B0 -> η_c K_s η_c -> 4K

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Outline

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Data Sample

9000 events for 4K Ks signal MC = 1287 fb^{-1}

The MC contains both etac $->$ 4K (82%) and etac $->$ phi phi (18 %)

B+B- 4857402 events = 9.252 fb^{-1}.

B0B0bar 4183361 events = 7.968 fb^{-1} .

CCbar 10348226 events = 7.799 fb^{-1}.

UDS 18227900 events = 8.331 fb^{-1}

Skim / Ntuple Production

The selection cuts for the skims (exclusive) were

BGFMultiHadron

R2 < 0.6

eTotal > 2 GeV

pTotalMag > 1 GeV

nTracks > 4

nGoodTrkLoose > 3

nGoodTrackTight > 2

Tag bits B0− >eta cK S0 or B+− >eta cK+ added.

1.63 < P* of fast kaon < 1.91

If at least one candidate found

2.82 < Mass Etac < 3.14

5.1 < Mass B0 < 5.5

DeltaE < 0.2

For data a blind region of

70 MeV in Delta E and 20 MeV in the Beam Constrained Mass was defined

Correlation Between Variables

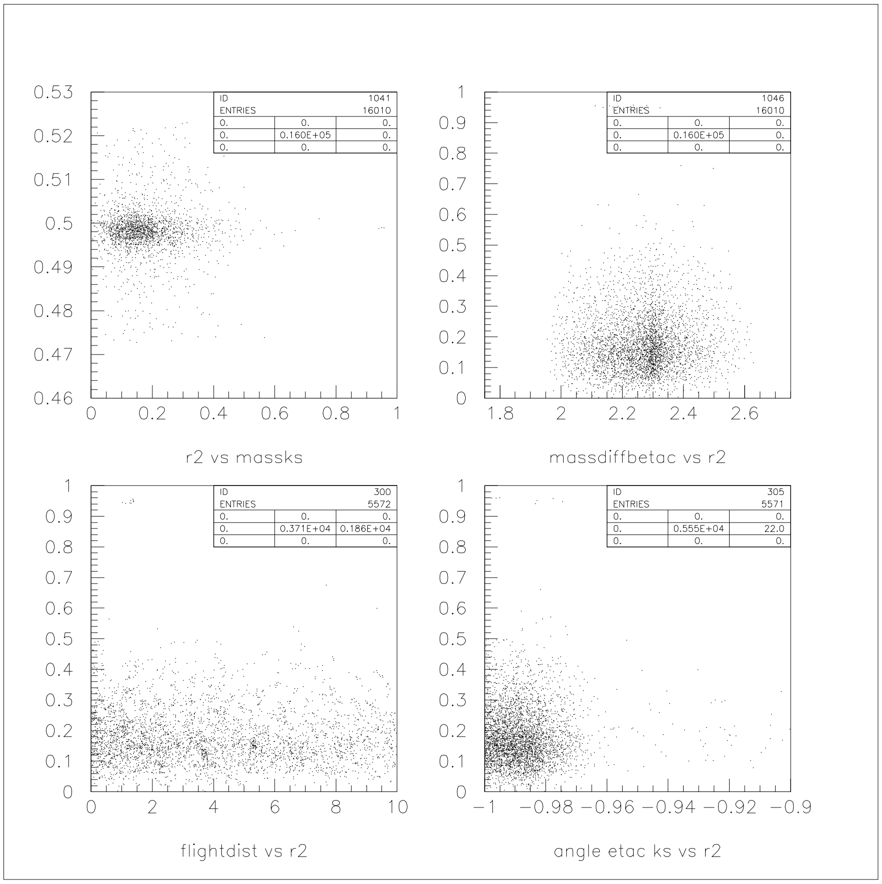

Figure 1: Correlations

Correlation Between Variables

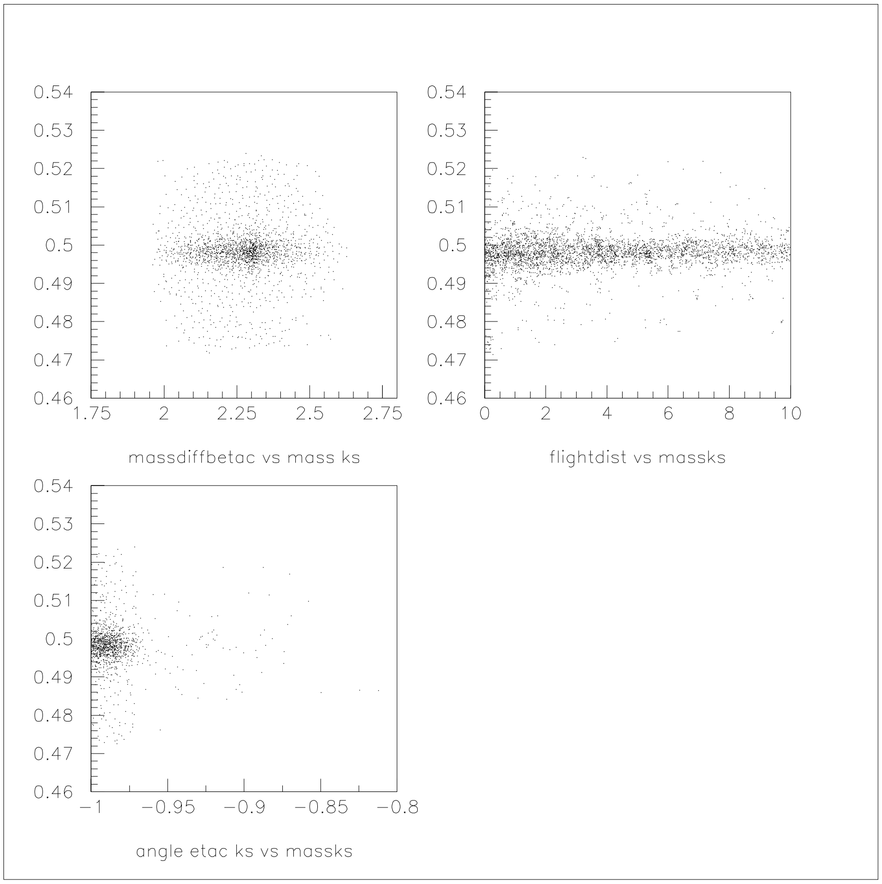

Figure 2: Correlations

Correlation Between Variables

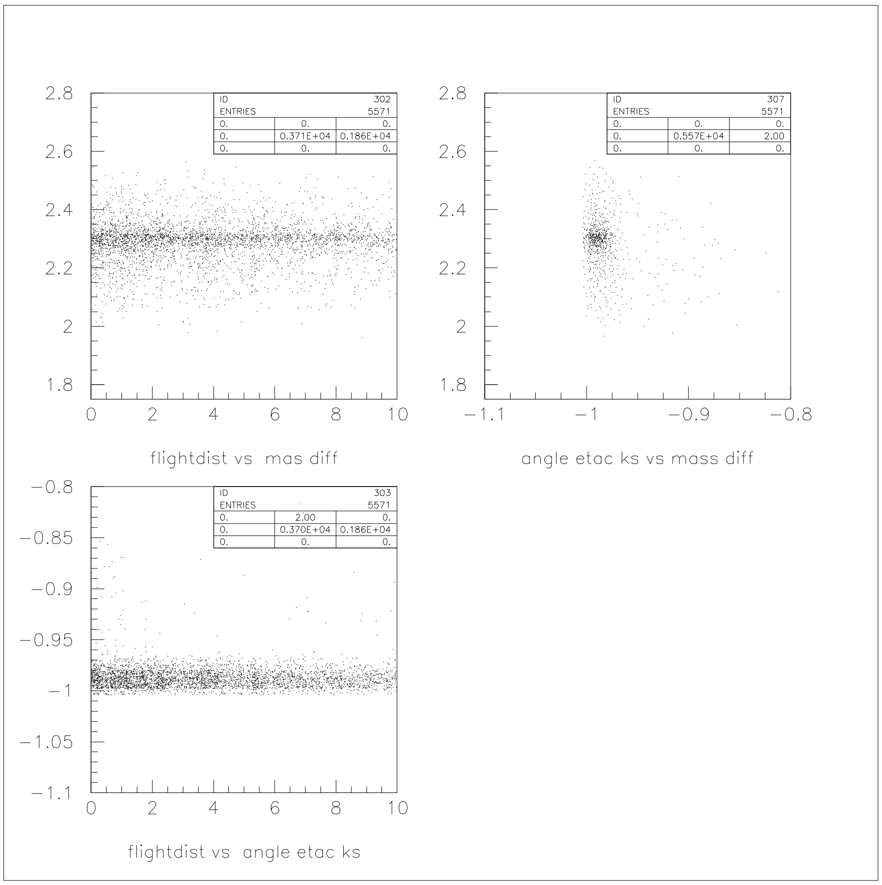

Figure 3: Correlations

Correlation Between Variables

It looks like there might be a correlation between the mass difference between the B0 and the Etac and the mass of the Ks. To check this plot a profile histogram.

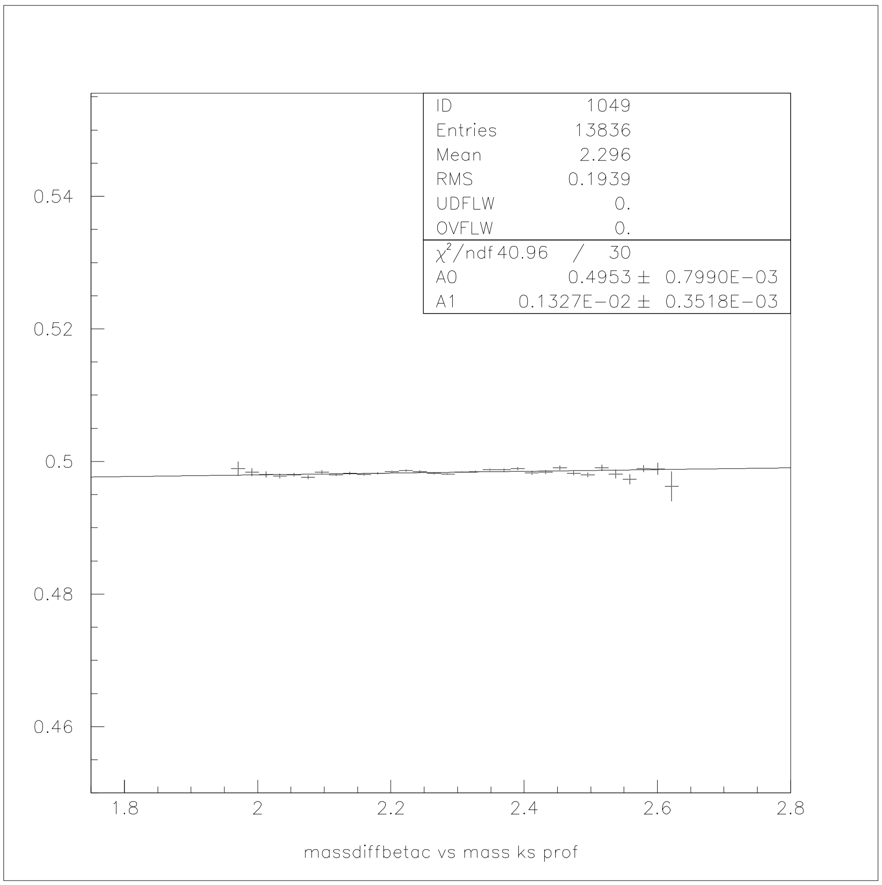

Figure 4: Correlations

.ps

Correlation Between Variables

The mass difference between the B0 and the Etac will also be corrleated with the mass of the B0 and the mass of the Etac. This correlation means that a cut applied to the mass difference also cuts severely on the mass of the B0 and the Etac

