Prompt particle yields in Run14 AuAu

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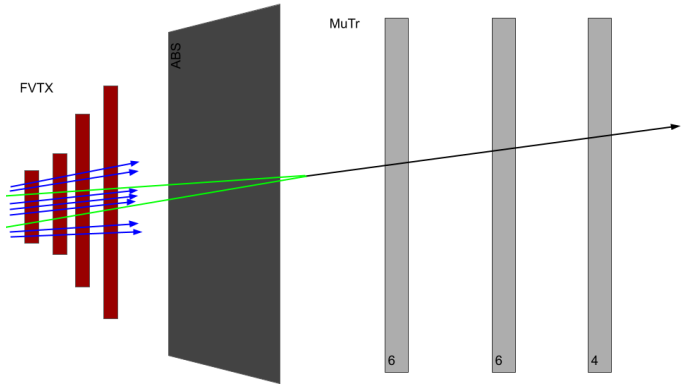
Mismatch distribution Normalization

Checking the Mismatch Normalization



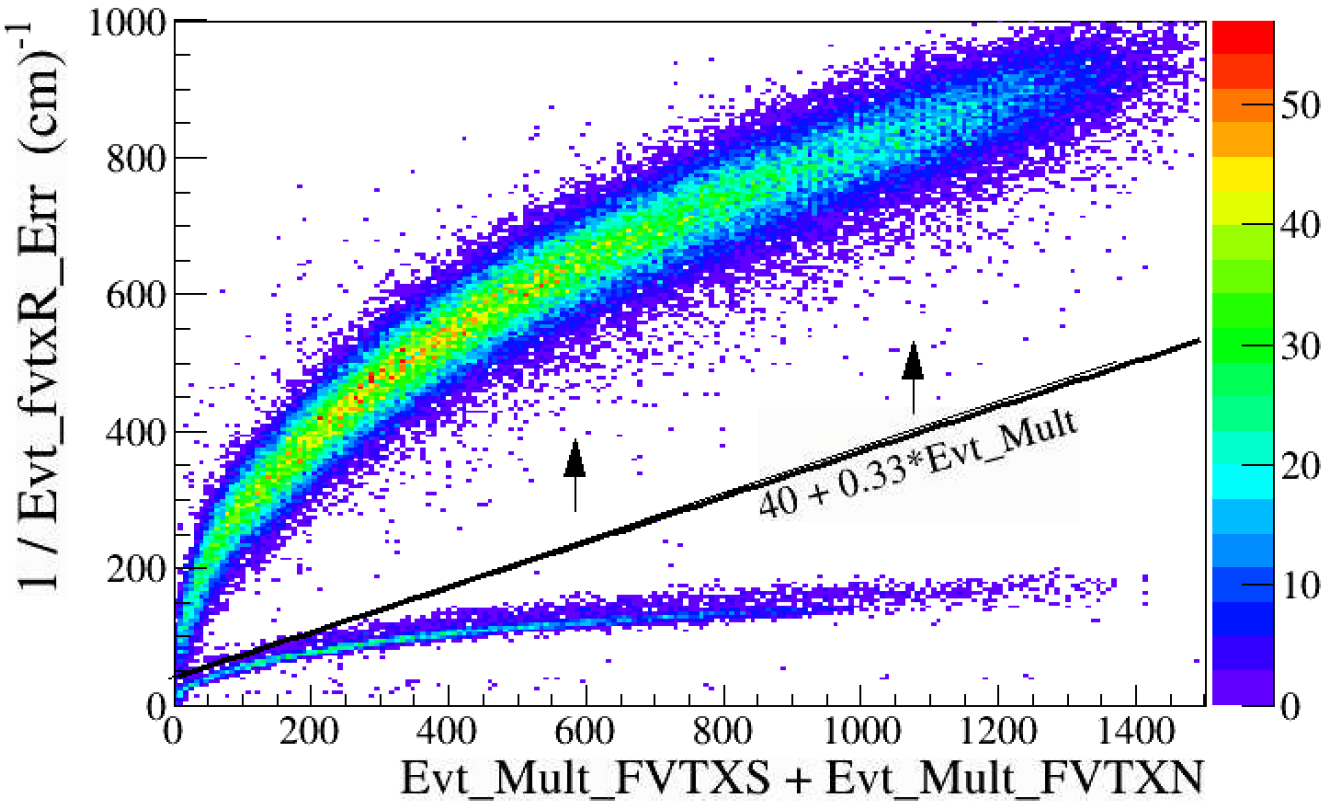
- during the B→ J/ψ analysis in Cu+Au (PPG198) it was demonstrated that the only way to deal with the FVTX-MuTr mismatches is to keep all the FVTX-MuTr match combinations with a match χ^2 <3
- the mismatch background is then determined by an event-mixed technique where the FVTX and MuTr tracks belong to different events
- the normalization of this mixed-event distribution, or swapped event as we called, is determined by counting how many FVTX tracks were counted in the same event (nFVTX) and in swapped events (snFVTX)

$$\text{swapped event normalization} = \frac{nFVTX}{snFVTX} \quad (1)$$

The question is:

- if this technique still works in the higher multiplicity environment of Au+Au collisions compared to Cu+Au collisions ?
- is the normalization broken when we select centrality ranges ?

