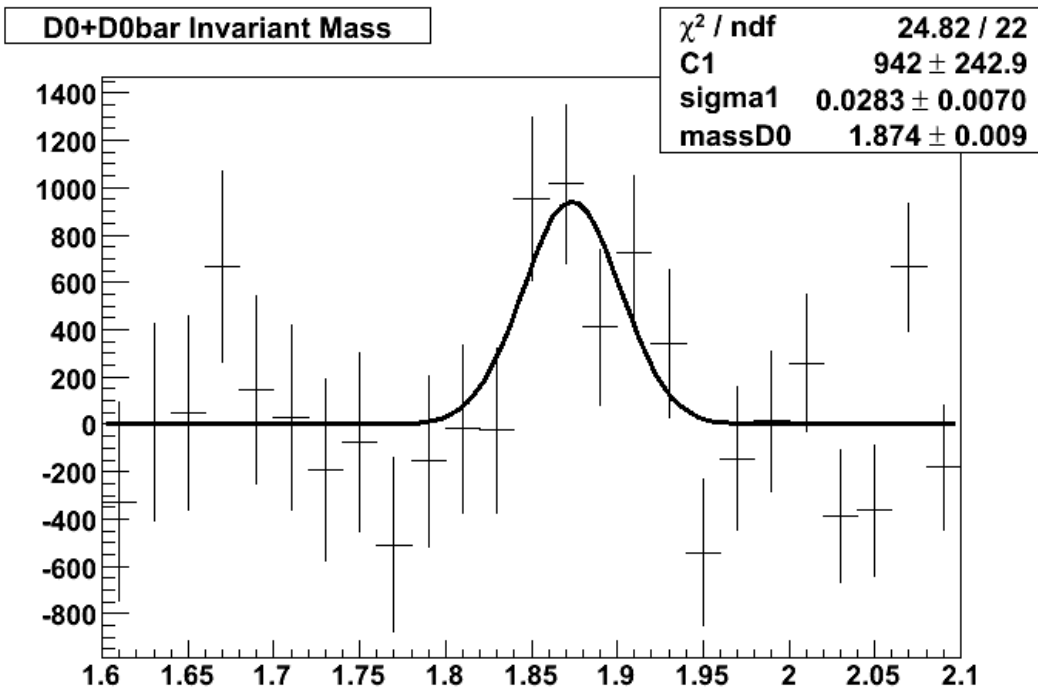
$\overline{\mathrm{D}^0}$ Invariant Mass

D0bar Invariant Mass

χ^2 / ndf	16.57 / 22
C1	335 ± 162.5
sigma1	0.0261 ± 0.0093
massD0	1.89 ± 0.02

- 4.4 M minimum bias Au+Au events in $|\mathrm{pvZ}| < 10$ cm

- SVT hits = 3

- TPV > 15

- D0dcaPV < 300 μm

- D0 decay length < 350 μm

- Dca Daughters < 200 μm

- dE/dx cuts (previous slide)

s ~ 1100 ± 660

distribution is wider and shifted
- add Stephen's nSigma calibrations

$D^0 + \overline{D^0}$ Invariant Mass

D0+D0bar Invariant Mass

χ^2 / ndf	24.82 / 22
C1	942 ± 242.9
sigma1	0.0283 ± 0.0070
massD0	1.874 ± 0.009

- 4.4 M minimum bias Au+Au events in $|pvZ| < 10$ cm

- SVT hits = 3

- TPV > 15

- D0dcaPV < 300 µm

- D0 decay length < 350 µm

- Dca Daughters < 200 µm

- dE/dx cuts (previous slide)

