Study of $B_s \rightarrow D_s\pi$ reconstruction with $D_s \rightarrow KsK$

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- Motivations
- MC studies
- Ks Dedicated Alg. vs Default
- Results from data
- Conclusions/Future plans

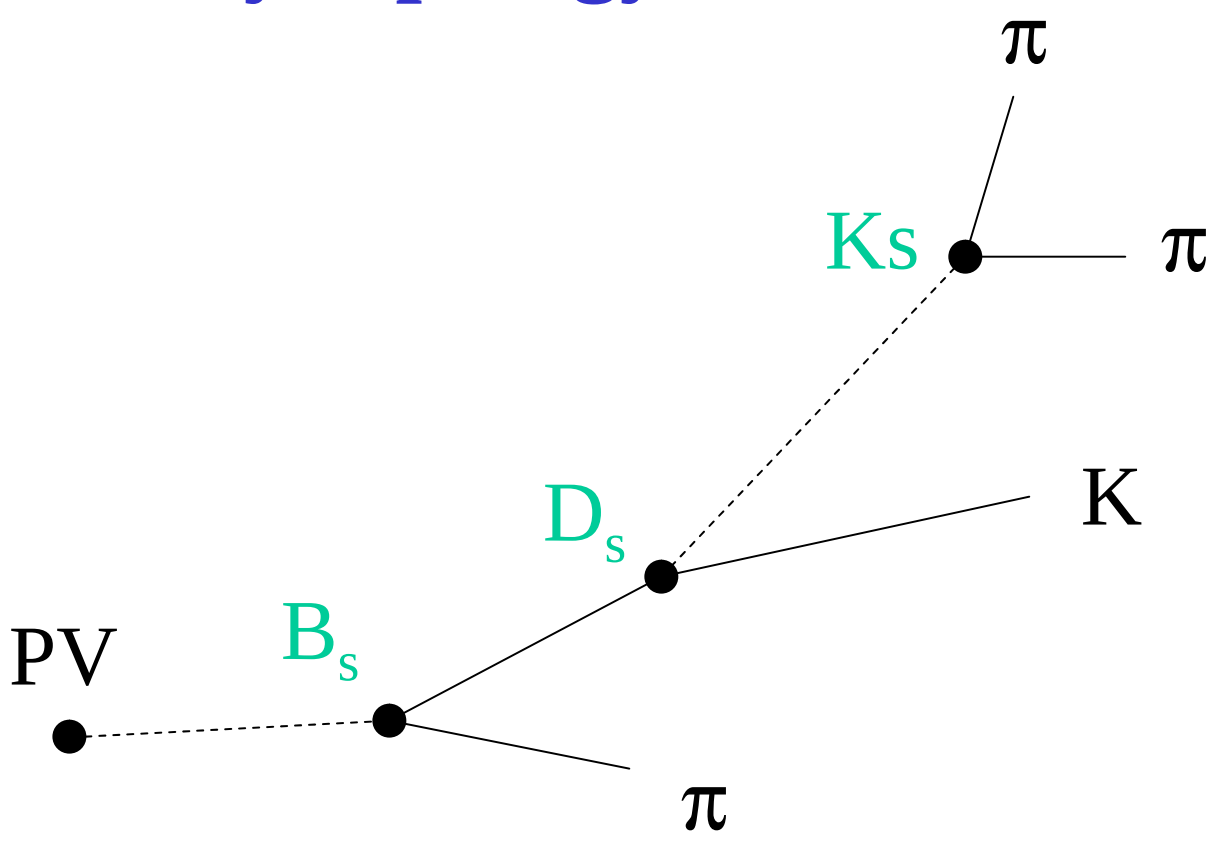
Motivations:

- Clean channel
- BR($D_s \rightarrow$ KsK) = 1.8%
- ISL now works
- Join the effort to collect statistic in $B_s \rightarrow D_s\pi$

Drawbacks:

- Three vertices decay
- Lower luminosity due to ISL problem

Decay topology



π (from B_s) and K trigger in 95.7% of cases (MC scenario A): good handle to beat combinatorial background

Reference channel $B^0 \rightarrow D^-\pi^+$, $D^- \rightarrow Ks\pi^-$: very similar topology and kinematics

Tools

•CharmMods 4.9.1
•VertexFit (fixed to handle two 1-track vertices decays)
•KsRecModule (modified)

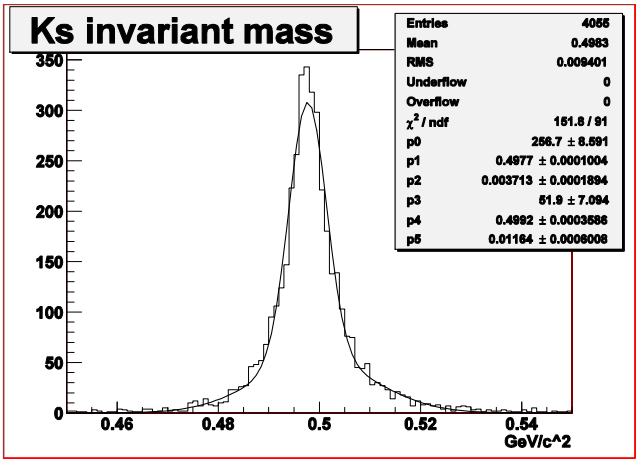
Generated 2M events with Full MC (BGen+ QQ+ CdfSim + TrigSim +SVTFilter) according to Alex recipe