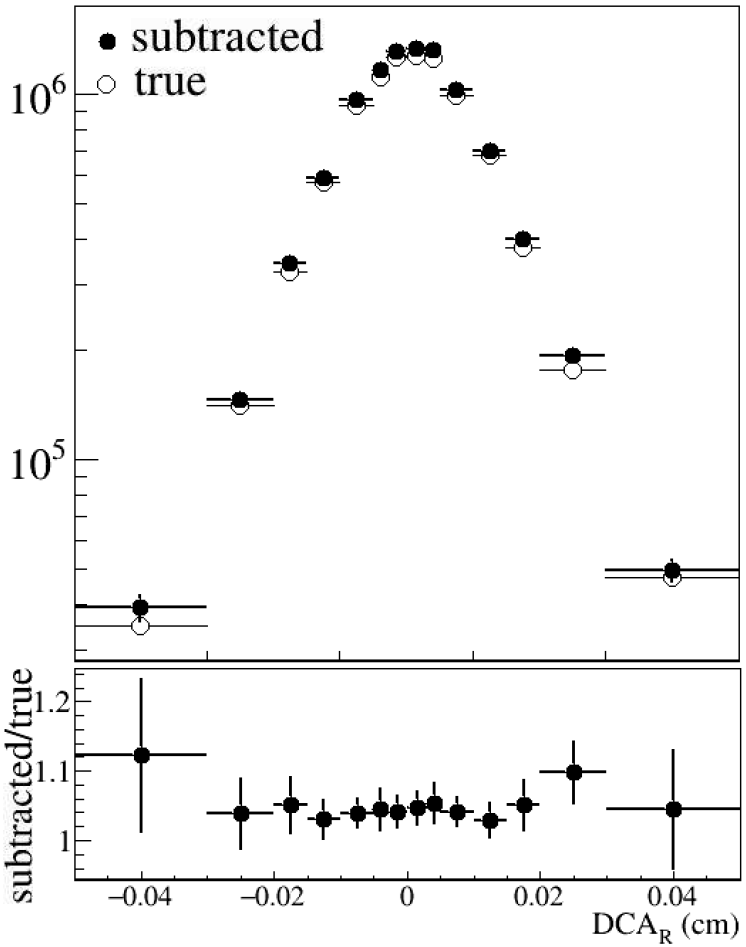
Removing multiple vertex events



- multiple vertexes or collision events appears when the vertex error is unexpected large
- arrows in the figure indicate the region which is KEPT

