

D Meson Detection at SPD

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- SpdRoot simulation
- signal only : 'gg2ccbar + qqbar2ccbar' : Pythia8
- background only : SoftQCD processes EXCEPT elastic : Pythia8
- Mixed : SoftQCD (Pythia8) + isotropic D0
- SpdRoot version 4.1.3, default inner tracker is DSSD+MAPS but used custom option for 4 layers MAPS only

Secopndary Vertex Reconstruction

- Vladimir Andreev's sample code for K0decay analysis was VERY useful
- SpdRCVerticesFinder for primary vertex ONLY
- SpdRCKFpartV0Finder for secondary vertex (parameters below)
- min its hits : 2, track sel : hard cut, prim vtx : reco
- min chi2 of daughter trk to PV : 0.1
- max chi2 between daughter trks : 20
- invariant mass range $1. \leq m_{inv} \leq 3. \text{ GeV}/c^2$

Differentiating Criteria

- Using MC info, tracks are traced back to mother particles
- For D_0 : if both daughter tracks had same D_0 as mother : **signal**
- Otherwise **background**
- decay length, $c\tau$, daughter χ^2 to prim vtx, invariant track χ^2 to prim vtx and sec vtx are plotted for **signal** and **background** separately to find distinguishing criteria
- The goal is to avoid peaks of background while retaining decent amount of signal
- Most often variables follow similar patterns for signal and background making it difficult

Comparing variables : 1

Beyond $\sim 0.2\text{cm}$, background falls off faster than signal

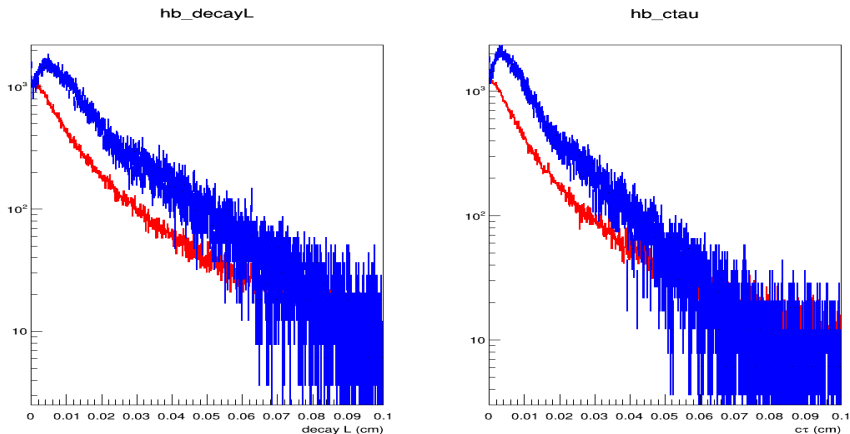


Figure 1: Decay length (left) and $c\tau$ (right) : **signal**, **background**

Comparing variables : 2

L/dL a very useful distinguishing criterion. Above ~ 5 , background falls off by a factor of 10 faster. Daughter χ^2_{PV} , above ~ 1 . to avoid bkg peak

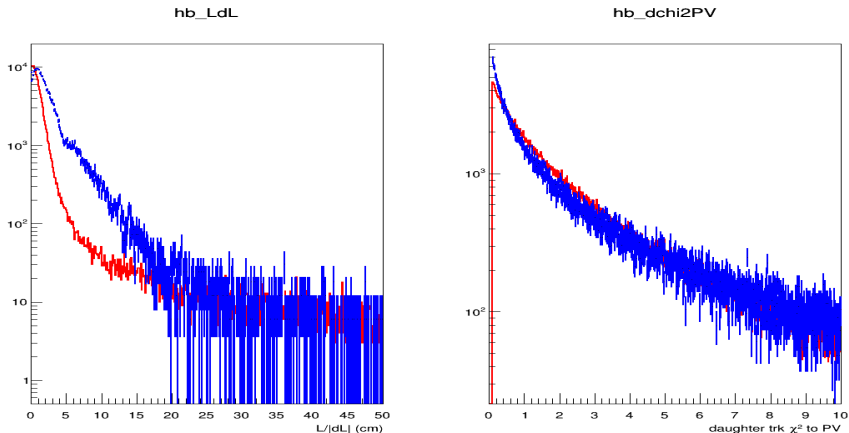


Figure 2: Decay length divided by error (left) and daughter track chi2 to primary vertex (right) : **signal**, **background**

