Status of Jet Probability for CDF Run II

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- **Short review on what is in the old version of Run II Jet Probability**
- **Introduce the update version**
- **Plans**

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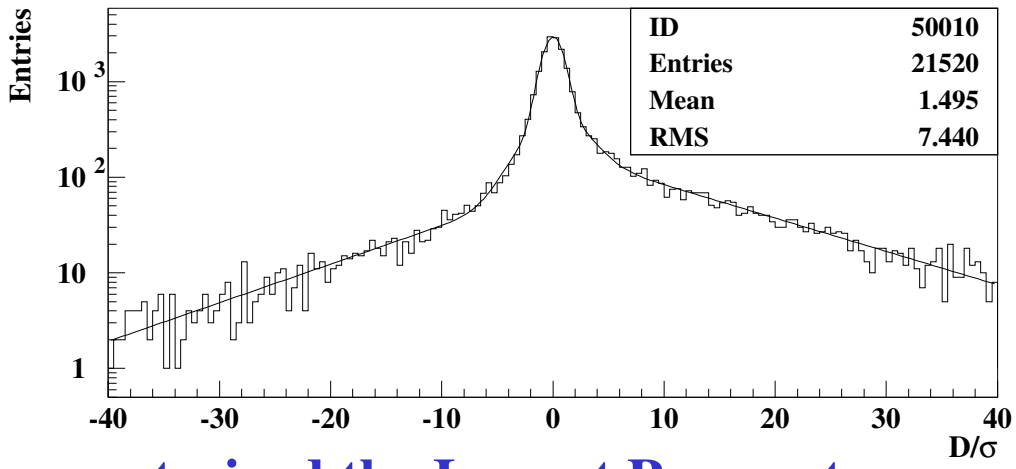
Old version of Jet Probability

- **Presented the old (1st) version a few months ago**
- **Development was based on the Trackings and Jet clustering codes in version 3.1.0**
- **Jets reconstructed using JetClu (cone size=0.4). Only keep Jets with Et_Jet>7 GeV.**
- **Tracks are associated to Jet if they are within $\Delta R<0.4$ around the Jet axis. Only keep tracks with Pt>1 GeV, and abs(Impact Parameter)<0.1 cm**
- **Impact Parameter *(D)* is two dimensional ($r-\phi$)**
- **Tracks are SVX only or SVX+COT (OutSideIn) (Mistake in my previous report. In 3.1.0, for SiPatternRecModule, OutSideIn Tracking is TRUE by default.)**
- **Parameterize the Impact Parameter Significance distribution *(DS = D/D_err)***



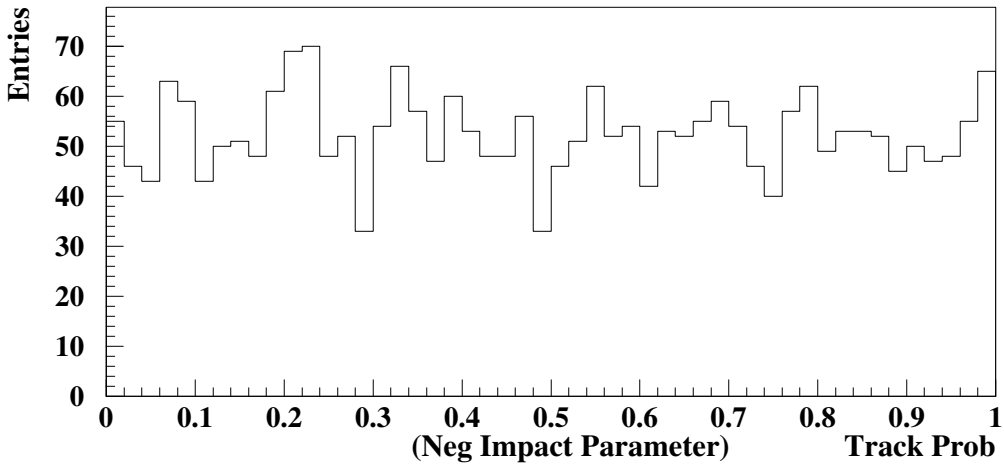
•Parameterized the Impact Parameter Significance distribution for different track types :

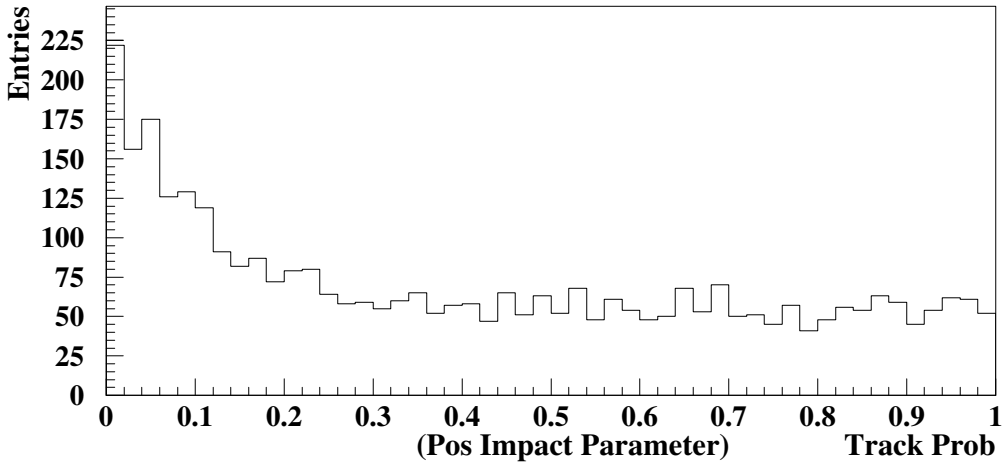
4-5 r-ϕ hits	>= 6 r-ϕ hits
0 Share hit	0 Share hit
1	1
2	2
>=3	>=3

•Use negative side of distribution to represent the *DS* resolution, to extract Track Prob, Jet Prob.