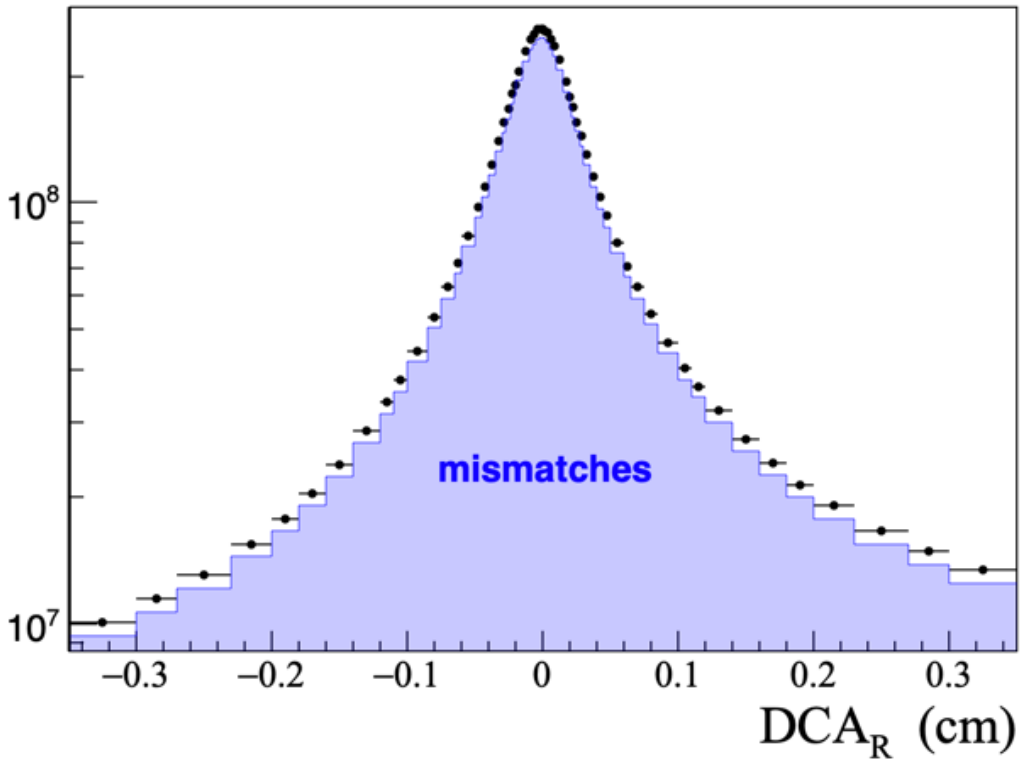
Embedded simulated J/ψ

MuTr from $J/\psi \rightarrow \mu$ and unidentified FVTX trks



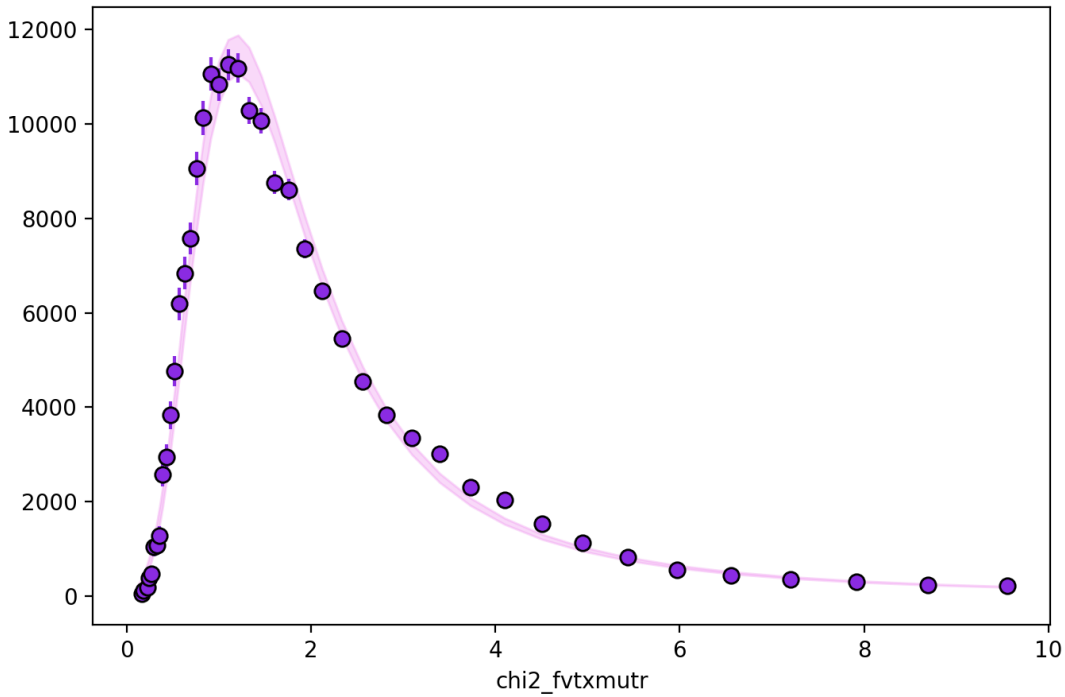
- MuTr tracks belonging to MC particles abs(mc_pid)==13
- blind association with FVTX tracks
- **overall 4.0±0.1 % discrepancy on the scale**
- getting in the level of the normalization uncertainties seen in Cu+Au data

Mismatching for lastgap=0



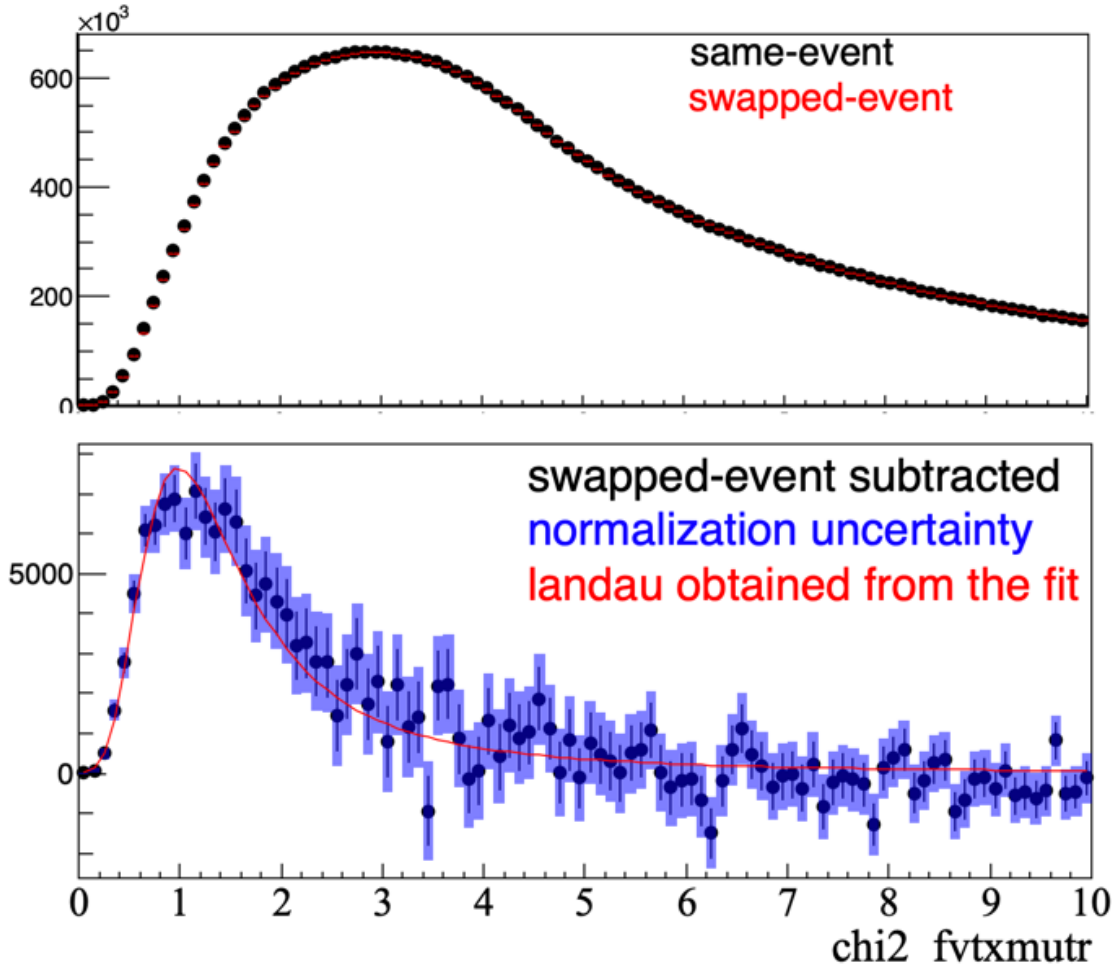
- signal/mismatch = 1/18
- that means, a 4% uncertainty in the swapped event normalization means a **72% uncertainty in the signal !**
- subtraction not working in some centrality bins

Another method to get the swapped event normalization



- the true chi2_fvtxmutr distribution is reasonably described by a Landau distribution
- it shapes doesn't depend on the track and source

