Status of $\overline{\mathrm{p}}\mathrm{p} \to \overline{\Xi}^{+}\Xi^{-}(1690)$

Event generator and detector response

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25 February 2015

Hyperon SeeVogh Meeting

Mitglied der Helmholtz-Gemeinschaft

Outline

- Investigated channel
- Event generator output (EvtGen)
- Detector response (hit counts)

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Investigated Channel

- Excited cascade: $\bar{p}p \to \bar{\Xi}^{+}\Xi^{-}(1690)$
  - Not much is known for $\Xi^{-}(1690)$
  - Production threshold at 3012 MeV
    (J/Ψ: 3097 MeV)

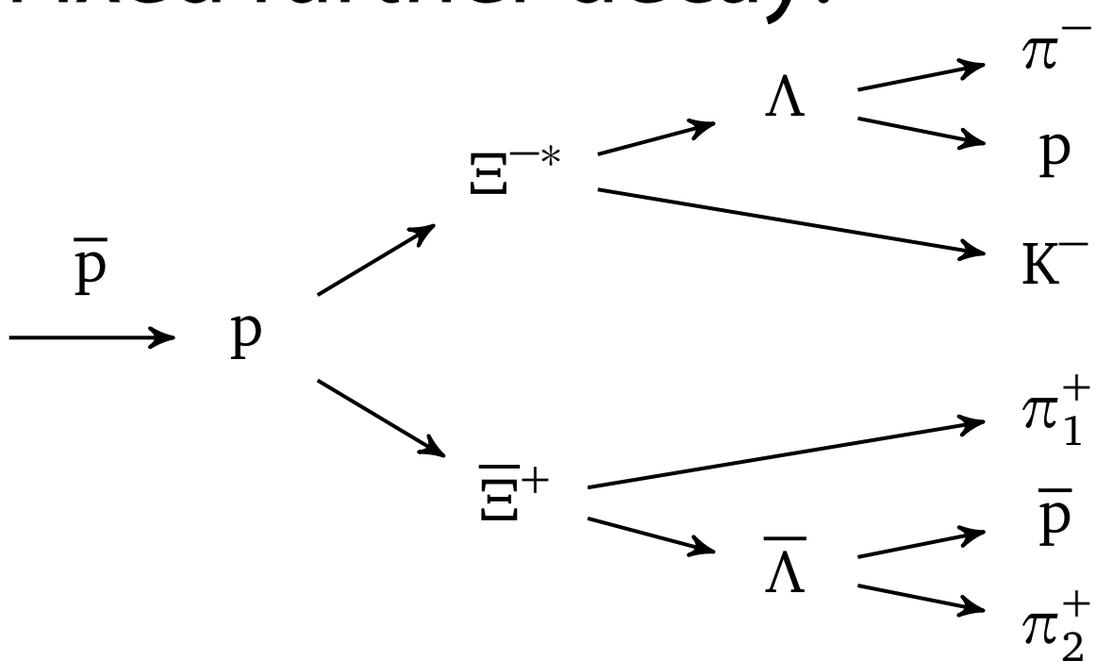
Ξ(1690) $I(J^P) = \frac{1}{2}(?^?)$

Mass $m = 1690 \pm 10$ MeV [c]
Full width $\Gamma < 30$ MeV

Ξ(1690) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda\bar{K}$	seen	240
$\Sigma\bar{K}$	seen	70
$\Xi\pi$	seen	311
$\Xi^{-}\pi^{+}\pi^{-}$	possibly seen	213

http://pdg.lbl.gov/, summary tables, generated on 2015-02-24

- Fixed further decay:



Note: Ξ^{-*} in my case always $\Xi^{-}(1690)$.

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Simulation Input

- Beam momentum: 4.07 GeV/c (= threshold for J/Ψ)
- PandaRoot: oct14
- Production model: PHSP
- Number of events: 100 000

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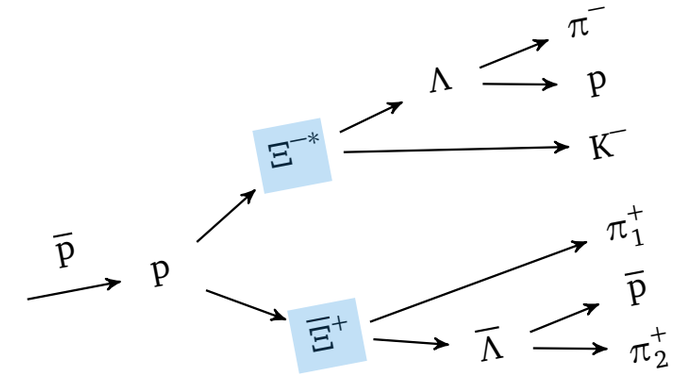
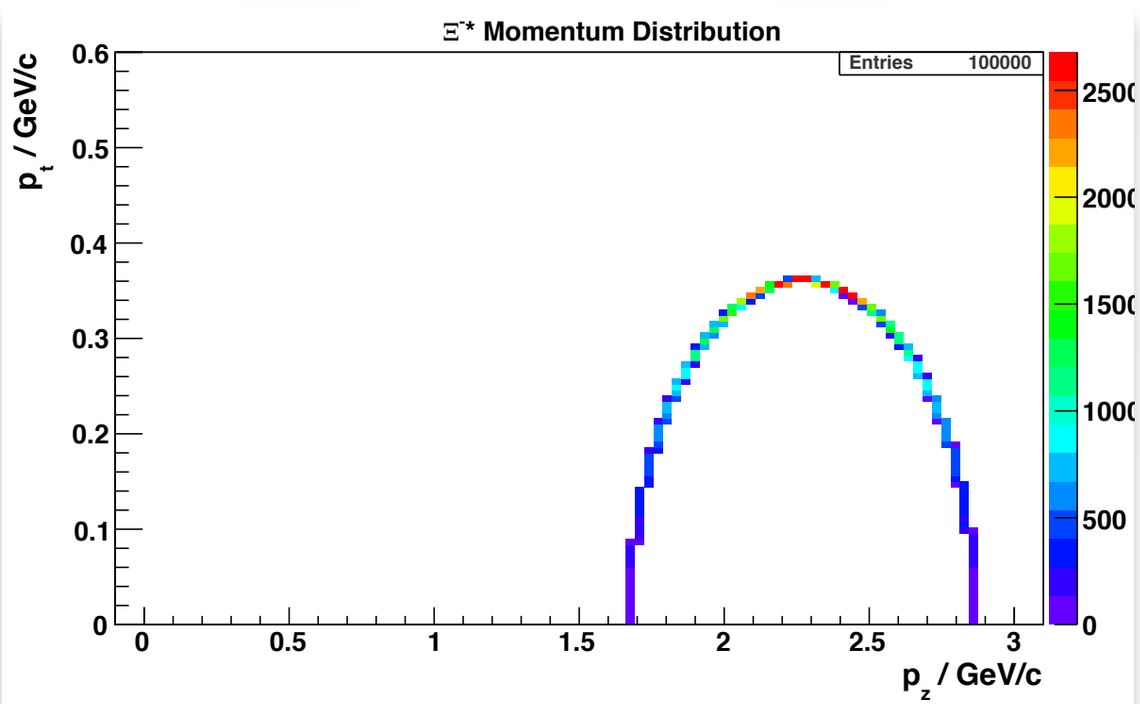
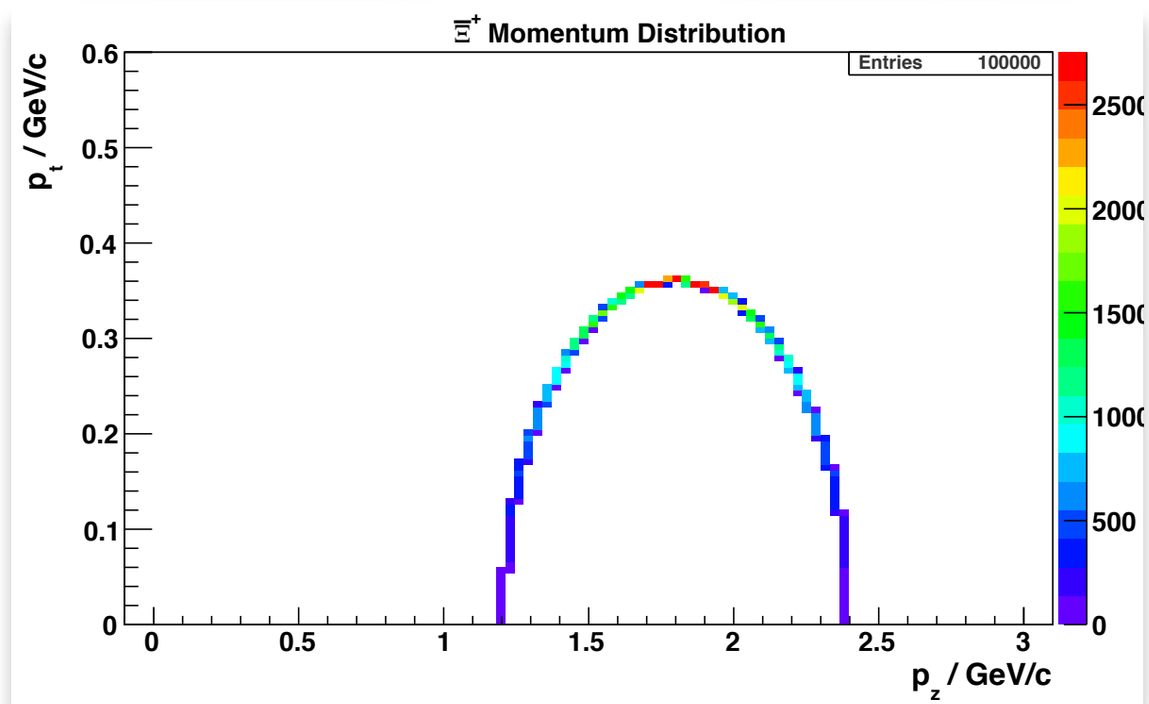
EvtGen — Momentum Distribution Ξ



