Underlying Event Analysis with the ALICE detector

Correction Studies

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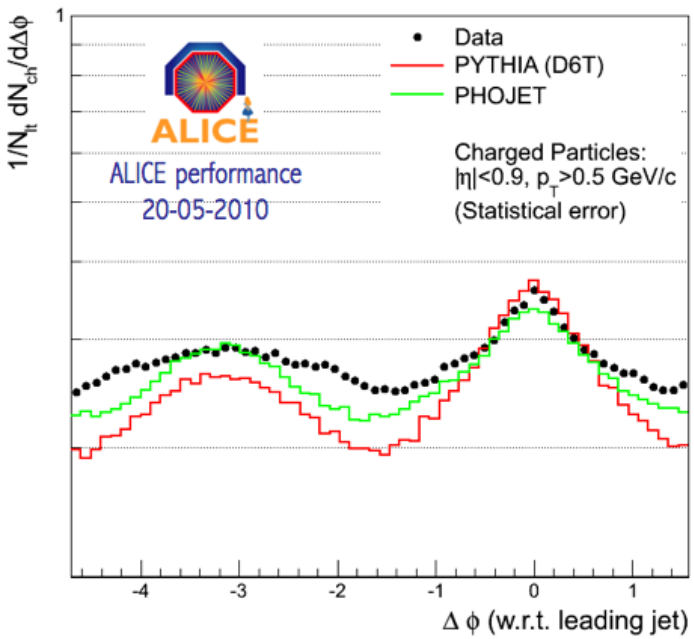
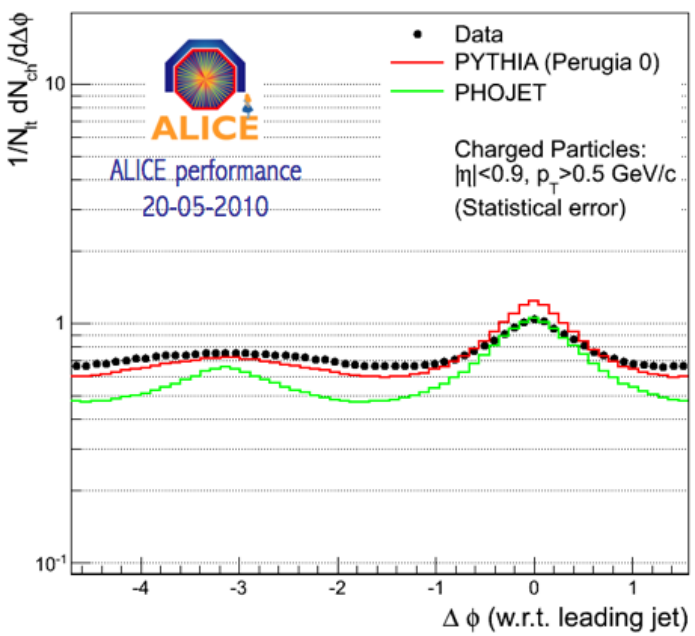
Corrected data are not yet final,
we present the correction procedure
that will be applied to measured datapoints.

Motivations

- ALICE has measured the Underlying Event
- discrepancy uncorrected data / Monte Carlo (full detector simulation)

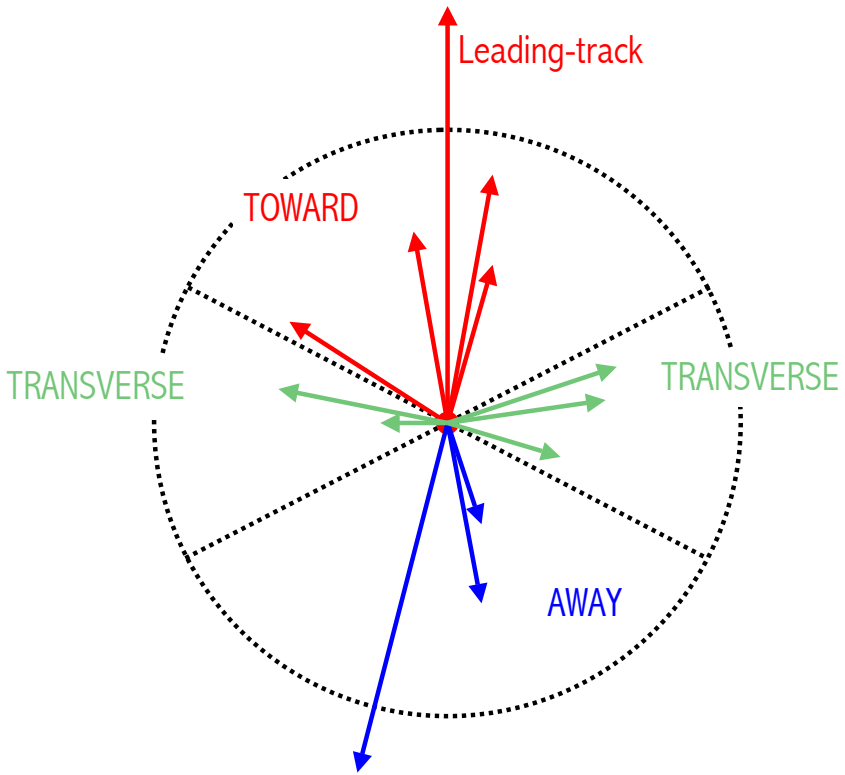
Uncorrected data at $\sqrt{s} = 900$ GeV (left) and $\sqrt{s} = 7$ TeV (right).