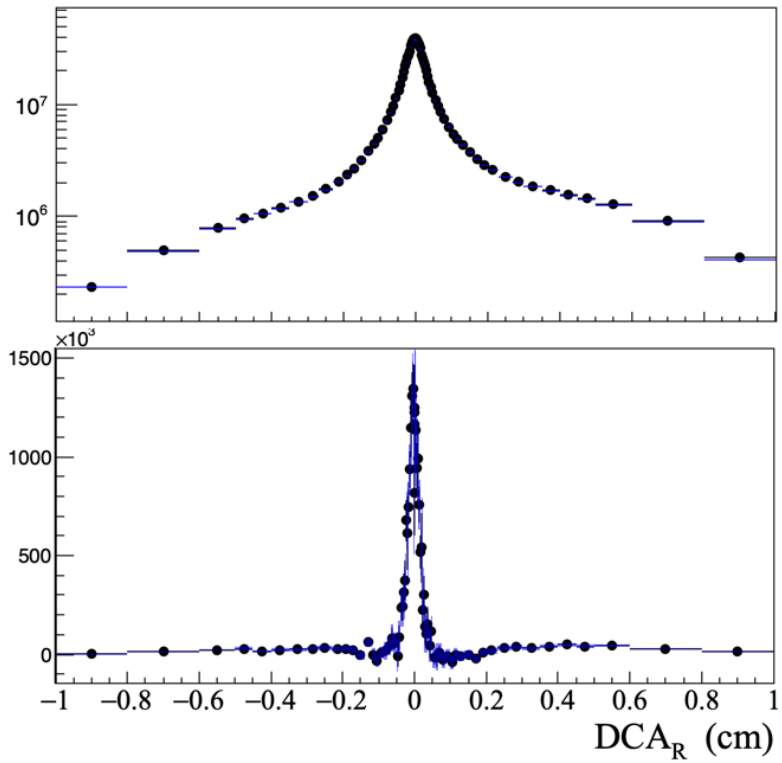
Getting normalization from the chi2_fvtxmutr fit



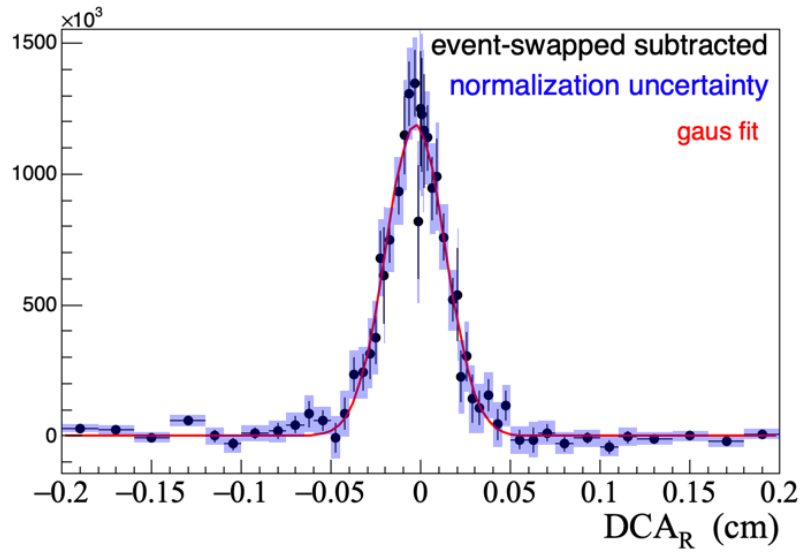
- a precise normalization *N* can be obtained by fitting the real data chi2_fvtxmutr distribution with