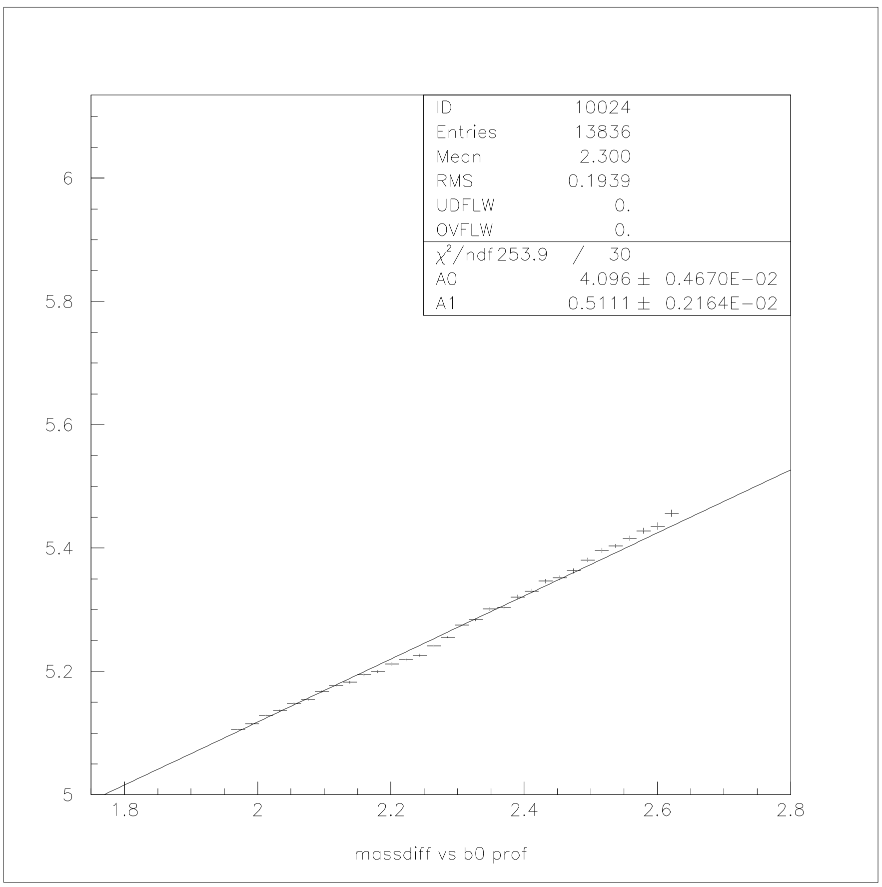

Figure 5: Correlations

Correlation Between Variables

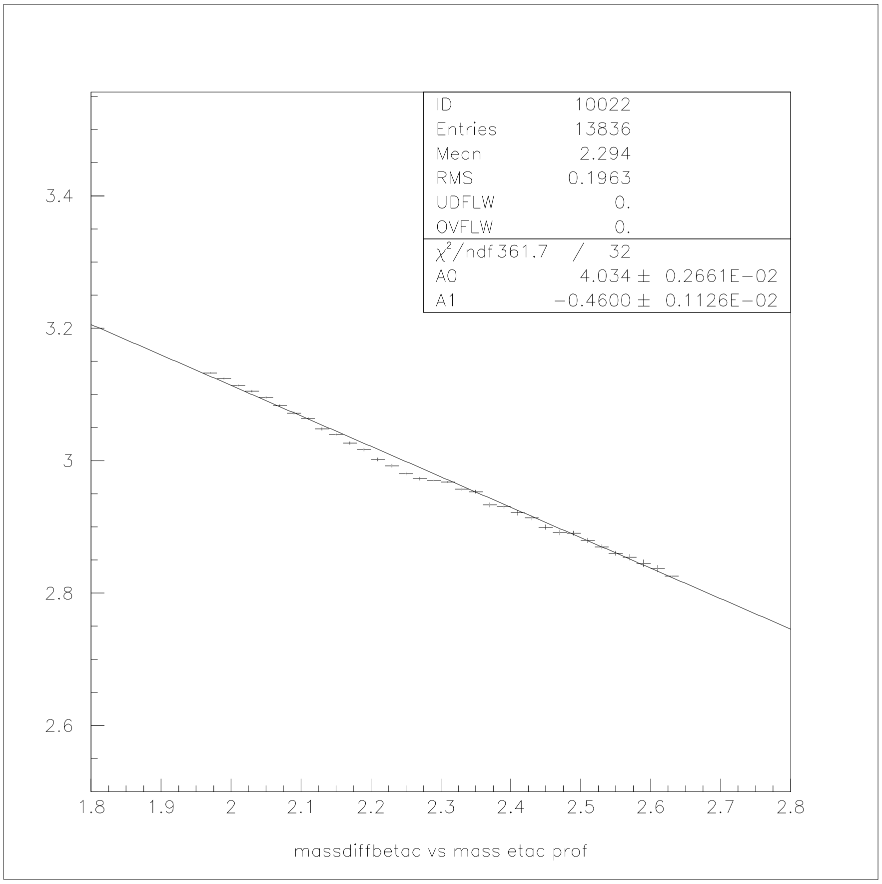

Figure 6: Correlations

Signal Box

The delta E and Mbes are plotted after requiring the tagbit to be set and a truth match. The original plan was to integrate these graphs and find out the size of the box that had 99 % of the signal in it. However because of the tails in the delta E plot, the signal box obtained would be larger than the blind box. So the blind box was used as a signal box, this has 93 % of the signal in it.