Xi



$\overline{\text{Xi}}$



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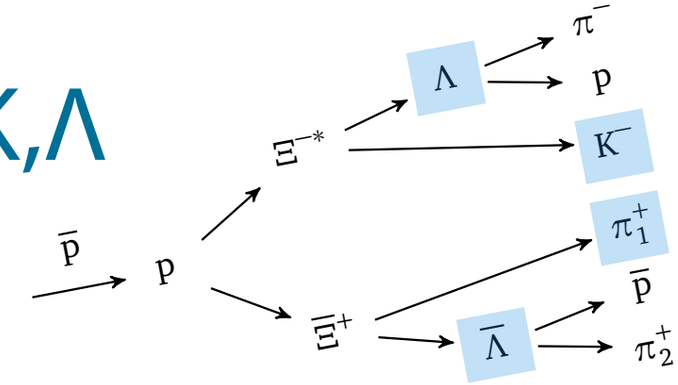
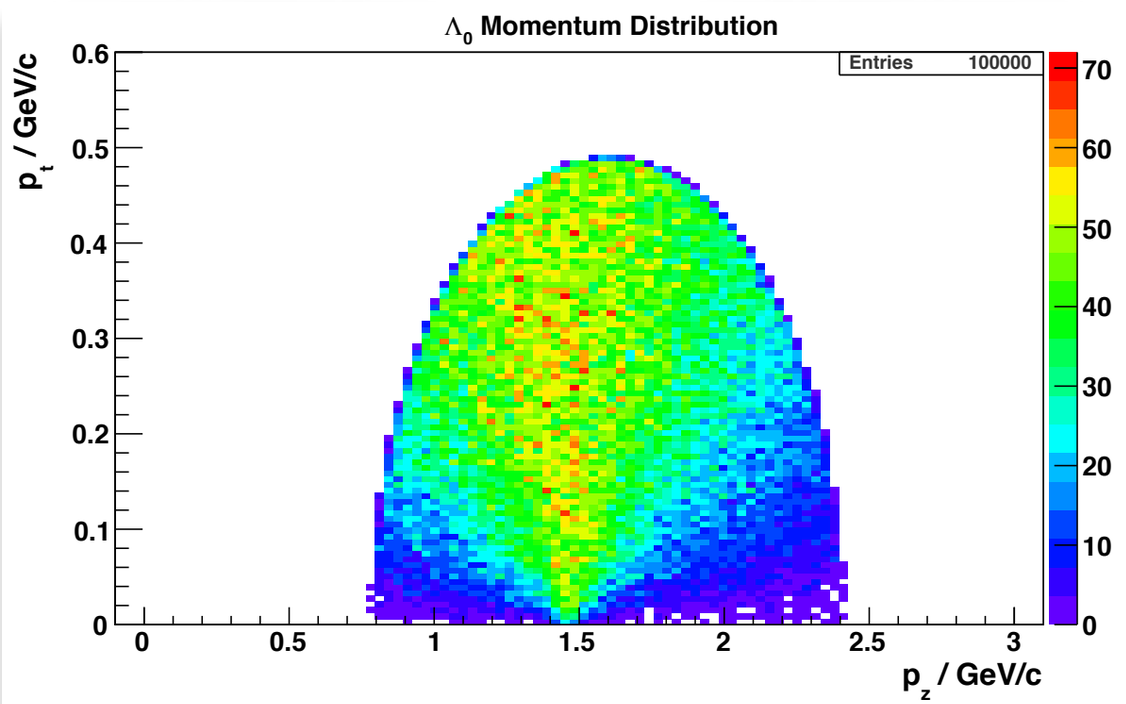
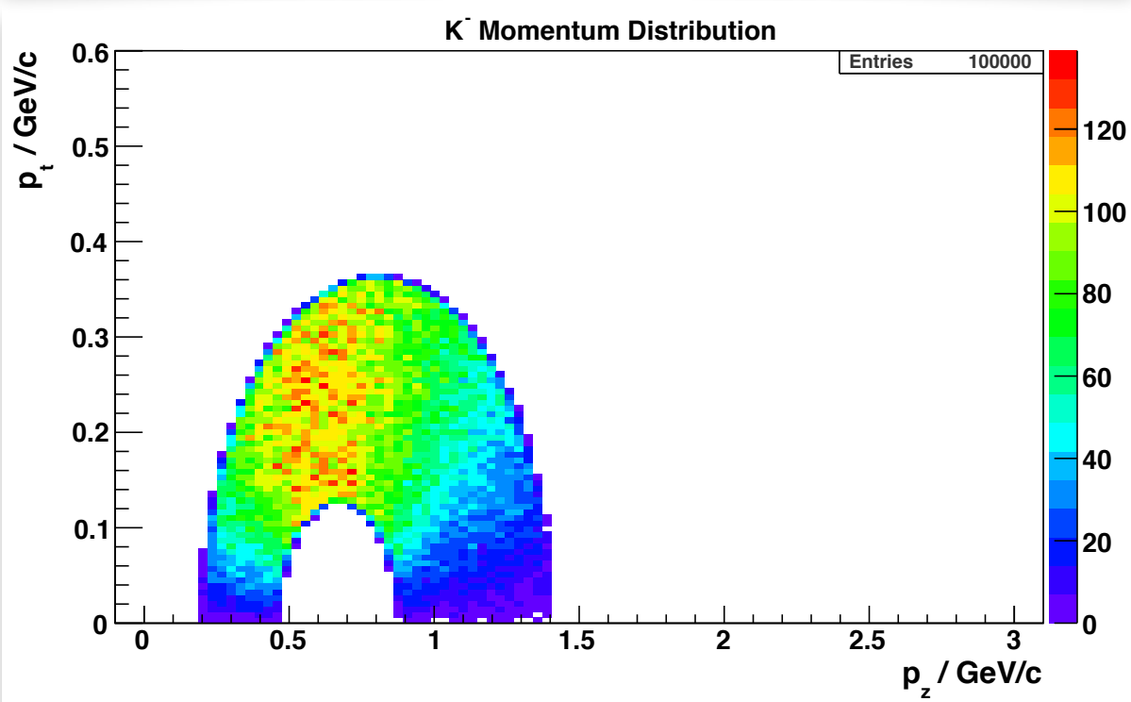
EvtGen — Momentum Distribution π,K,Λ