$$chi2\_fvtxmutr = Landau + N \cdot \text{swapped event distribution}$$

Subtracted DCA_R distribution



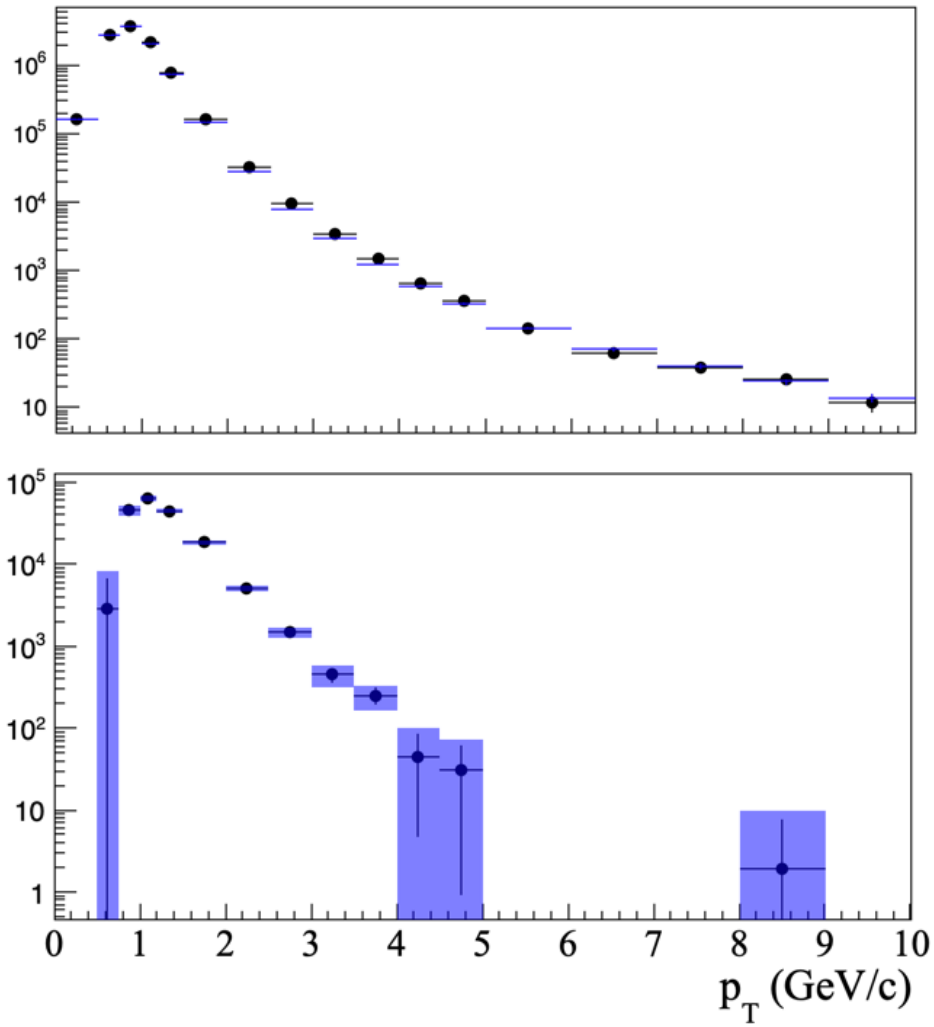
ZOOM in



- using the normalization *N* obtained from the chi2_fvtxmutr fit
- convincing prompt hadron $\mathrm{DCA_R}$ distribution

Signal Couting

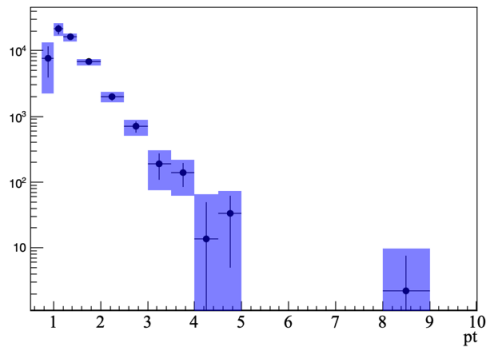
Prompt hadron distribution



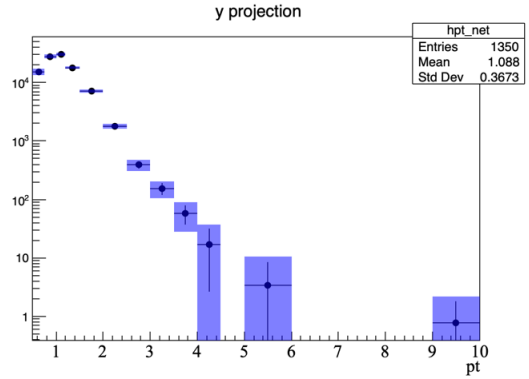
- $|\mathrm{DCA_R}| < 0.05$
- blue bands represent the normalization uncertainty

