

Charm Physics: Status of the Simulations for $D_s(2317)^+$ with PandaRoot

Analysis Proposal: D_{sJ} mesons

$D_{s0}^*(2317)^+$

$$M = 2317.8 \pm 0.6 \text{ MeV}/c^2$$

$$\Gamma < 3.8 \text{ MeV}$$

$$M_{D^{*s0}} - M_{D_{s\pm}} = 349.3 \pm 0.6$$

$D_{s1}(2460)^+$

$$M = 2459.6 \pm 0.6 \text{ MeV}/c^2$$

$$\Gamma < 3.5 \text{ MeV}$$

$$M_{D_{s1\pm}} - M_{D^{*s\pm}} = 347.2 \pm 0.7$$

$$M_{D_{s1\pm}} - M_{D_{s\pm}} = 491.1 \pm 0.7$$

$D_{s1}'(2536)^+$

$$M = 2535.12 \pm 0.13 \text{ MeV}/c^2$$

$$\Gamma = 0.92 \pm 0.05 \text{ MeV}$$

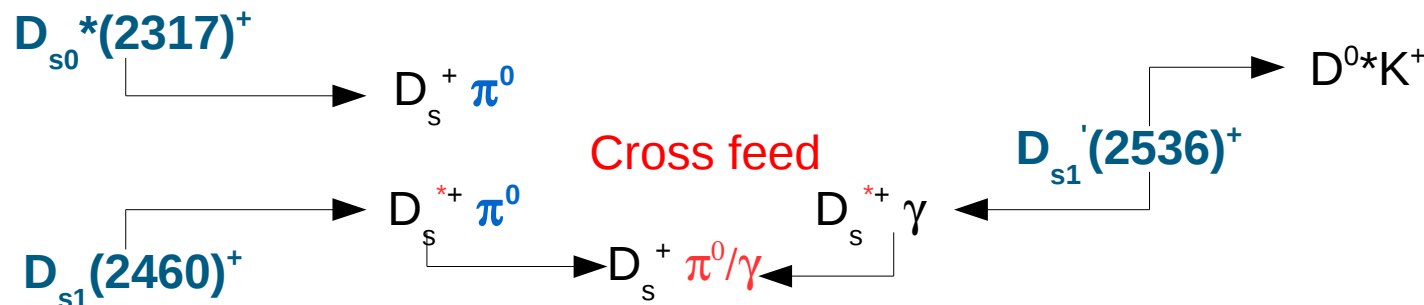
$$M_{D_{s1\pm}'} - M_{D^{*s\pm}} = 422.8 \pm 0.5$$

$$M_{D_{s1\pm}'} - M_{D^{*\pm}} = 584.84 \pm 0.04$$

$$M_{D_{s1\pm}'} - M_{D^{*0}} = 528.14 \pm 0.08$$

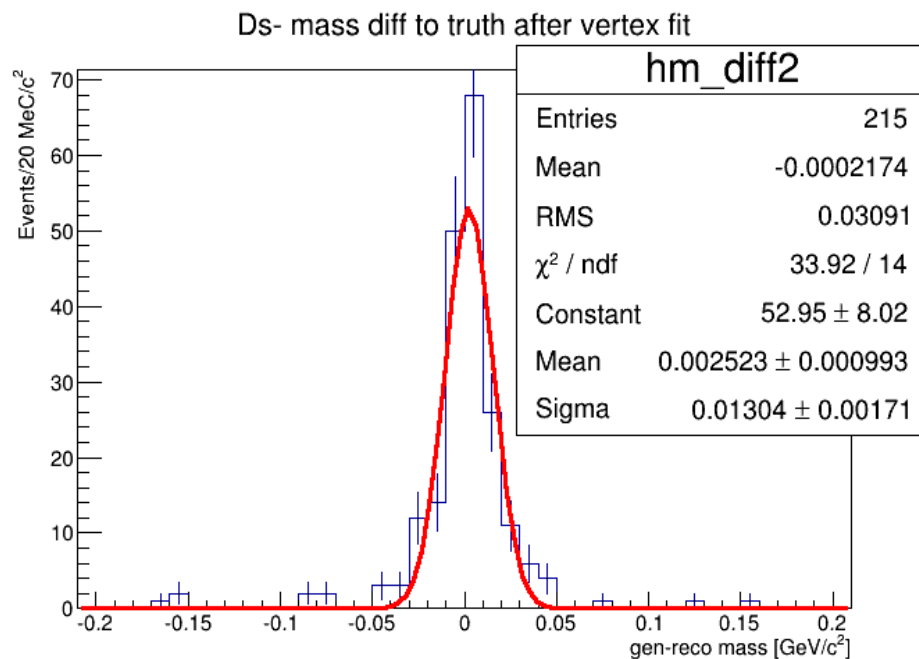
Motivation:

- Study of the mixing of $D_{s1}(2536)^+$ and $D_{s1}(2460)^+$
- Study of chiral symmetry breaking [\Rightarrow precise measurement of ΔM]
- Study of the excitation function of the cross section in $p\bar{p} \rightarrow D_s^- D_{sJ}^+$



@ last meeting: release Jan14

Release: jan14, full simulation



- PID = “best”
- PndVtxFitter is used
- EvtGen: 10 000 events
- Full simulation
- D_s^- efficiency ~21%
- D_s resolution= 13.0 MeV/c²



- $D_{SJ}(XXX)$ efficiency very low due to the photon reconstruction problems.
- Idea: missing mass of the event to reconstruct $D_{SJ}(XXXX)^+$
- Check momentum smearing
- Similar reconstruction problems with all $D_{SJ}(XXXX)$ decaying to photons

@ today: scrut14

- Simulation is repeated in the new release `scrut14` (fast sim)

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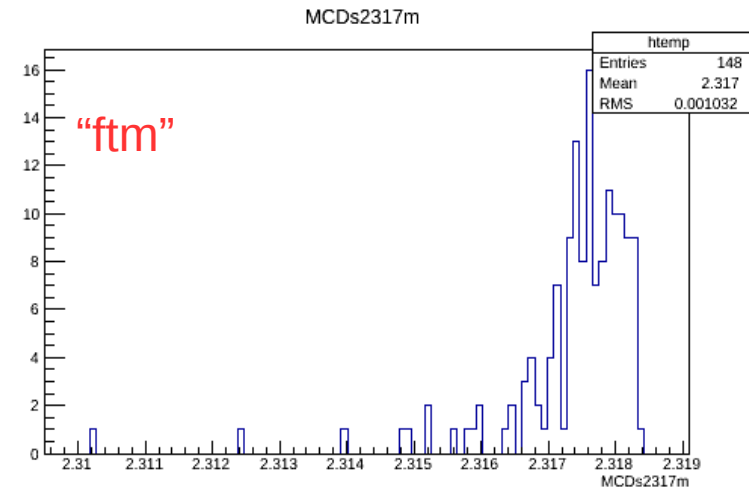
Decay pbarpSystem
1.0 D_s0*+  D_s-  PHSP;
Enddecay
#
Decay D_s0*+
  1.0 D_s+ pi0  PHSP;
Enddecay
#
Decay D_s+
  1.0 K- K+ pi+  DS_DALITZ;
Enddecay
Decay D_s-
  1.0 K+ K- pi-  DS_DALITZ;
