

Topological reconstruction of D^0

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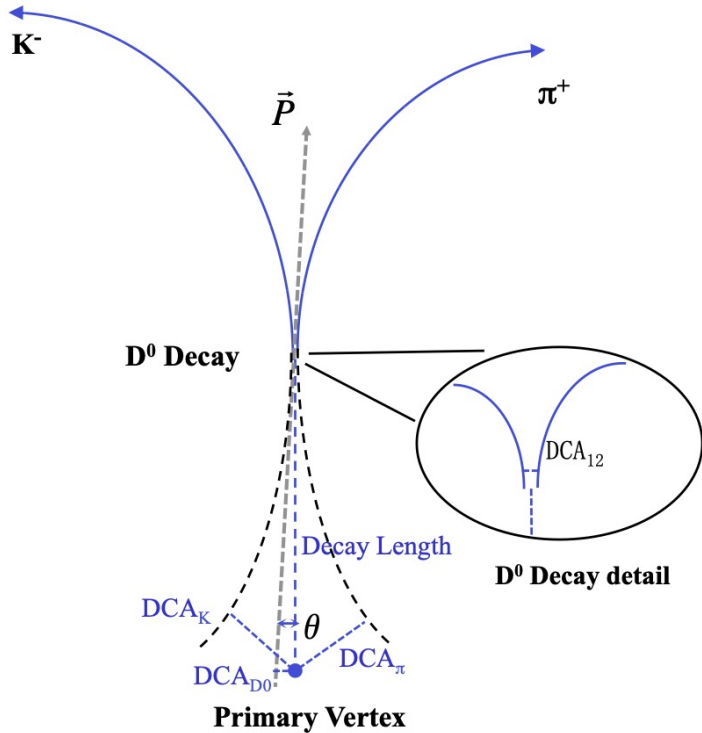
11/14/2024

Analysis setup

- PYTHIA 8.306 ep@18x275, NC, $Q_{\min}^2 = 100$
- With beam effects
- D^0 -enriched sample: each event contains at least one D^0 or anti- D^0
- Select events with D^0 or anti- D^0 that decays into $\pi + K$
 - Branching ratio: $(3.947 \pm 0.030)\%$