s ~ 3340 ± 1200

Same sign background

- Like sign background does not have quite the same shape as opposite sign

- Number of entries does not make sense
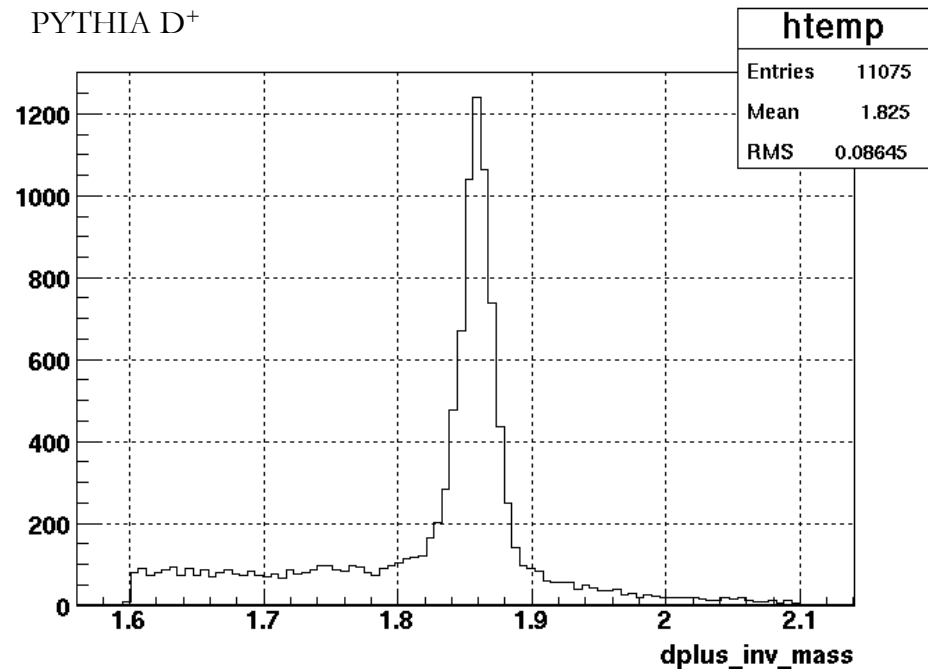