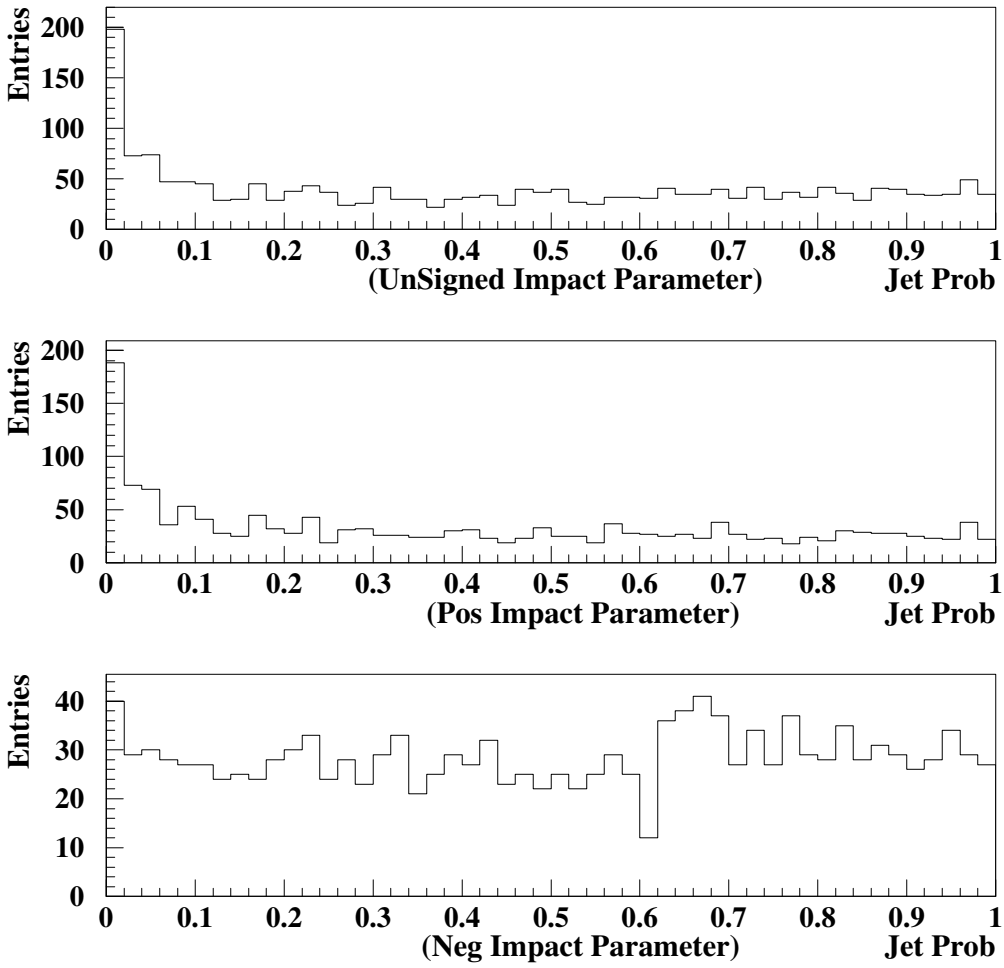
•t t-bar MC sample was used to determine the *DS* resolution

$p\bar{p} \rightarrow t\bar{t}$ (Track Probability)