A correction procedure is needed, based on simulations and real data.

Analysis Settings



- $\sqrt{s} = 7$ TeV
- $p_T > 0.5$ GeV/c (tracks and leading-track)
- $|\eta| < 0.8$
- leading-track not included in distributions

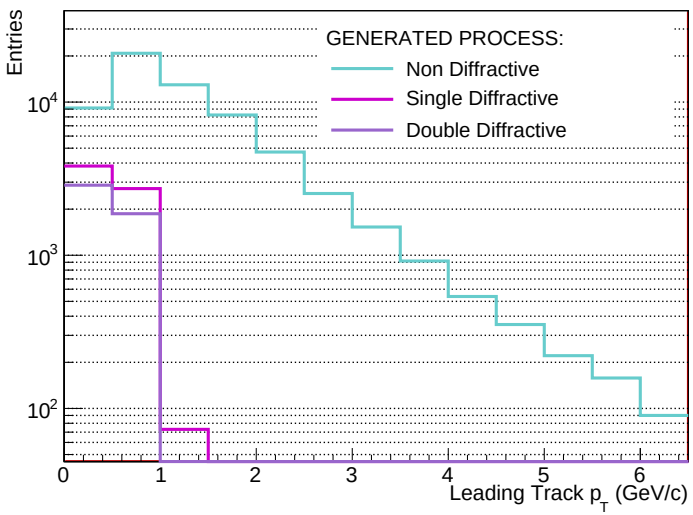
Event Selection

- Off-line selection of MB triggers
- Reconstructed vertex
- Leading-track

	Ev. selected
Trigger	87 %
Vertex	83 %
Leading-track	63 %

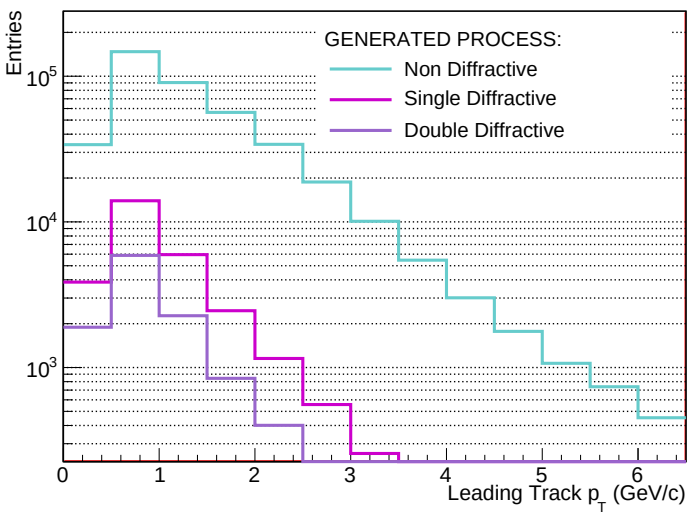
PYTHIA

Required analysis topology



PHOJET

Required analysis topology



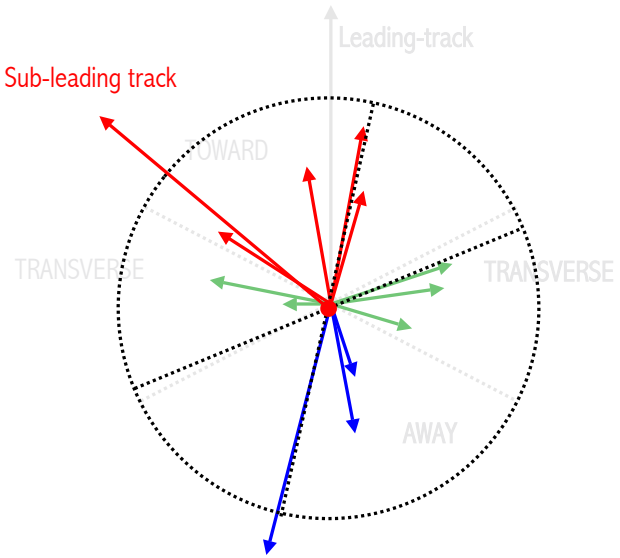
Harder diffraction contribution predicted by PHOJET.

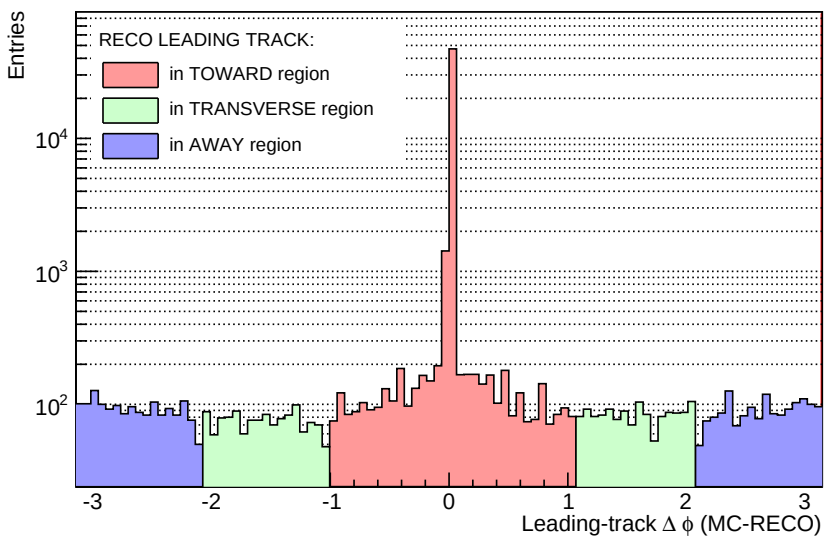
Leading-track misidentification bias

If instead of the leading-track, the sub-leading is taken...