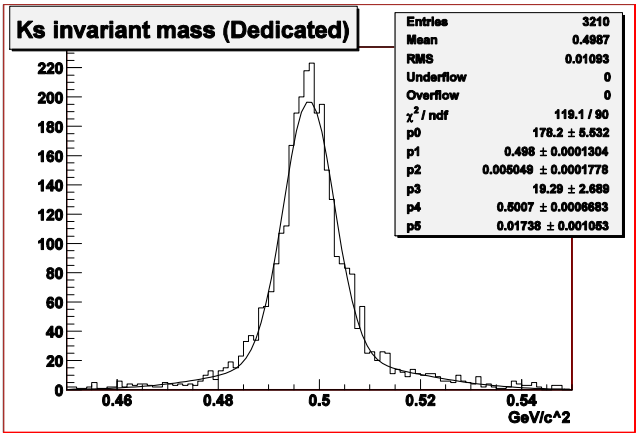
Reconstruction in MC

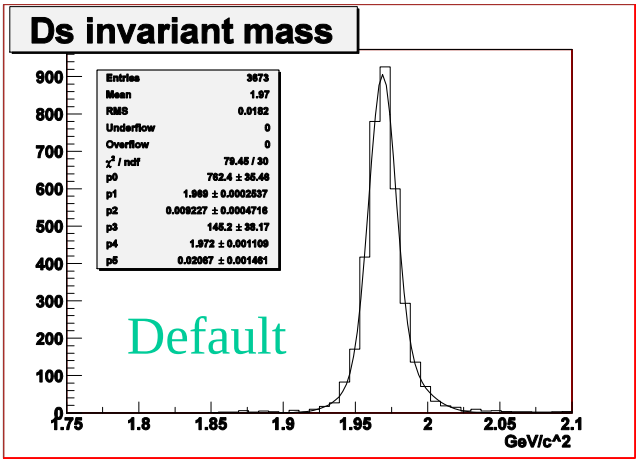
•25 Ax and 25 St COT hits each track
•3 r-ϕ Si hits for $\pi(B_s)$ and K
•Track Pt >0.4 GeV and $|\eta| < 2$ each track

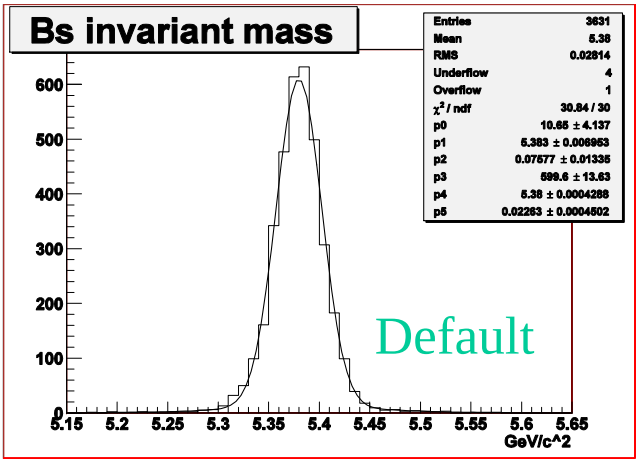
	Events	Efficiency
Generated	2,000,000	-
Passed L1+L2 trigger	16,502	0.82%
D_s Reconstruction (Def.)	3,673	22.3%
B_s Reconstruction (Def.)	3,631	98.3%