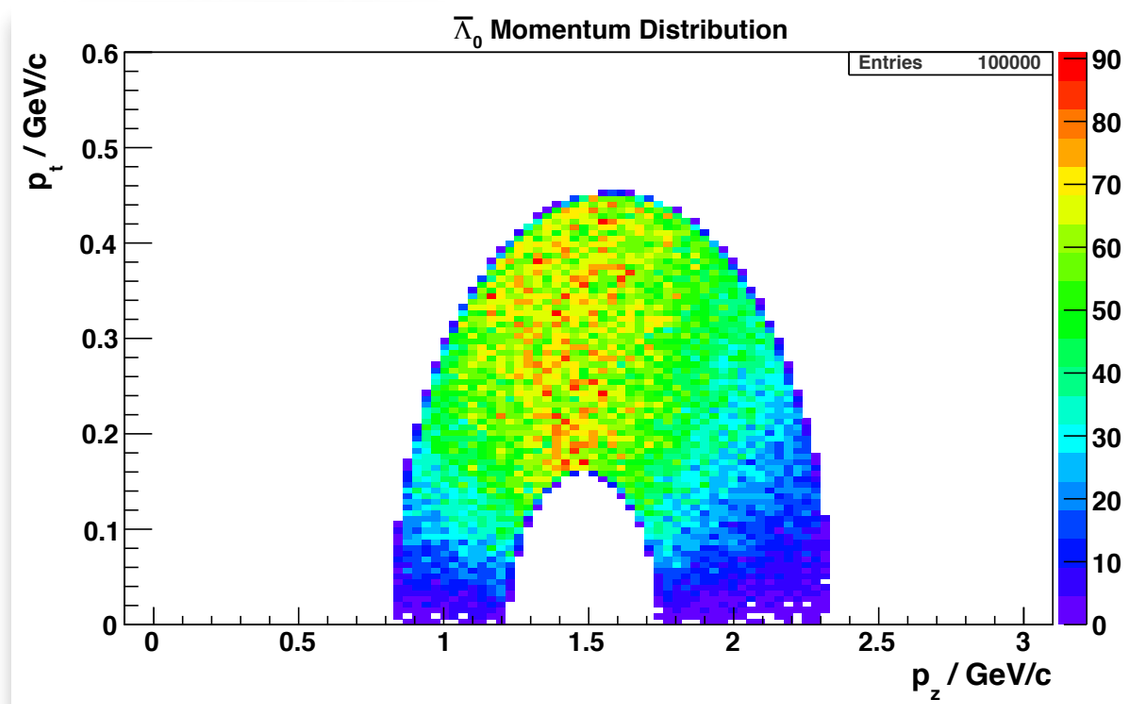


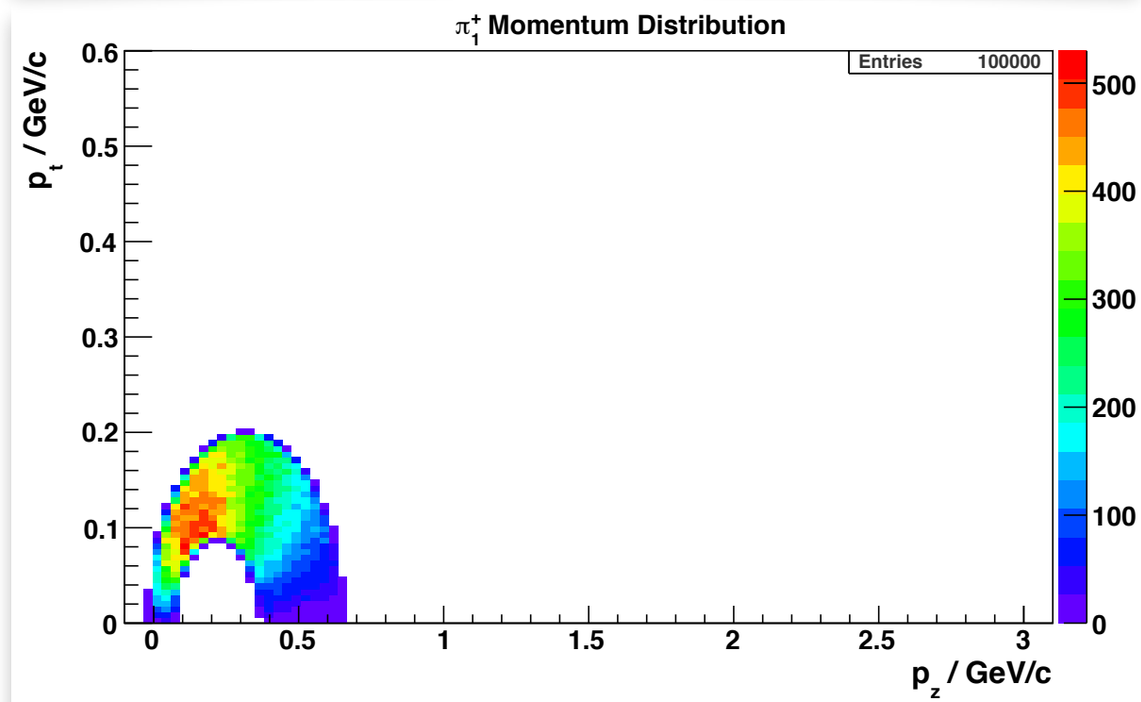
Xi





$\overline{\text{Xi}}$





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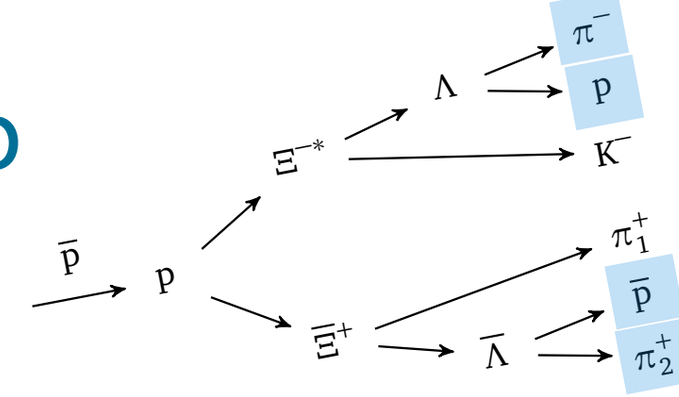
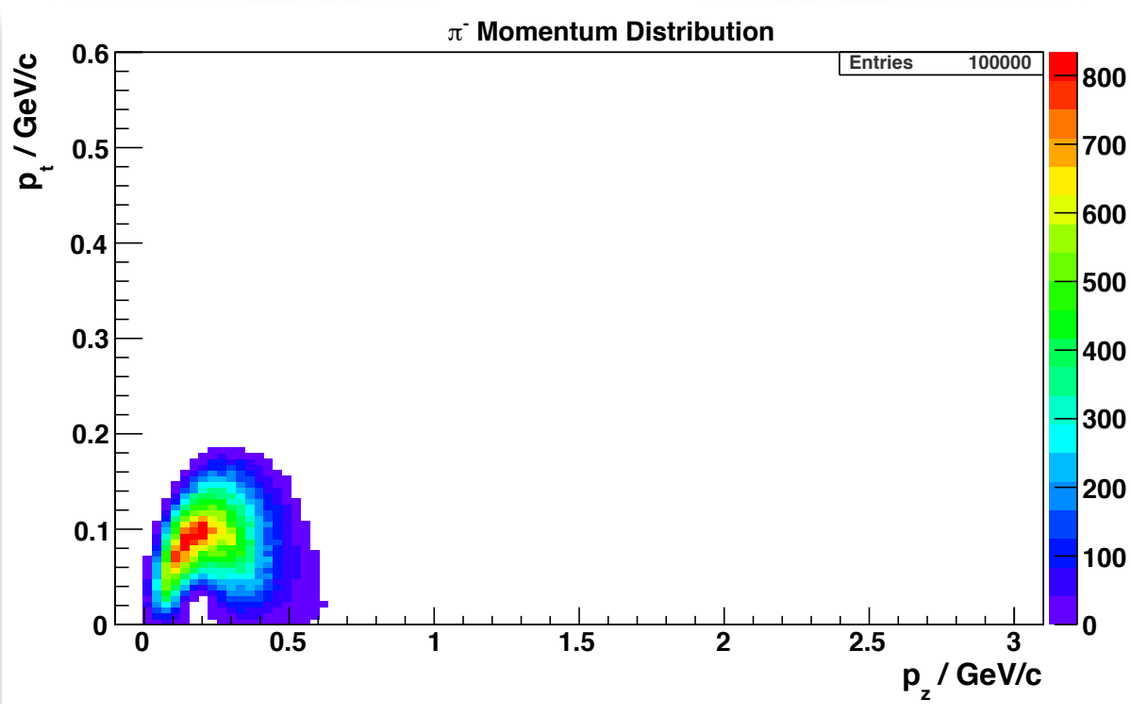
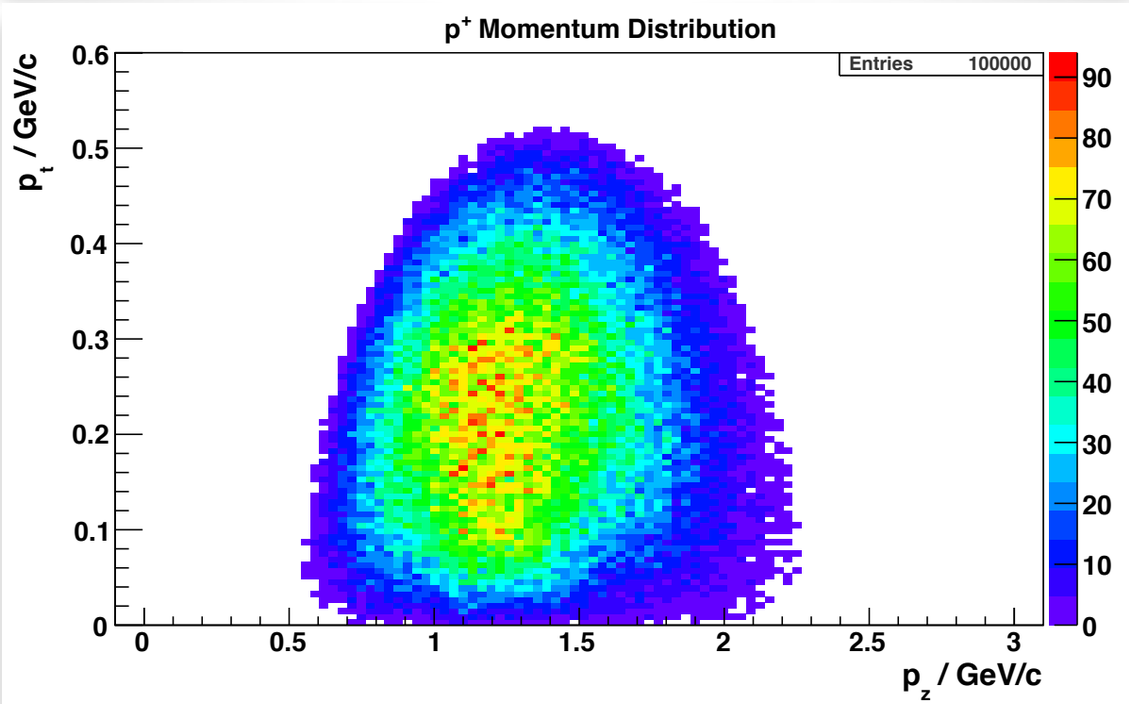
EvtGen — Momentum Distribution π,p