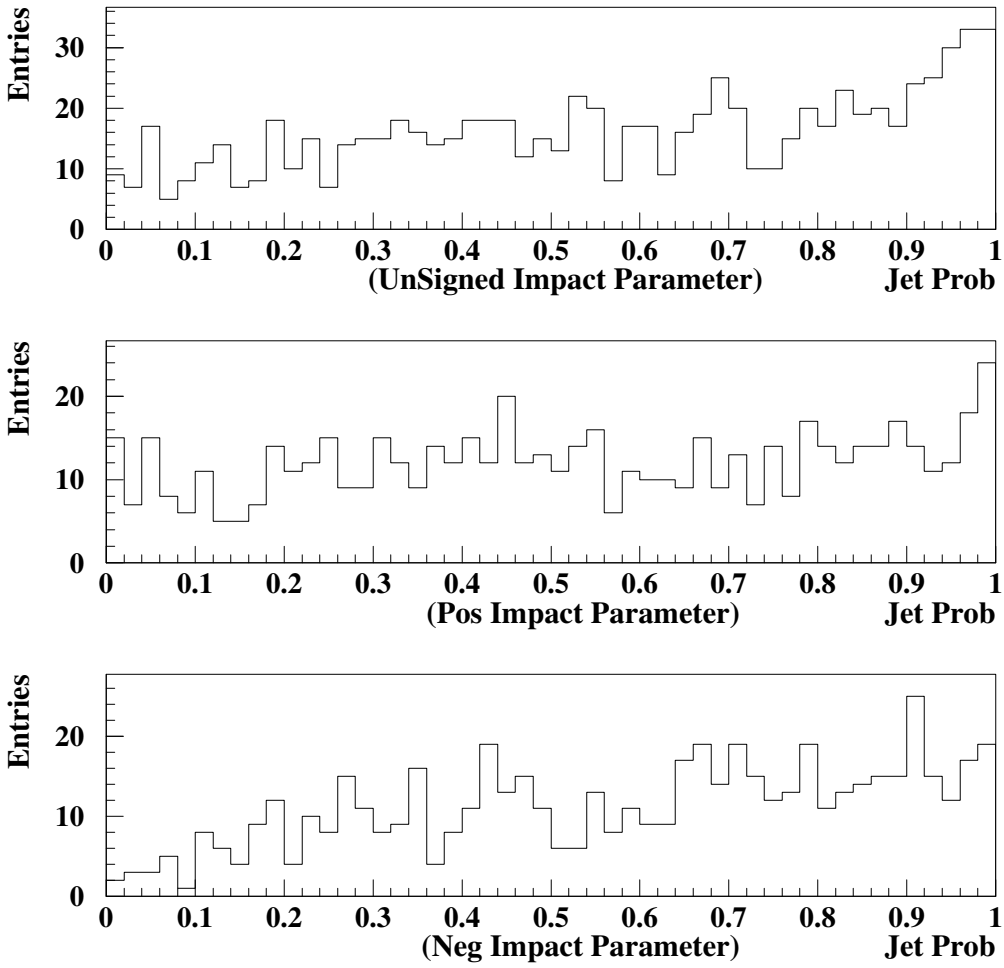




$p\bar{p} \rightarrow t\bar{t}$ (Jet Probability)



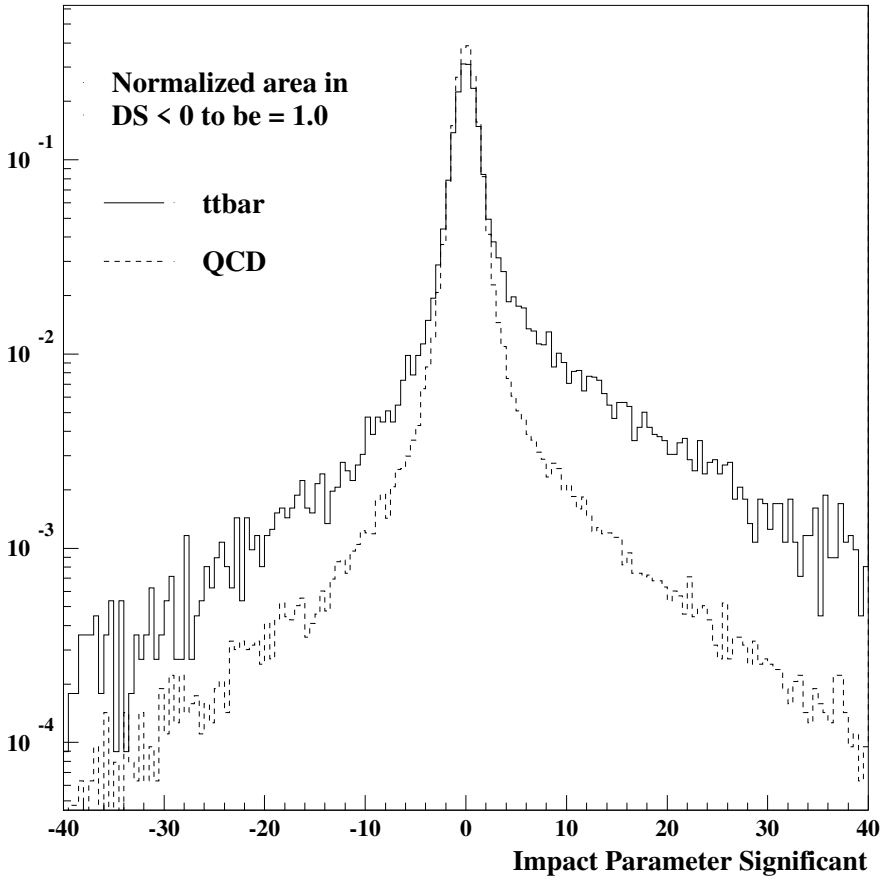
$p\bar{p} \rightarrow q\bar{q}$ (QCD) (Jet Probability)