Mass resolutions





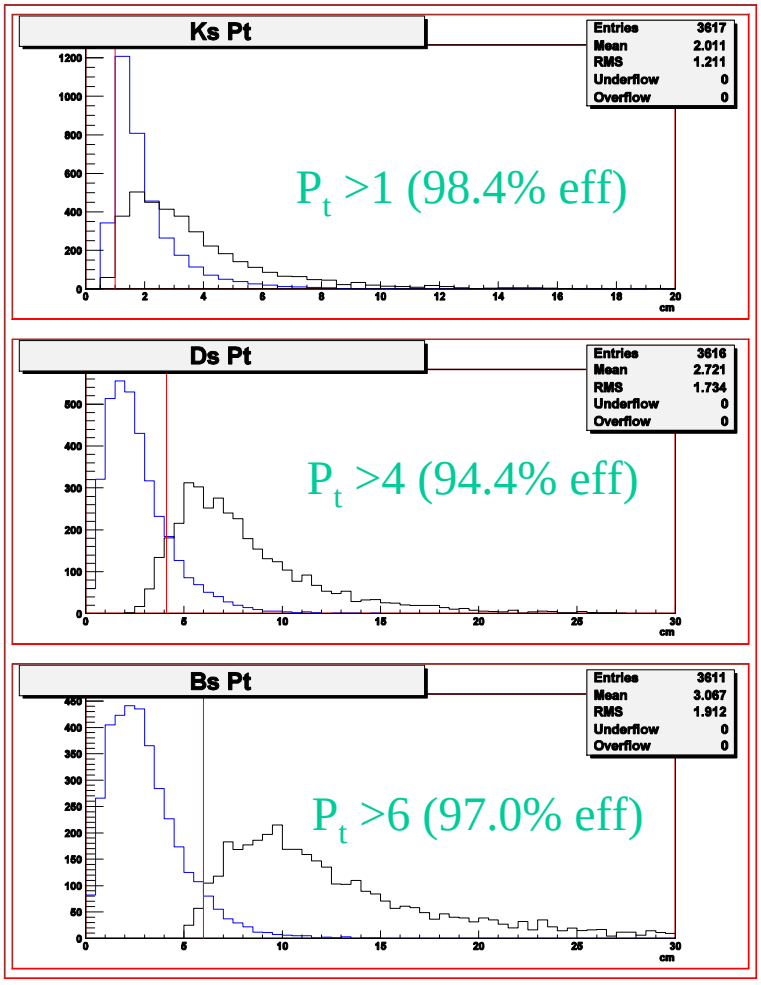




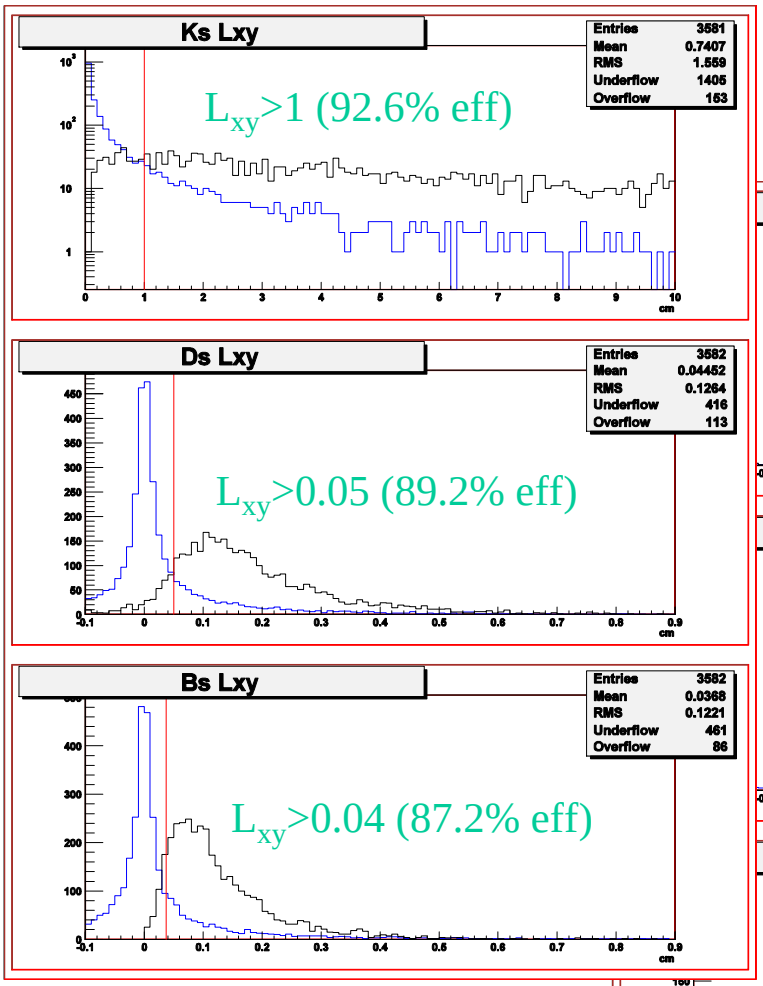
- No Mass constrain (not supported yet)
- Tracks with different # of Si hits: mass fit with two gaussians
- Ded. Alg. Requires only 20 Ax and St COT hits: slightly worse Ks Mass resolution
- B_s Mass resolution strangely worse then in other studies

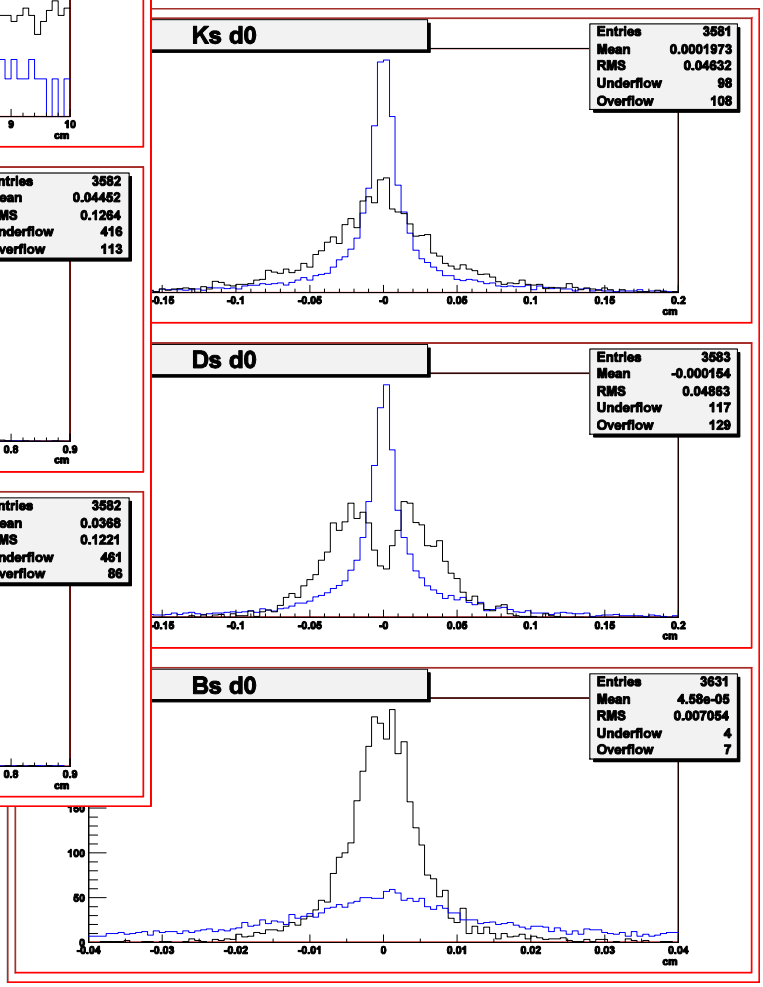
Cut Selection

•Used generic bbar MC sample (from Saverio) as background (**blue**)
•Signal (**black**) normalized to the number of entries
•No meant to be an optimization, but a resonable starting point