- **bin migration:**
  along leading-track p_T axis (X)
- **event disorientation:**
  effect on number density or Σp_T (Y)

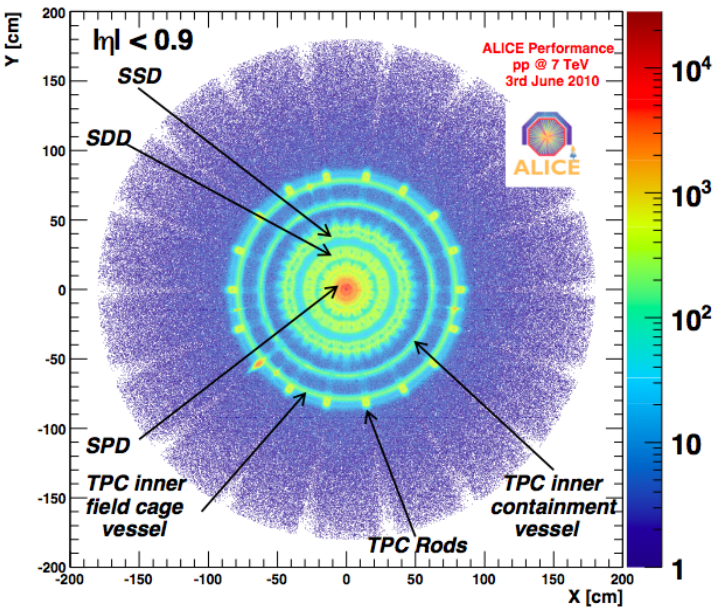
In $\sim 5\%$ of the cases the sub-leading track falls in the transverse region.





Optimization of track cuts (1/3)

Require 1 cluster in the first layer of the Inner Tracking System:



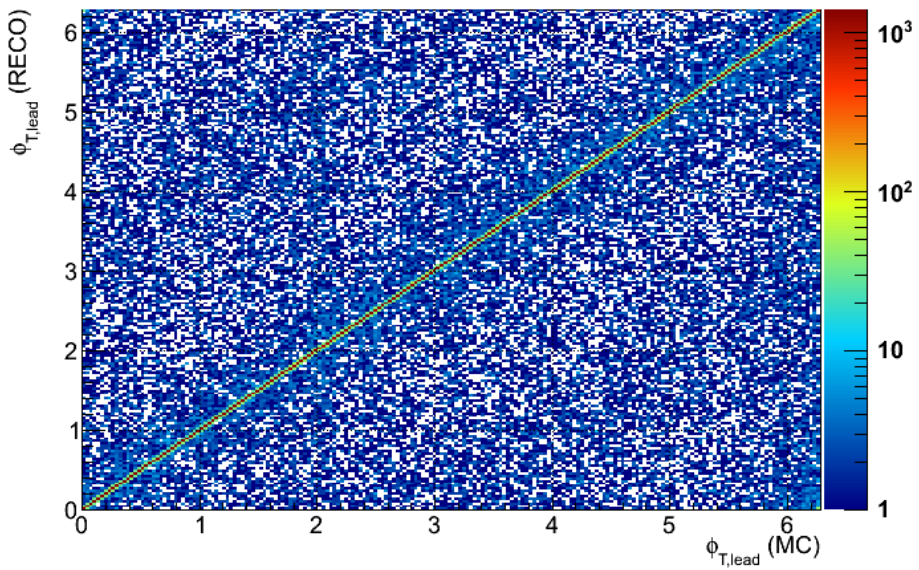
ALICE tomography from the *Photon Conversions* working group.

- avoid **secondary interactions** in the following silicon layers and thermal shield
- reduce contribution from **decays of strange particles**

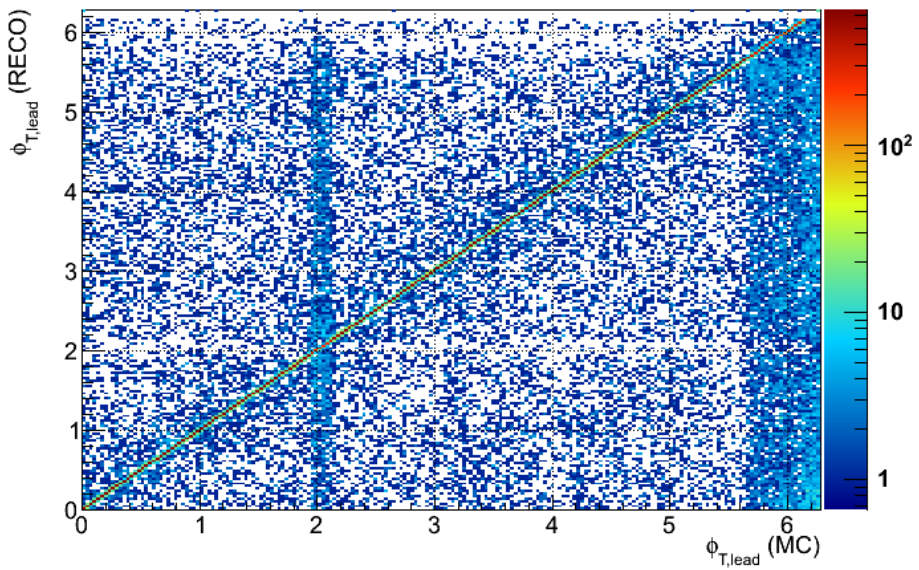
Optimization of track cuts (2/3)

Unfortunately the silicon pixel detector (SPD) has localized dead areas...