Enddecay
#
Decay phi
  1.0 K+ K-  PHSP;
Enddecay
Decay pi0
  1.0 gamma gamma  PHSP;

```

**All results today:
Fast simulation
p = 8.8 GeV/c**

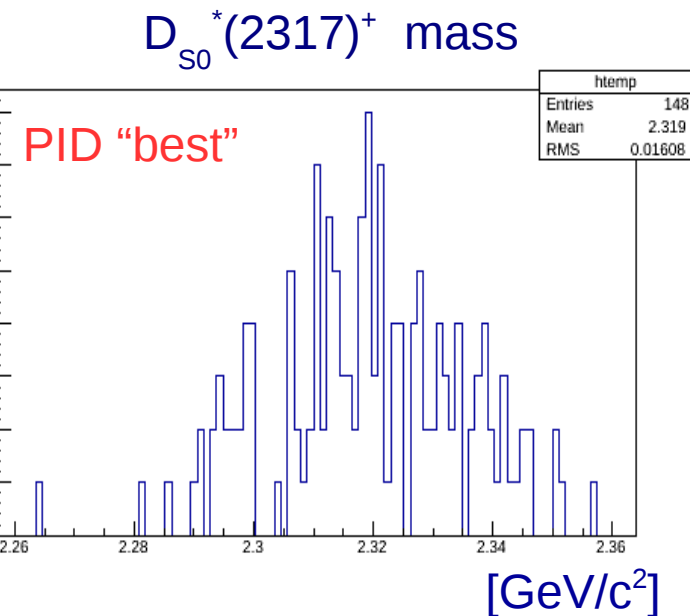
Mass reconstruction: $D_{S_0}^*(2317)^+$

- MC generator: 10000 events
- PID: “Best”
- Tracks: $p > 100$ MeV/c
- Reconstructed: 148 events



$$\bar{p}p \rightarrow D_S^- D_S(2317)^+$$

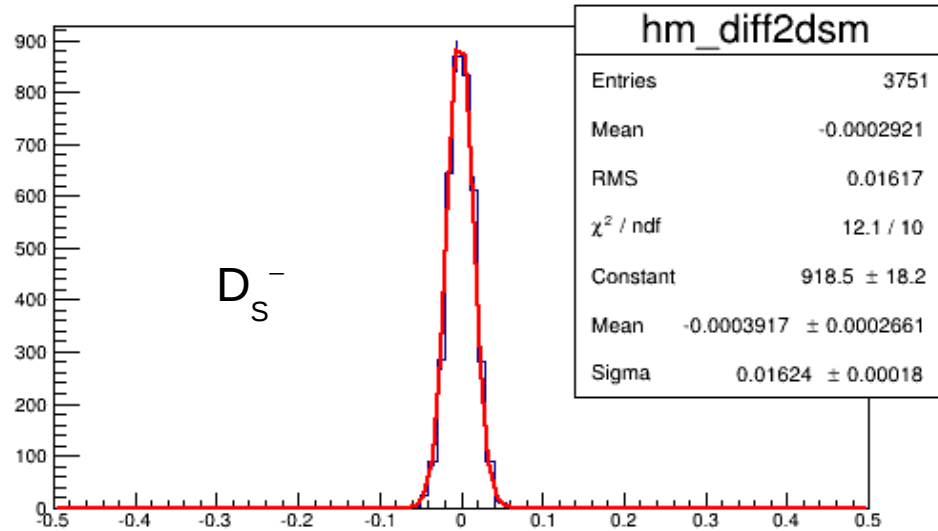
- Need to improve the reconstruction efficiency: missing mass of the event
- $D_{S_0}^*(2317)^+$ will be reconstructed on the recoil of D_S^-