Cut Selection





- Cuts agree with other studies
- Total cut efficiency ε_{ana}=70%

Common Reconstruction requirements

Retrack

•KAL method

•Drop L00, Keep ISL

•Rescale COT Cov:

cur=5.33, d0=3.01, ϕ_0=3.7, Z_0=6.53, λ=0.58

•Alignment: ofotl_prd_read 100024 24 TEST (ISL internal alignment)

Quality Cuts

•25 Ax and 25 St COT hits each track

•3 r-ϕ Si hits for $\pi(B_s)$ and K

•Track Pt >0.4 GeV and $|\eta| < 2$ each track

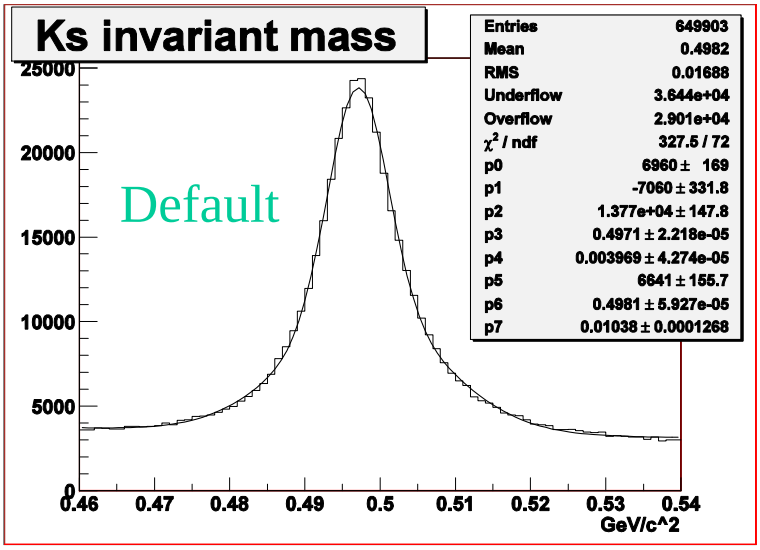
Data

•Used 2335 files on CAF hbot0h (prereq B_CHARM) run #>149355(ISL)

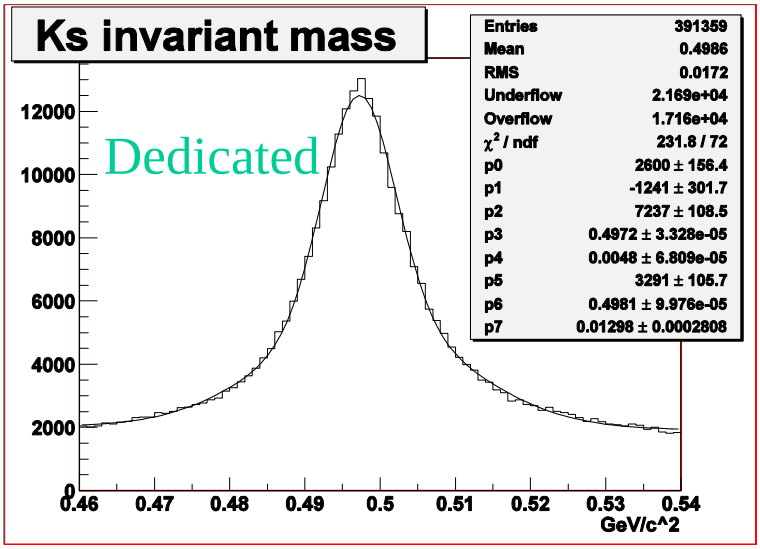
•Eliminated bad runs (Stefano recipe)