Centrality dependency

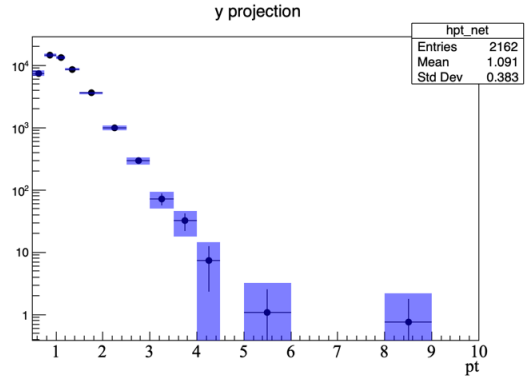
0<Cent<20



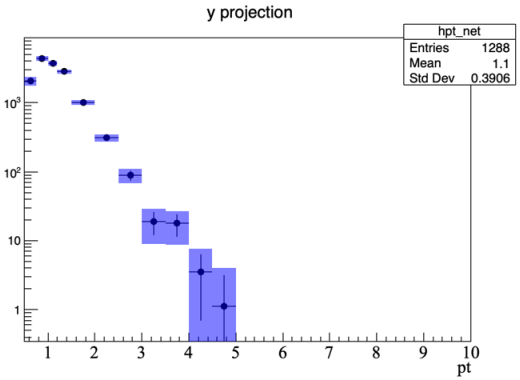
20<Cent<40



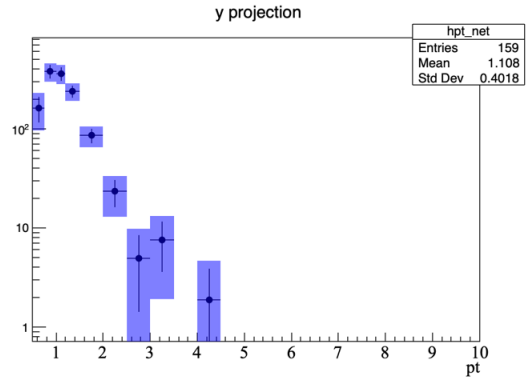
40<Cent<60



60<Cent<80



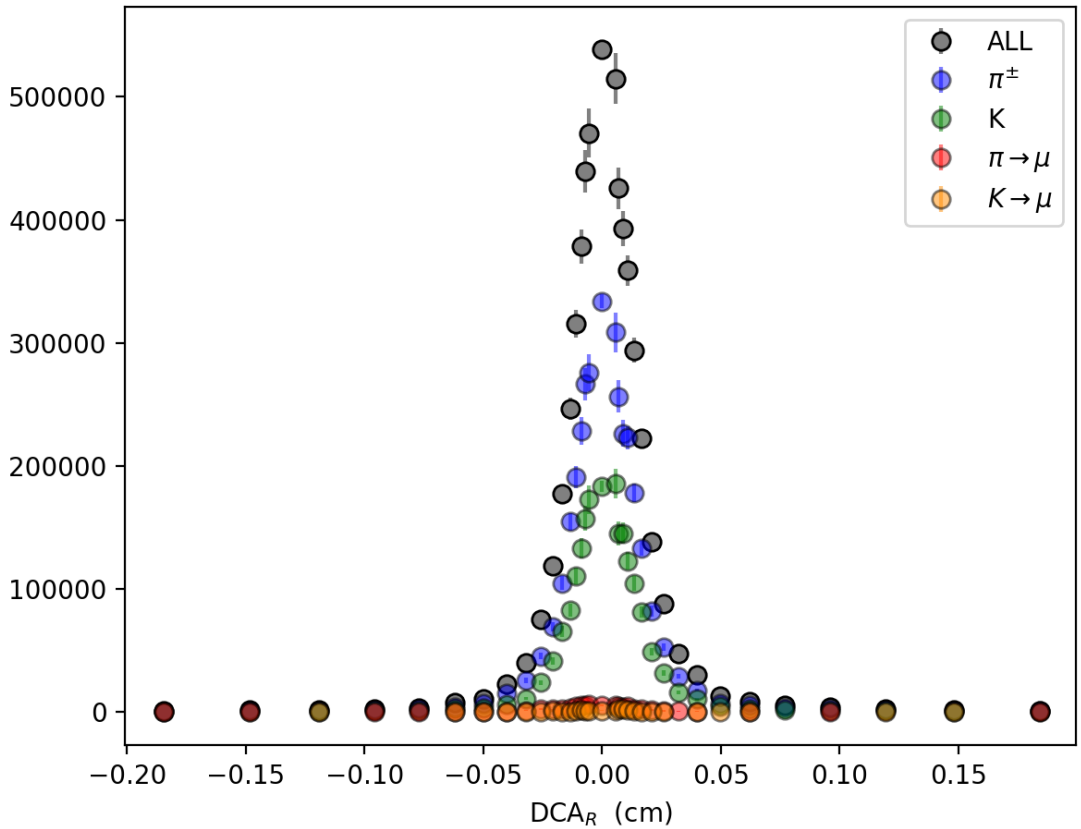
80<Cent<92



Detector Efficiency

Prompt hadron composition for lastgap==0

PYTHIA MB embed in run14 AuAu data

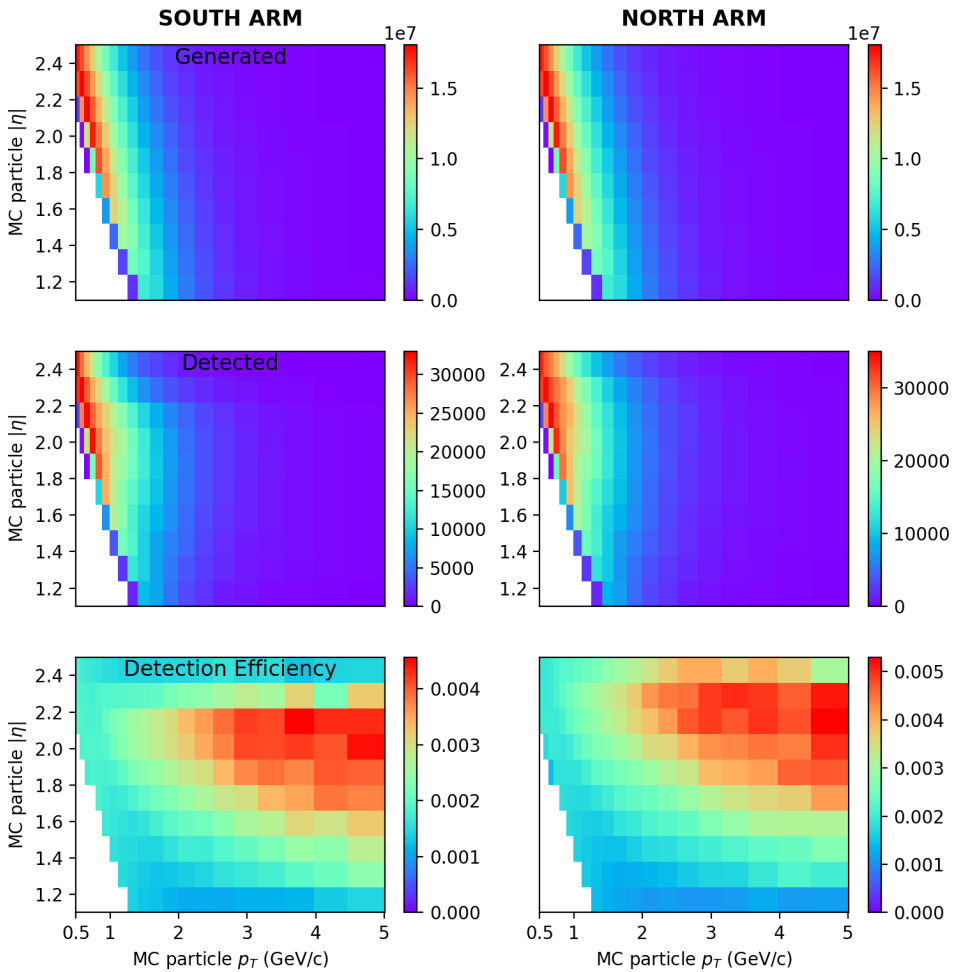


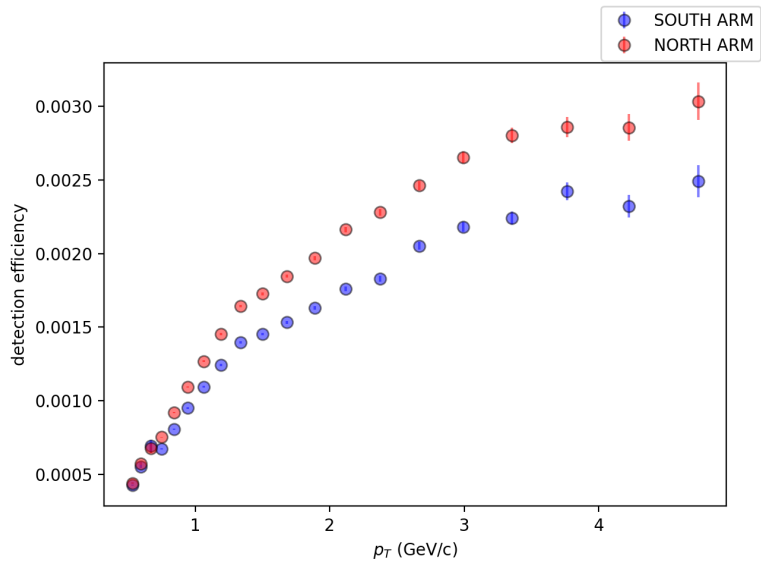
prompt pions	11286.0	61%
prompt kaons	6398.0	34%
pion decays	252.0	1.4%
kaon decays	71.0	0.4%

Detector Efficiency

- generated pions, hadrons and protons using PYTHIA8 in Minimum Bias mode
- only the particles which do not decays are considered in this simulation