- Advantage: charged particles are easy to reconstruct with PandaRoot; expected better reconstruction efficiency and mass resolution



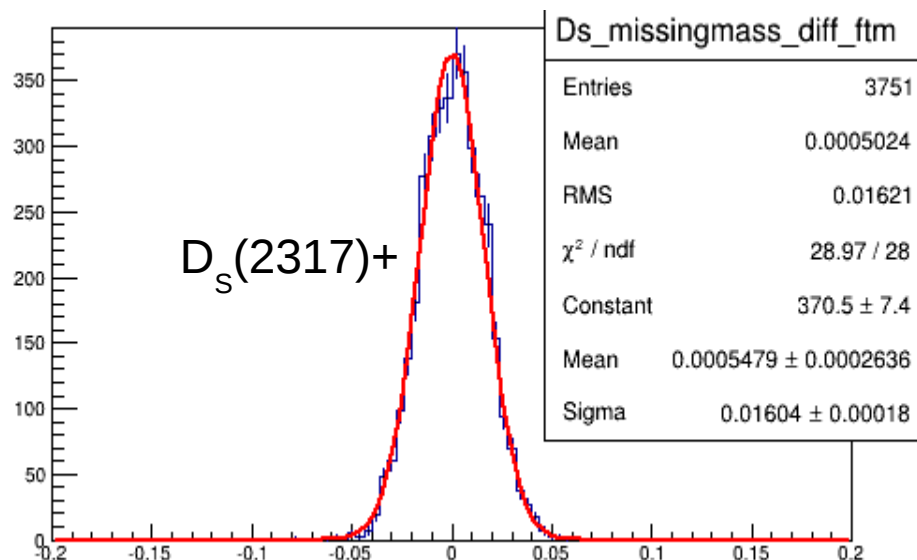
Missing mass of D_s^- : $D_s(2317)^+$

true – reco mass [GeV/c²]

Ds- mass diff to truth after vertex fit



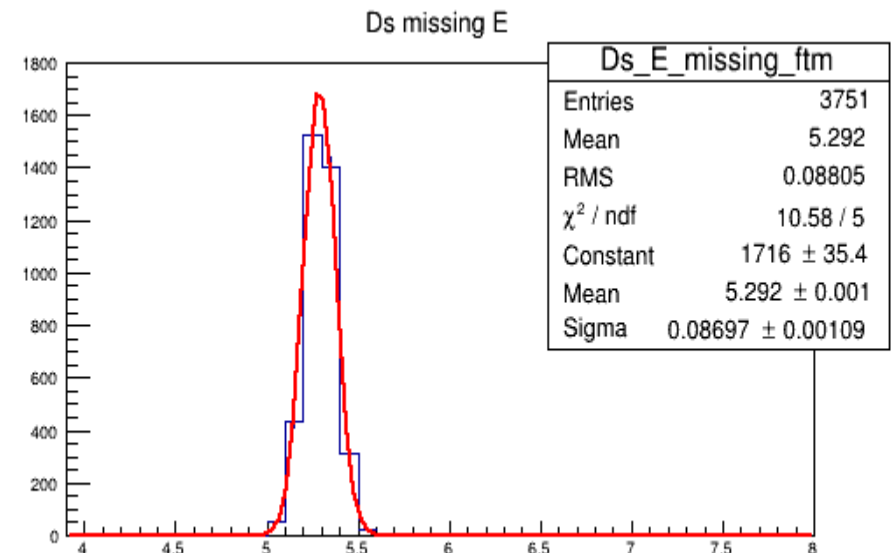
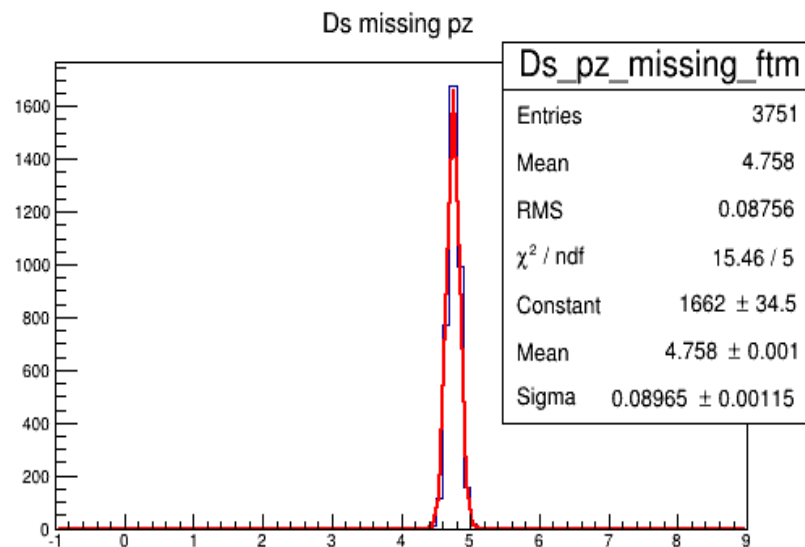
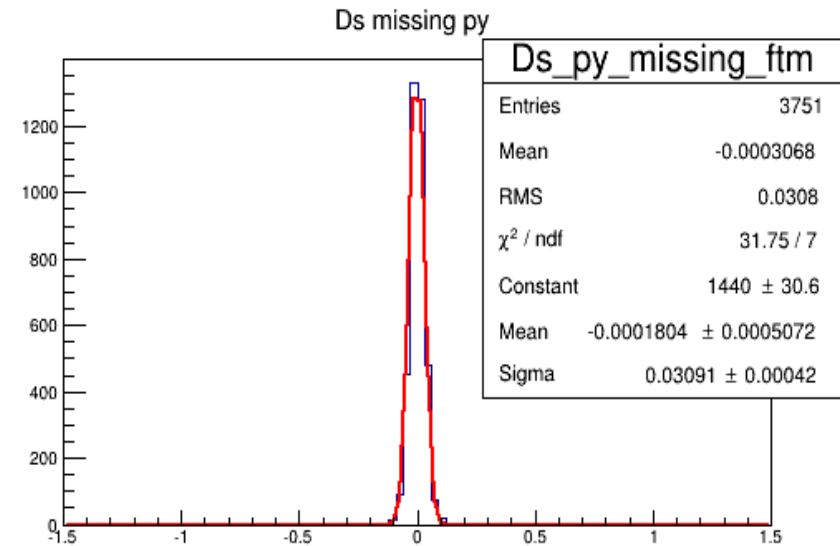
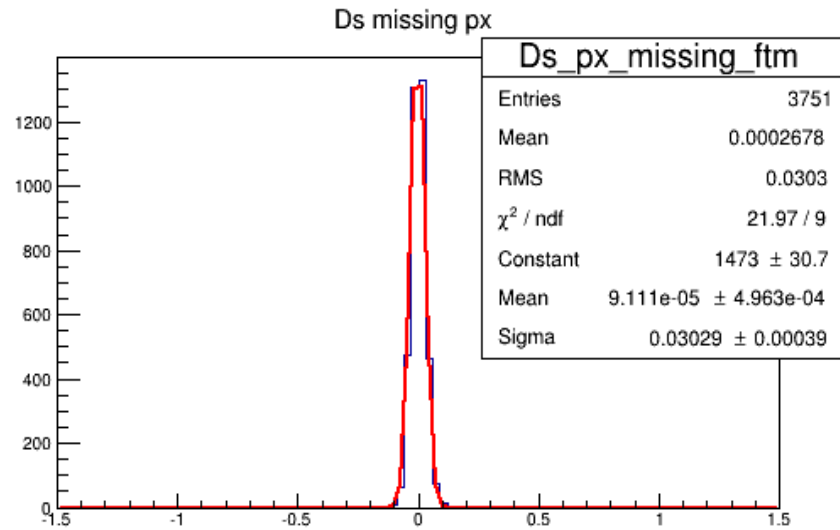
- 3751/10000 ~ 37.5% efficiency
- Mass resolution = 16 MeV/c²