•Luminosity <53 pb^{-1}

Ks → π π



N= 30,9085
m= 0.497 GeV
σ= 4.0MeV

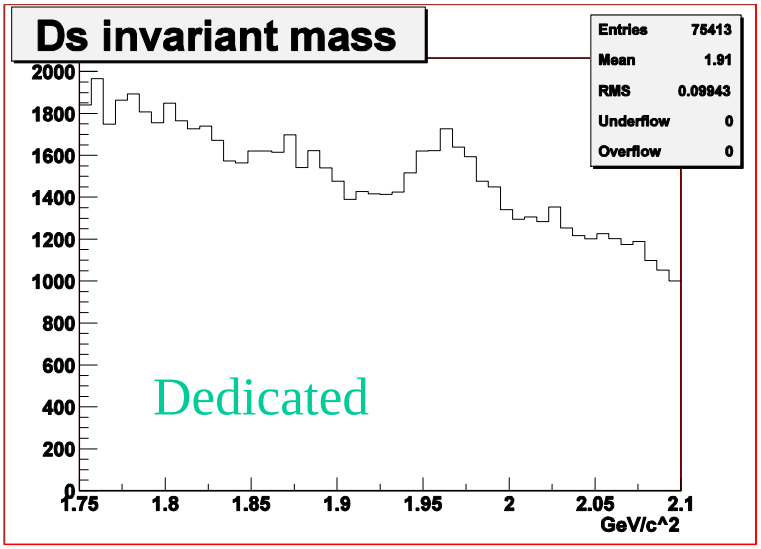


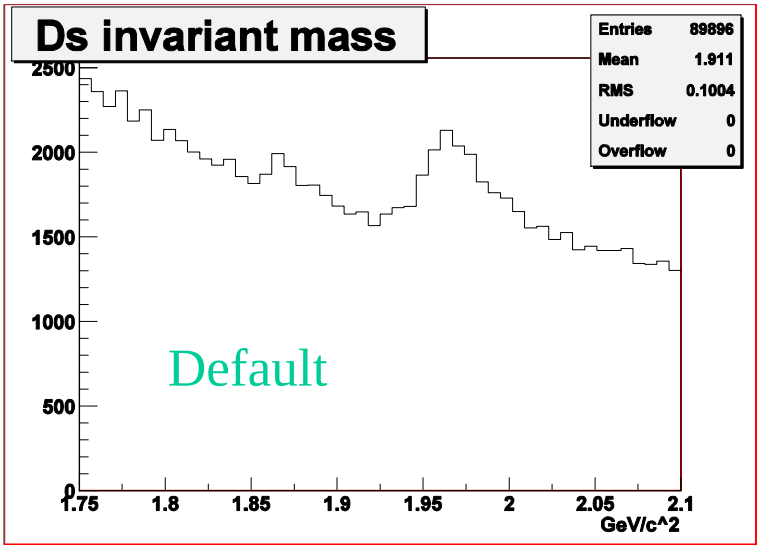
- Prob >10^{-4}
- L_{xy} (Ks)>1 cm
- Pt (Ks)>1 GeV

N= 19,0537
m= 0.497 GeV
σ= 5.0MeV

- Ded. Alg with 10% less statistics (jobs crashed)
- Ded. Alg. has better S/N (1.75 vs 1.63), but much less efficient
- N_{def}/N_{ded} ~ 1.45 in fairly agreement with MC value of 1,26
- Resolutions agree with MC

$D_s \rightarrow KsK$

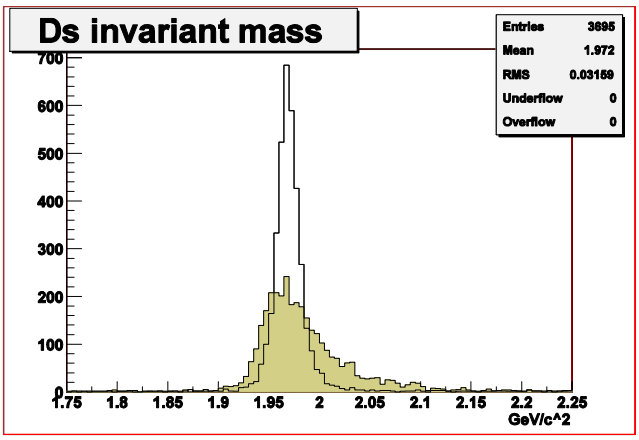


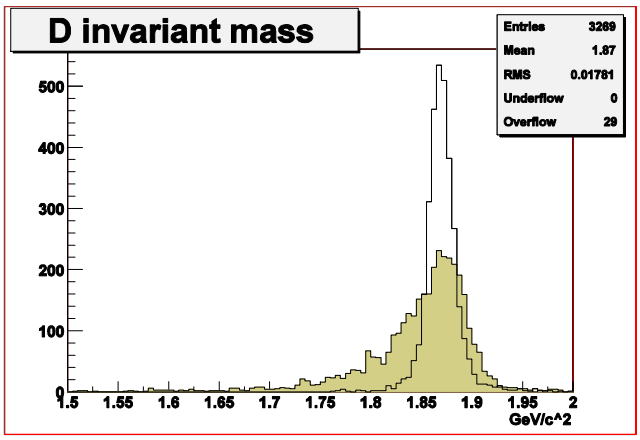


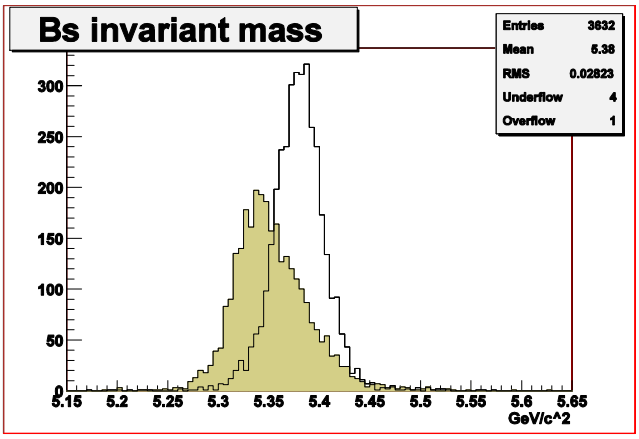
- $0.470 < m(Ks) < 0.525$
- L_{xy} (Ks)>1 cm
- Pt (Ks)> 1 GeV
- $L_{xy}(D_s)$>0.05 cm
- Pt (D_s)> 5 GeV
- Prob $>10^{-4}$
- Third track must be a trigger track

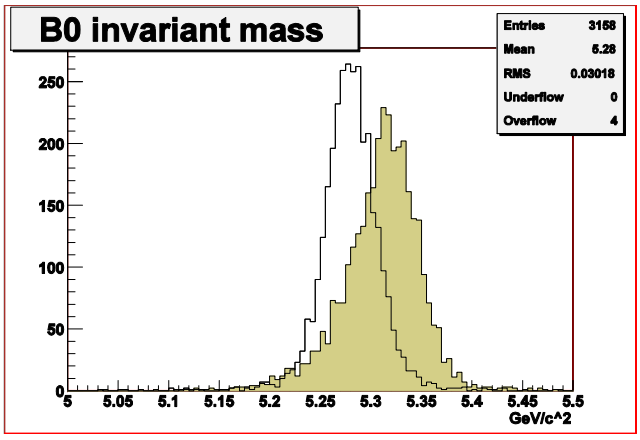
- Ded. Alg. not competitive yet
- Small peak on the left is D → KsK (BR 3 x 10^{-3})
- D_s peak broad due to reflection of D → Ksπ