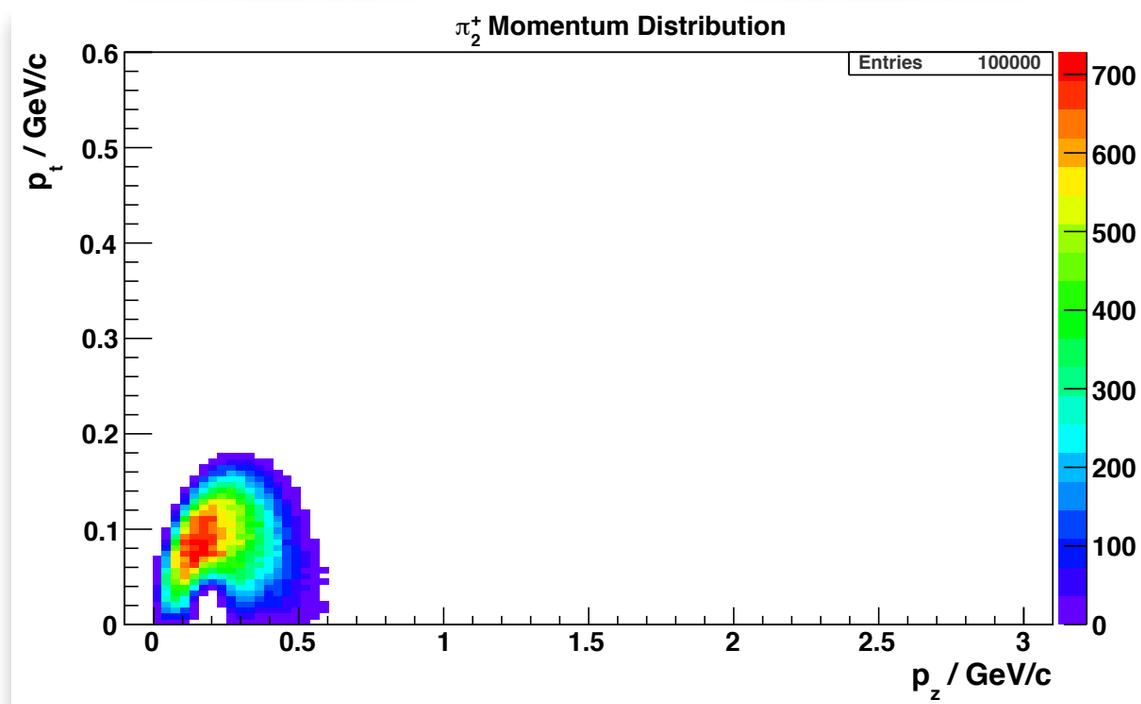


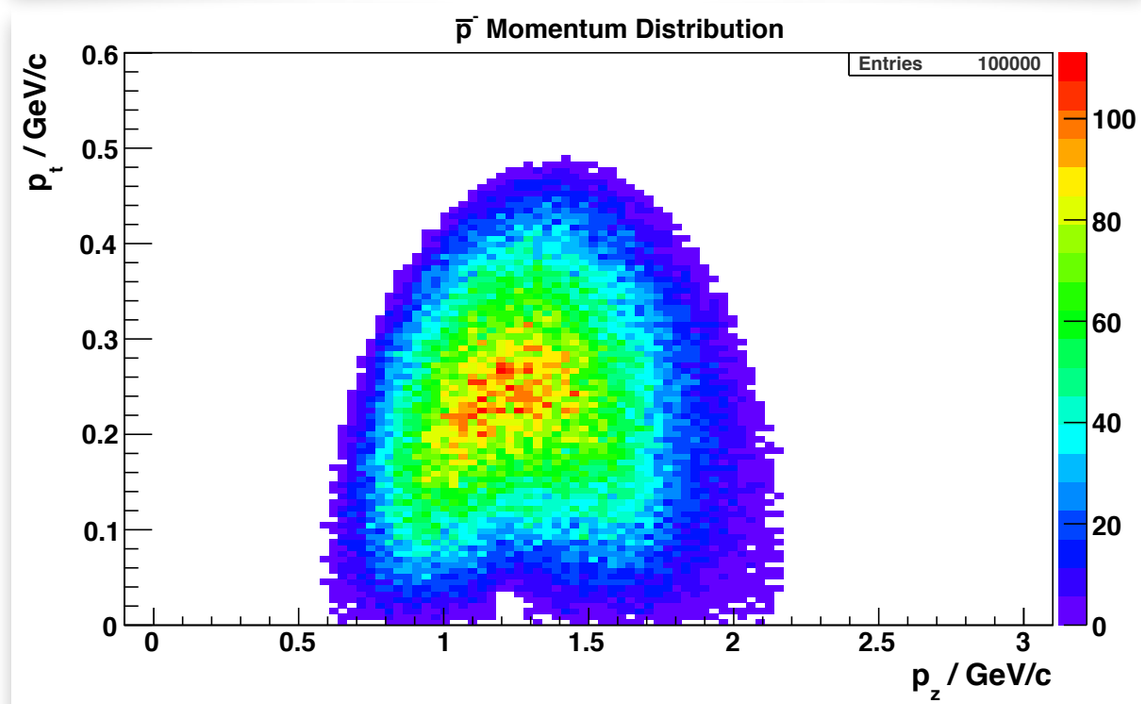
Xi





$\overline{\text{Xi}}$





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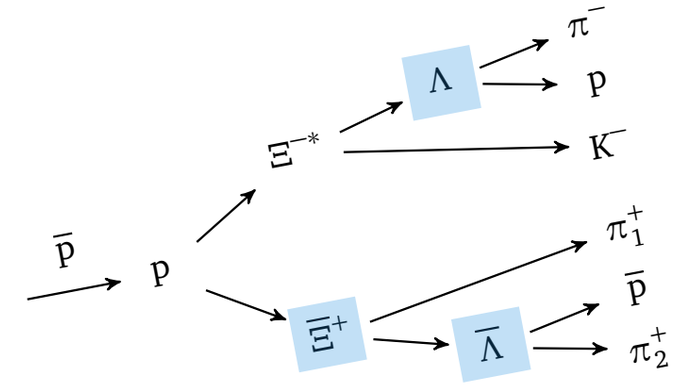
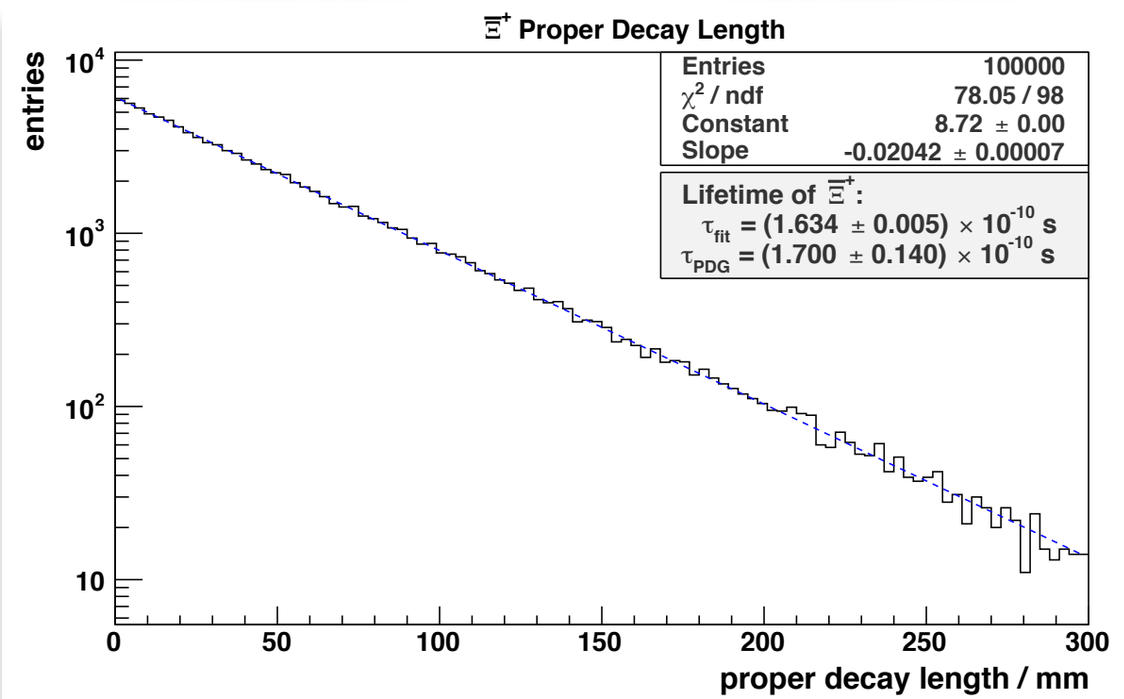
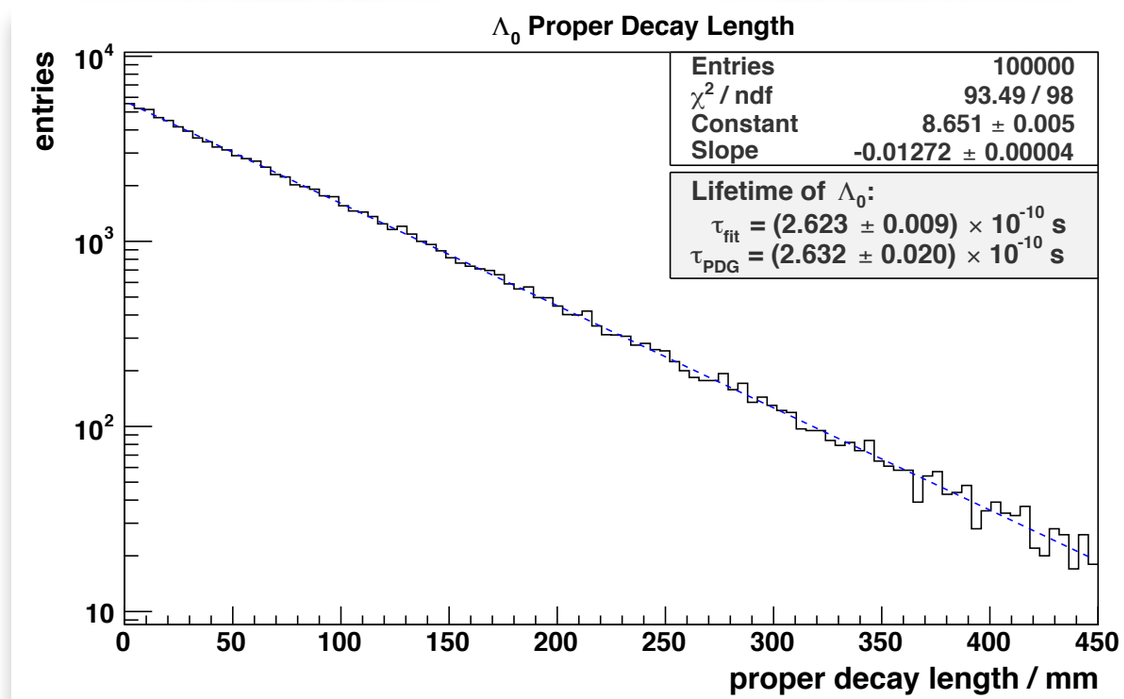
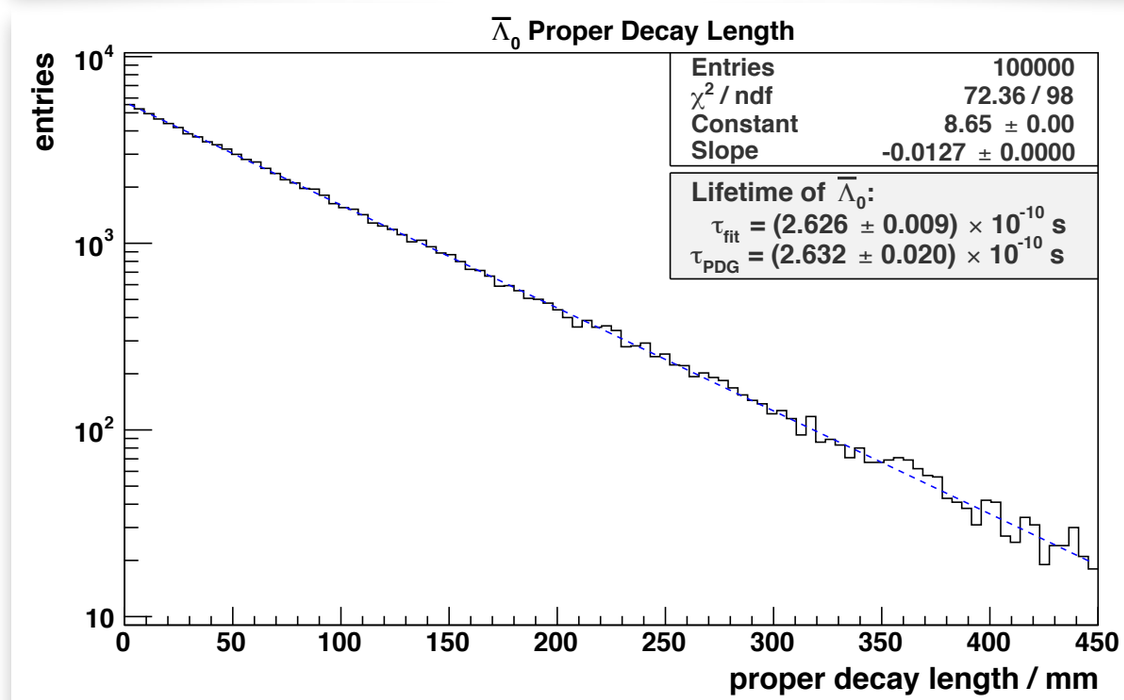
EvtGen — Proper Time Distribution





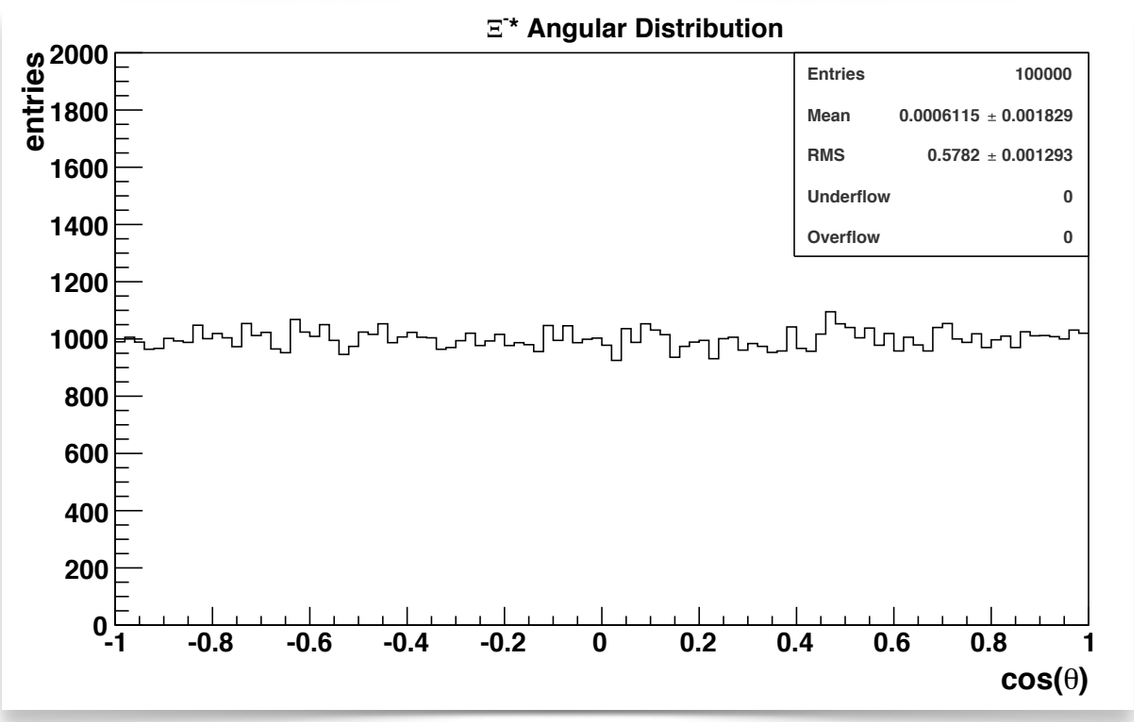


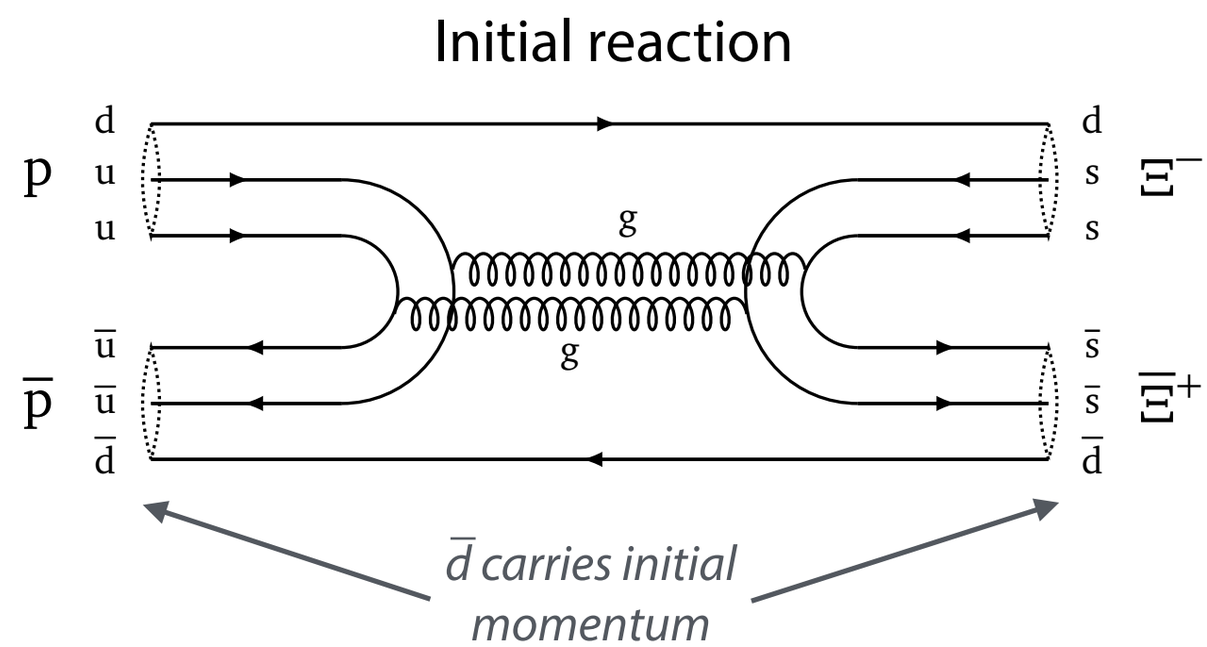
All values within the uncertainty given by PDG



