Track efficiency studies of SVD-only tracking using D* reconstruction

A status report

Andreas Moll

On behalf of the work of Burkard Reisert

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Excellence Cluster Universe

Max-Planck-Institut für Physik
(Werner-Heisenberg-Institut)

- Introduction
- Results: soft pion tracking
- Results: track matching
- Soft pions in D* reconstruction results

First physics analysis using BELLE data and BASF software done at the MPI

Goals:

- ✓ Learn how to use the software
- ✓ Measure the efficiency of the SVD-only tracking code

Analysis parameters:

- MonteCarlo generated events
- **500.000** events
- Version: b20090127_0910
- Experiment **55**
- SVD-only tracking turned **on** and **off**

Soft pion tracking

- Loop over all **generated** soft pions
- count number of associated **reconstructed** pions

 # correct link: $\pi_{rec} \rightarrow \pi_{gen}$

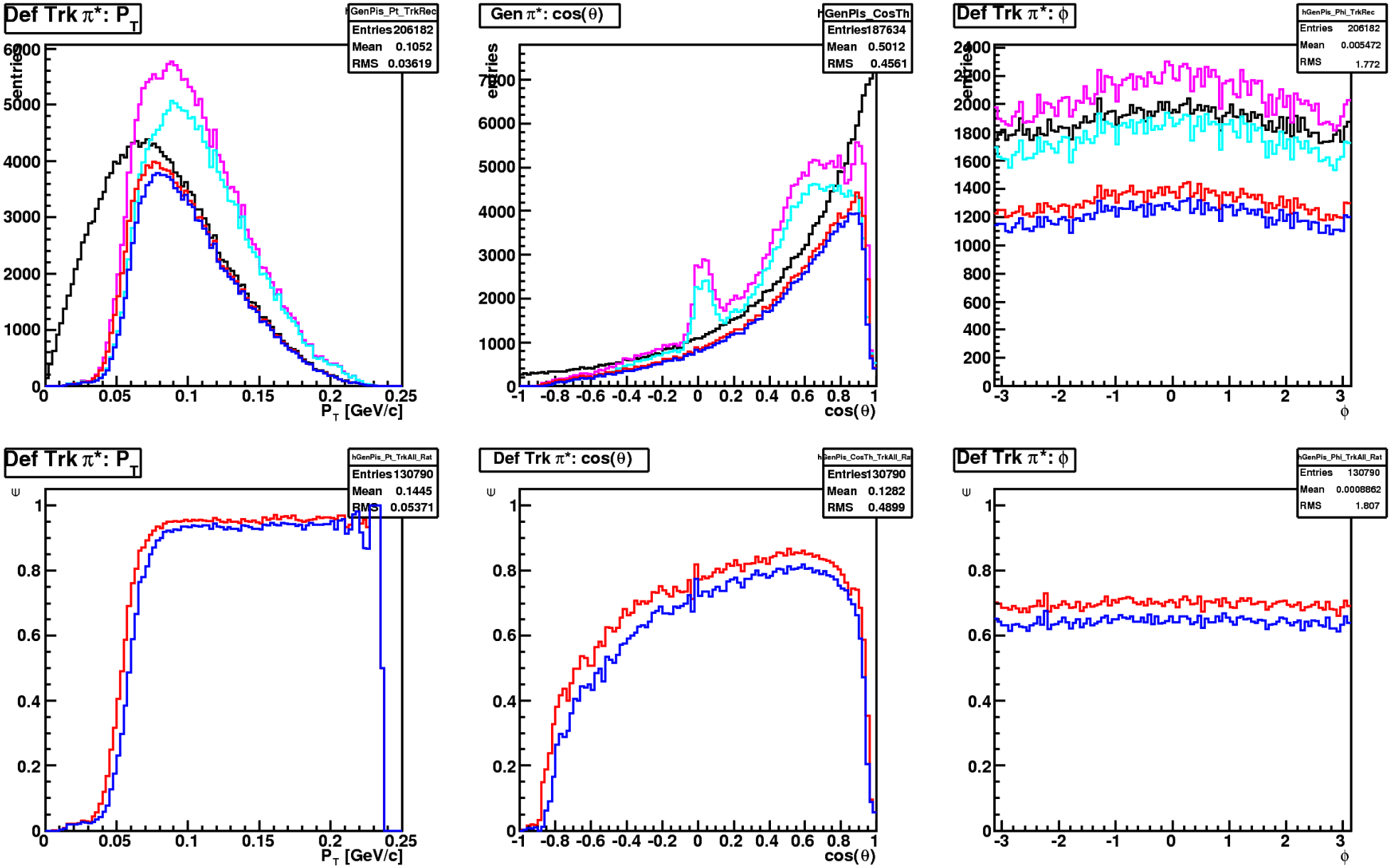
Default + SVD-only tracking

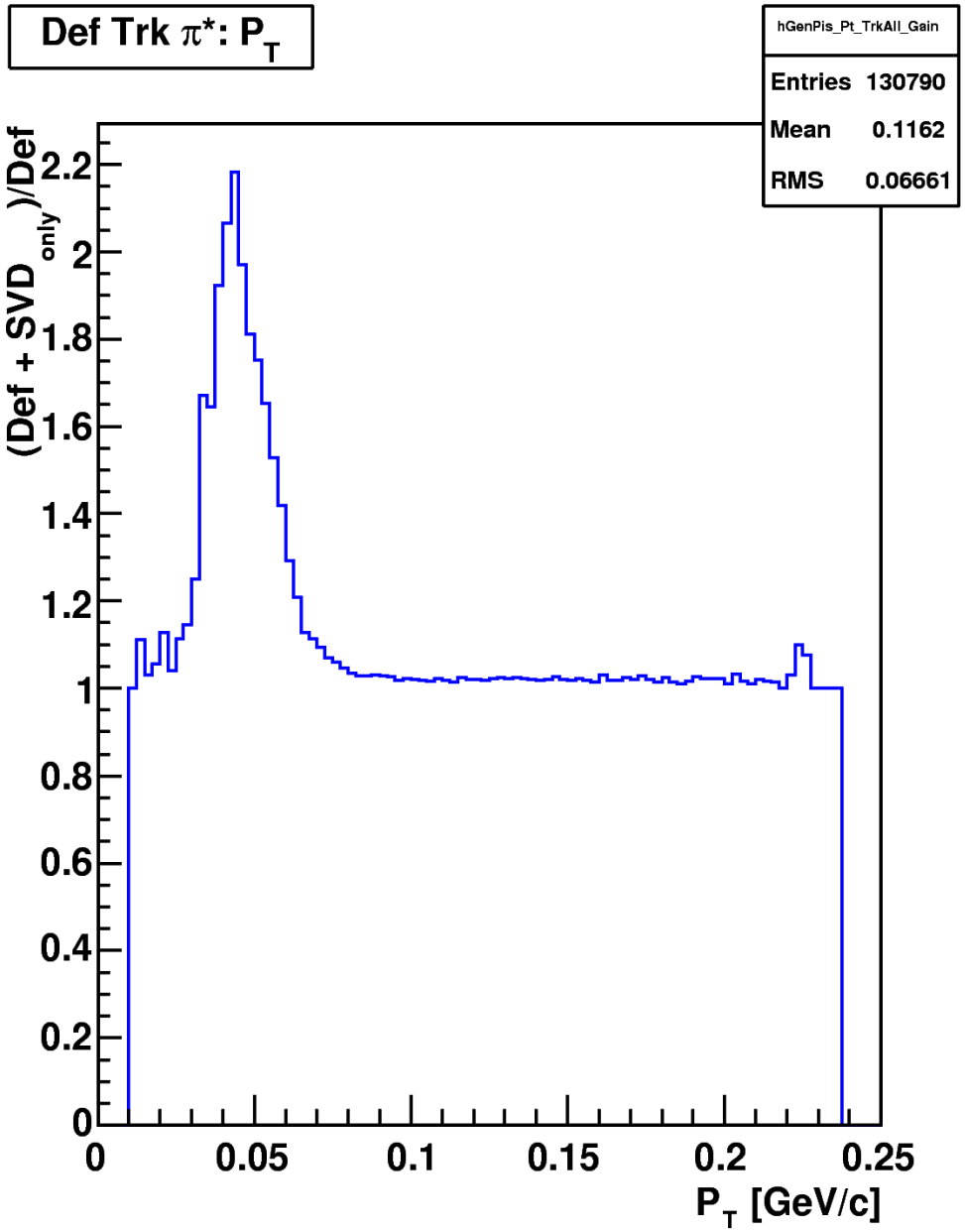
Count link only once

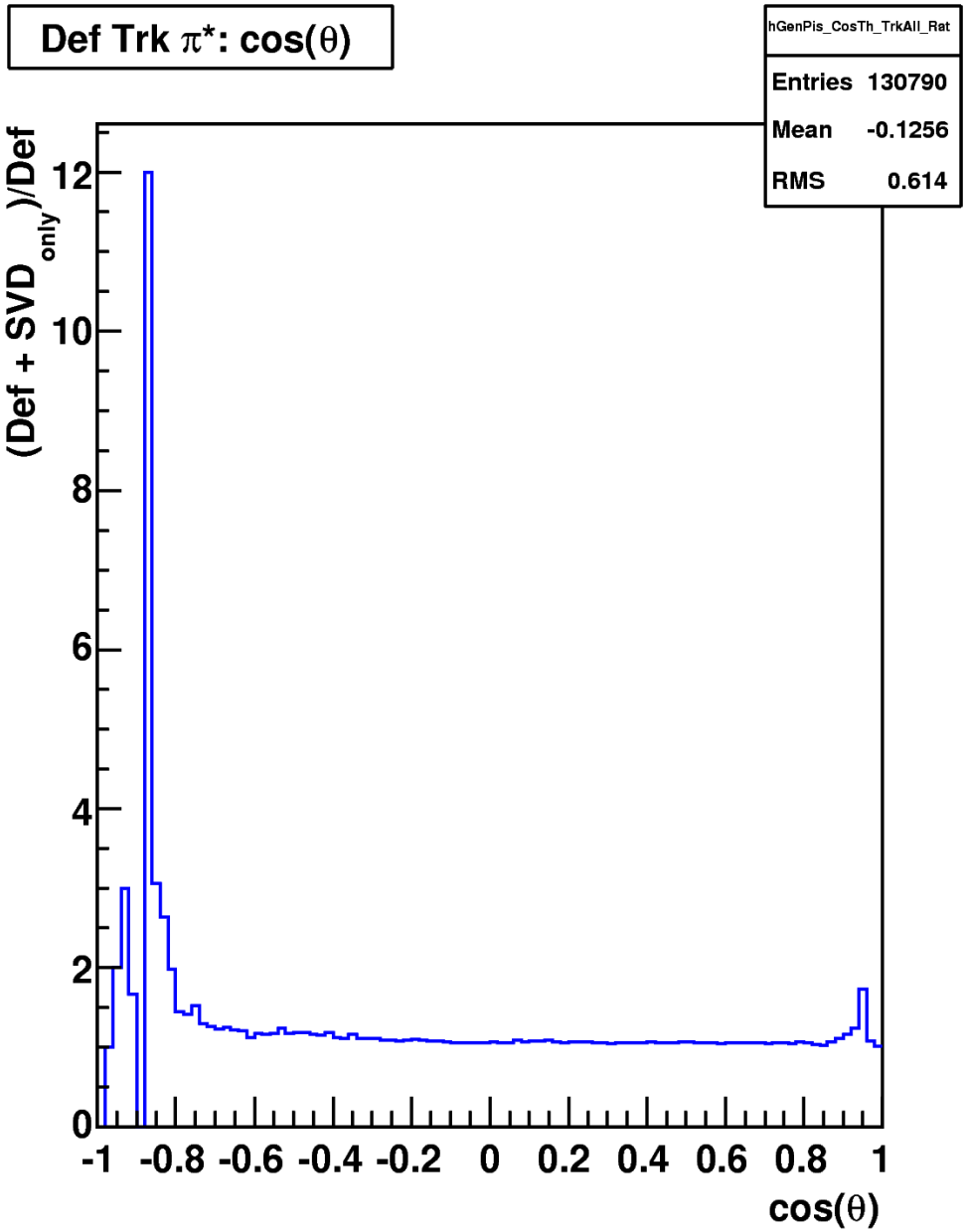
Default tracking

Count link only once

Monte Carlo

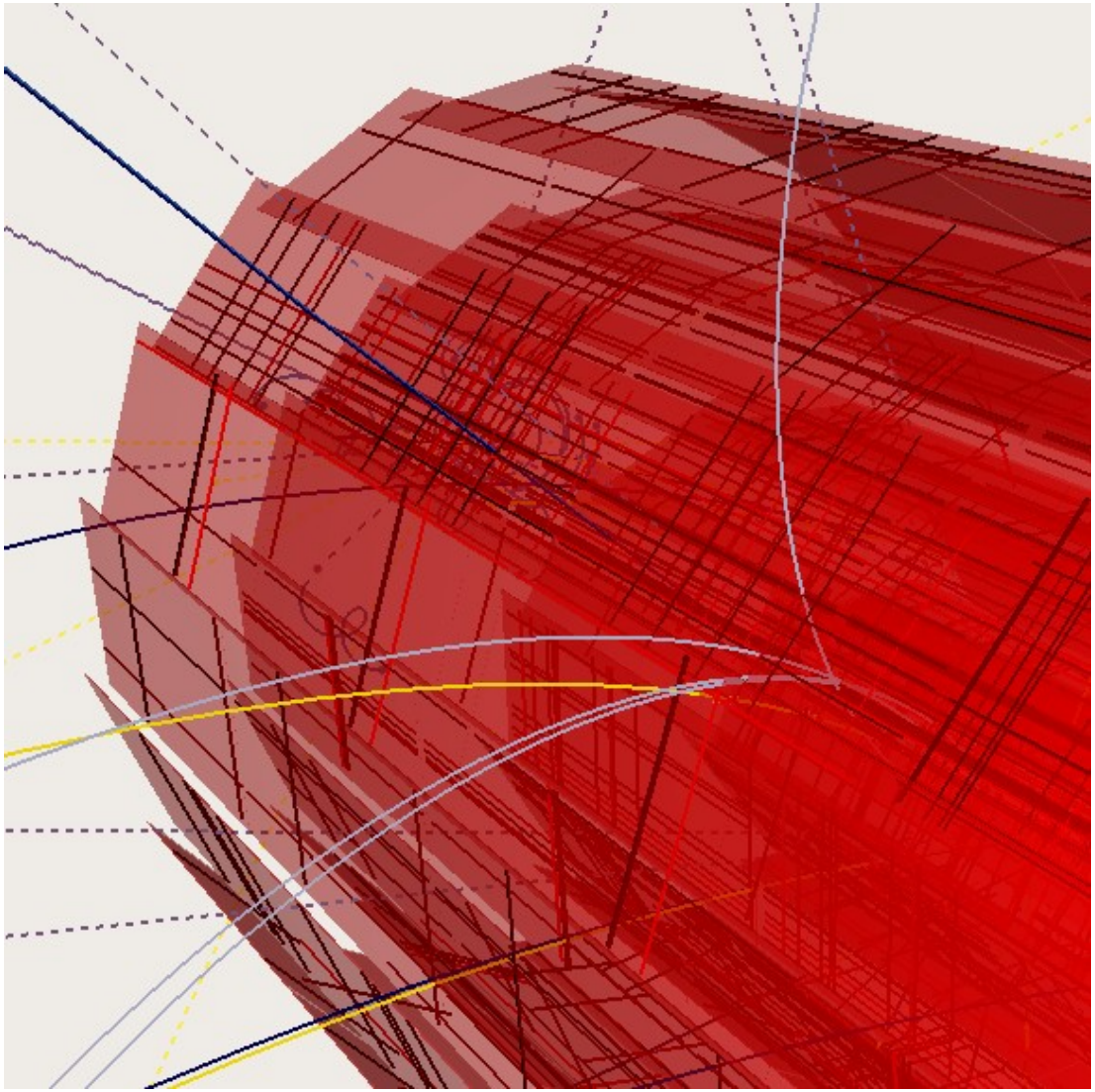


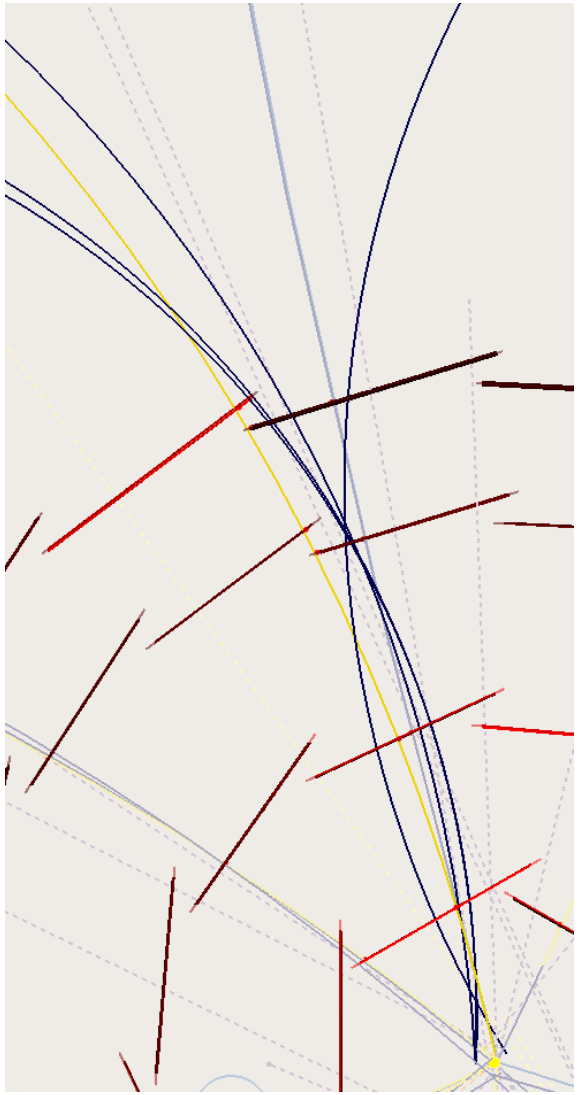

Def Trk π*: P_T
hGenPis_Pt_TrkAll_Gain
Entries 130790
Mean 0.1162
RMS 0.06661
(Def + SVD_only)/Def
P_T [GeV/c]