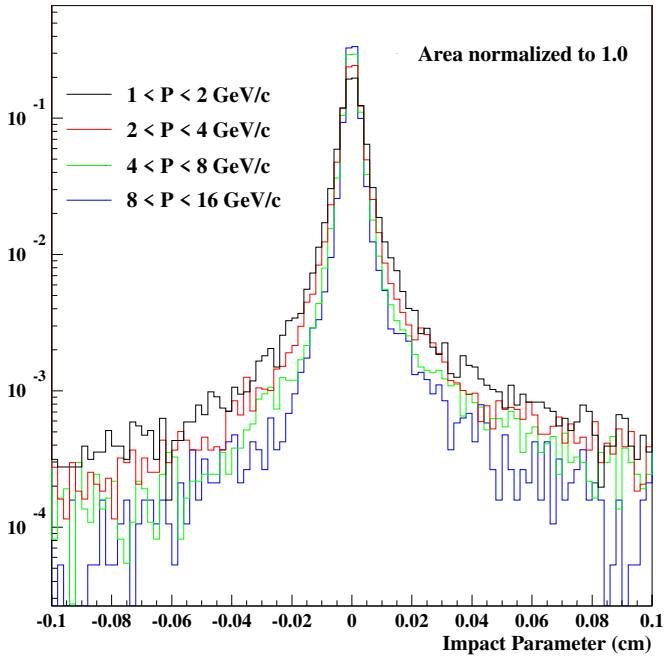
- Jet probability is not quite flat for primary jets from QCD sample. May need to parameterize the SVX resolution using the QCD sample instead.

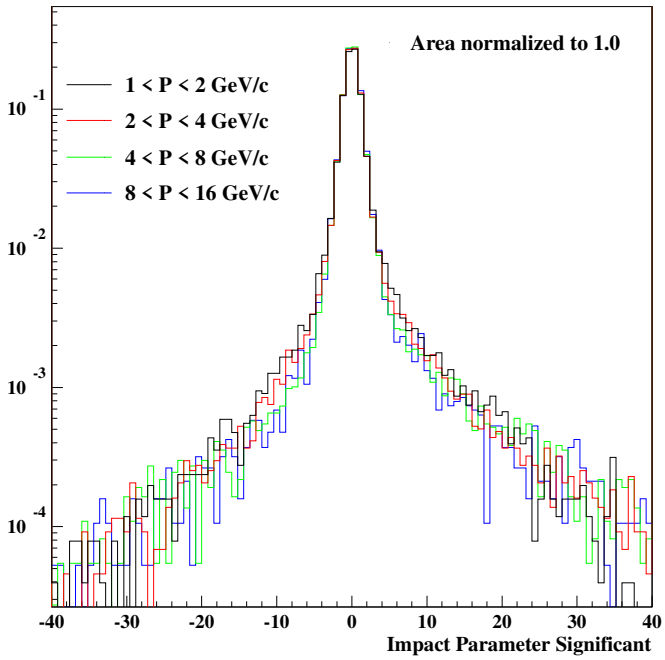
Update version of Jet Probability

- Re-parameterize the *DS*
- Development was based on version 3.4.0 for Tracking and Jet clustering
- Impact Parameter is still 2-D
- Use QCD MC sample (instead t t-bar)
- Compare *DS* distributions between QCD and t t-bar



•Study whether to parameterize *DS* as function of p, η, # r-ϕ hits, # shared r-ϕ hits ?