Mitglied der Helmholtz-Gemeinschaft

EvtGen — cos(θ) Distribution





- cos(θ) distribution is flat (as expected from PHSP)
- Somewhat other distribution expected
  - One quark carries initial momentum
- No proper production model existing yet

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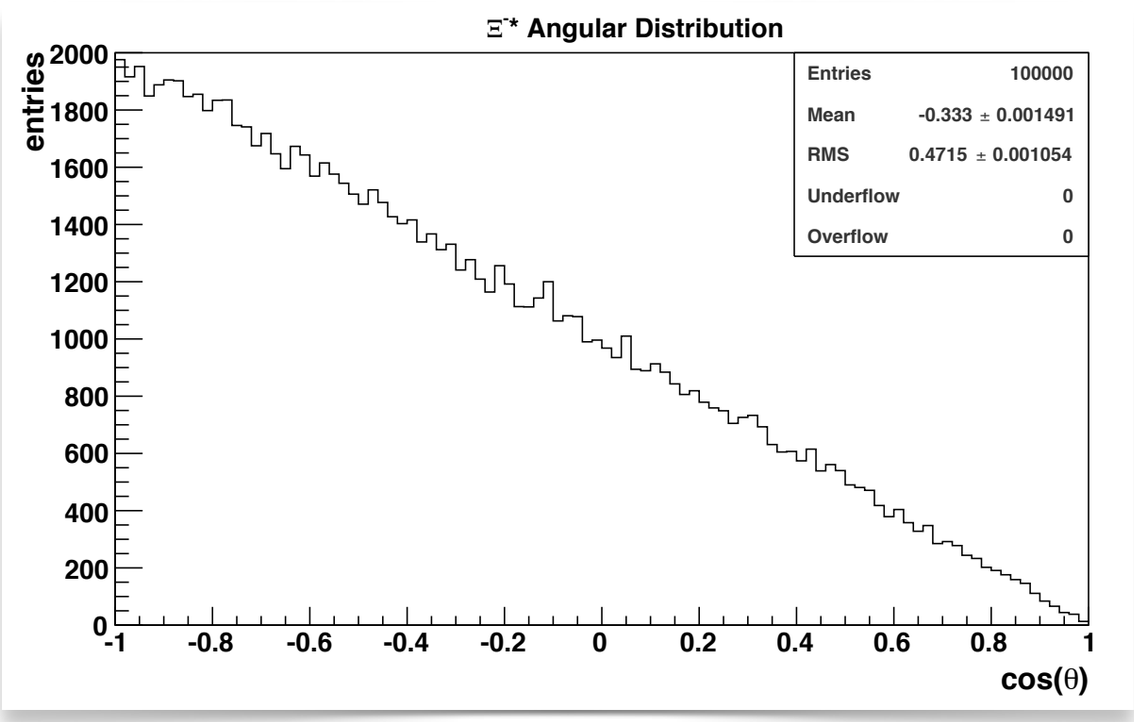
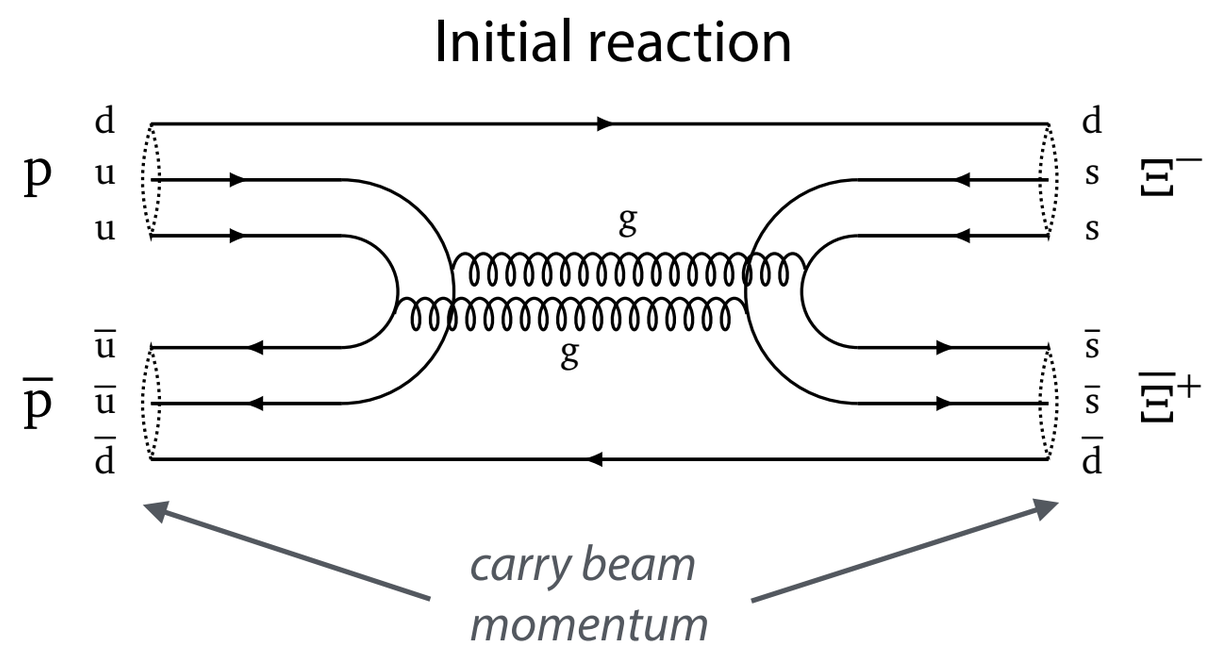
EvtGen — cos(θ) Distribution





- After EvtGen, filter events based on probability function
  - Time constraints, just a qualitative check for systematic effects
- Linear probability:
  - Maximum for $\overline{\text{Xi}}$ forwards (Xi backwards)
  - Minimum for $\overline{\text{Xi}}$ backwards (Xi forwards)

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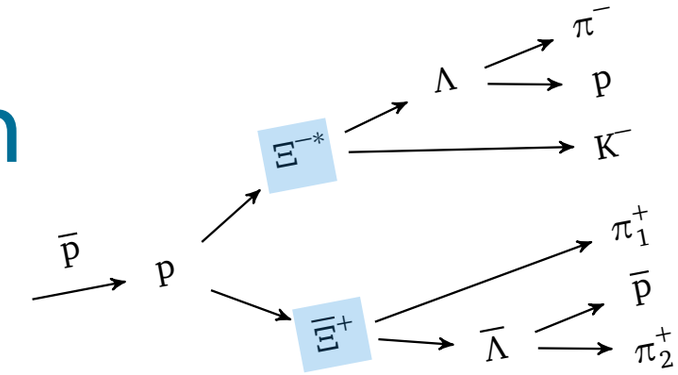
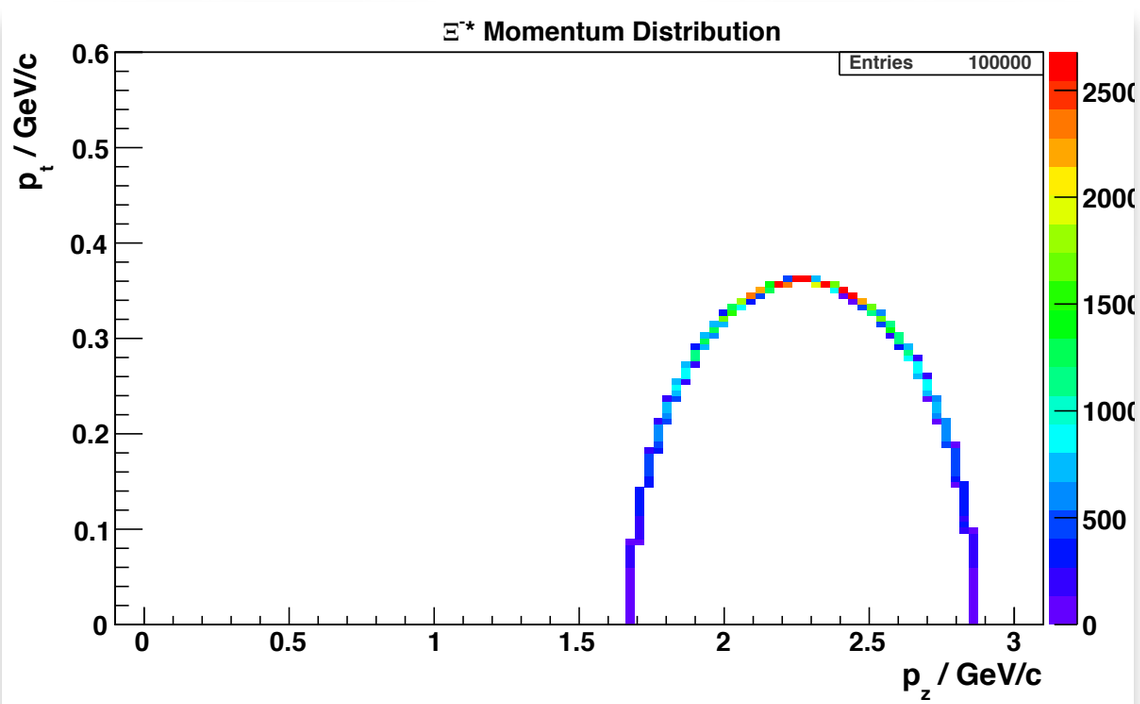
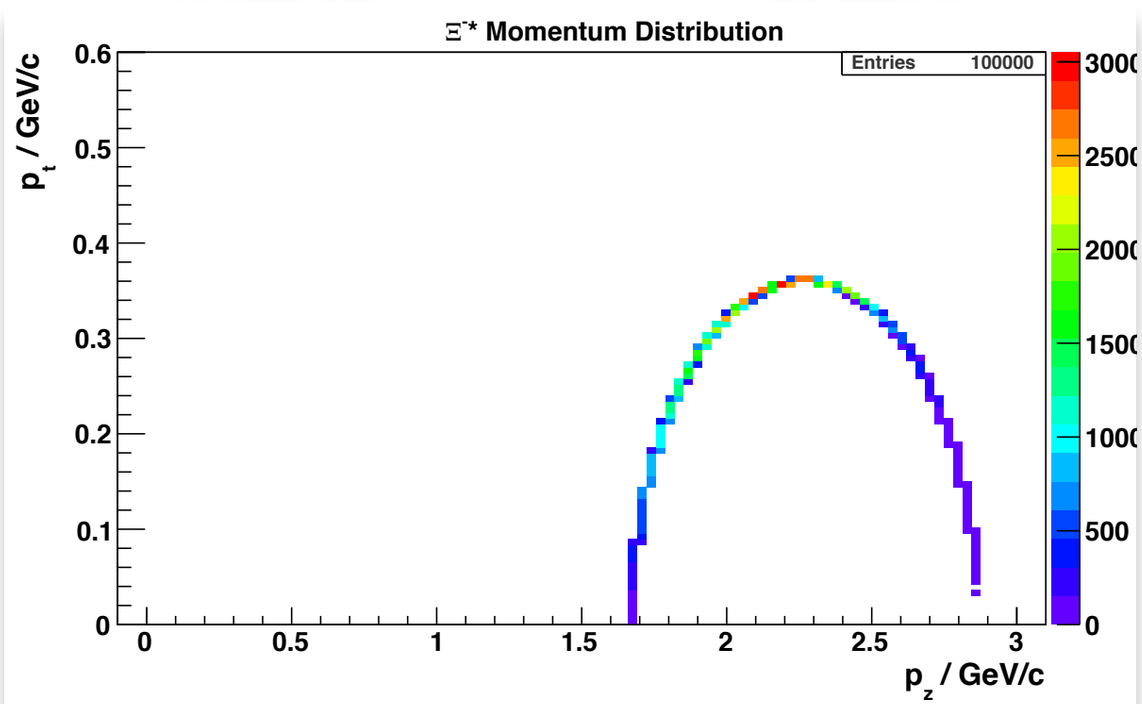
Filter Effect on Momentum Distribution