- Geometrical cuts could be the cause
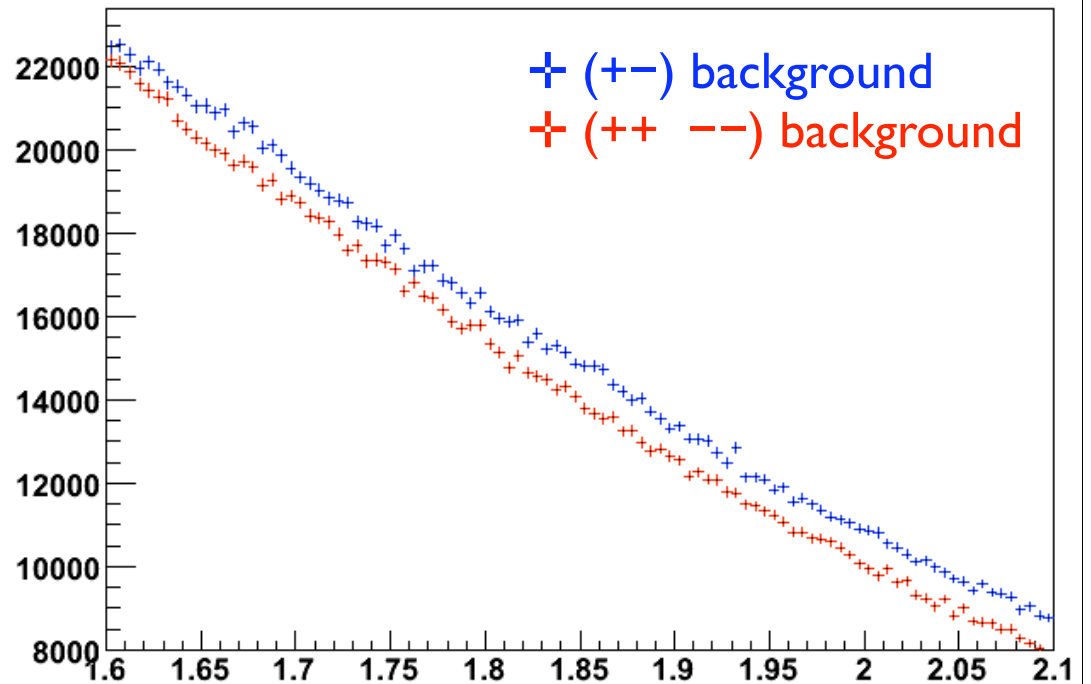
D⁰ pt distribution
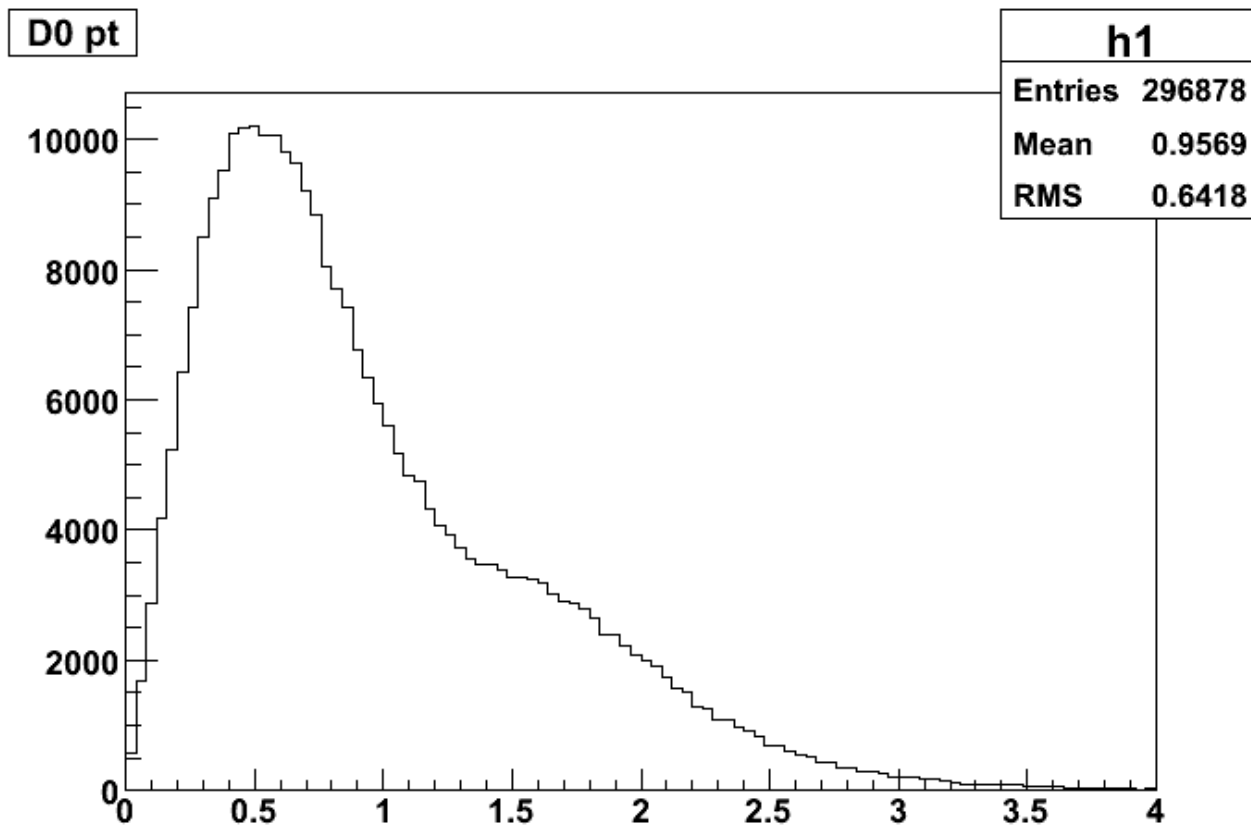
D$^+$ using micro vertexing