- all generated particles are stored in a normalization file
- only those particles which produced at least 5 hits in the MuTr are saved in a HepMC picoDST container (MCHEPMCCONTAINER)
- the fraction of particles which produced hits in the Mutr represent the **detector efficiency**
- the detector efficiency is
  - independent of the collision centrality
  - should be the same for run14 and run15
  - but may depend on the event vertex distribution
- the event vertex is obtained from the embed real data event

Detector Efficiency



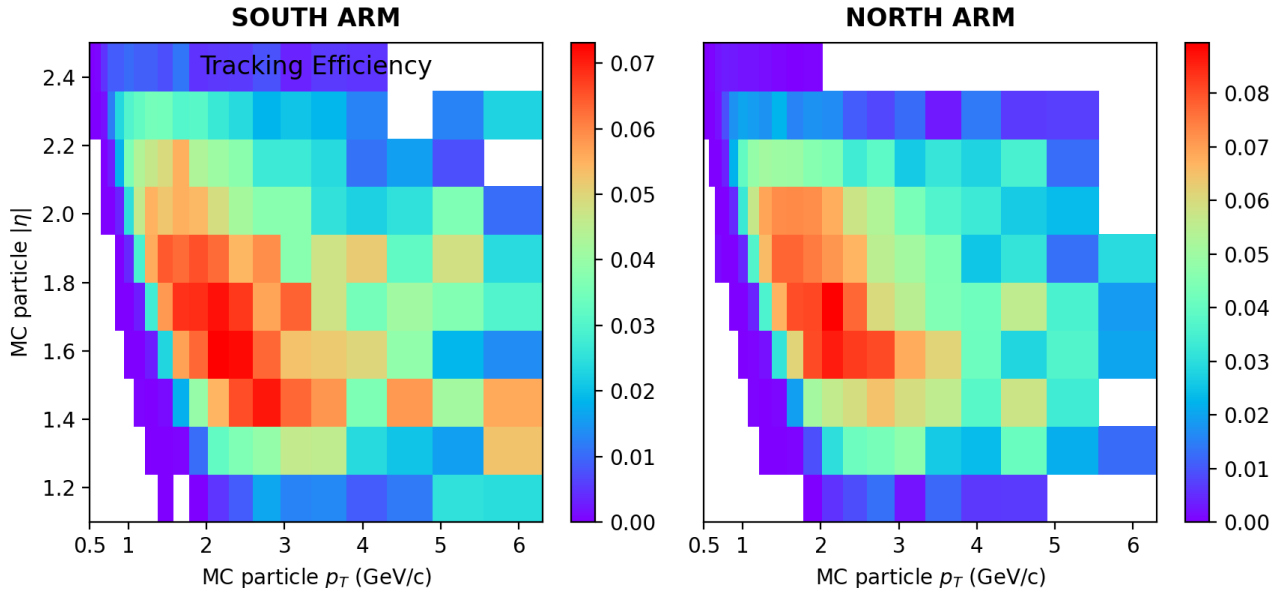


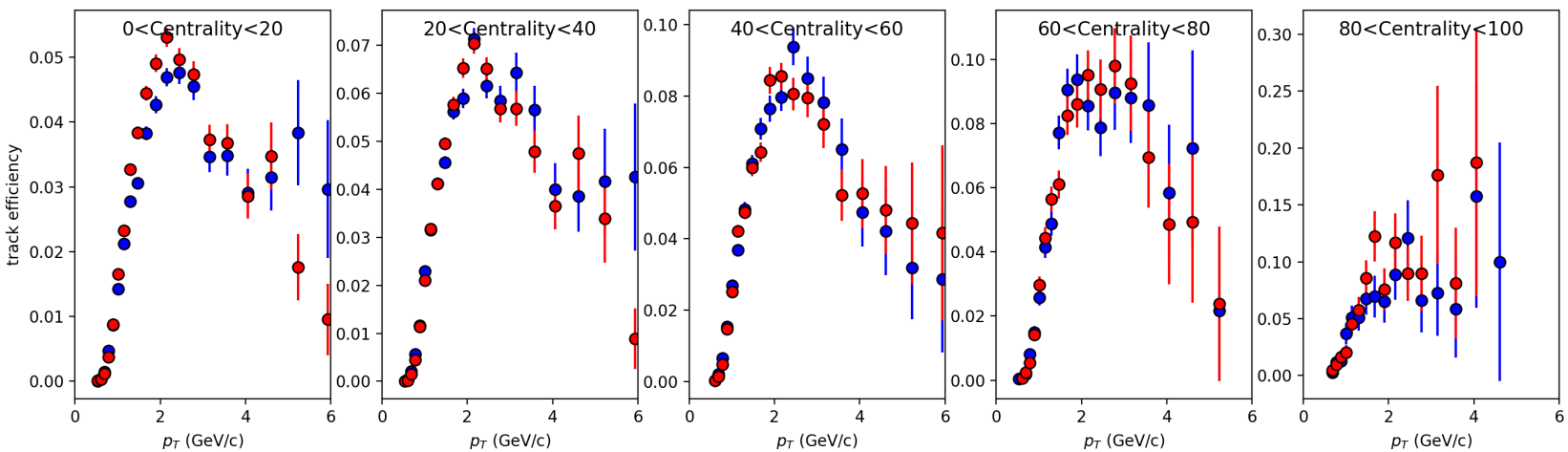
- fraction of particles which produce at least 5 hits in the MuTr