Def Trk π*: cos(θ)
hGenPis_CosTh_TrkAll_Rat
Entries 130790
Mean -0.1256
RMS 0.614
(Def + SVD_only)/Def
cos(θ)

Example: **Four** reconstructed tracks associated to **one single** generated pion

Generated pion (track) Reconstructed tracks (pions)

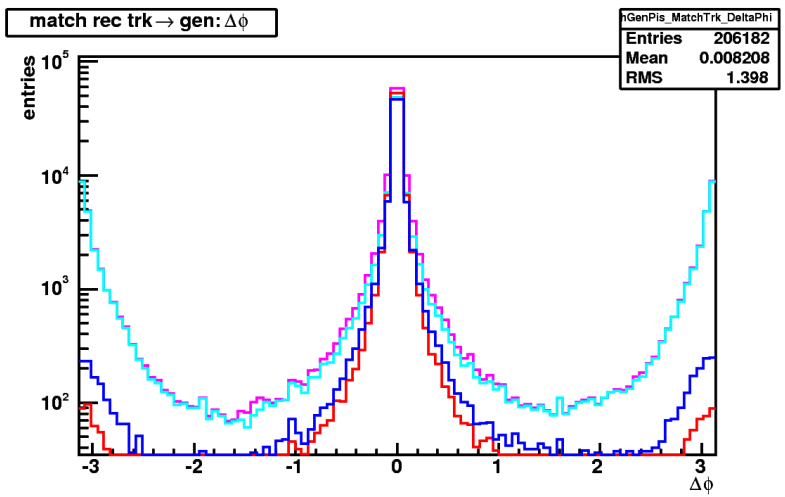


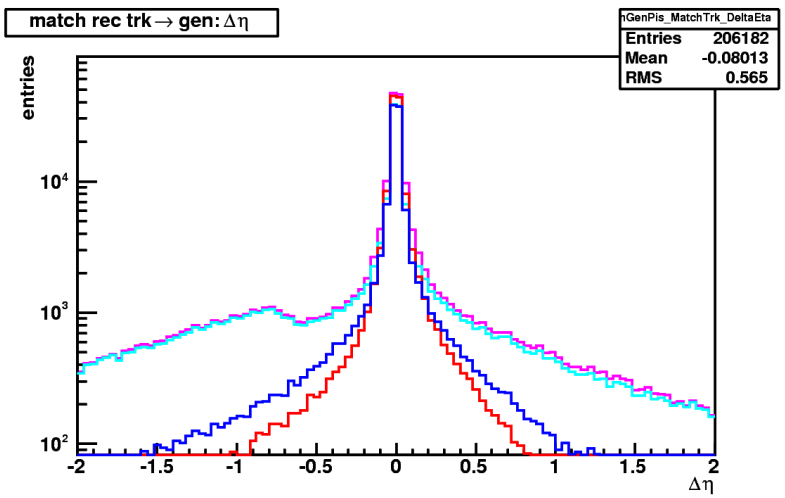


Matching reconstructed with generated soft pion tracks

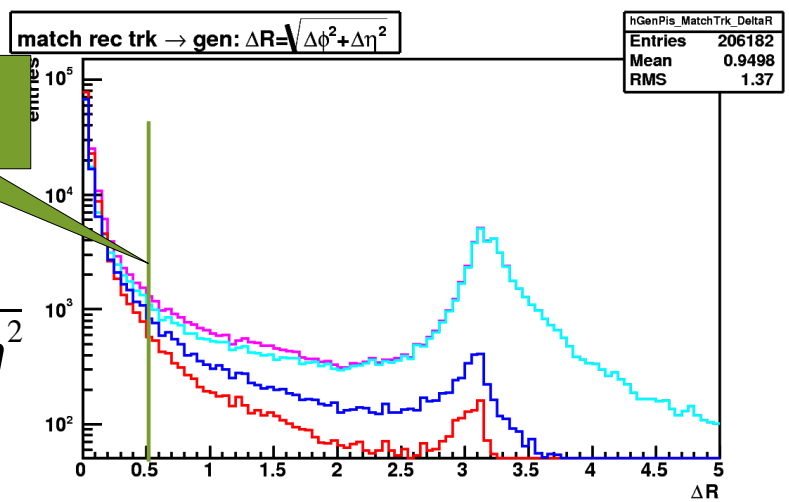
Pseudorapidity: $\Delta\eta = -\ln\left[\tan\left(\frac{\theta}{2}\right)\right]$, θ angle between $\vec{p}$ and the beam axis.

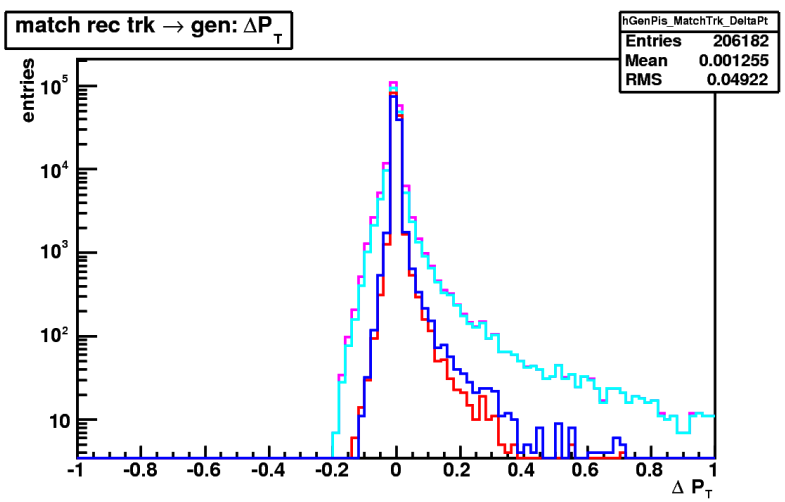
$$\Delta\phi = \left|\phi_{rec} - \phi_{gen}\right|$$





$$\Delta R = \sqrt{\Delta\phi^2 + \Delta\eta^2}$$





found matching tracks at $\Delta\phi = \pm 180°$

Soft pion tracking (with cut)

- Loop over all **generated** soft pions
- Apply **cut**: $\Delta R < 0.5$
- count number of associated **reconstructed** pions