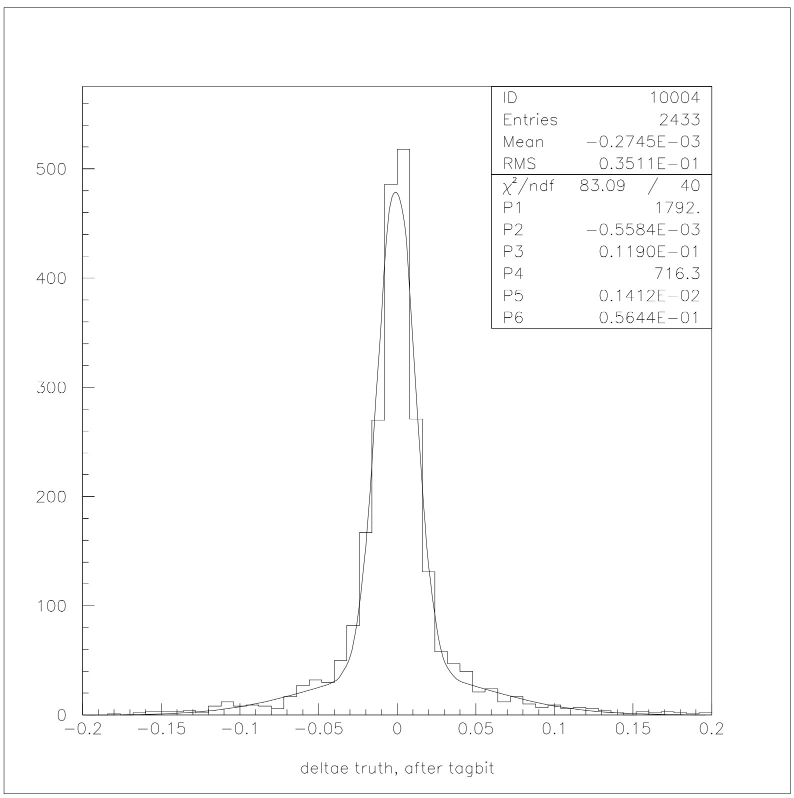

Figure 7: Delta E

Signal Box

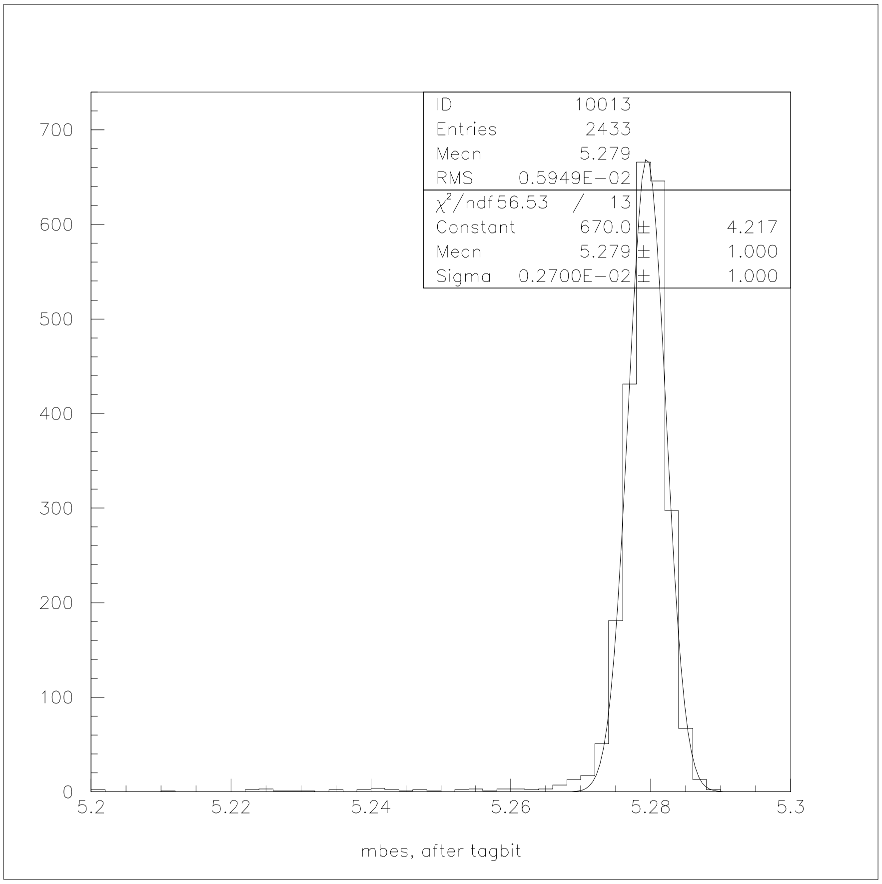

Figure 8: Mbes

Delta E

Requiring GTL reduces the tails for delta E considerably

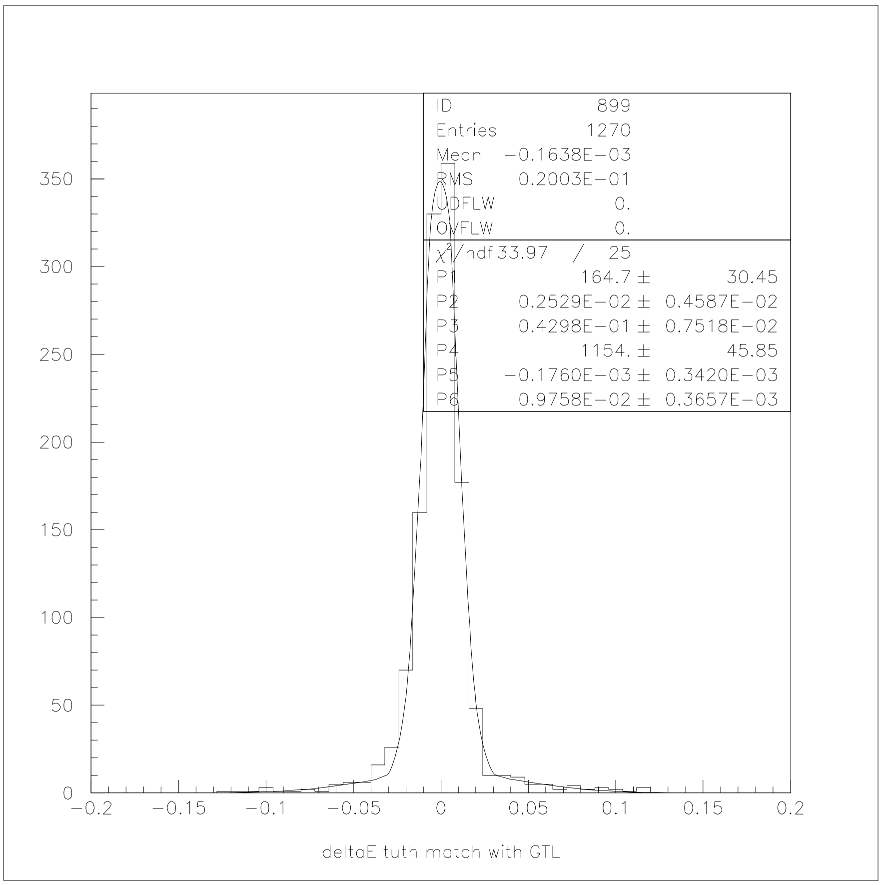

Figure 9: Delta E truth match + GTL

Cut Optimization

Plot S/ $\sqrt{(}S+B)$ in the signal region.

The maximum of this plot is the chosen cut value.

Optimization done for each cut parameter independently , ie not done in cascade.

Cut Optimization Example

S/$\sqrt{}$ S+B plots , efficiency plots , signal plot and total background scaled plots are shown.