- Selection cuts still needs to be optimized



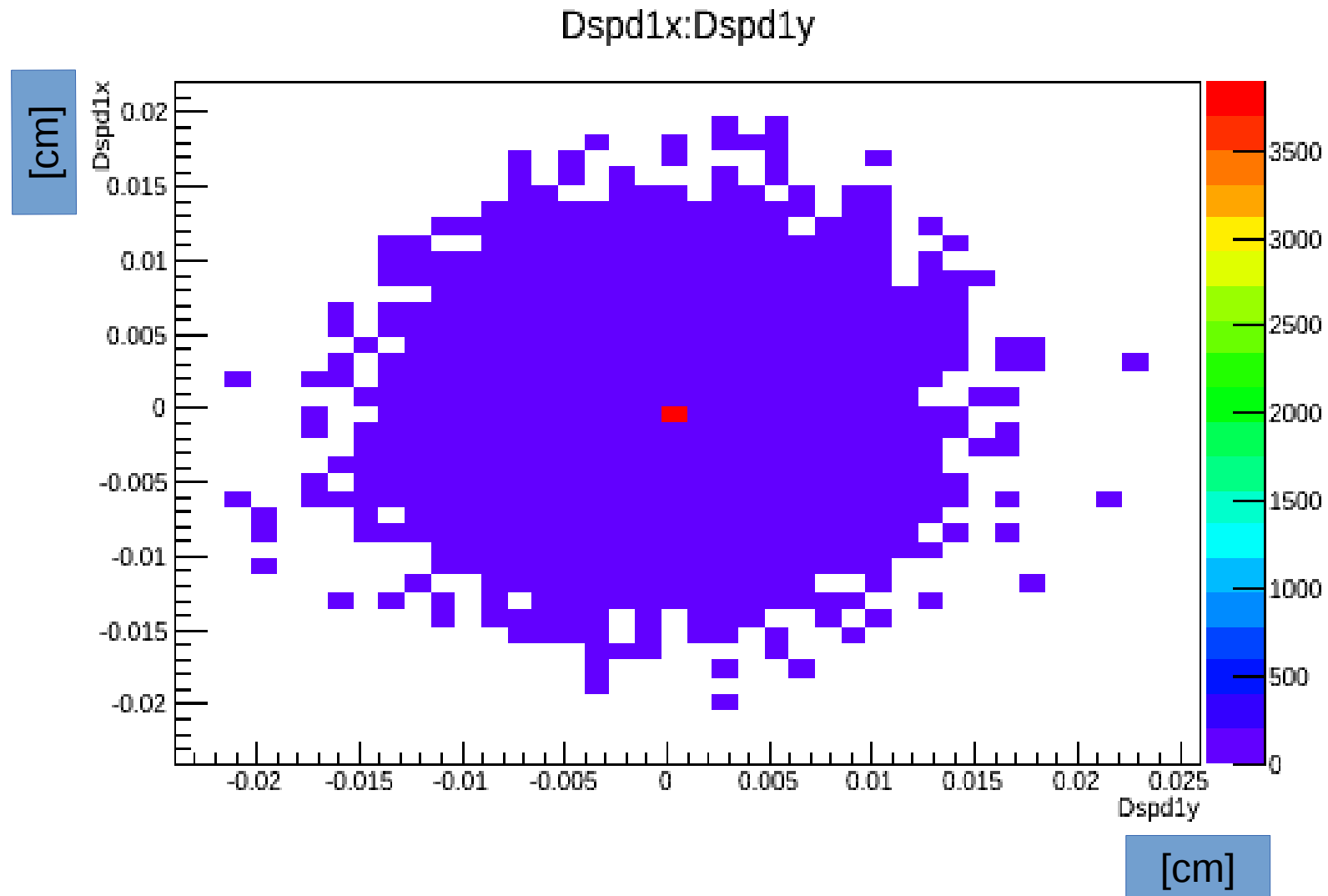
$\bar{p}p \rightarrow D_s^- D_s(2317)^+$

- Mass resolution: 16 MeV/c²
- PndVtxFitter is used

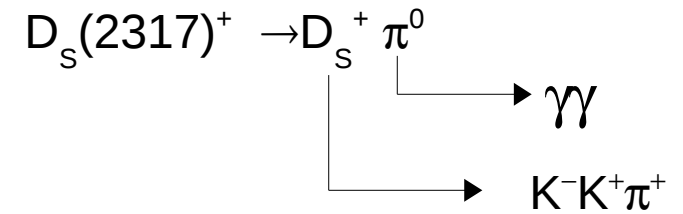
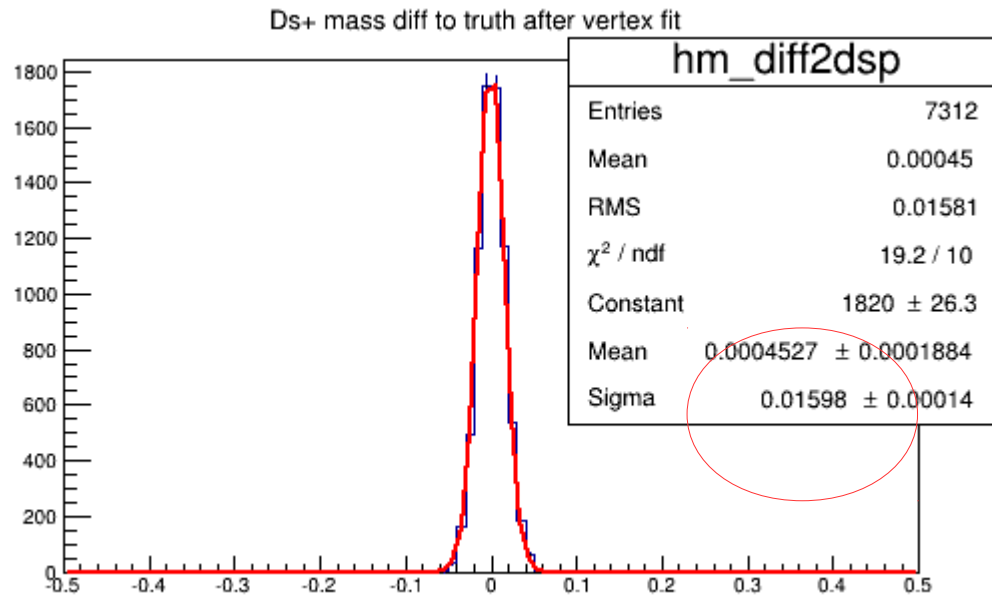
Missing momentum of D_s^- : $D_s(2317)^+$



Vertex resolution

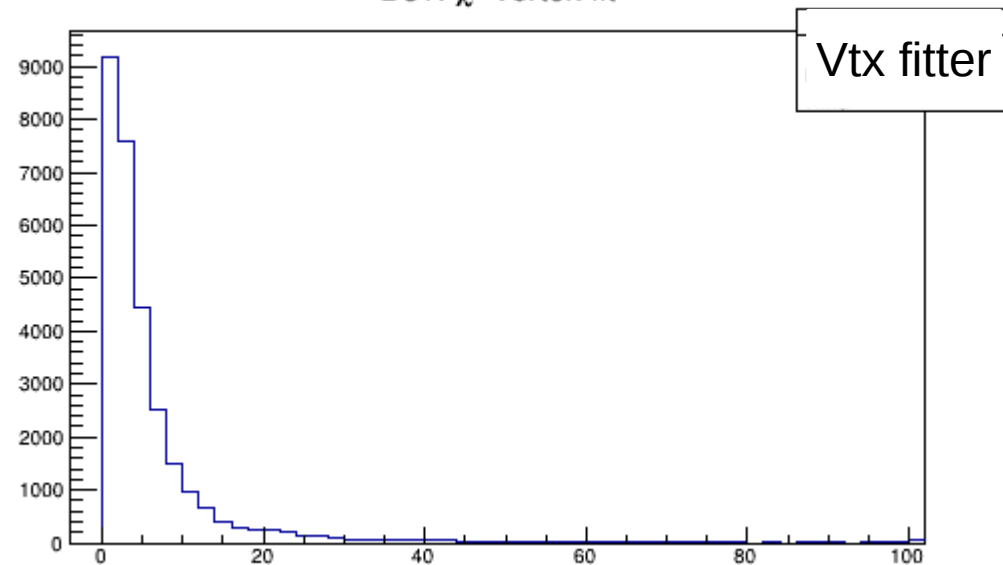


D_S⁺ reconstruction



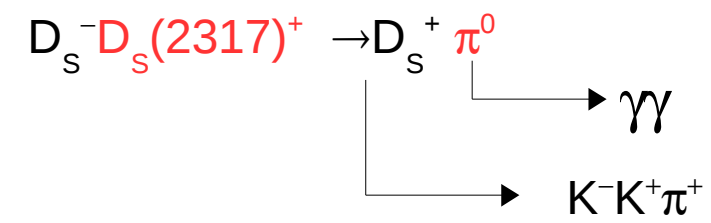
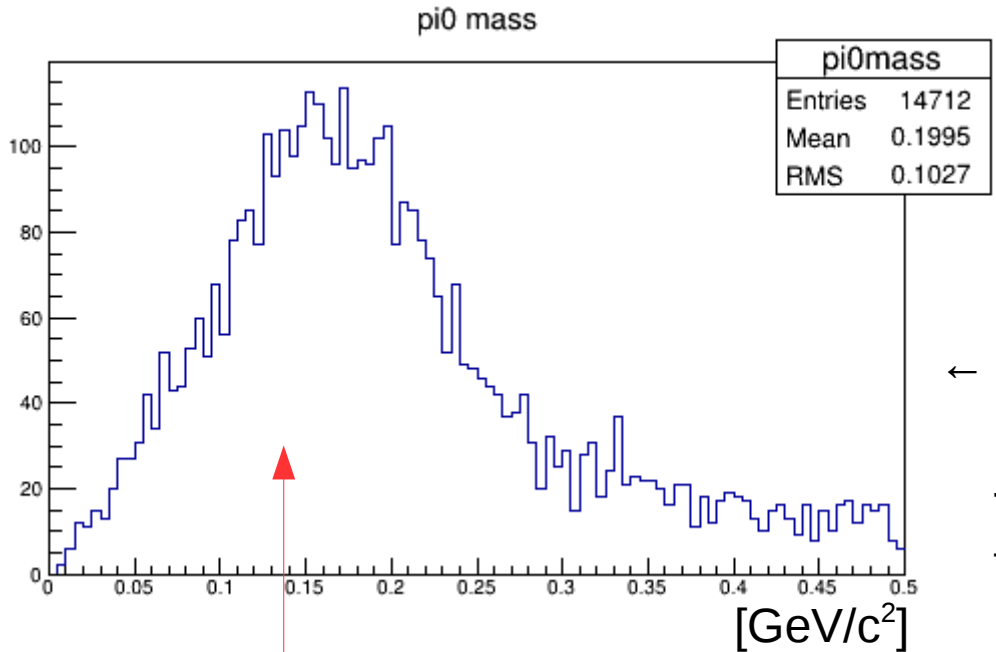
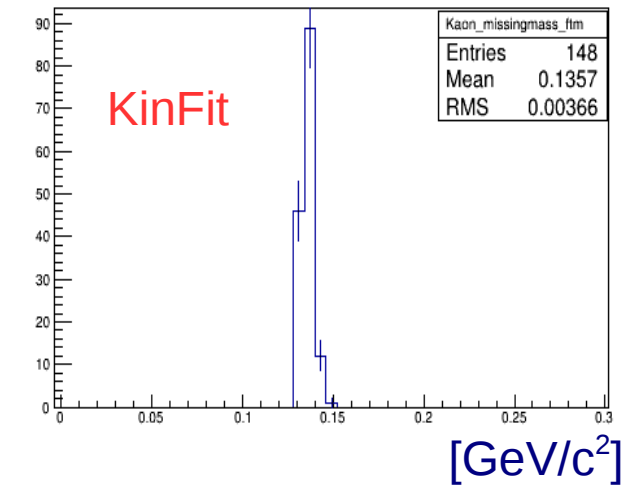