 # correct link: $\pi_{rec} \rightarrow \pi_{gen}$

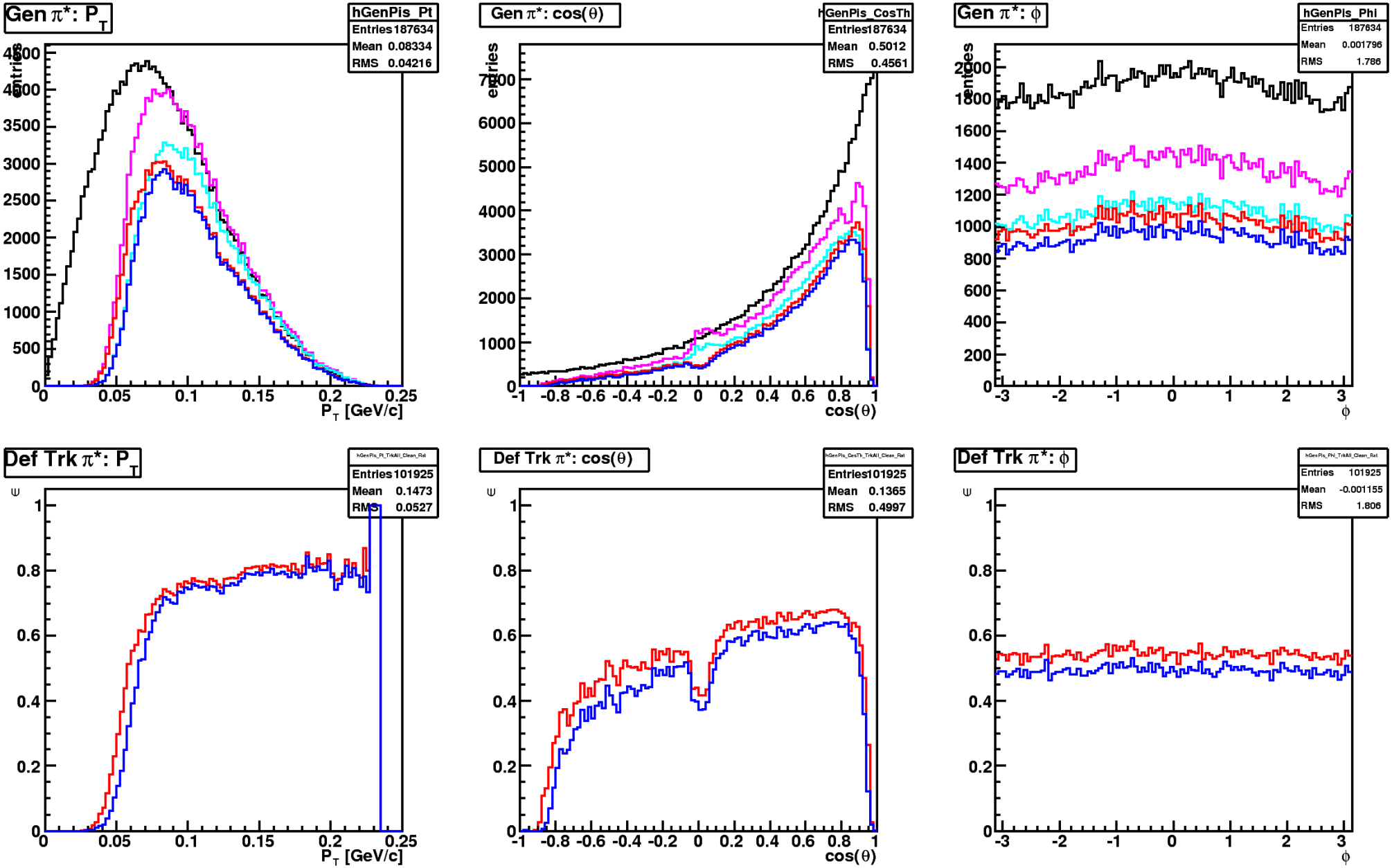
Default + SVD-only tracking

Count link only once

Default tracking

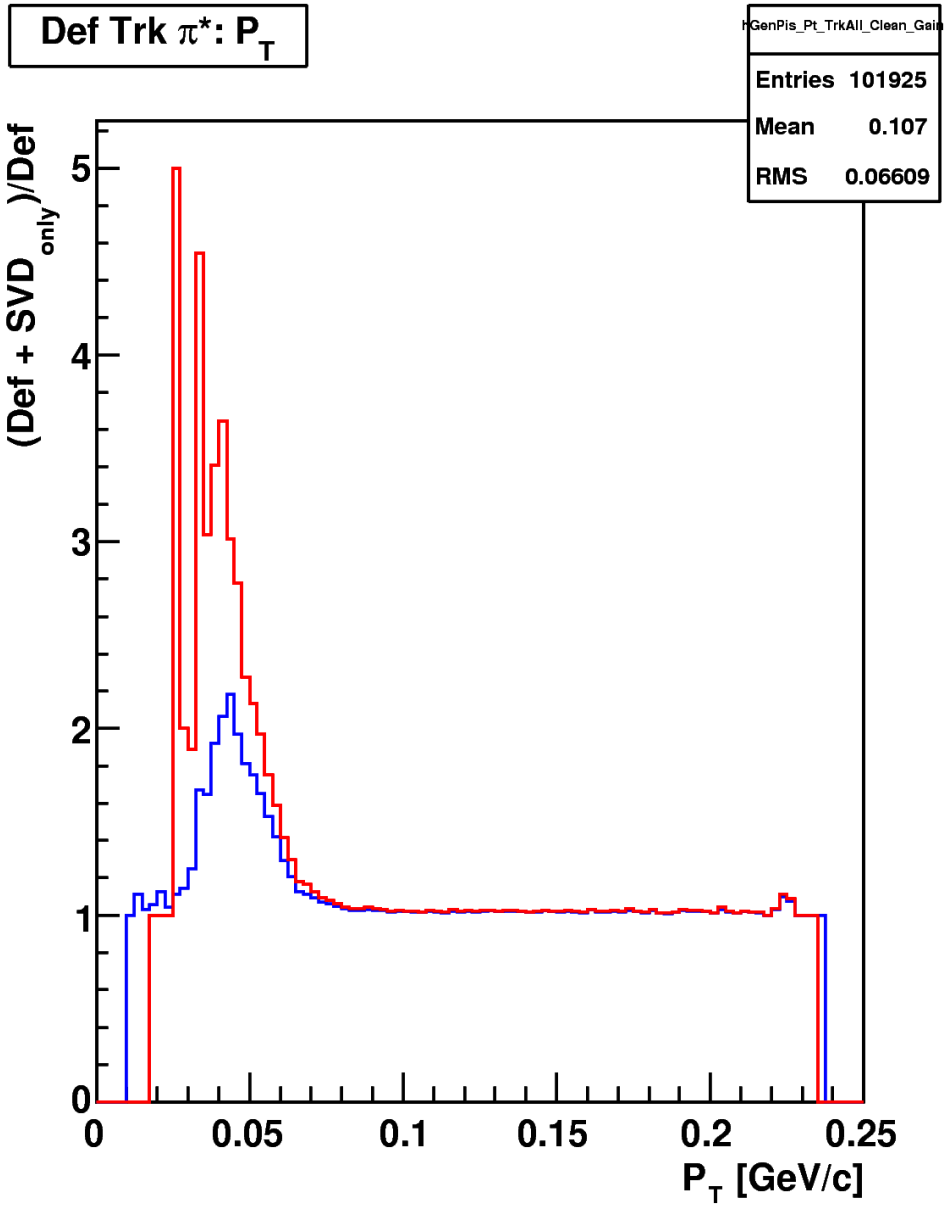
Count link only once

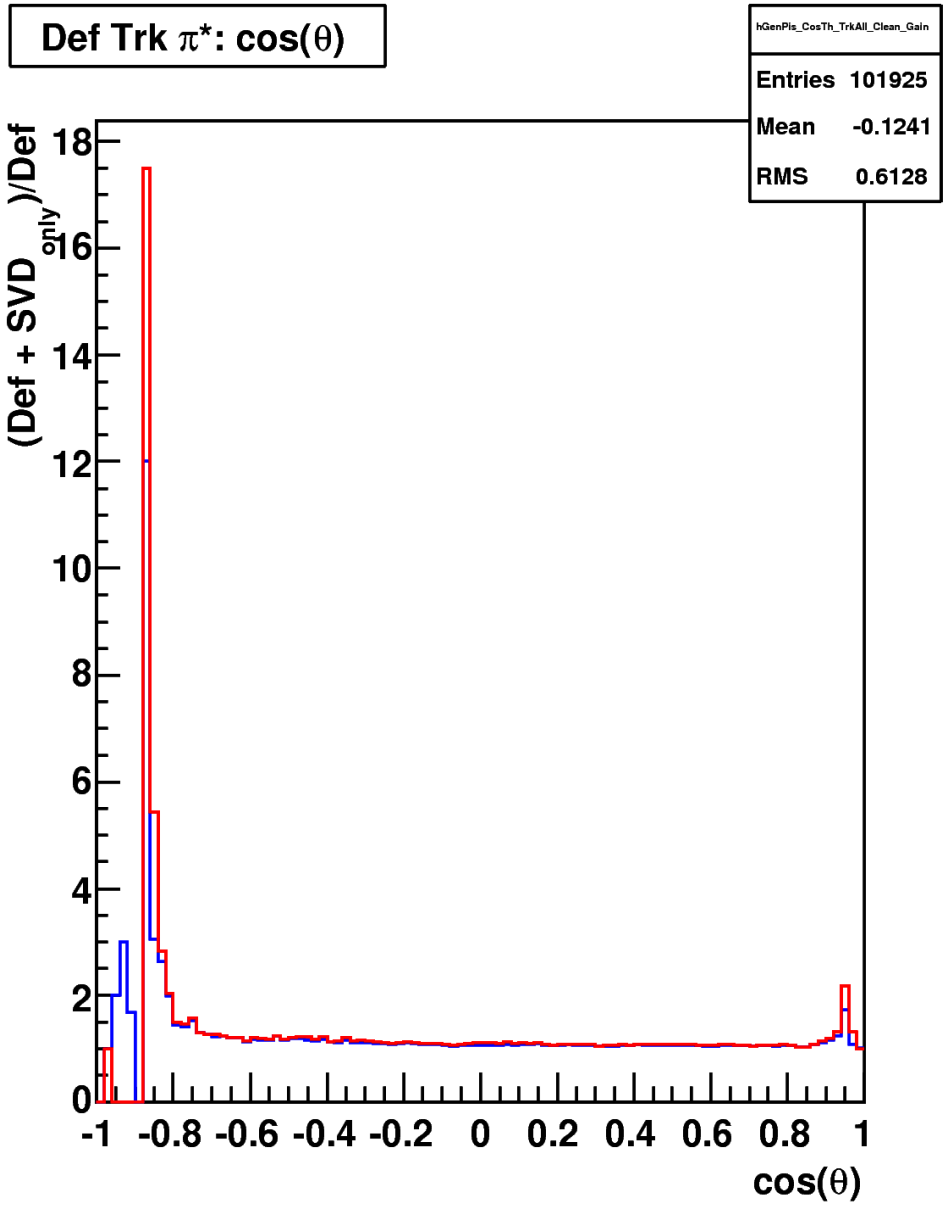
Monte Carlo



With cut at ΔR < 0.5

Without cut at ΔR < 0.5

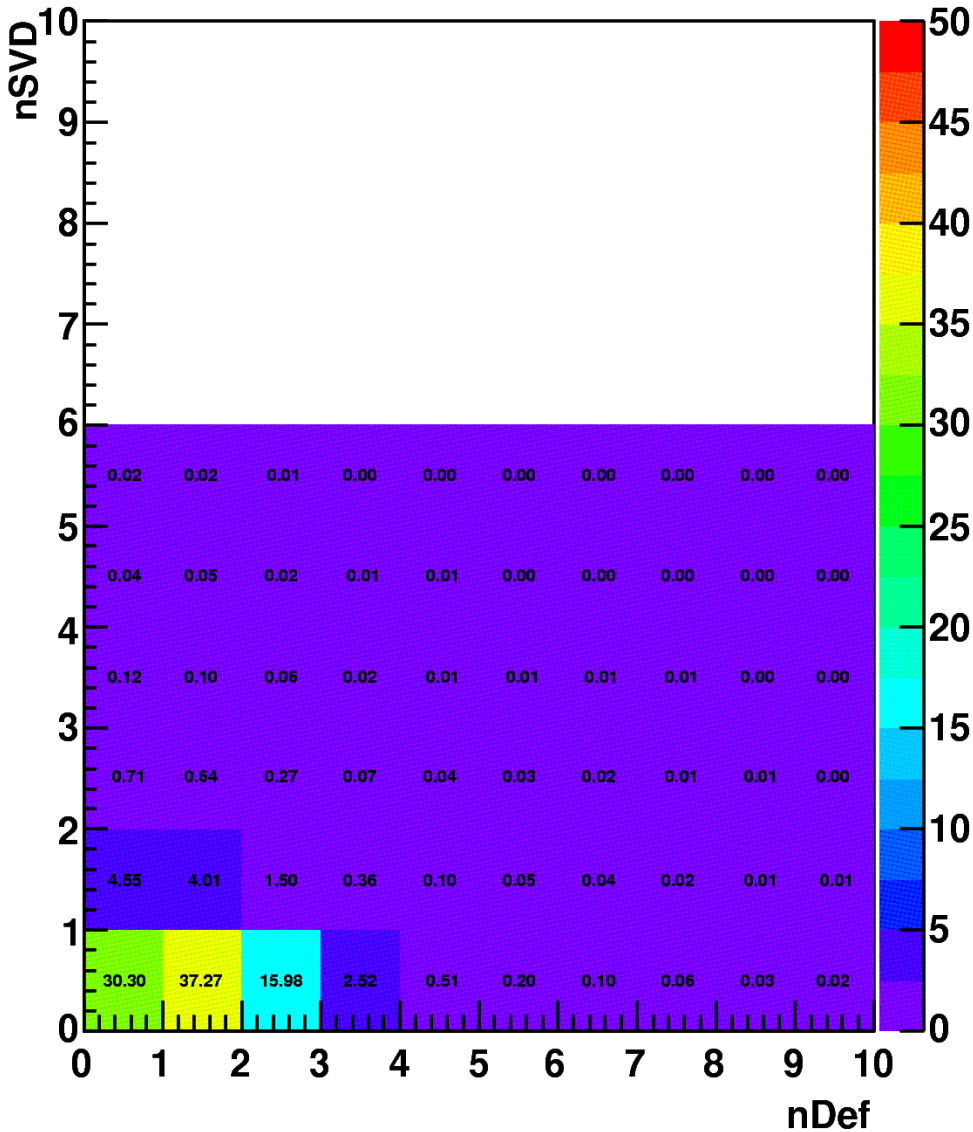




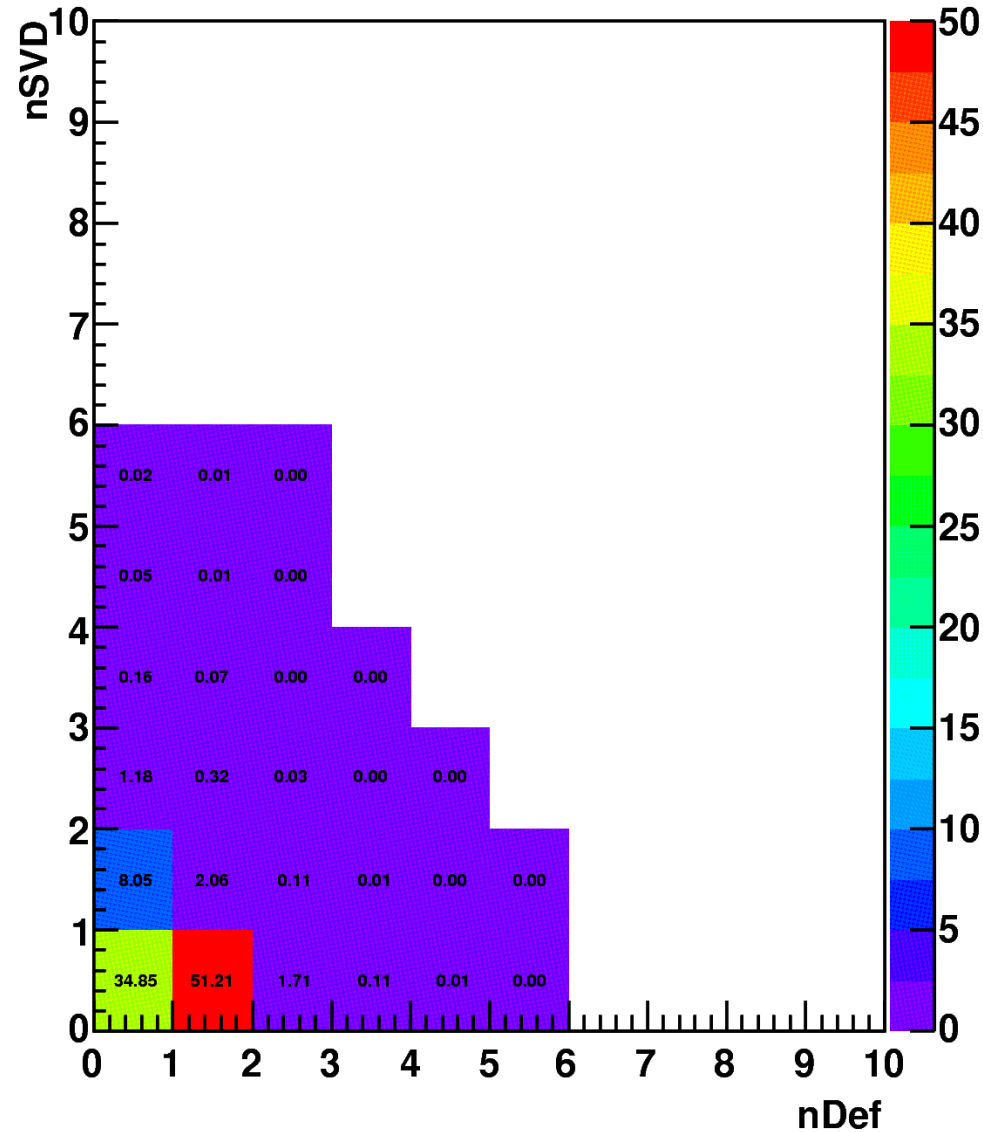
nDef number of multi-assigned π_{rec} to π_{gen} in **default tracking**

nSVD number of multi-assigned π_{rec} to π_{gen} in **SVD-only tracking**

π* reco ambiguity **Without** cut at ΔR < 0.5



π* reco ambiguity **With** cut at ΔR < 0.5



$$D^{*+} \to \pi^+ D^0 \quad , \quad D^{*-} \to \pi^- \overline{D^0}$$

D* reconstruction using the following decays:

		Branching fraction
$D^0 \to K^- \pi^+$	$\overline{D^0} \to K^+ \pi^-$	3.89 %
$D^0 \to K^- \pi^+ \pi^0$	$\overline{D^0} \to K^+ \pi^- \pi^0$	13.9 %
$D^0 \to K^- \pi^+ \pi^+ \pi^-$	$\overline{D^0} \to K^+ \pi^+ \pi^- \pi^+$	8.10 %
$D^0 \to K_S \pi^+ \pi^-$	$\overline{D^0} \to K_S \pi^- \pi^+$	2.99 %
$D^0 \to K^+ K^-$	$D^0 \to K^- K^+$	0.393 %