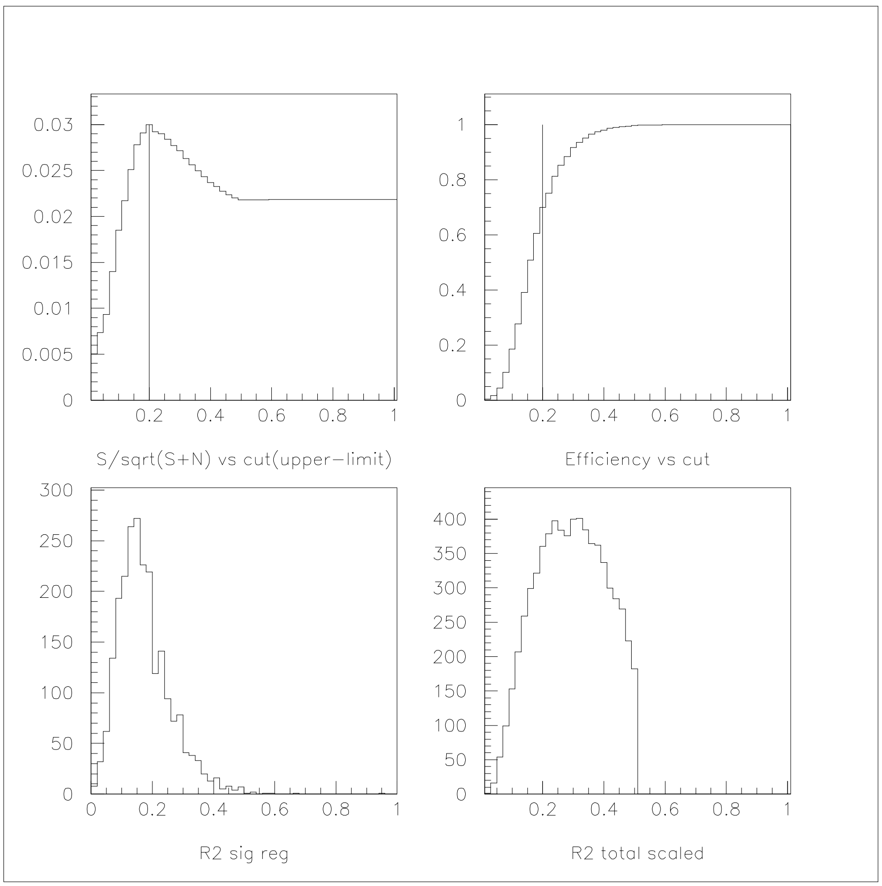

Figure 10: R2 opt

Cut Optimization Example

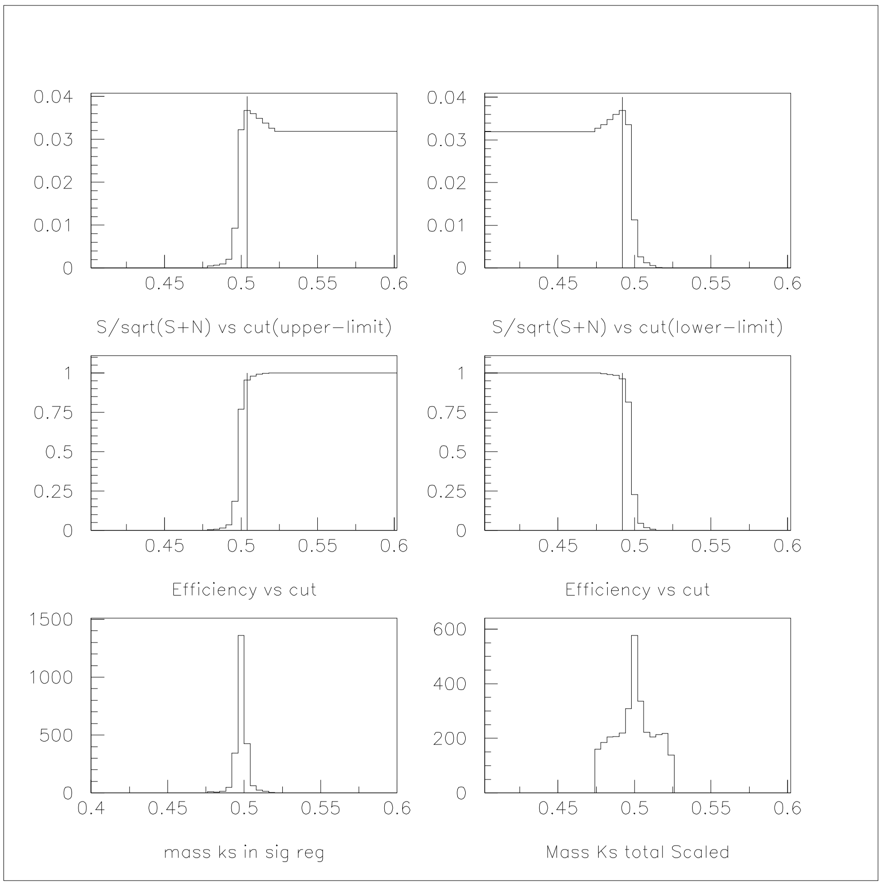

Figure 11: Mass Ks opt

Cut Optimization Example

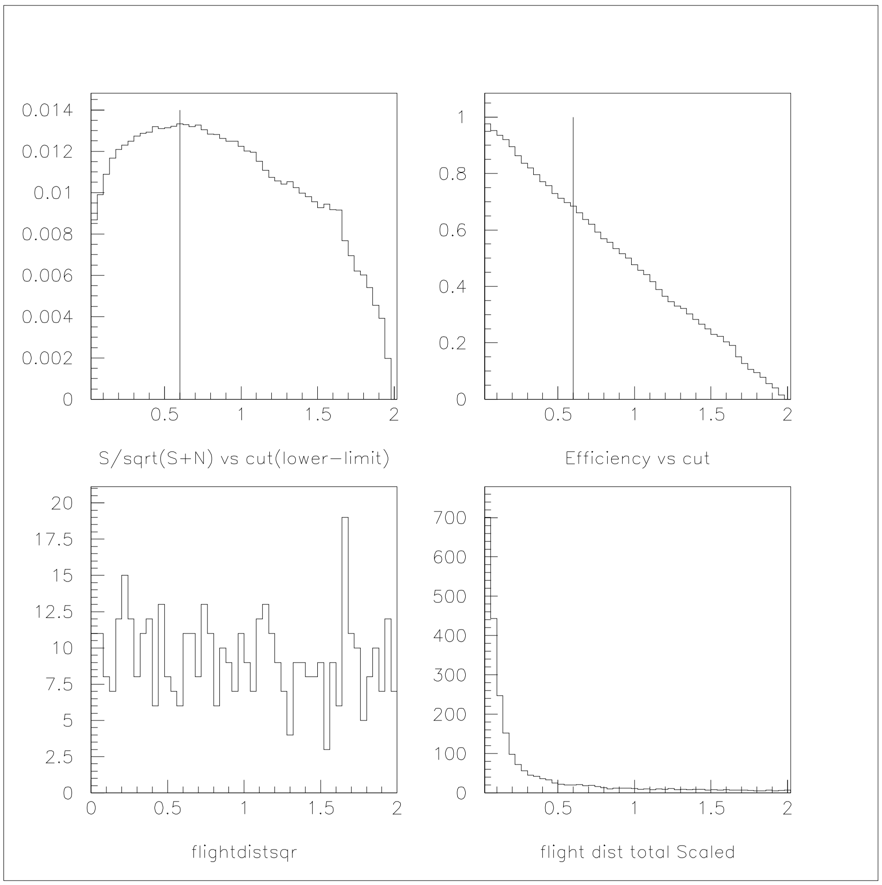

Figure 12: Flight Distance Optimized