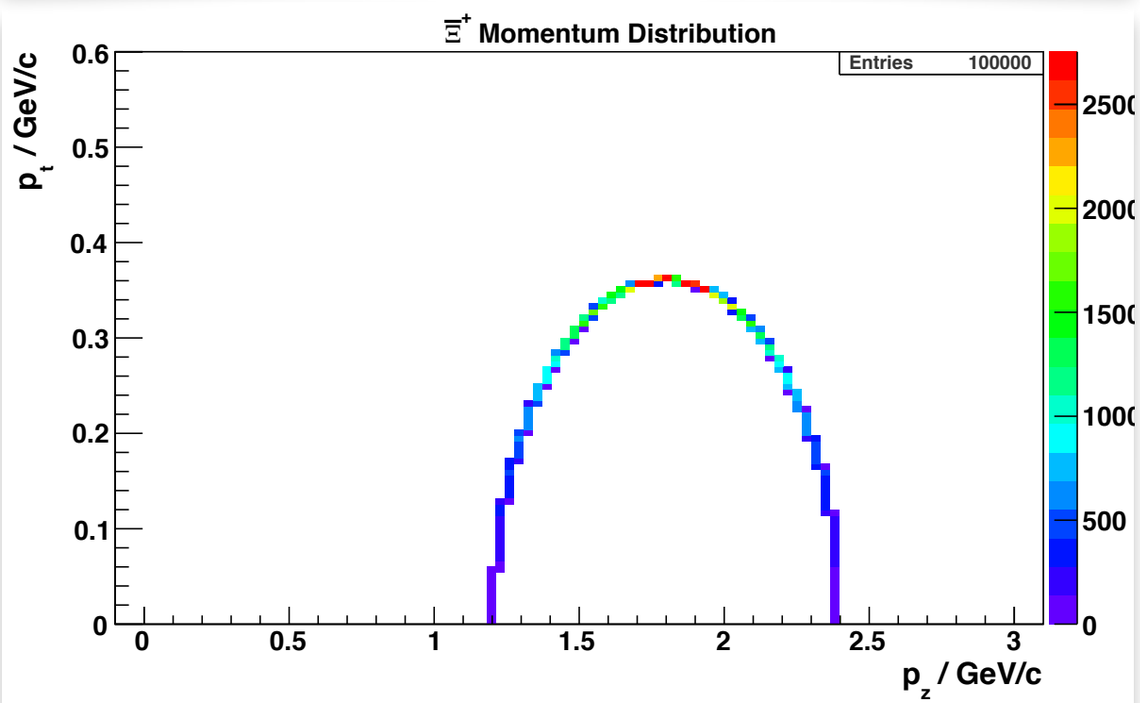


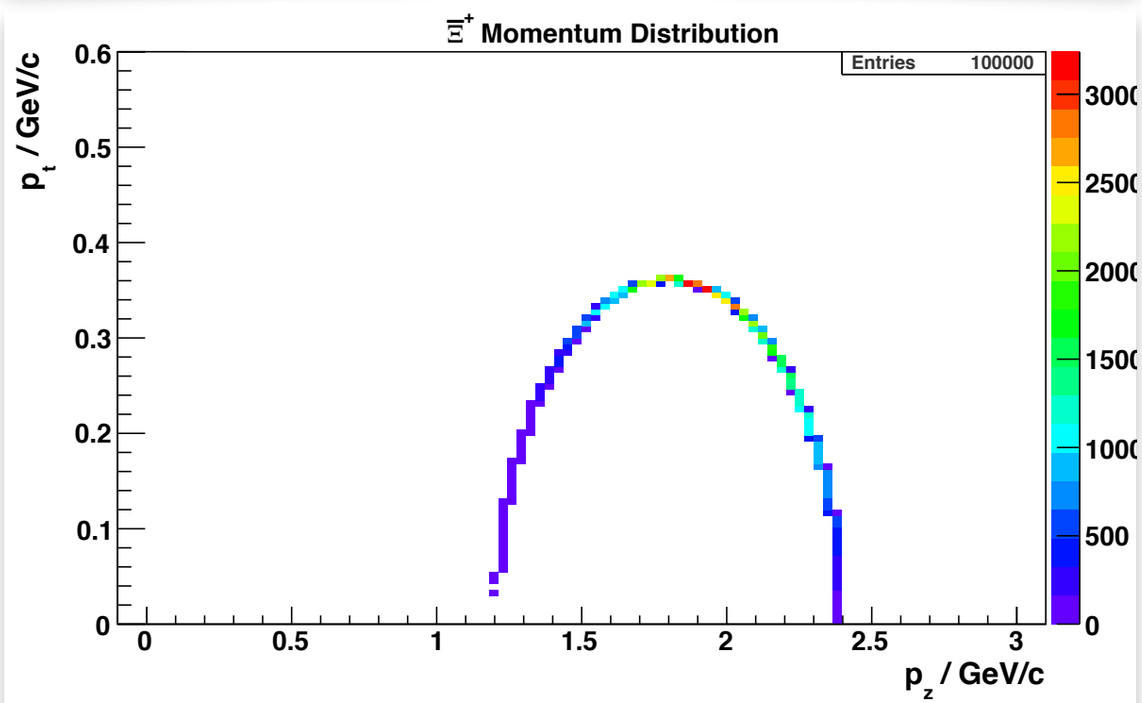
regular PHSP

filtered



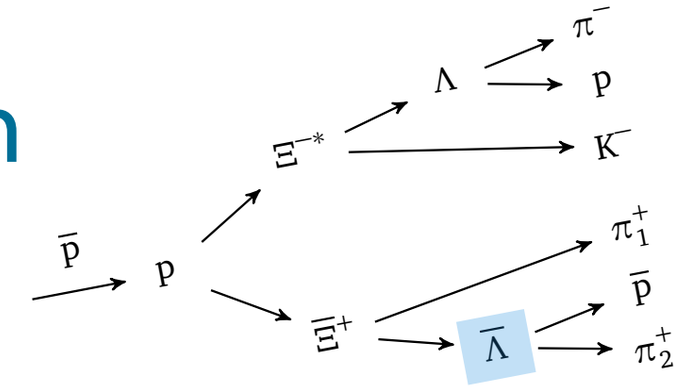




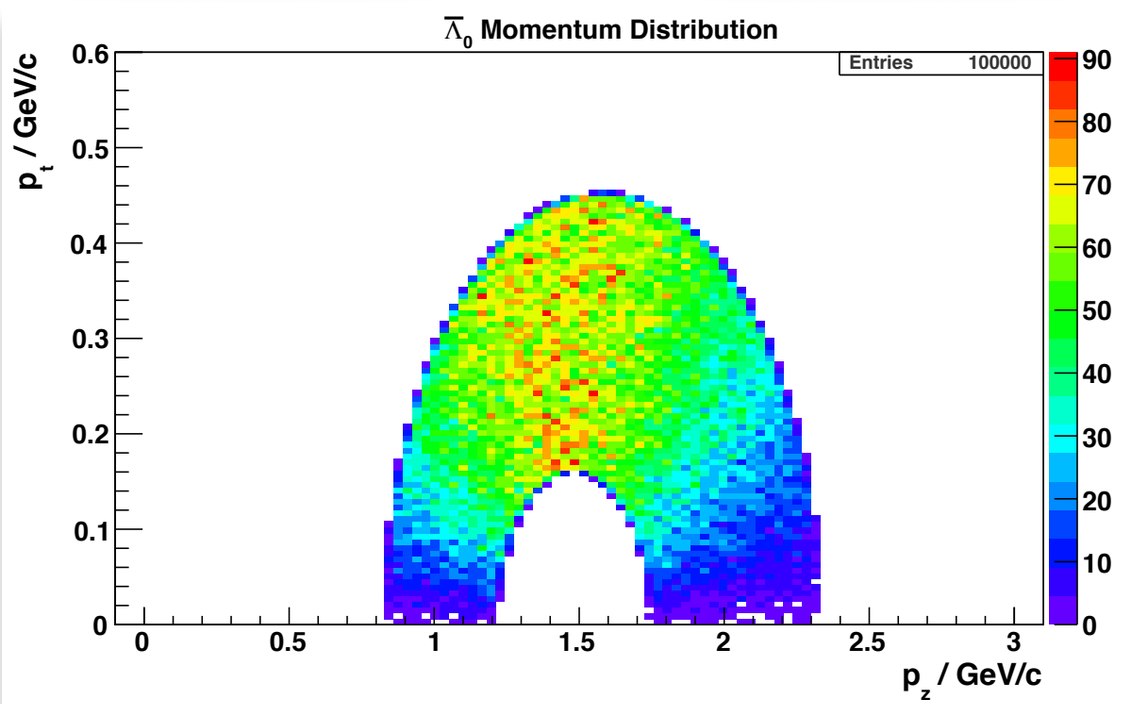


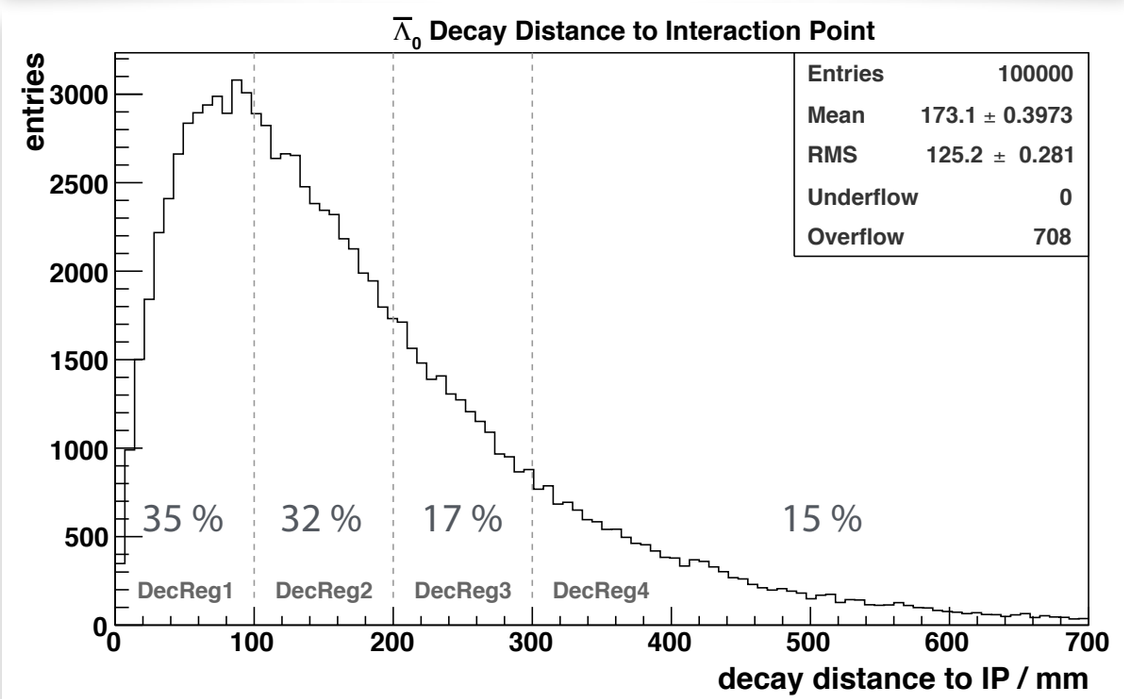
Mitglied der Helmholtz-Gemeinschaft

Filter Effect on Momentum Distribution

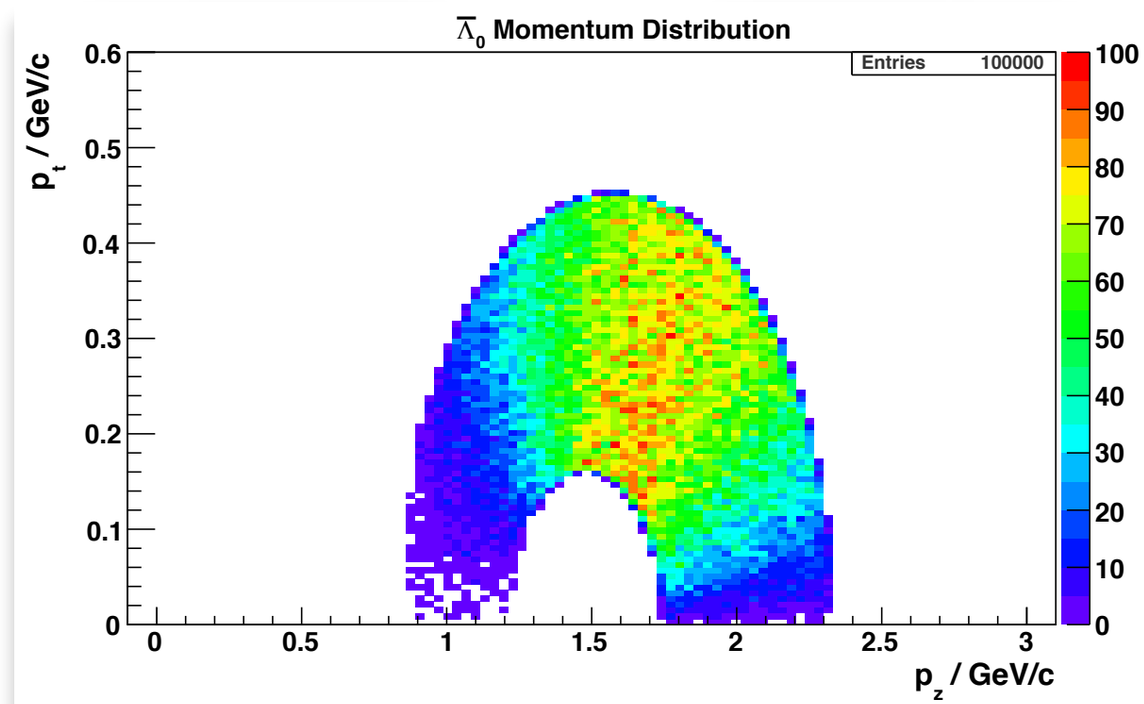


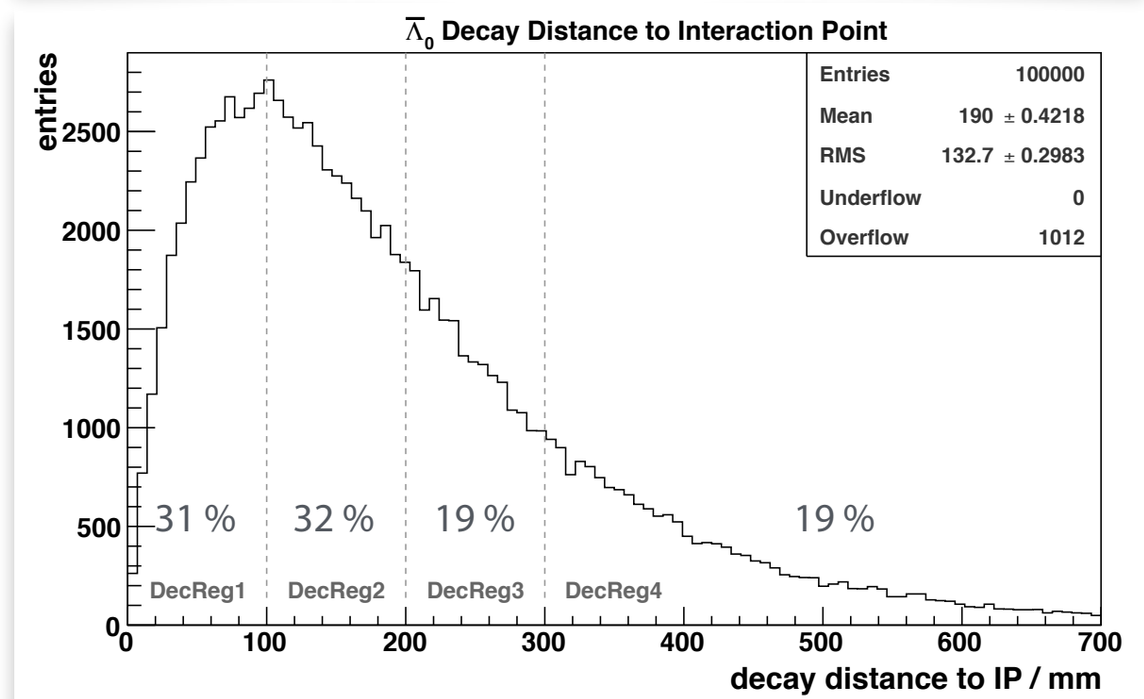
regular PHSP





filtered





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Event Filter also for Full Simulation

- Extended event filter of Martin Galuska
  - Filter based on probability function
  - Structure similar to FairEvtFilterOnSingleParticleCounts