Comparing variables : 3

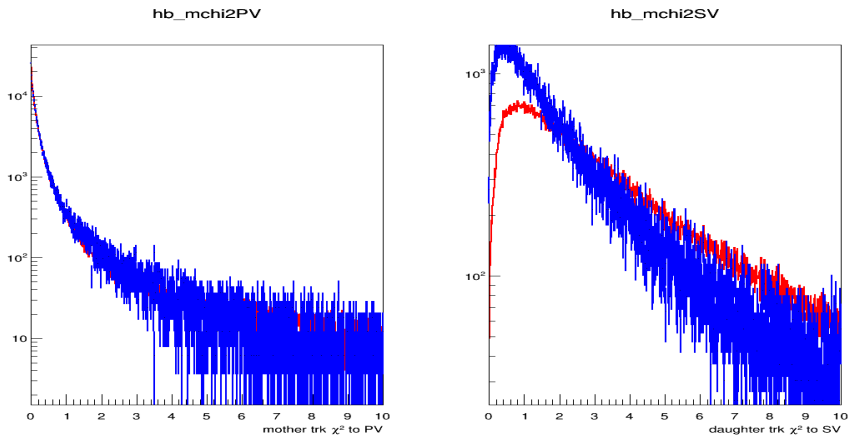


Figure 3: Invariant/mother track χ^2 to primary vertex (left) and invariant track χ^2 to secondary vertex (right) : **signal**, **background**

Comparing variables : 4

Background distributions is wider as expected, allowing a maximum distance cut

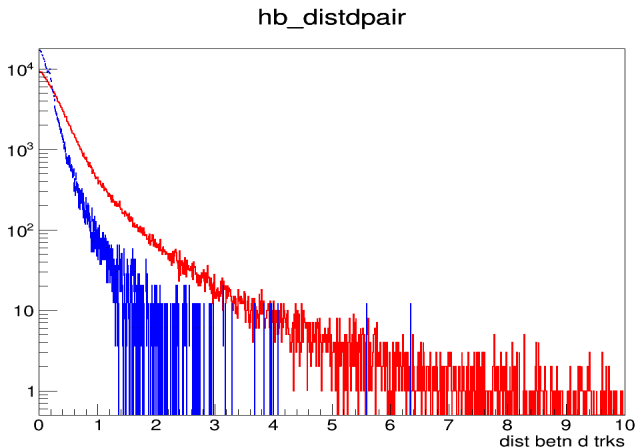


Figure 4: DOCA between extrapolated daughter tracks : **signal**, **background**

From left to right, top to bottom :

- Before cuts
- $L/dL > 3$.
- $L > 0.02$
- daughter trk χ^2 to PV > 1 .
- mother χ^2 PV > 0.5 , mother χ^2 to SV > 3.0
- $L/dL > 3$., $L > 0.01$, $d\text{trk}\chi^2\text{PV} > 0.9$, $m\chi^2\text{PV} > 0.1$, $m\chi^2\text{SV} > 2$.

Signal and Background

From **same number** of D0 and MB events :

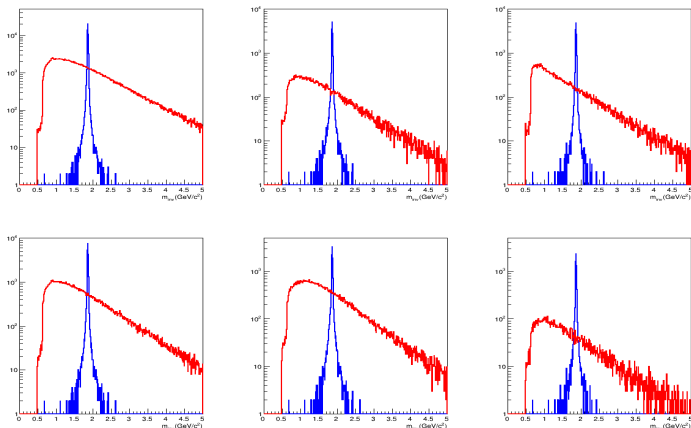


Figure 5: DOCA between extrapolated daughter tracks : **signal**, **background**

- Open charm production process cross-section : 2.593×10^{-3} mb
- MinBias non-elastic cross-section : 32.835 mb
- $D^0 \rightarrow K^- \pi^+$ BR : 3.89%
- $D^+ \rightarrow \pi^+ K^- \pi^+$ BR : 9.22%
- All info combined gives ratio of background to signal events in a given data sample $\sim 10^5$
- Playing with the cut sets SO FAR : S/B $\sim 10^{-3}$

- There are scopes of improvement i.e. distance betn pair of daughter tracks not used yet (some confusion remains)
- For two particle decays ($D0, \bar{D}0$), Armenteros Podalansky variable can be used, not for D^+, D^- of course
- ANY improvement in event selection from by online filter would be helpful
- Charged D meson show similar trends, but need to look a bit more carefully before I present
- However, SpdRCKFpartV0Finder required pid for reconstruction, so performace at high pT may be affected by PID performance of detector
- With new SpdRoot build will test for DSSD only inner tracker

Thank You