- EIC geometry: *epic-24.09.0*
- EICrecon: **default realistic seeding**

Topological reconstruction

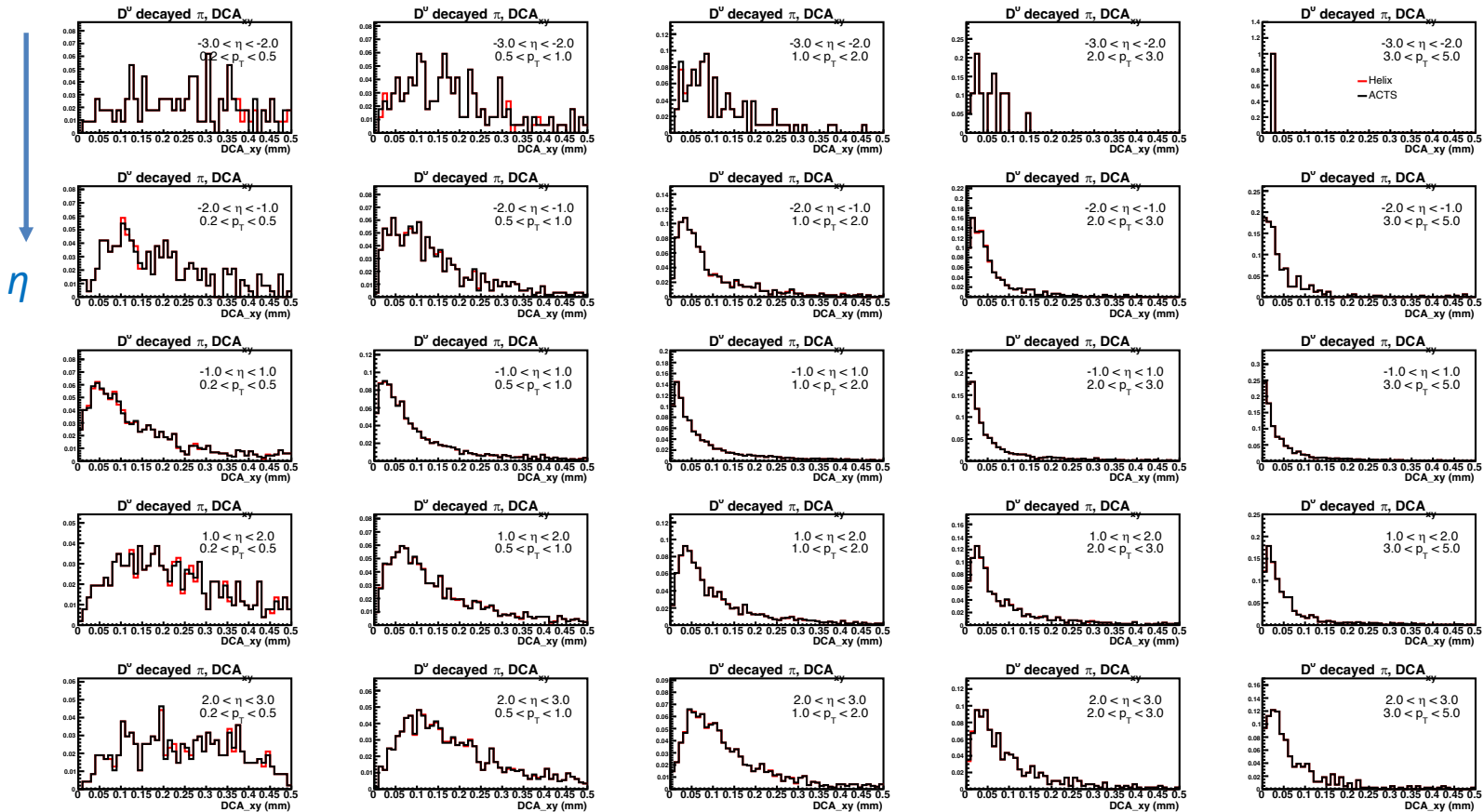


- Topological variables
 - DCA_π , DCA_K , DCA_{12}
 - DCA_{D^0} , decay length, $\cos(\theta)$
- Calculated based on helix swimming in a constant magnetic field
 - Adopted from STAR code
 - $B = -1.7$ T

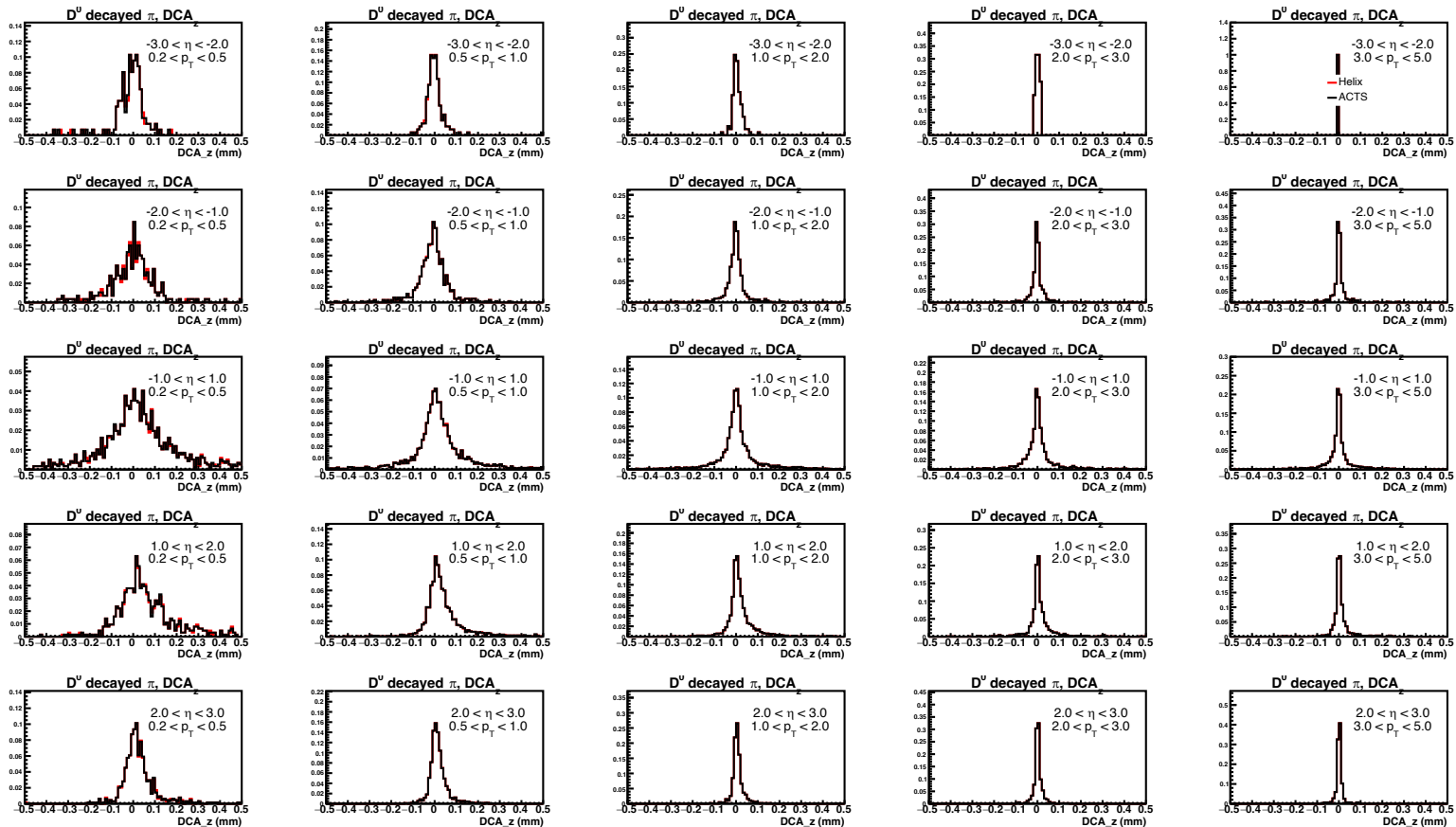
Compare secondary track DCA: ACTS vs. helix