No pixel cluster required.



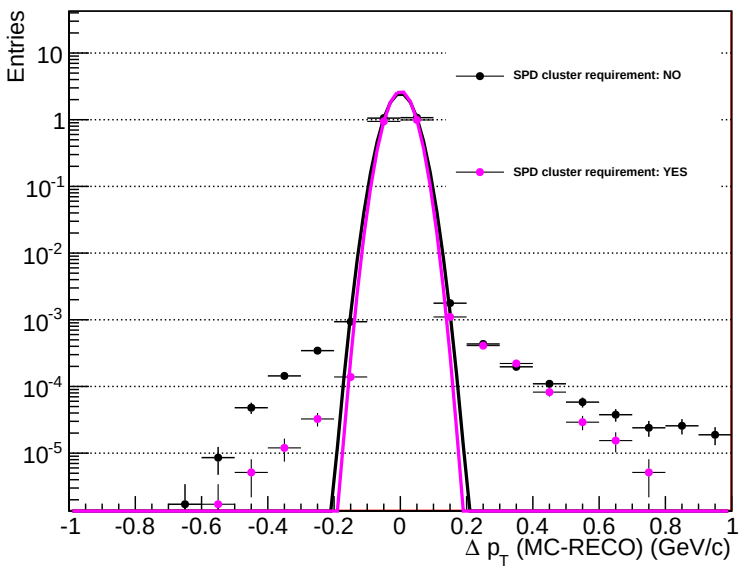
Pixel cluster required.

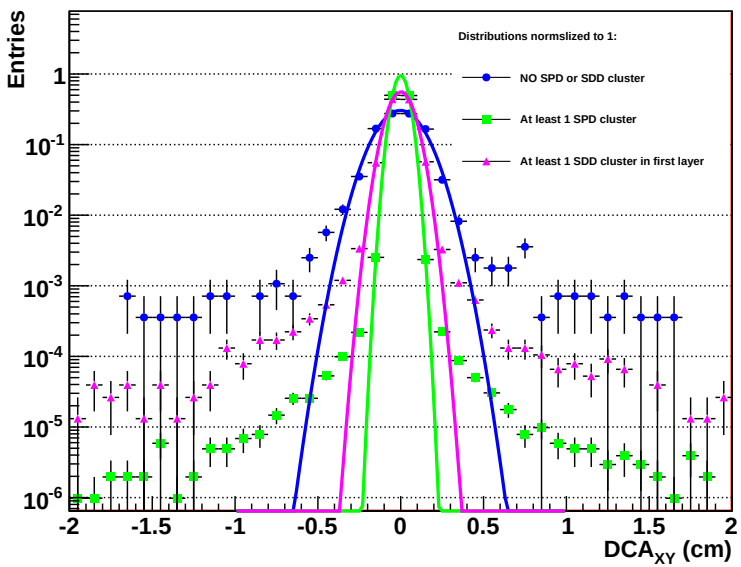


... which causes a **growth of the misidentified events** from 5% to 8%.

Optimization of track cuts (3/3)

Provided that the tracking resolution does not deteriorate significantly...





In the p_T bin 0.5-1 GeV/c spatial resolution deteriorates *only* a factor 2

Data driven correction to misidentification bias

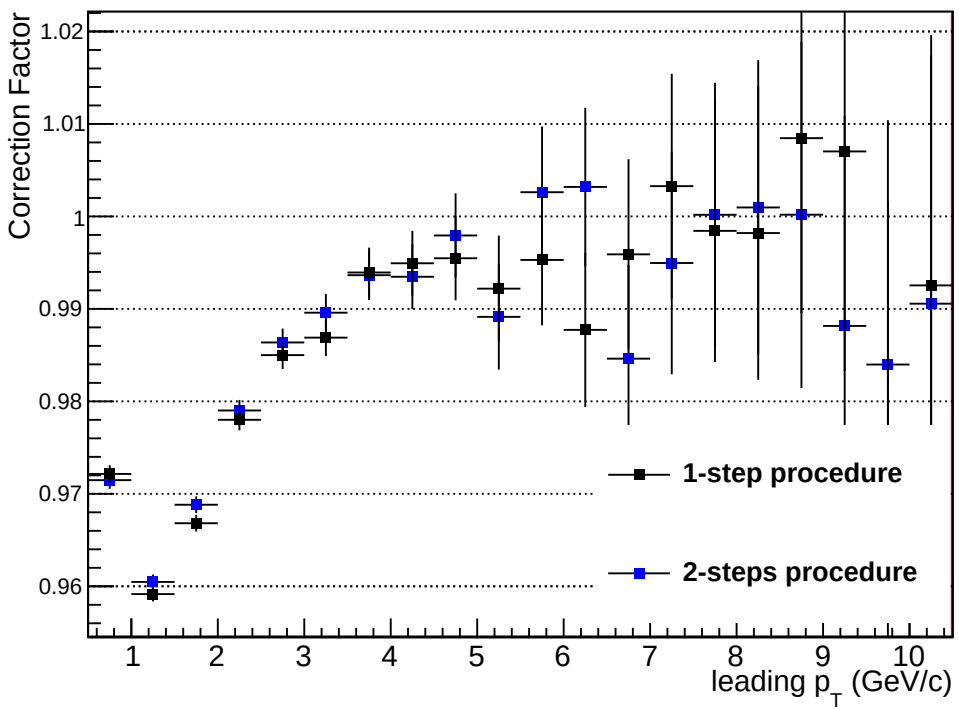
Starting from the reconstructed distribution, for each event:

- **apply the tracking efficiency a second time on the data**
- with the help of a random number generator decide if the leading-track is reconstructed
- if it is reconstructed:
  - use the reconstructed leading track to define topological regions
- if not:
  - **use the sub-leading track instead**
- the correction is extracted as function of leading track p_T

Two-steps data driven correction

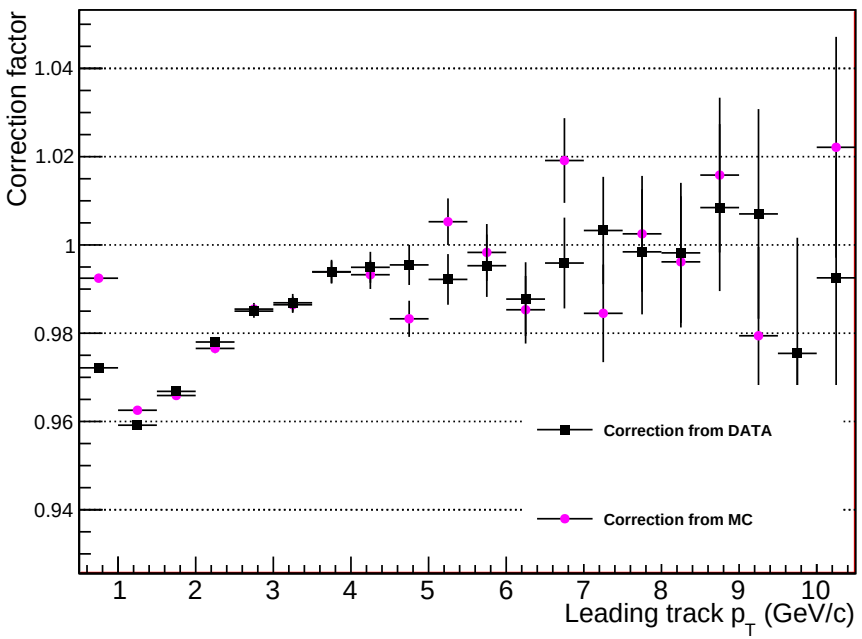
- the tracking efficiency is applied in 2 steps ($\frac{1}{2}$ eff. at the time)
- the correction factor obtained is compatible with the 1 step procedure

Misidentification bias on number density distribution.



Misidentification bias from Monte Carlo

Misidentification bias on number density distribution.



In the Monte Carlo driven procedure the correction comes from the ratio between events defined by:

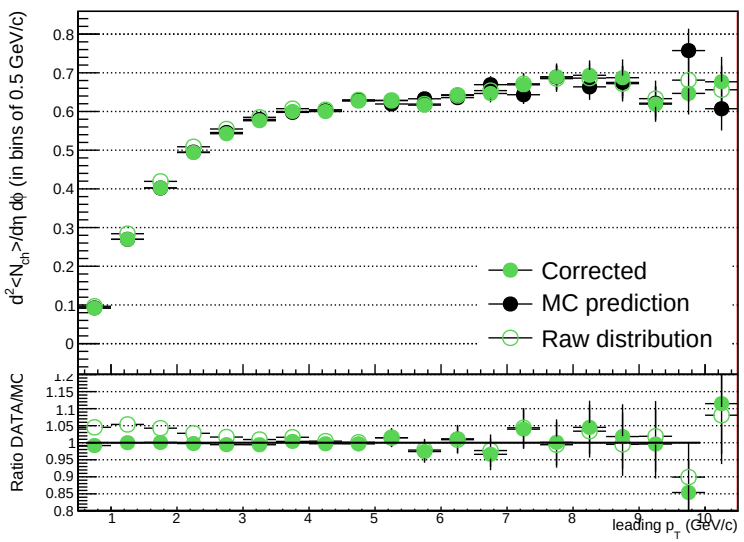
- reconstructed leading-track
- true leading-track

The data driven correction is validated by its compatibility with the Monte Carlo driven correction.

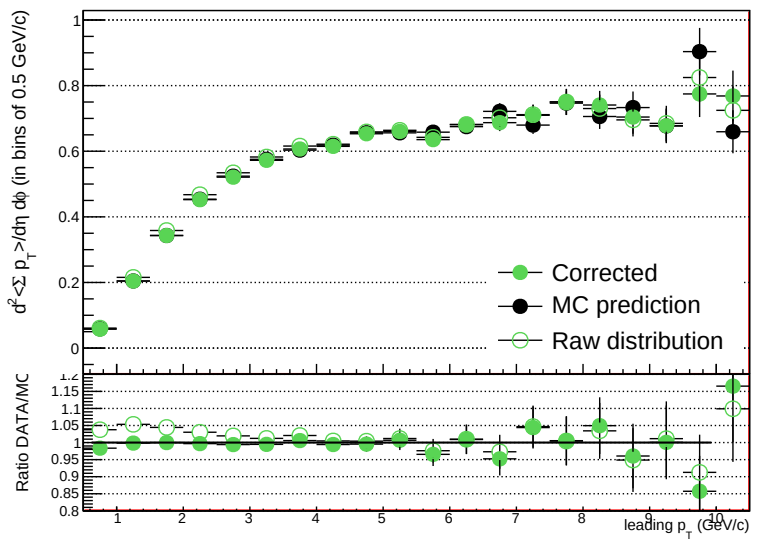
Validation of the correction

PYTHIA (Perugia0) sample corrected with PHOJET.