Track Reconstruction

- require track reconstruction in the FVTX and MuTr
- no MuID is required
- obtained a sample of 2M triggered events ($\geq$5 MuTr hits, $\geq$2 VTX+FVTX hits)
- additional simulation performed to enrich the $p_T > 2$ GeV/c range

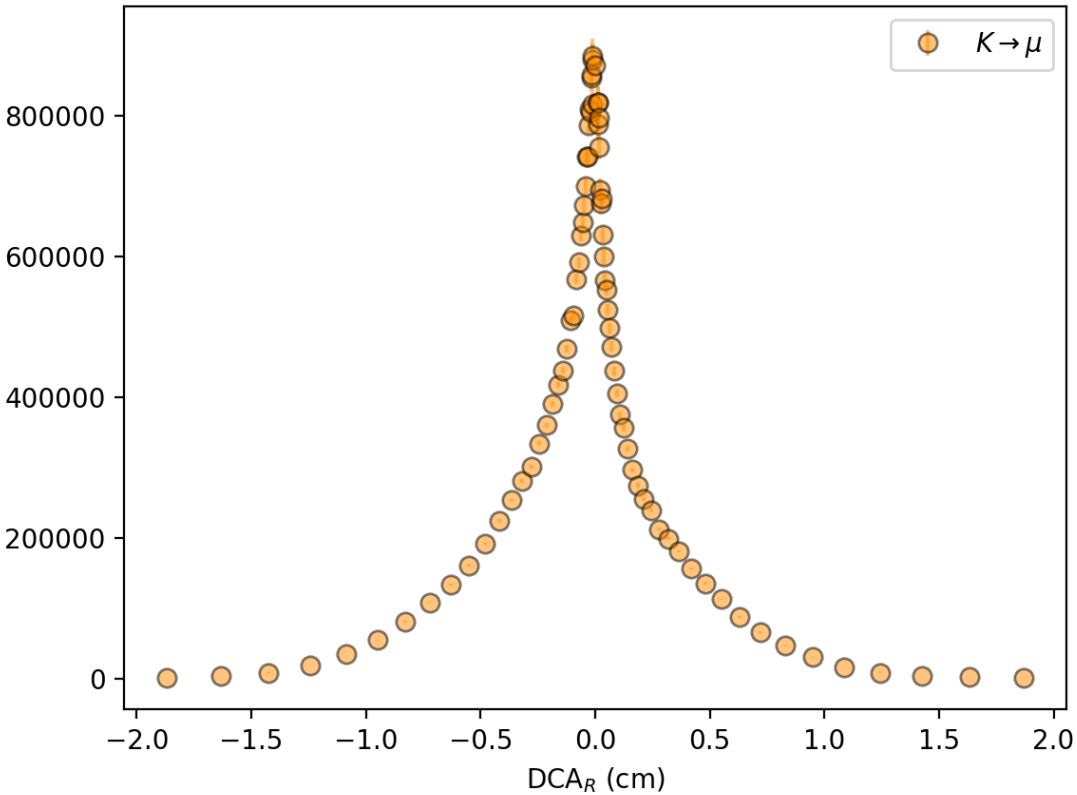
Track Reconstruction

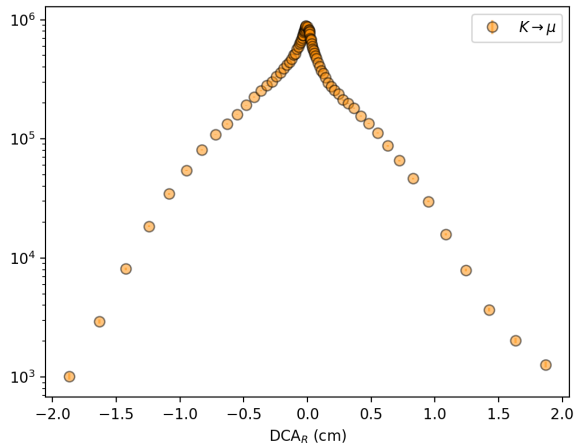




- waiting to finish pDST from Ajeeta's files which will double this statistics
- may need to run more high p_T simulation, waiting to make space in the FVTX disk

Kaon Decay simulation for future HF analysis





- a large sample is needed for BDT training
- Changed the Physics trigger in G3TOG4_HADRONS.C to accept only muons from kaon decays
- only events where a muon produced 2 hits in VTX/FVTX + 5 hits in MuTr + 4 hits in MuID were accepted for embedding
- 14M $K \to \mu$ decays generated, 440K reconstructed