Signal reflections





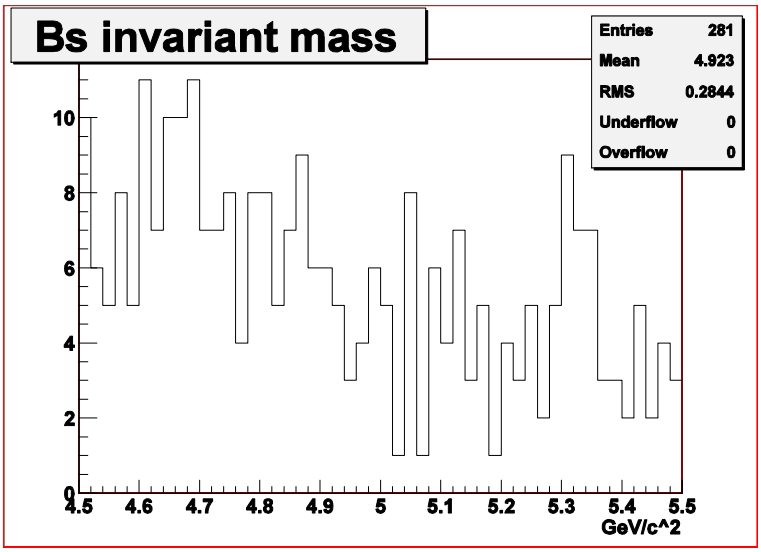




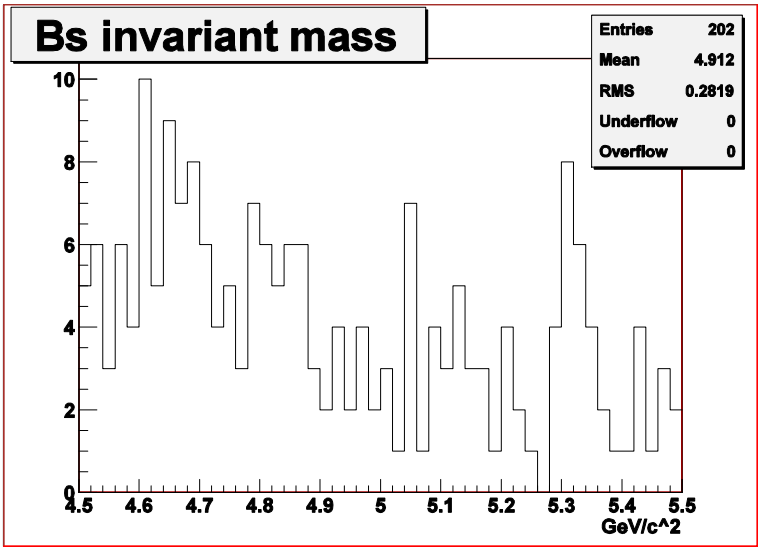
- Generated 2M evts of reference channel (0.76% trigger efficiency)
- Assigned wrong K or π hypothesis (shaded areas)
- Reflected signal very close also at B rec. level, but separation can improve with mass constraints
- A BR measurement will be very difficult!

$B_s \rightarrow D_s \pi$

All candidates



Best χ^2 candidates only



- $0.470 < m(Ks) < 0.525$
- L_{xy} (Ks)> 1 cm
- Pt (Ks)> 1 GeV
- $1.93 < m(D_s) < 2.00$
- $L_{xy}(D_s) > 0.05$ cm
- Pt (D_s)> 5 GeV
- $L_{xy}(B_s) > 0.04$ cm
- Pt (B_s)> 6 GeV
- Prob $>10^{-4}$
- K and π (B_s) tracks must be trigger tracks

Peak consistent with reflection

Is the number of events we see consistent?

$$\frac{N(Bs)}{N(Bd)} = \frac{f_s}{f_d} \times \frac{\varepsilon_{trig(Bs)}}{\varepsilon_{trig(Bd)}} \times \frac{\varepsilon_{ana(Bs)}}{\varepsilon_{ana(Bd)}} \times$$

$$\times \frac{BR(D_s \to KsK)}{BR(D \to Ks\pi)} \frac{BR(B_s \to D_s \pi)}{BR(B_d \to D \pi)}$$

LEP

$$= 0.23 \times \frac{0.82}{0.76} \times \frac{0.70}{0.76} \times \frac{2.6}{3.0} \frac{1.8}{1.4} = 0.20$$