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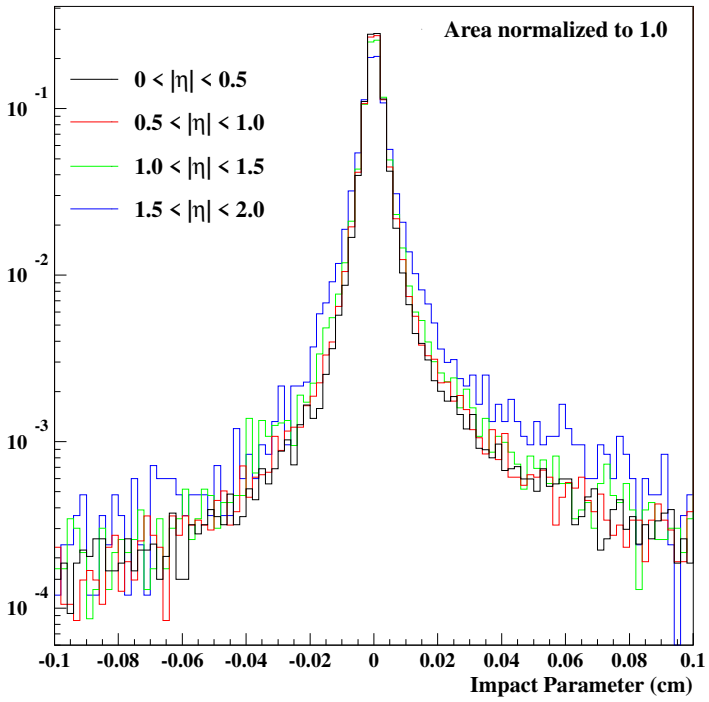
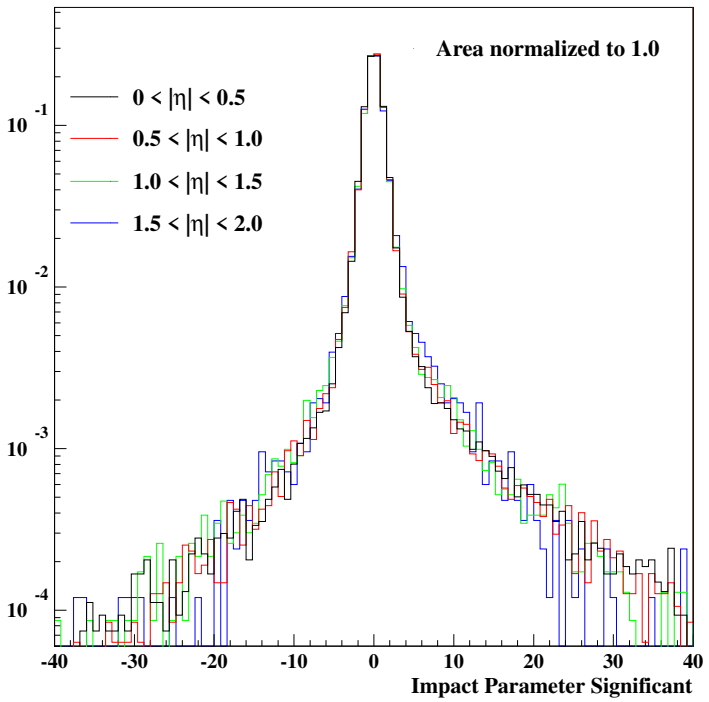
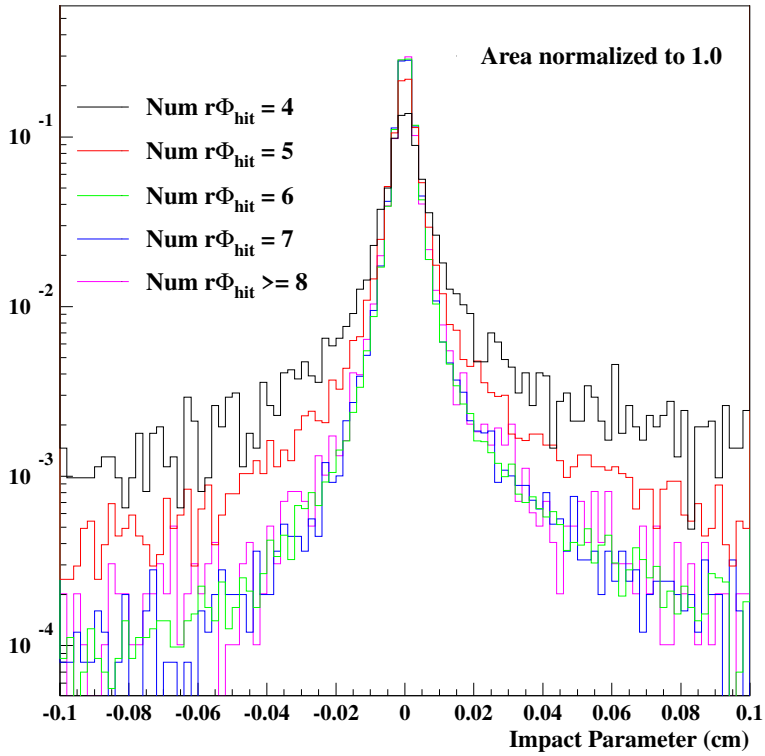
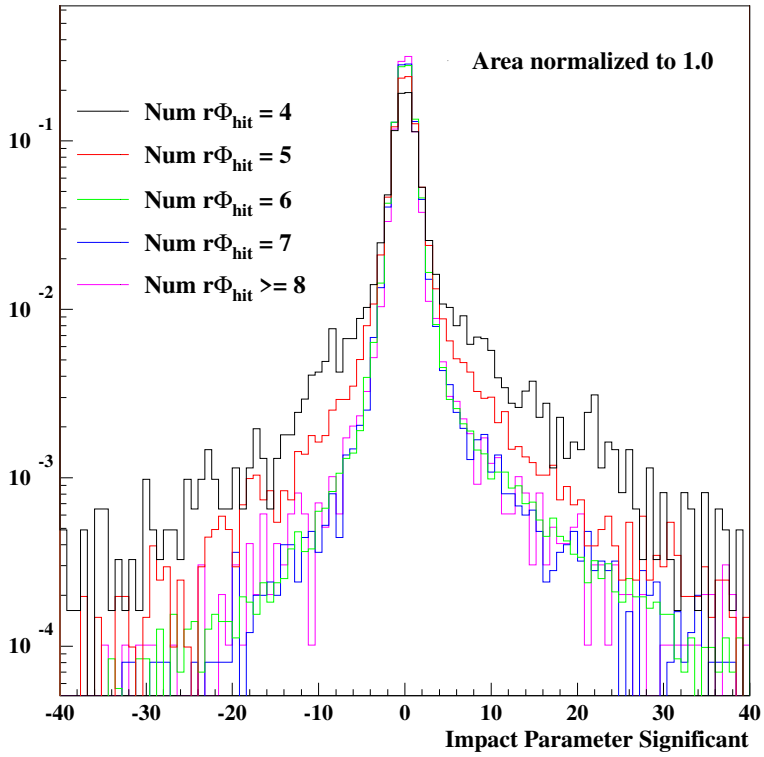

Area normalized to 1.0
0 < |η| < 0.5
0.5 < |η| < 1.0
1.0 < |η| < 1.5
1.5 < |η| < 2.0
10 -1
10 -2
10 -3
10 -4
-0.1 -0.08 -0.06 -0.04 -0.02 0 0.02 0.04 0.06 0.08 0.1
Impact Parameter (cm)