PYTHIA D$^+$

- D$^+$ ➔ K$^-$π$^+$π$^+$
- B.R. 9.5%
- cτ = 318 μm

- Use D0 finder code to reconstruct Kπ (pair #1)
- Loop again over Kπ (pair #2)
- Require pair #1 and pair #2 to have the same K
- Require pion from pair #1 is not the pion in the pair #2

Event and D^+ cuts

- $|PVz| < 10$ cm
- Trigger Id = 200013, 200001,or 200003
  Events analyzed $\rightarrow$ 6.9M minimum bias events (FF)

- TPC hits $\geq$ 15
- SVT hits = 3 for all three daughters
- Dca Daughters $\leq$ 200 μm
- D0 decay length $\leq$ 800 μm
- D0dcaPV $\leq$ 400 μm
- $|nSigma\pi_1| < 2.0, |nSigma\pi_2| < 2.0, |nSigmaK| < 2.0$
- $p_K > p_\pi$
- $p_{K,\pi} > 150$ MeV/c

D⁺ Invariant Mass
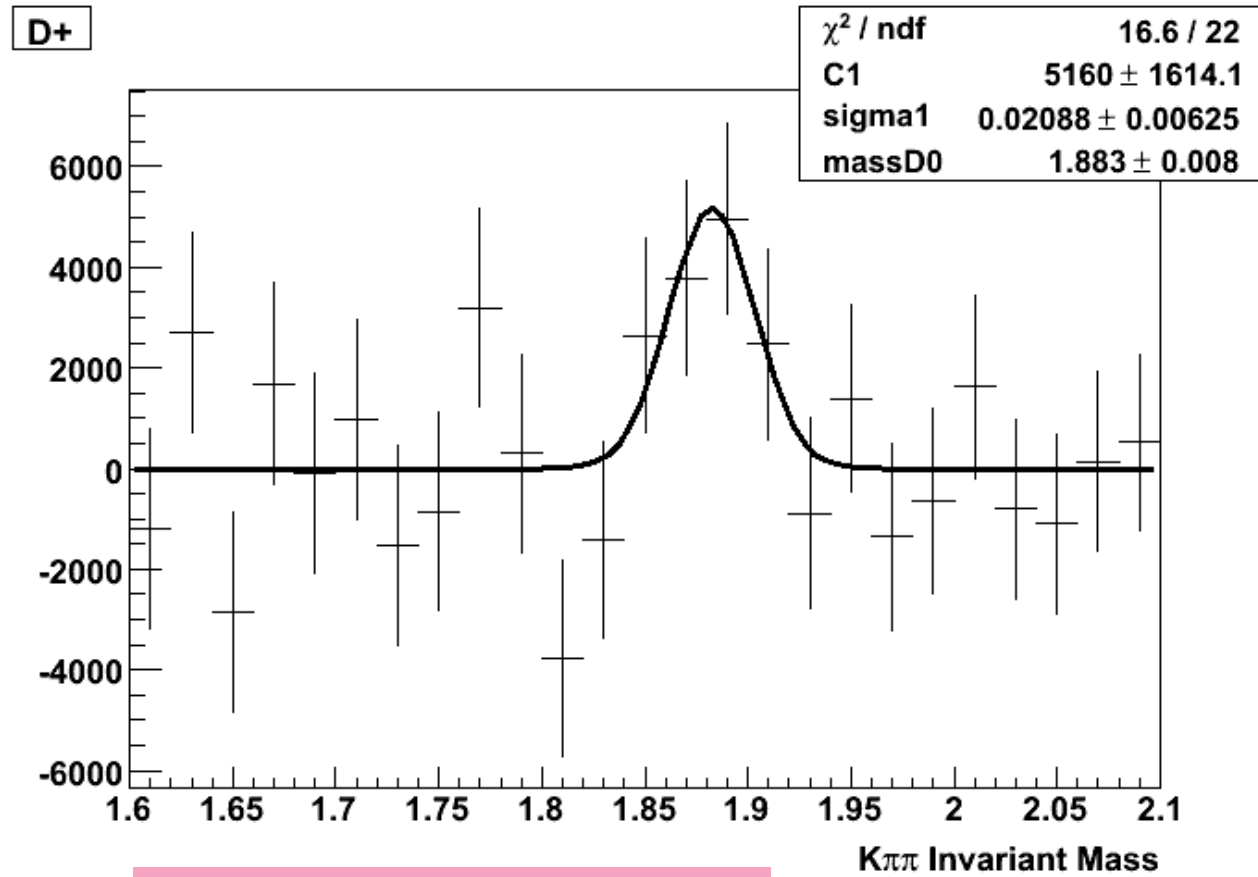
s ~ 13500 ± 5800
s/b ~ 1/6000
σ ~ 2.9

Plans

D^0

Understand the D^0/D^0bar problem
- Add Stephen's nSigma calibrations

Stephen Baumgart has worked on this using V0s.
- understand D0 p_T spectrum

D^+

Nathan Joseph, an REU student, is working with me on this.
- Analyze additional events
- D^- code