QQ file

$B^0 \rightarrow D \pi$ MC study

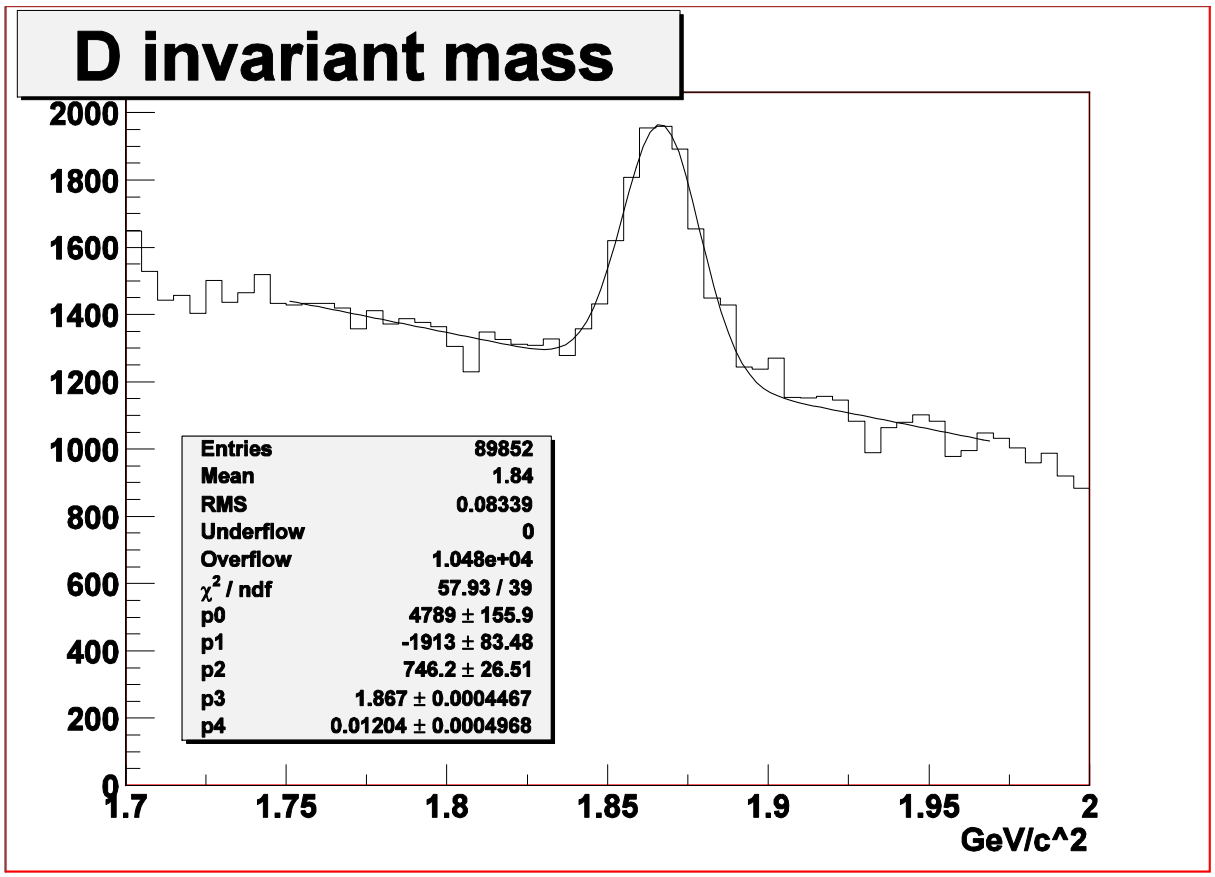
Efficiencies

	Events	Efficiency
Generated	2,000,000	-
Passed L1+L2 trigger	15,242	0.76%
D_s Reconstruction	3,269	21.5%
B_s Reconstruction	3,158	96.6%