- FairEvtFilterOnParticleDist usage in sim macro

```
// event filter
FairEvtFilterOnParticleDist * aXiBoost = new FairEvtFilterOnParticleDist("aXiBoost", mom);

// select events with a forward boost for the anti Xi
TF1 * aXiThetaProbDist = new TF1("f_aXiThetaProbDist", "[0] + [1] * x", -1, 1);
aXiThetaProbDist->SetParameter(0, 0.5);
aXiThetaProbDist->SetParameter(1, 0.5);
aXiBoost->AddCosThetaDist(aXiThetaProbDist, -3312);

primGen->AndFilter(aXiBoost);
```

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DETECTOR RESPONSE

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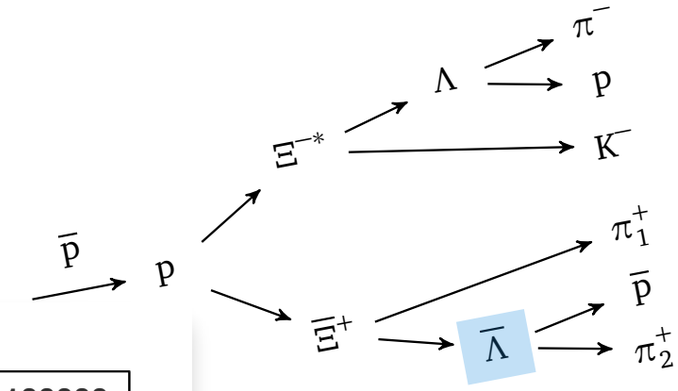
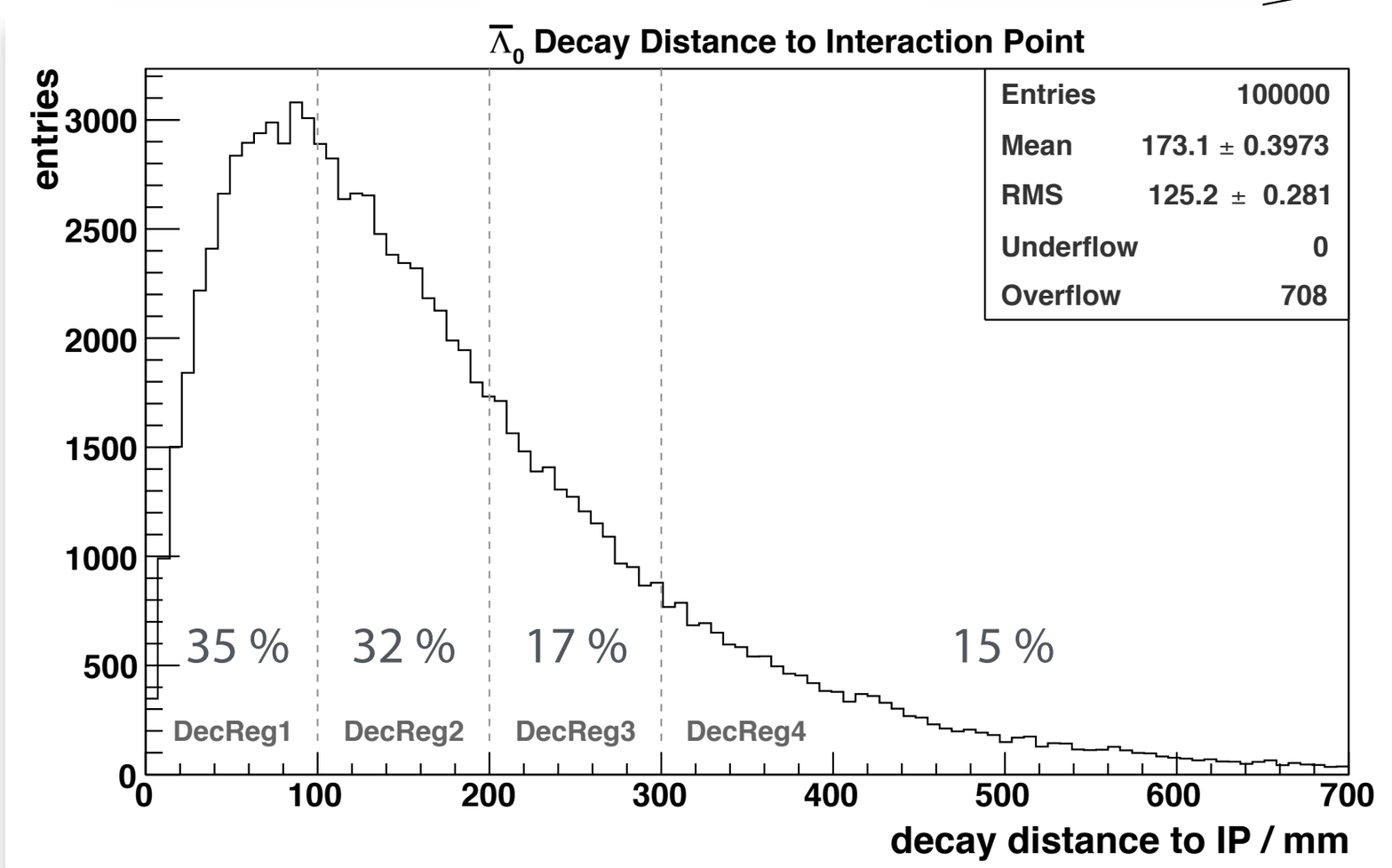
Decay Position of $\bar{\Lambda}$ to IP