Area normalized to 1.0
0 < |η| < 0.5
0.5 < |η| < 1.0
1.0 < |η| < 1.5
1.5 < |η| < 2.0
10 -1
10 -2
10 -3
10 -4
-40 -30 -20 -10 0 10 20 30 40
Impact Parameter Significant


Area normalized to 1.0
Num rΦhit = 4
Num rΦhit = 5
Num rΦhit = 6
Num rΦhit = 7
Num rΦhit >= 8
10 -1
10 -2
10 -3
10 -4
-0.1 -0.08 -0.06 -0.04 -0.02 0 0.02 0.04 0.06 0.08 0.1
Impact Parameter (cm)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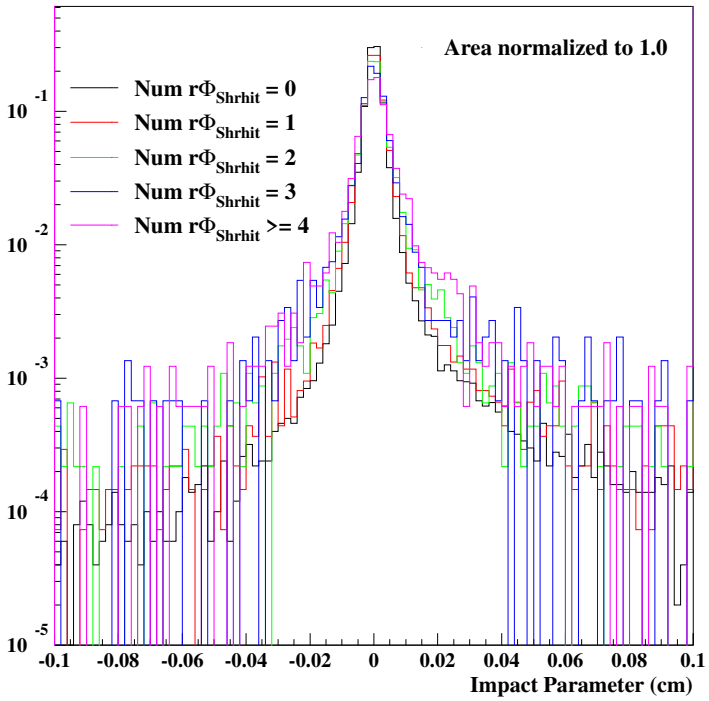
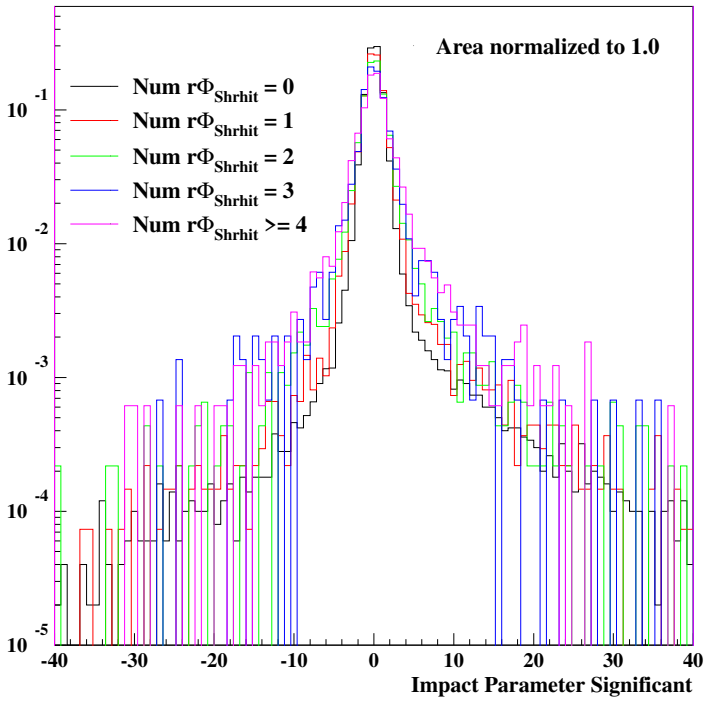
Num rΦhit = 6
Num rΦhit = 7
Num rΦhit >= 8
10 -1
10 -2
10 -3
10 -4
-40 -30 -20 -10 0 10 20 30 40
Impact Parameter Significant