Mass resolutions

	σ_1 (MeV)	σ_2 (MeV)
D	10.9+/-0.3	31.8+/-3.4
B^0	22.8+/-0.6	67.4+/-9.9

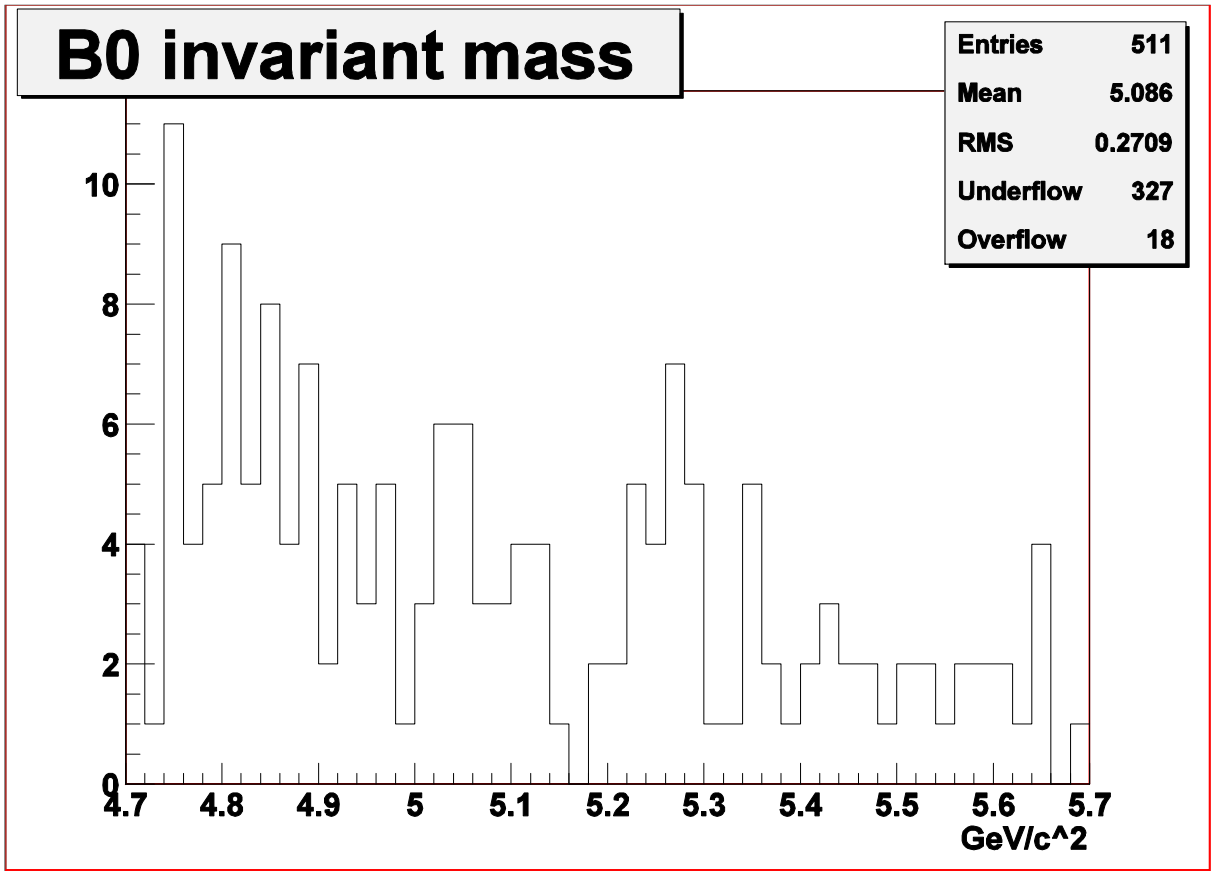
$D^- \rightarrow Ks\ \pi^+$



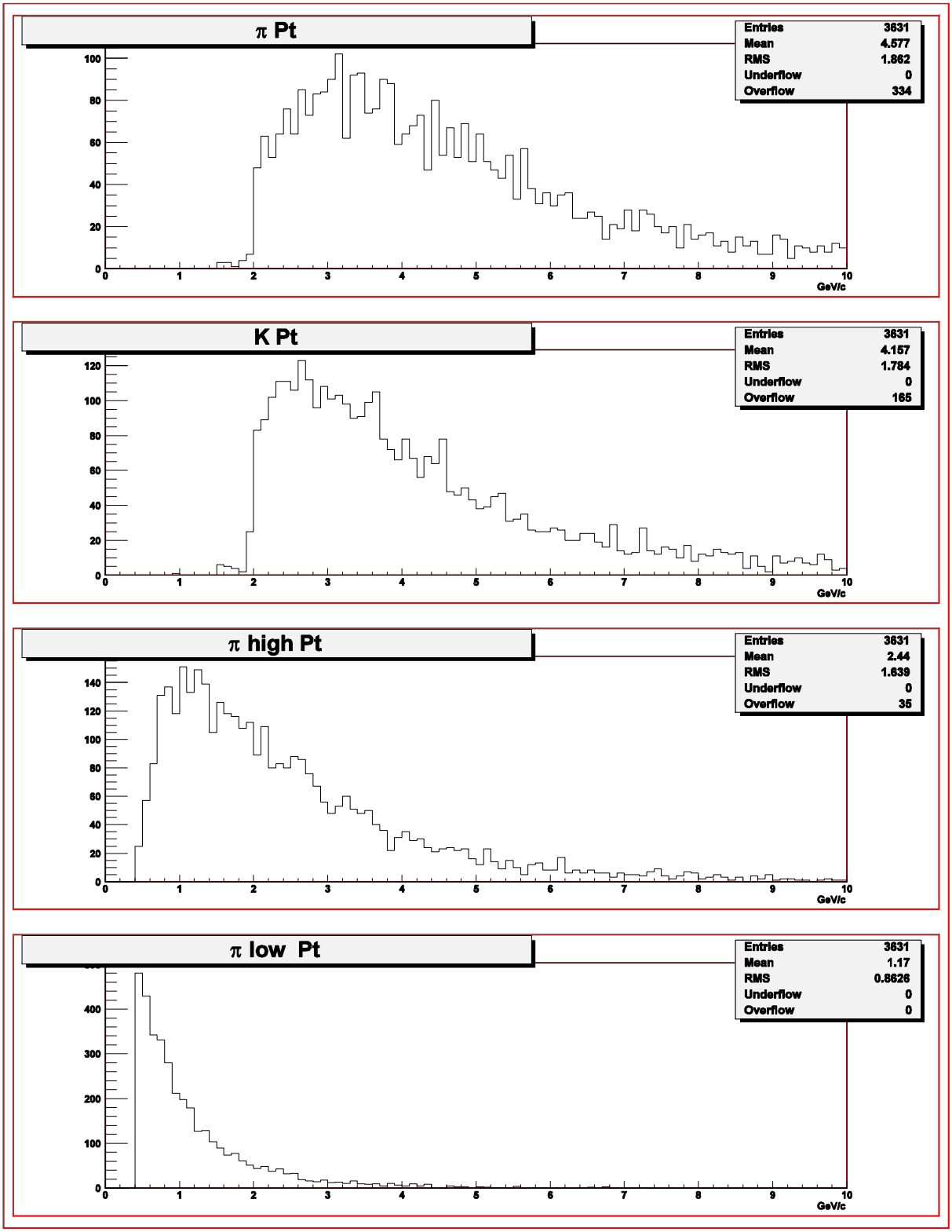
N= 4,665
m= 1.867 GeV
σ= 12MeV
S/N= 0.298

- Same cuts used to reconstruct D_s
- Reflection from $D_s \rightarrow$ Ks K not evident
- Mass resolution agrees with MC

$B^0 \rightarrow D^- \pi^+$



- About 40% less statistics than other plots (jobs still running)
- Same cuts used to reconstruct B_s


π Pt
Entries 3631
Mean 4.577
RMS 1.862
Underflow 0
Overflow 334
GeV/c
K Pt
Entries 3631
Mean 4.157
RMS 1.784
Underflow 0
Overflow 165
GeV/c
π high Pt
Entries 3631
Mean 2.44
RMS 1.639
Underflow 0
Overflow 35
GeV/c
π low Pt
Entries 3631
Mean 1.17
RMS 0.8626
Underflow 0
Overflow 0
GeV/c

Conclusions

- Dedicated algorithm not competitive yet
- BR measurement difficult due to reflections
- B_s reconstruction feasible in this channel (cuts optimization and more luminosity)

Future plans

- Run on full sample
- Optimize cuts
- Understand better peak composition (CDF Note 4239)
- Use dE/dx and kinematics to disentangle reflection