TRANSVERSE REGION example:



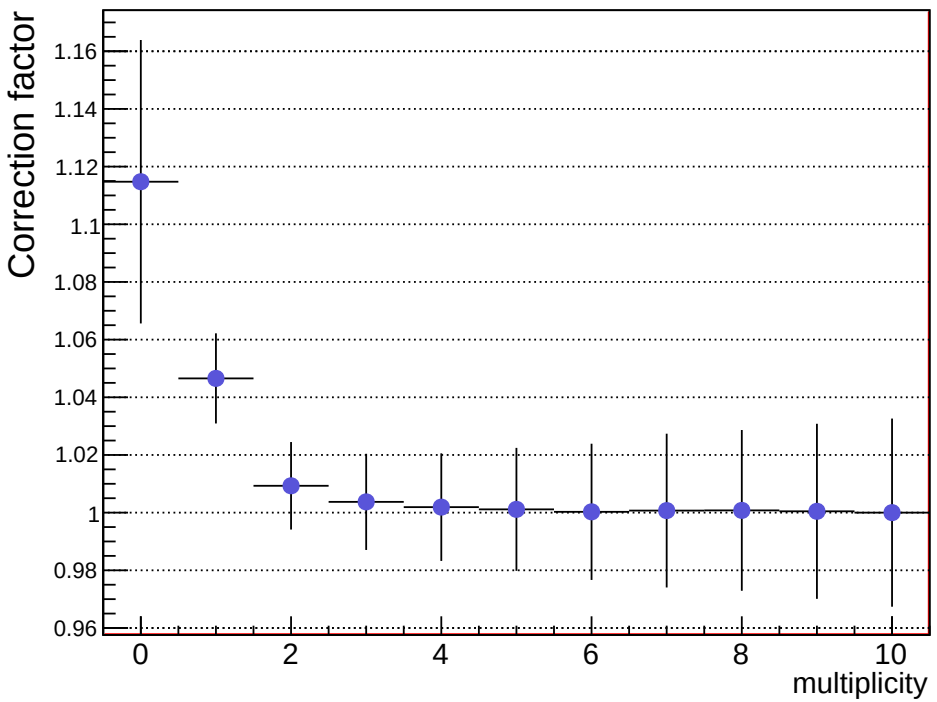
Number density.



Accumulated p_T.

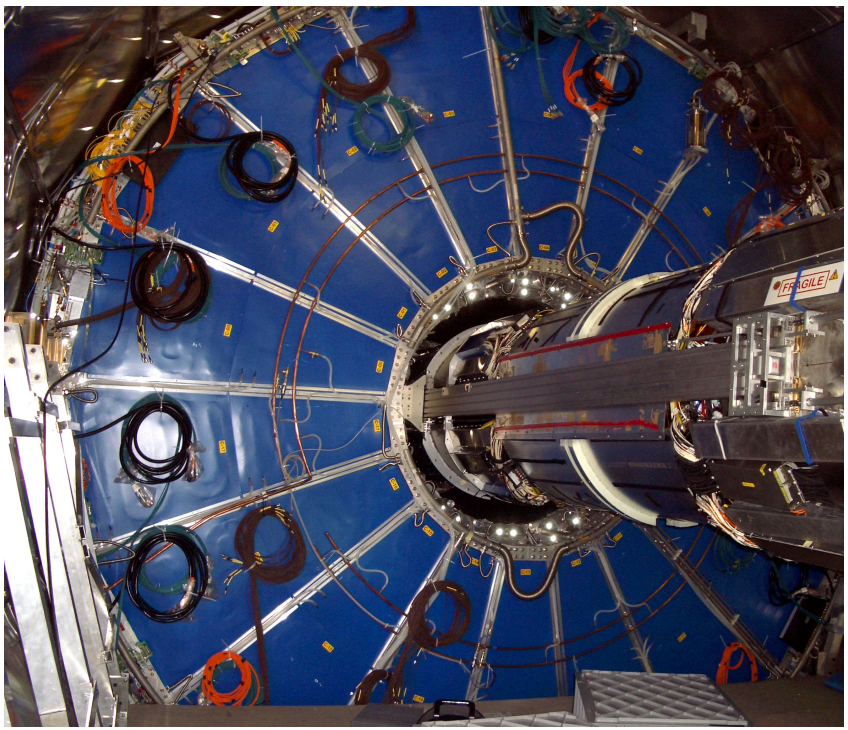
Correction factor for vertex reconstruction efficiency

- vs. multiplicity (tracks $p_T > 0.15$ GeV/c)
- convert measured multiplicity into true via correction factor (from profile of response matrix)