Cut Optimization Example

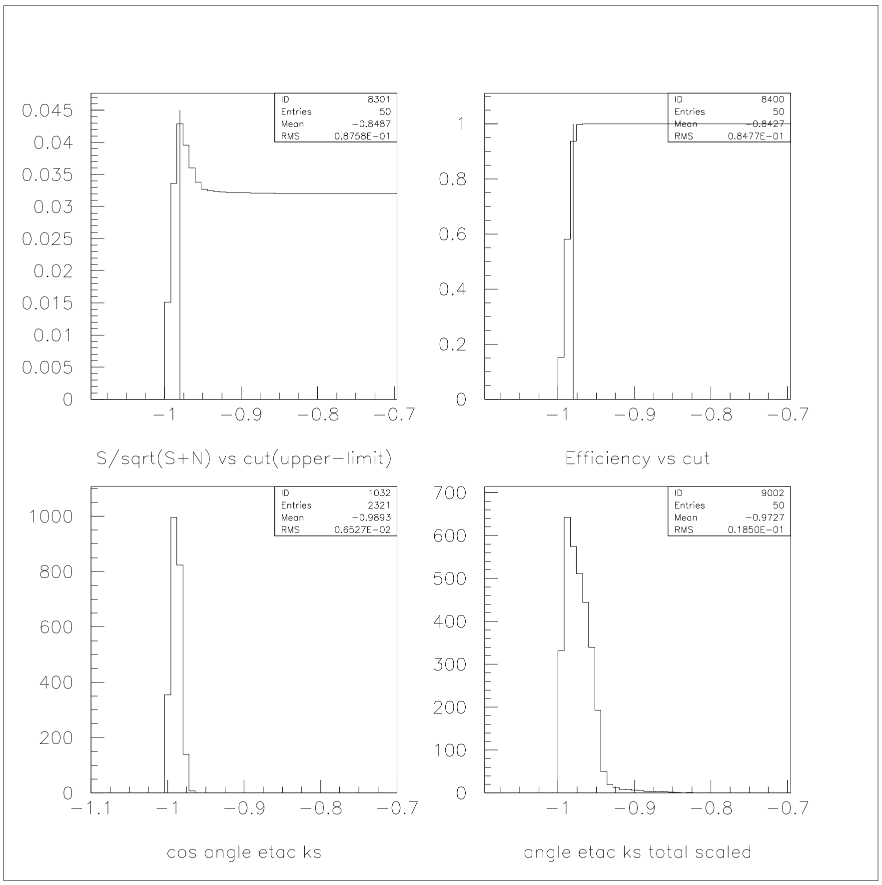

Figure 13: Cos Angle Between Etac and Ks opt

Cut Optimization Example

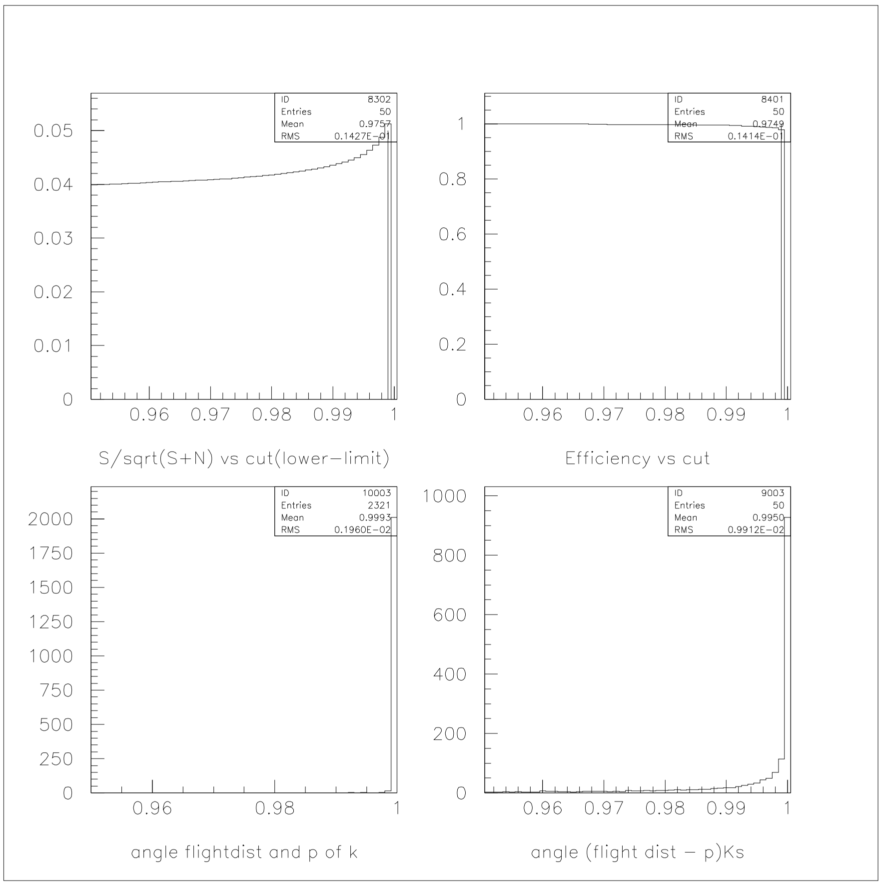

Figure 14: Angle between (flight -p)ks opt

Cuts Applied

1. EtacExcl4prong =1

2. PID 4 not a pion

3. $R2 < 0.2$

4. abs (Mass Ks - pdg Mass Ks)< 0.004

5. Flight Distance > 0.6 cm

6. Cos Angle between Etac and Ks in CMS < -0.98

7. Cos Angle between (flightdist - p)Ks > 0.999

8. $2.9298 <$ Mass of Eta C < 3.0298 (50 MeV) not optimized.