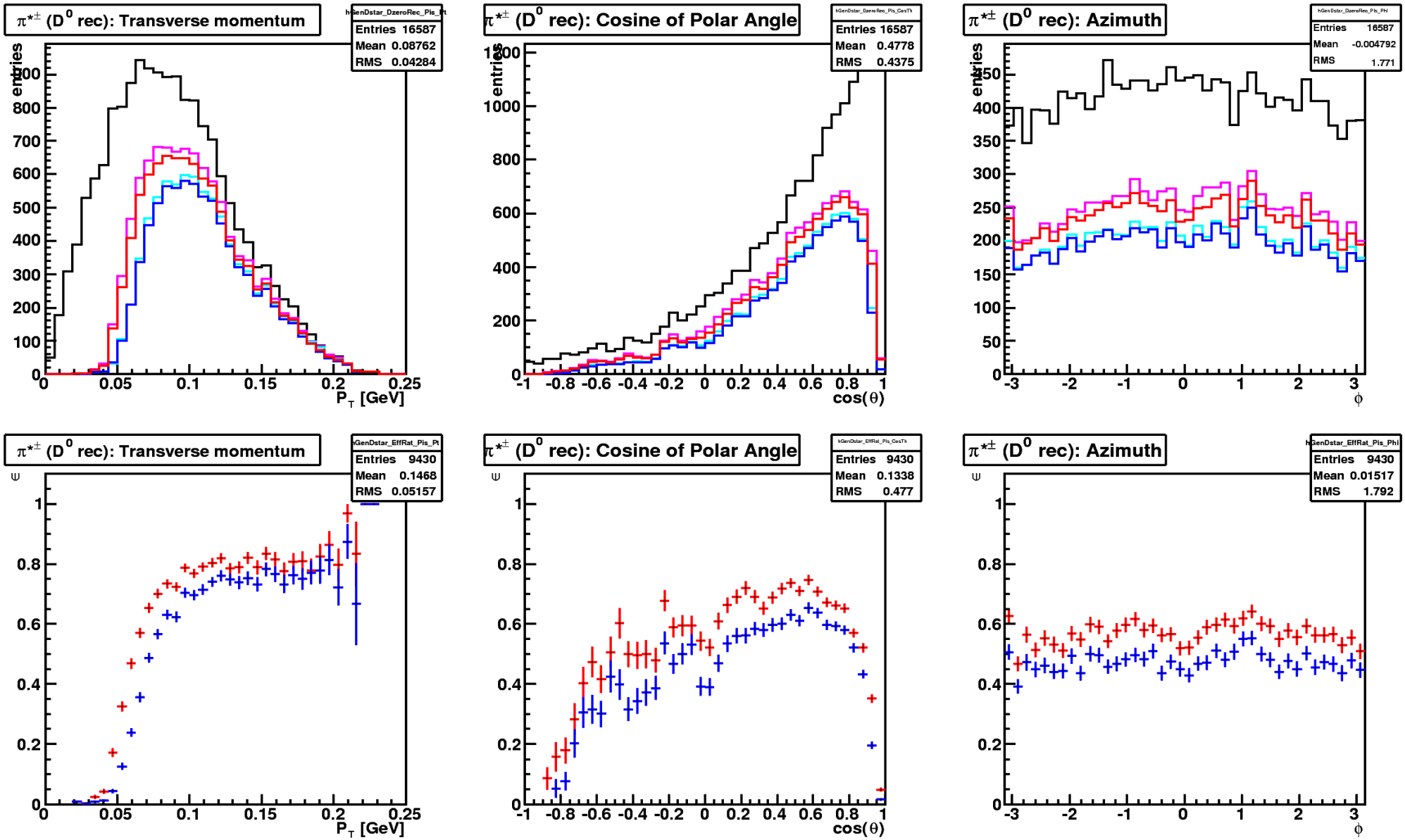
 # correct link: $\pi_{rec} \rightarrow \pi_{gen}$ with D^0 reconstructed