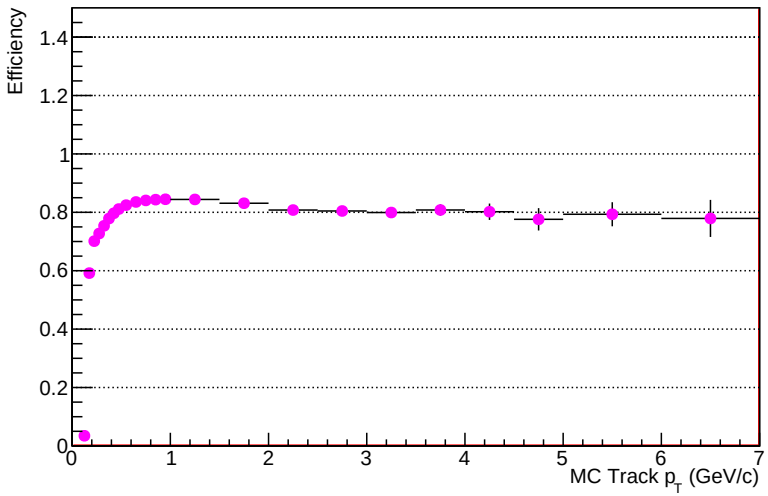
Track selection cuts

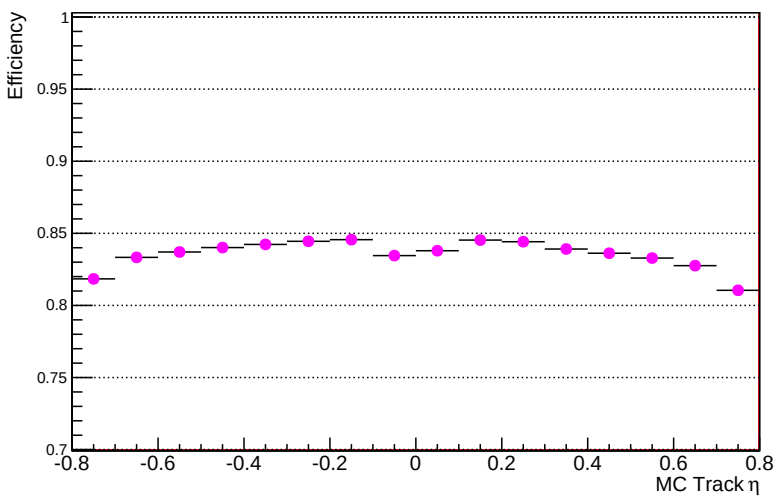
ITS being inserted in the TPC.



- Cuts optimized to avoid contamination from secondaries.
- combined information from **Time Projection Chamber** and **Inner Tracking System**
- p_T dependent DCA_{XY} cut (7 σ of distribution)

Tracking efficiency



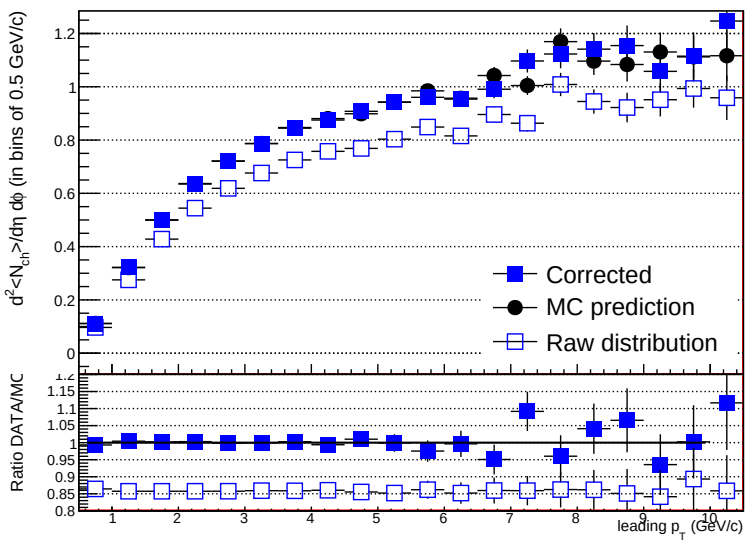


- 2D correction map: p_T, η (projections shown here)
- comparison between:
  - generated tracks
  - generated track if reconstructed matched a primary
- fraction of fake tracks $\sim 0.01\%$

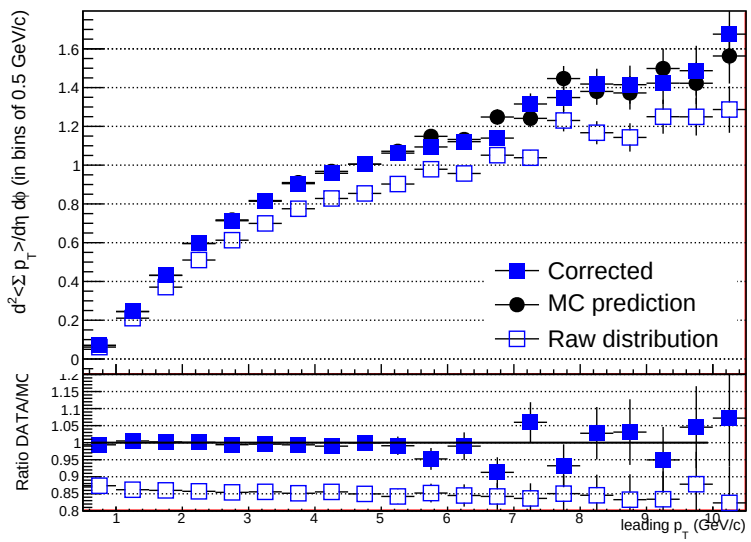
Validation of the correction

PYTHIA (Perugia0) sample corrected with PHOJET.

AWAY REGION example:



Number density.