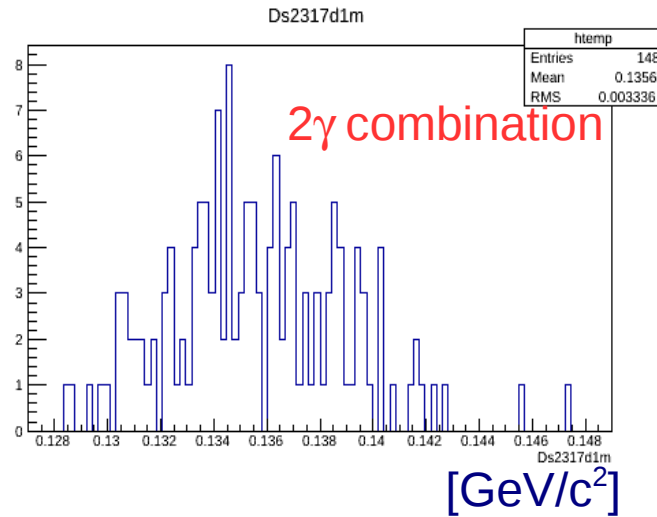
- PndVtxFitter is used
- The plan is to apply mass constraint fit to D_S⁺

Ds+: χ^2 vertex fit



π^0 reconstruction

2 photon reconstruction →
148/10000 events



← Missing mass of D_S^+
 Lot of background
 Technique of **energy-scaling** solves the problem (see Lu Cao talk!)

Comparison between fast sim and full sim

	Full sim	Fast sim	
$D_s(2317)^+$	130	148	✓
$D_s(2317)^+$ Missing mass of D_s^-	3500	3751	✓
Vtx_x, Vtx_y res	80 μm	48 μm	✓
Vtx_z res	250 μm	150 μm	✓
D_s^- mom resolution	52 MeV/c	56 MeV/c	✓
D_s^- mass resolution	16 MeV/c ²	16 MeV/c ²	✓

- The table shows the entries/10000 generated events
- Vtx resolution is found tighter with fast sim

Summary

- Simulations in the release scrut14 have started for Charm analysis
- Fast simulations give reasonable results
- Very low reconstruction efficiency for D_{S^*} mesons
- Study of the missing mass of the event shows improvement: reconstruction efficiency is much better
- Simulations of background with DPM: work in progress

...to be continued...