- $\bar{\Lambda}$ decays with large distances to interaction point
  - Secondary vertex finder mandatory
- Significant amount of $\bar{\Lambda}$ decays behind MVD (DecReg4)

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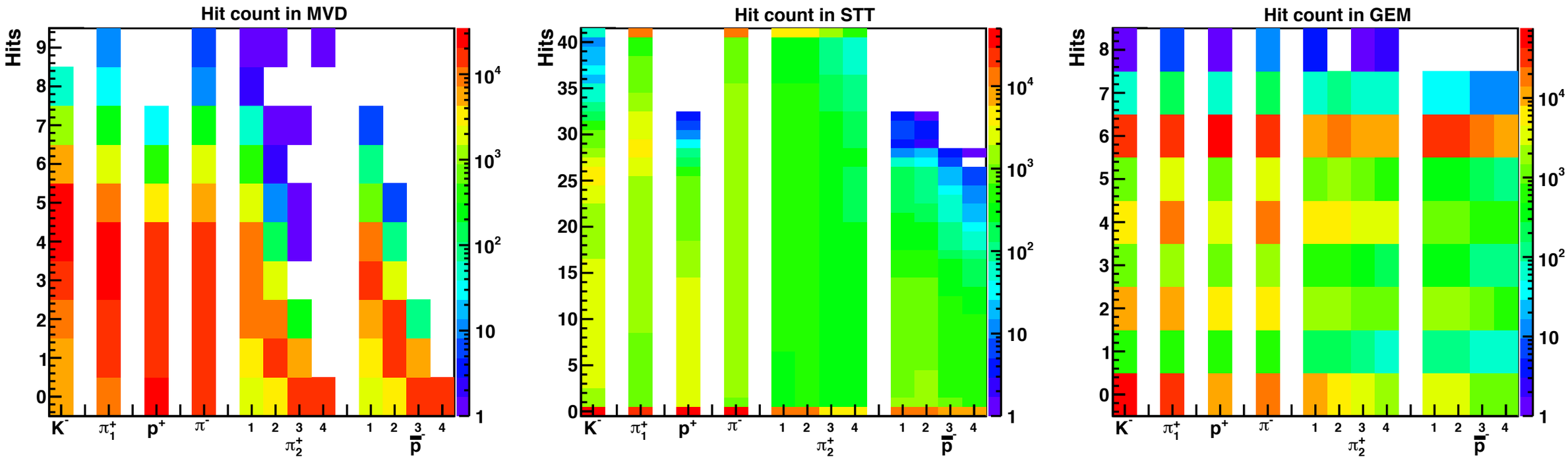
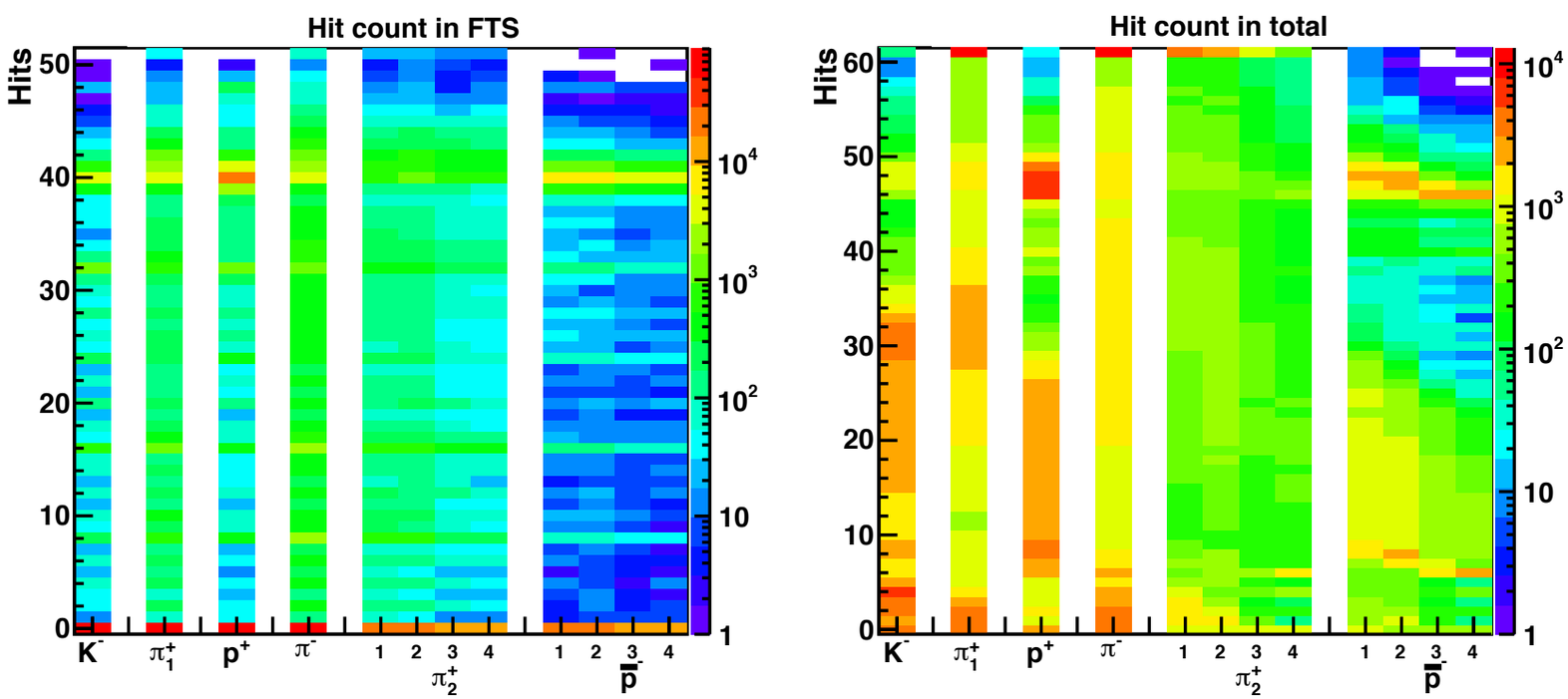
MC: Hit Counts in Tracking Detectors





Range 1: $|\vec{d}_{vertex}| < 10$ cm

Range 2: 10 cm $\leq |\vec{d}_{vertex}| < 20$ cm

Range 3: 20 cm $\leq |\vec{d}_{vertex}| < 30$ cm

Range 4: 30 cm $\leq |\vec{d}_{vertex}|$

Note: Bins for maximum hit count contain overflow.

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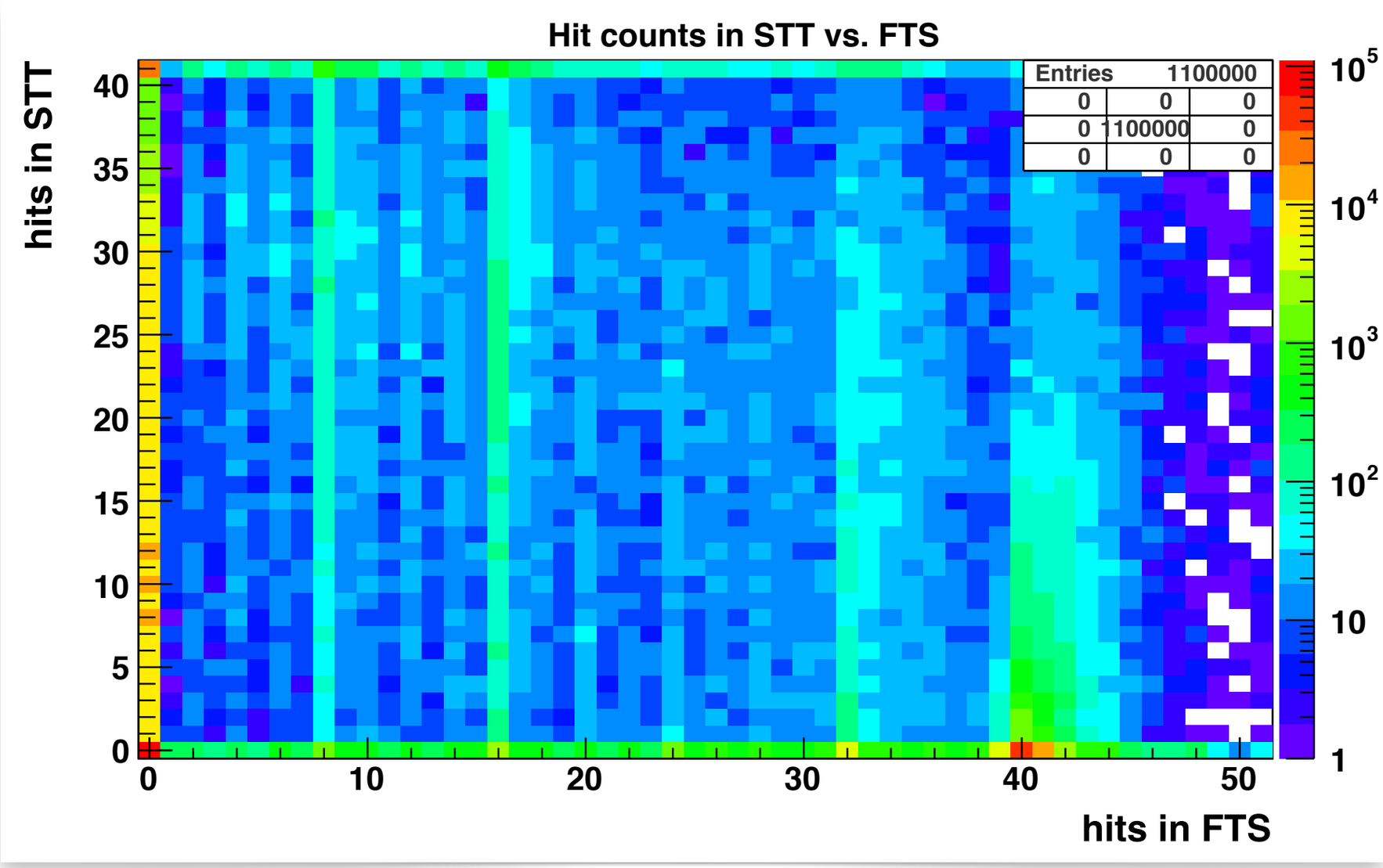
MC: Hit Counts STT vs. FTS



⇒ Tracks either hit STT or FTS, just a few in both

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Current Work

- Use ideal track finder → each hit creates a track
- Make this approach more realistic
  - Filter after track finding
    (e.g. NHitsMvd ≥ 3 && NHitsTotal ≥ 6)
  - Copy tracks matching the filter into filtered branch
  - Further reconstruction/pid/analysis may run on full and/or filtered track list

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Summary

- **Excited cascade** simulation analysis started
  - Production threshold close to J/Ψ
    ⇒ we'll probably take data on this anyways
  - Channel challenging to reconstruct,
    lots of delayed vertices

- Two **new tasks** for PANDA simulation
  - FairEvtFilterOnParticleDist to filter after EvtGen based on probability function
  - PndTrackFilterTask to filter (ideal) tracks after track finding
  - Save in SVN as soon as tested with large dataset

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