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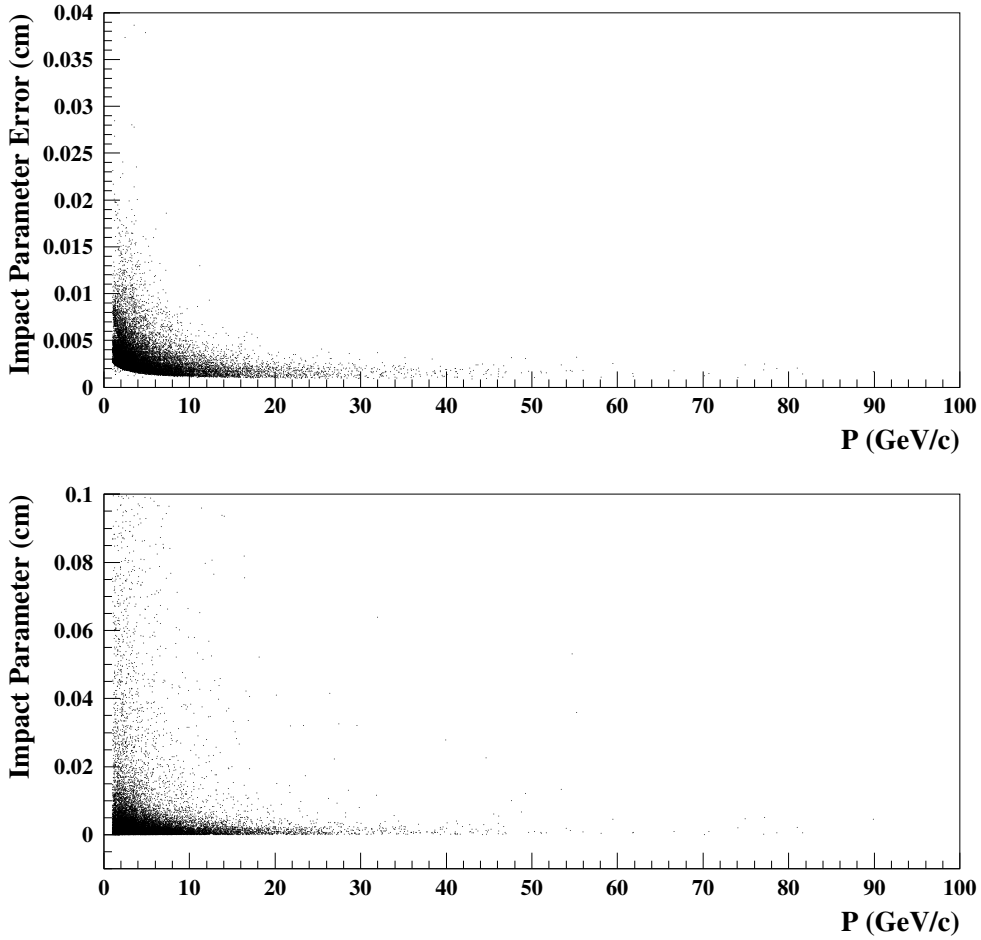
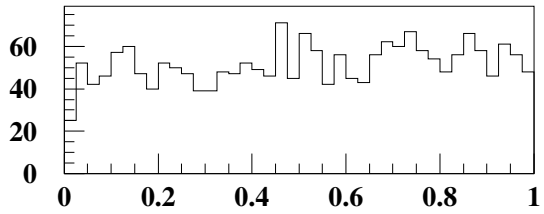
•Although *D* is sensitive to *p*, η, but *DS* has little sensitivity to *p*,η (example : both *D* and *D_err* have similar dependence on *p*) .



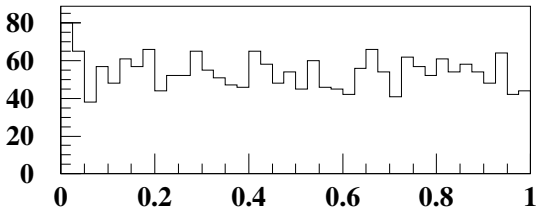
•Only parameterized *DS* as function of # r-ϕ hits, and # shared r-ϕ hits

- 4, 5, >= 6 r-ϕ hits
- 0, 1, 2, >= 3 shared r-ϕ hits

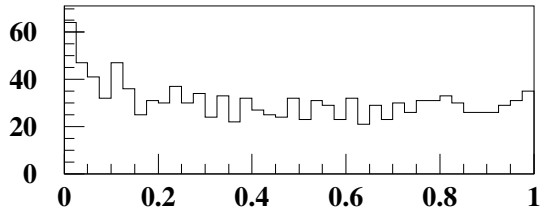
Track Probability from QCD and Heavy Quark Productions



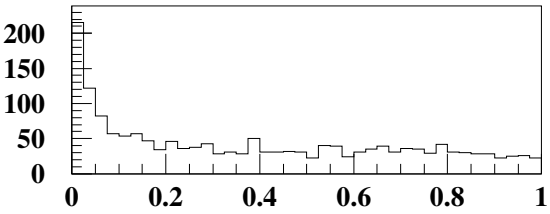
(QCD) TrkProb (Neg Sign)



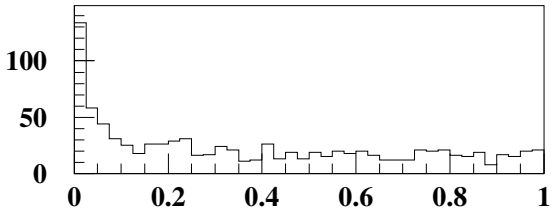
(QCD) TrkProb (Pos Sign)



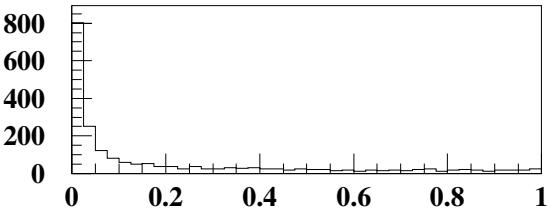
(ccbar) TrkProb (Neg Sign)



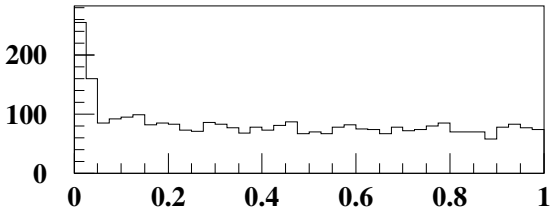
(ccbar) TrkProb (Pos Sign)