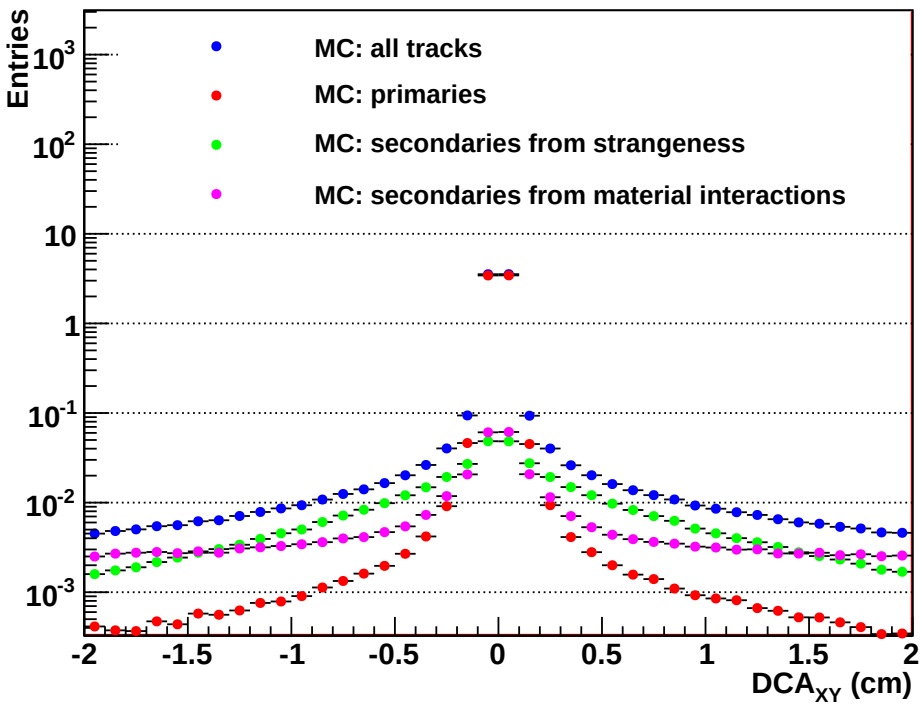
Accumulated p_T.

Sources of contamination

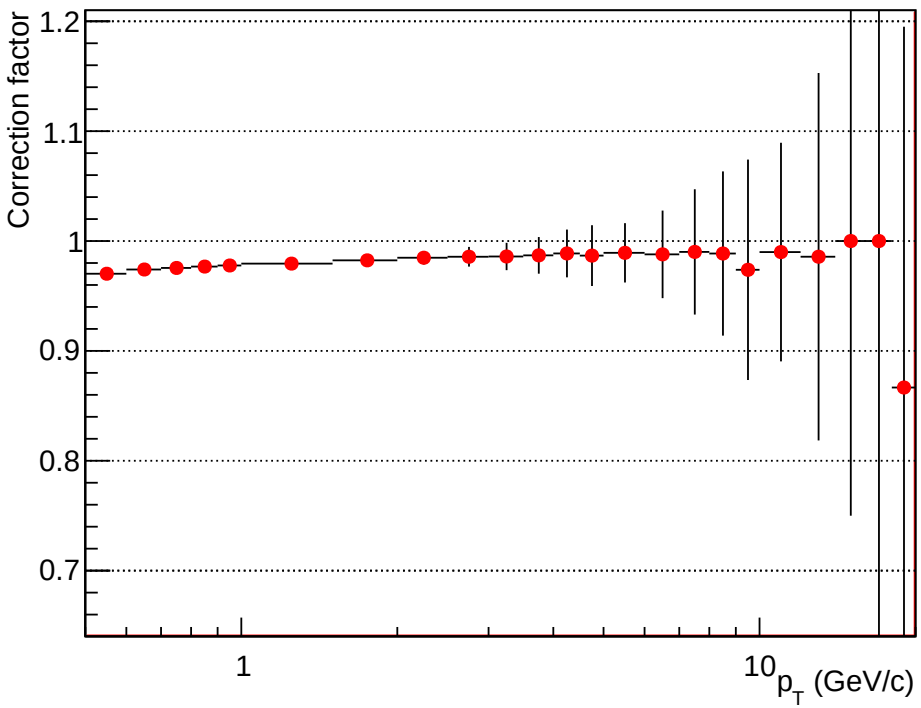
- correction obtained by comparing:
  - generated track if reconstructed matched any
  - generated track if reconstructed matched primary
- sources of contamination:
  - photon conversions
  - scattering in the material
  - weak decays of strange particles
- material budget under control (systematic uncertainty)
- correction factor (from data) to strangeness estimate from MC

Strangeness decays contribution from real data

- normalize nuber of primaries in central region (accepted by DCA cut)
- estimate excess in strangeness contribution comparing with real data in the side-bands



Contamination correction factor from Monte Carlo



The factor shown does not include the data-driven correction.

Summary of Correction Studies

	Relevant Variables	**Correction**
Misidentification bias	lead. track p_T	$< 5\%$
Vertex reconstruction	measured multiplicity	$< 10\%$
Tracking efficiency	track p_T, η	$< 20\%$
Contamination	track p_T, η	$< 5\%$

Systematics Studies

- choice of track cuts
- pile-up
- contamination from cosmics: negligible (efficiently excluded by track cuts)
- beam-gas events: negligible
- effect of different particle composition
- model dependence of corrections
- material budget

Outlook

- correction framework in place
- data-driven misidentification bias correction
- systematic uncertainties: work in progress

- fully corrected data coming soon ... ($\sim$ 1 month)