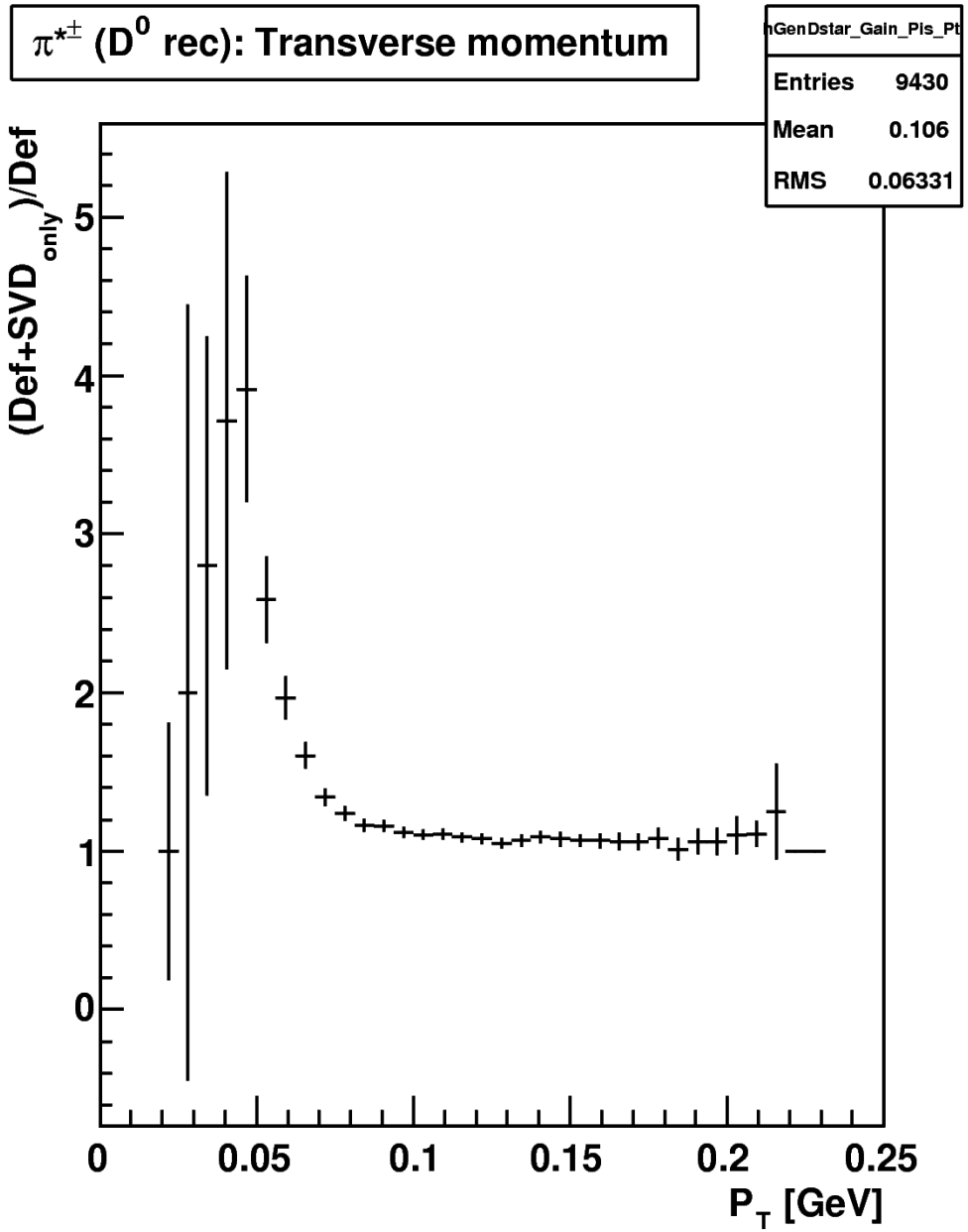
Default + SVD-only tracking

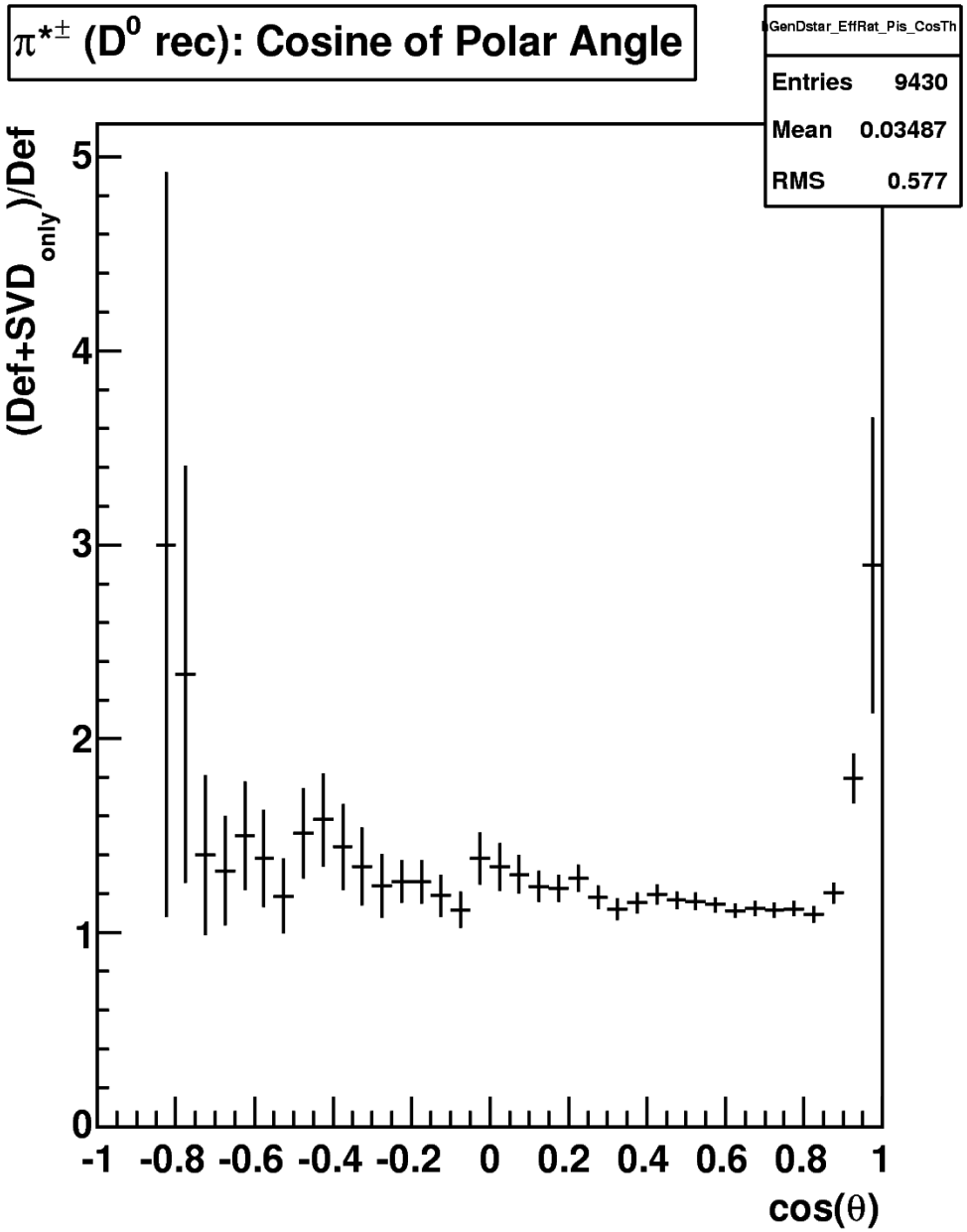
Count link only once

Default tracking

Count link only once

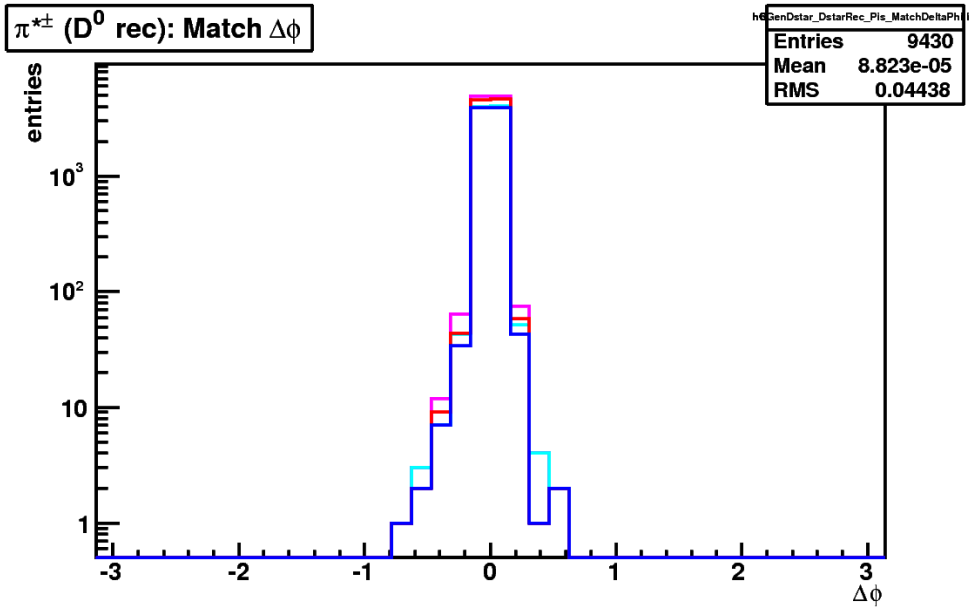


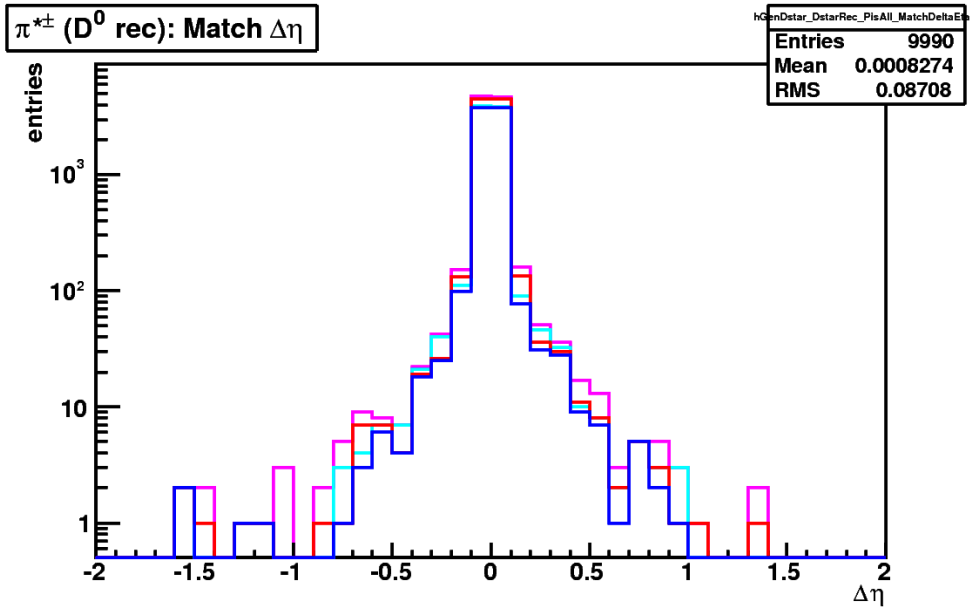

$\pi^{*\pm}$ (D^0 rec): Transverse momentum
hGenDstar_Gain_Pis_Pt
Entries 9430
Mean 0.106
RMS 0.06331
(Def+SVD$_{only}$)/Def
P_T [GeV]

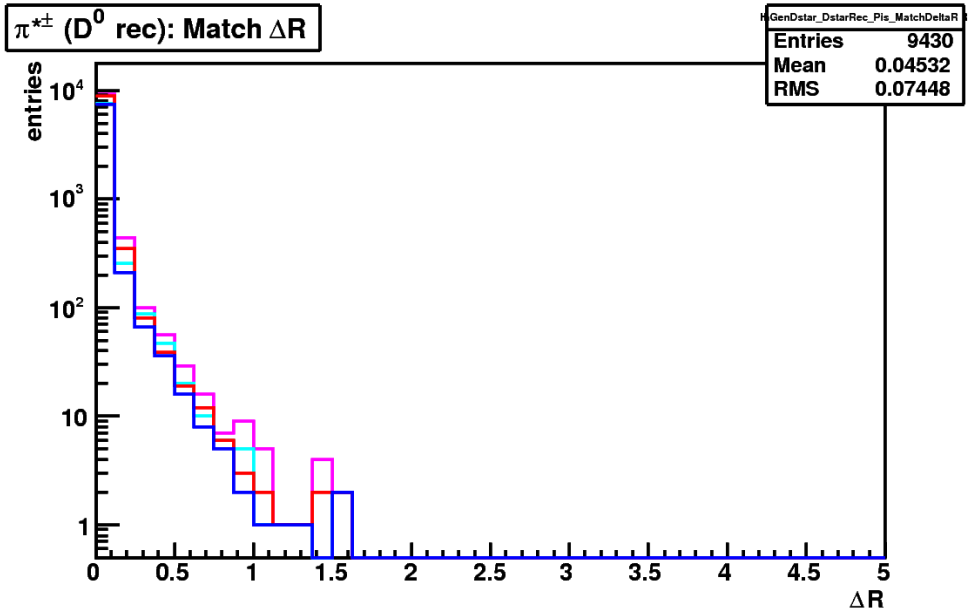

$\pi^{*\pm}$ (D^0 rec): Cosine of Polar Angle
hGenDstar_EffRat_Pis_CosTh
Entries 9430
Mean 0.03487
RMS 0.577
(Def+SVD$_{only}$)/Def
cos(θ)

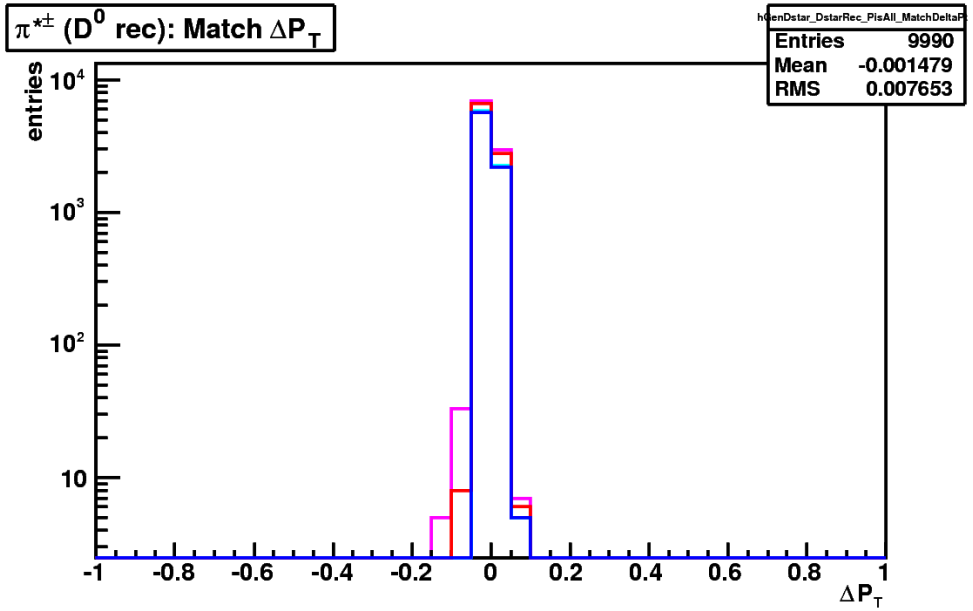
Matching reconstructed with generated pion tracks

$$\Delta\phi = \left|\phi_{rec} - \phi_{gen}\right| \qquad \Delta\eta = -\ln\left[\tan\left(\frac{\theta}{2}\right)\right] \qquad \Delta R = \sqrt{\Delta\phi + \Delta\eta}$$