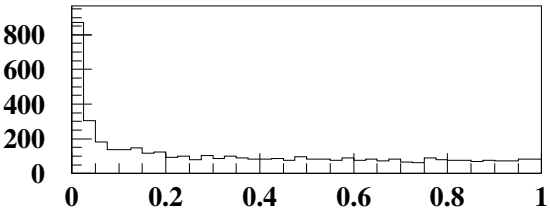
(bbbar) TrkProb (Neg Sign)



(bbbar) TrkProb (Pos Sign)



(ttbar) TrkProb (Neg Sign)



(ttbar) TrkProb (Pos Sign)

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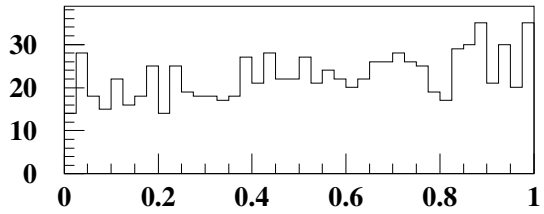
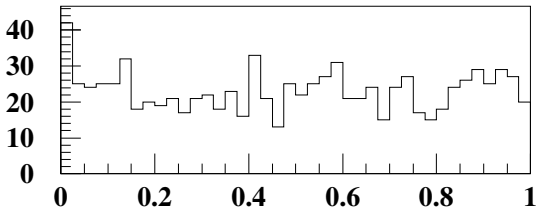
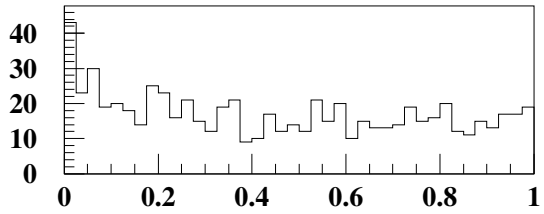
Jet Probability from QCD and Heavy Quark Productions



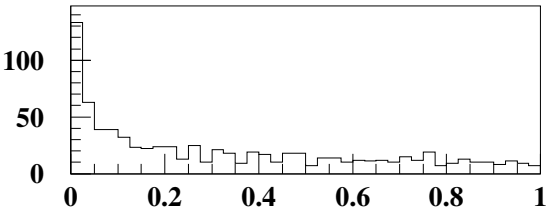
(QCD) JetProb (Neg Sign)



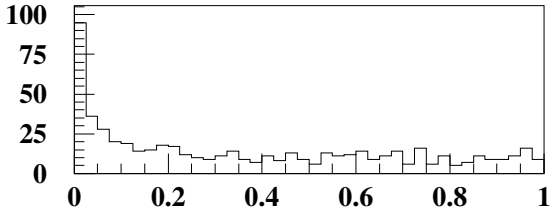
(QCD) JetProb (Pos Sign)



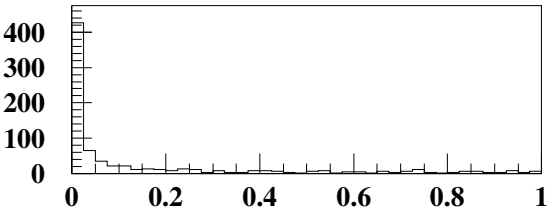
(ccbar) JetProb (Neg Sign)



(ccbar) JetProb (Pos Sign)



(bbbar) JetProb (Neg Sign)



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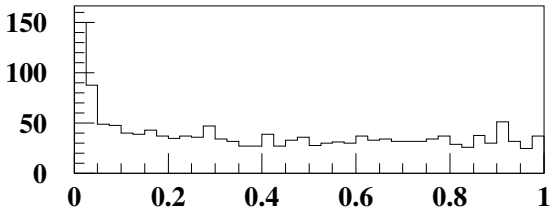

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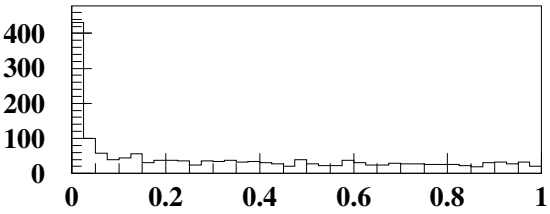

(ttbar) JetProb (Pos Sign)

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- **Peak at low Track/Jet Probability for positive impact parameter tracks from heavy flavor jets**
- **However there is also a peak (smaller) at low Track/Jet probability for negative impact parameter tracks from heavy flavor jets (which can be inferred from the comparison of the *DS* distributions between QCD and t t-bar)**
  - **This is possible if the secondary vertex from the heavy flavor decay is mistaken as the primary vertex**
  - **However currently the primary vertex is still taken to be (x,y)=(0,0) in the Tracking (is this right?)**

Plans

- **Investigate the peak at low Track/Jet Probability for the negative impact parameter tracks**
- **Use # of silicon layers, not just # of hits for the *DS* parameterization (may get many hits due to overlap of the wedges)**
- **Perform crude estimation of the efficiency/purity using this Jet Probability for heavy flavor tagging**
- **Include r-z hits , look at the possibility of using the z-impact parameter**