Mass Of Etac In Sig Region Before And After PID

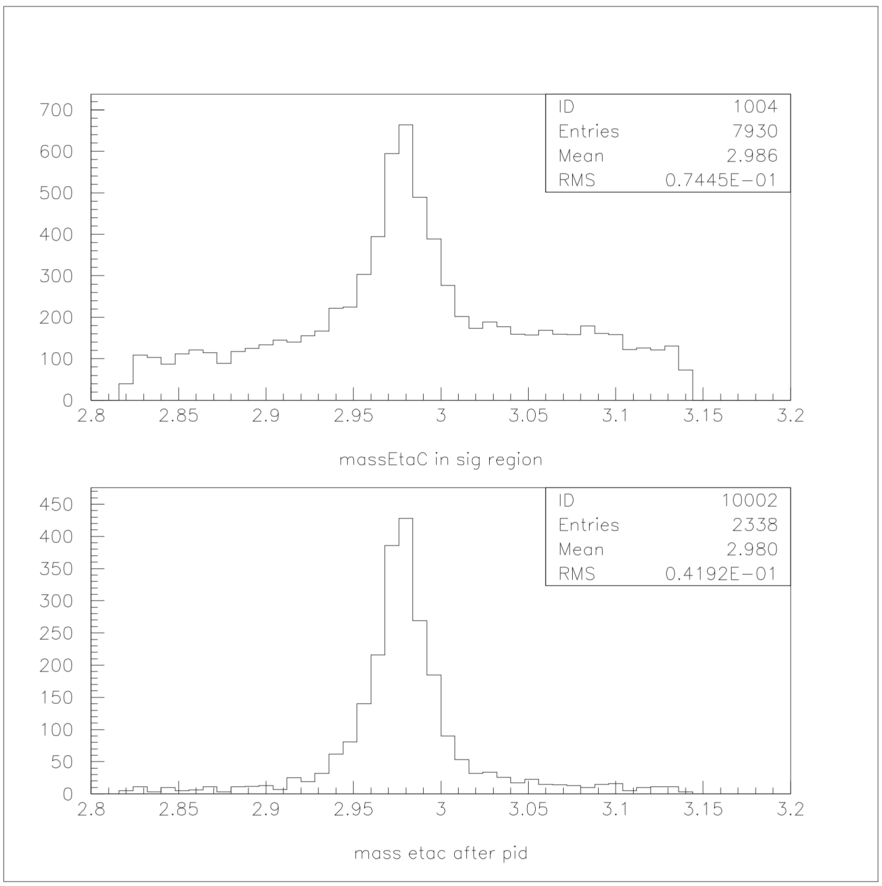

Figure 15:

Cut	N Signal true	N CCbar	N UDS	N B0B0bar	N B+B-
0	2321	7411	6192	2215 16 true	2203
1	2259	7410	6192	2215 16 true	2203
2	2038	122	126	57 12 true	64
3	1437	21	30	32	43
4	1192	4	9	16 2 true	11
5	1119	3	8	10 2 true	4
6	1097	0	7	5 2 true	2
7	1041	0	7	4 2 true	2
8	926	0	5	3 2 true	1

Yields

Scaling to 20.7 fb^{-1} expect 18 events of signal

$5/(8.331/20.7) = 12$ UDS events

$2/(7.968/20.7) = 5$ B0B0bar events

$1/(9.252/20.7) = 2$ B+B- events

$= 19$ background events.

The efficiency before cuts is 31.4% and 12.5 % after cuts

Two side band background boxes are defined with

$5.2 < \text{Mbes} < 5.3$

and
Delta E < -0.7

or Delta E > 0.7

The values of Mbes are found in these sidebands. The ratio of the argus function in the background box region to signal region is then obtained.

For MC background (UDS CCBar B0B0bar and B+B-) this ratio is 1 and there are 7 entries. But the background box is 18.57 times bigger than the signal box. So expect 7*(1/18.57) = 0.38 background events in the signal region. But also have to scale up to 20.7 fb^{-1} so expect 1 background events in the signal box.

For data there were 17 events in the background boxes and the ratio of signal to backround was 5.35785. So expect 17 * (5.35785/18.57) = 4.9 background events in the signal region.

Argus Function Fit

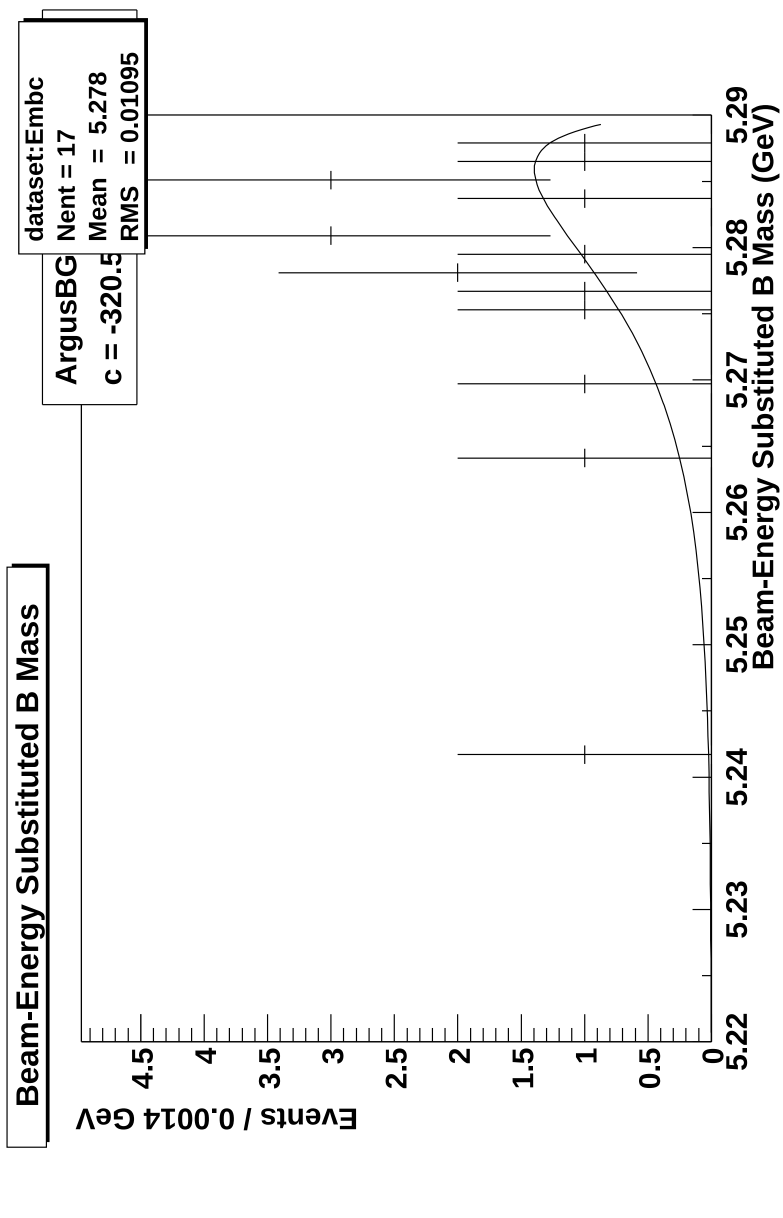

Figure 16:

Conclusions / Still to do

The mode looks promising

Need to optimize signal box

Need to optimize cuts in cascade

Compare Data and MC

Get S/B by using an argus function