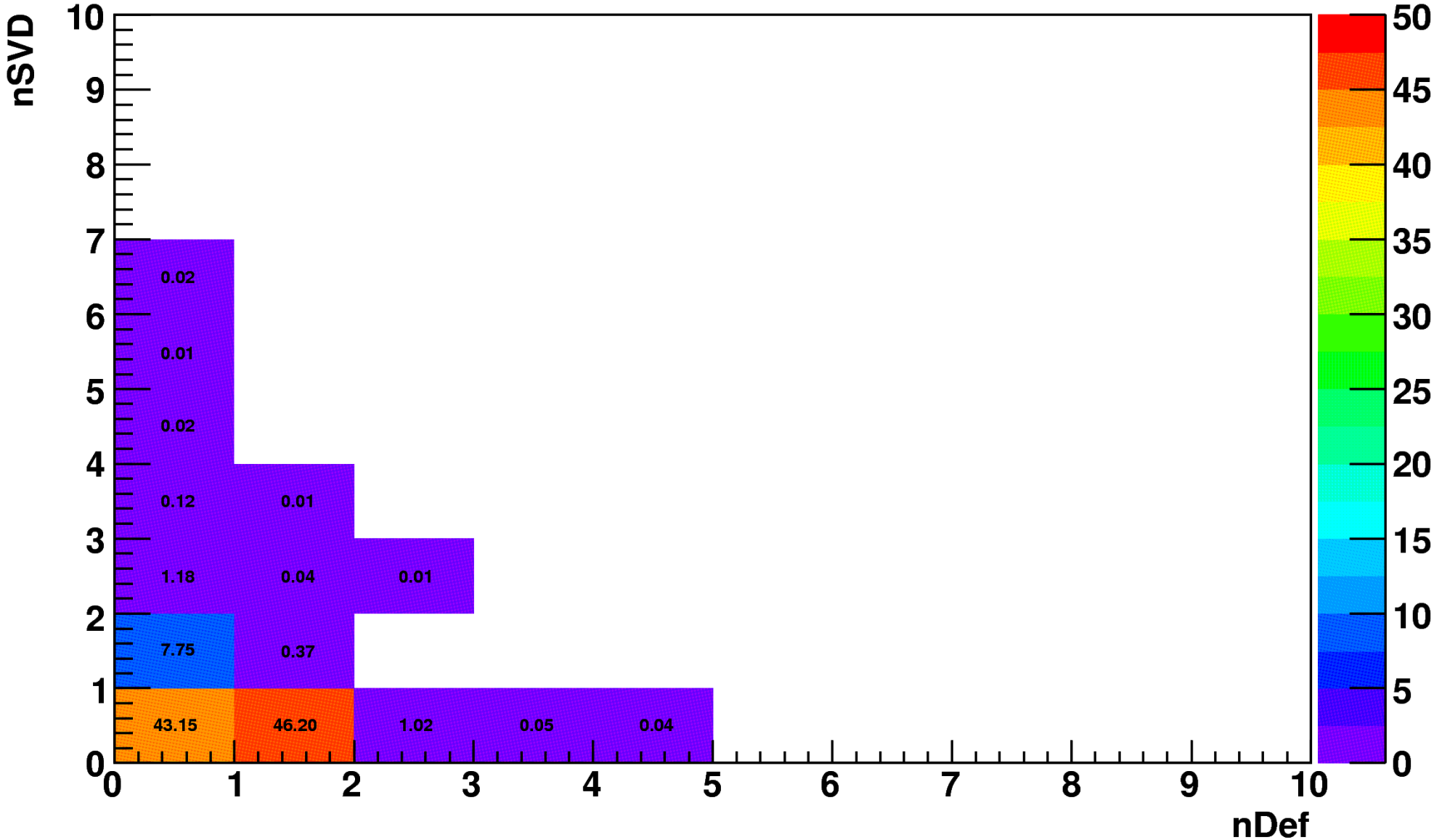




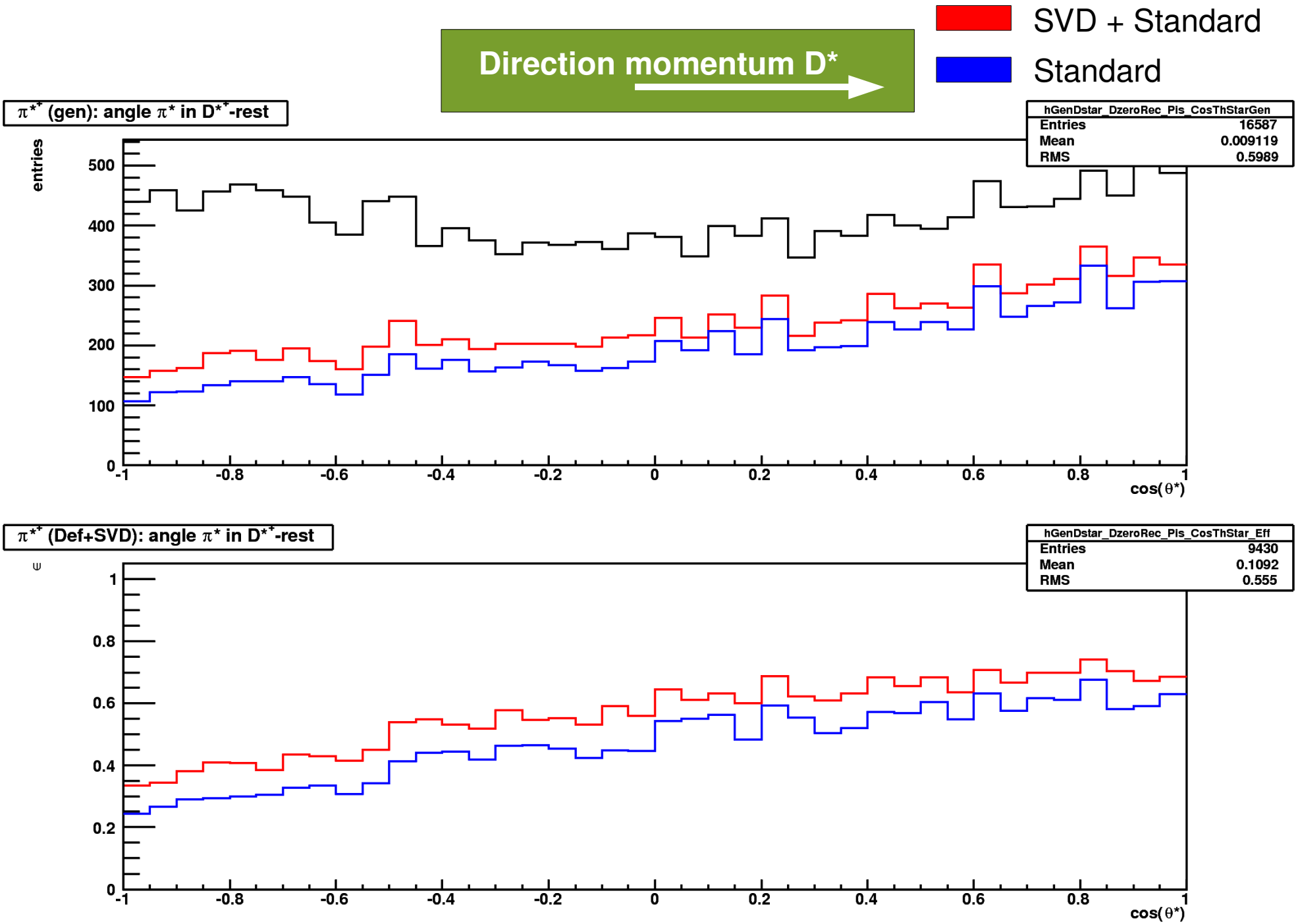
nDef number of multi-assigned π_{rec} to π_{gen} in **default tracking**

nSVD number of multi-assigned π_{rec} to π_{gen} in **SVD-only tracking**

$D^{*\pm}$ reco ambiguity



Angle distribution of π^+ in D^{*+} restframe



- Studied tracking of soft pions
  - Fake tracks at $\theta = 90°$
  - Multiple reconstructed SVD-only assigned to a generated soft pion.
  - Fake tracks, tangential fit to curling helix.
- Studied track matching
  - Wrong matching at $\pm 180°$
  - ΔR cut, removed most of these tracks.
- Studied soft pions in D* reconstruction
  - Above effects not noticeable

Backup

$K^{+/-}$ and $\pi^{+/-}$ candidates

- Maximum Likelihood-discrimination with confidence-level of 60% for $K^{+/-}$ 90% for $\pi^{+/-}$ and dr dZ cut to remove candidates too far away from IP (2 cm in R abd 5 cm in Z)

Soft $\pi^{+/-}$ candidates

- No additional constraints applied

K_S candidates

- apply “goodKs” method (momentum based cuts)
- mass cut 0.498$\pm$0.15 MeV
- Mass constraint vertex fit

π^0 candidates

- Cut on the minimum photon energy (50.0 MeV)

Details D0 reconstruction:

- create combinations according to decay table page 4 (D0MassRange: 100 MeV)
- Vertex fit
- Vertex confidence level cut (0.0001)

Details D* reconstruction (D0 from above and soft pions):

$$D^* \rightarrow \pi^+ D^0 \qquad D^* \rightarrow \pi^- \overline{D^0}$$

- Vertex fit
- Cut on the mass difference D*, D^0 (max. 0.16 GeV)
- Vertex likelihood cut (0.0001)