DCA_{xy} for secondary pion: ACTS vs. helix

p_T

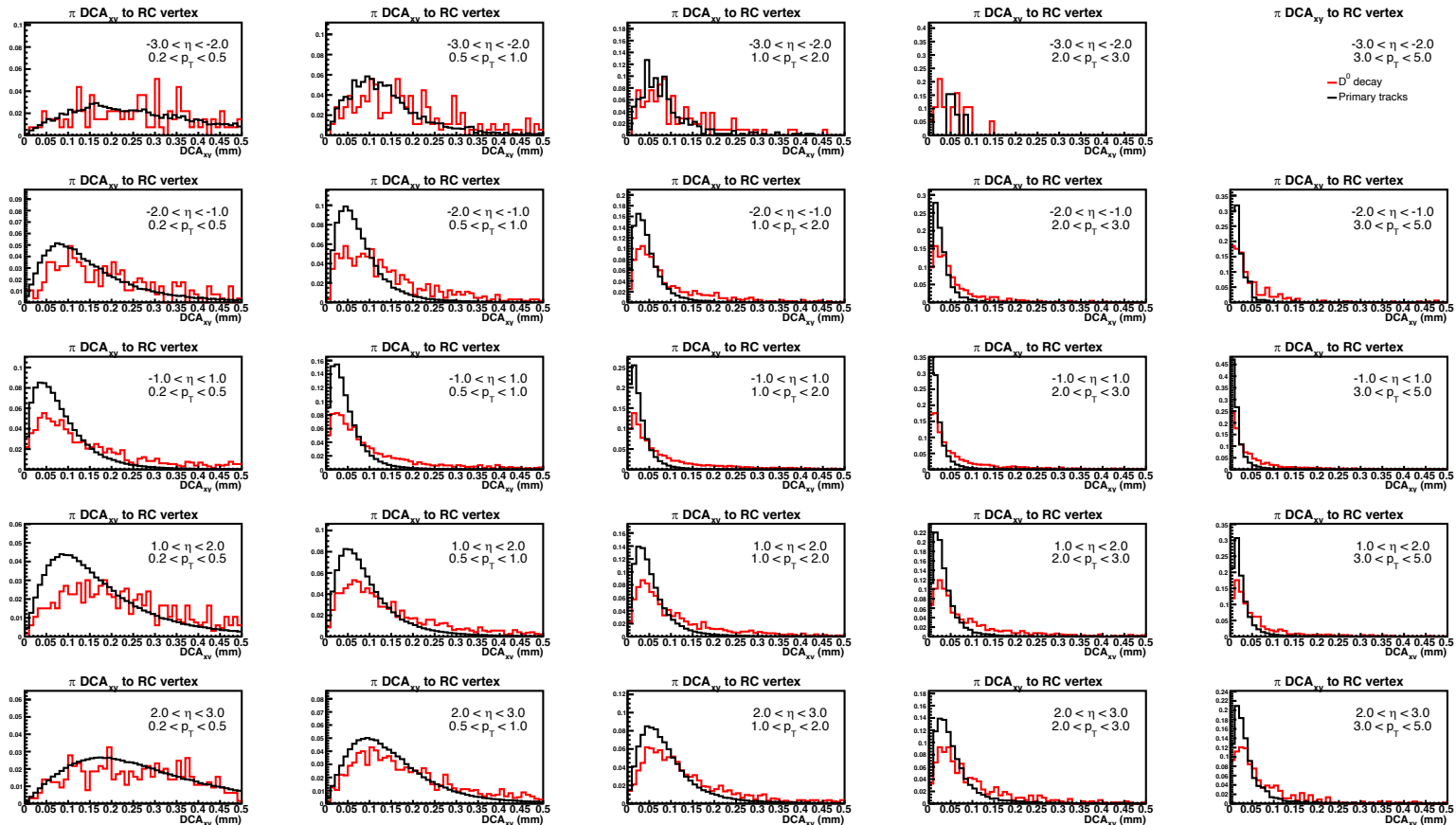


DCA_z for secondary pion: ACTS vs. helix

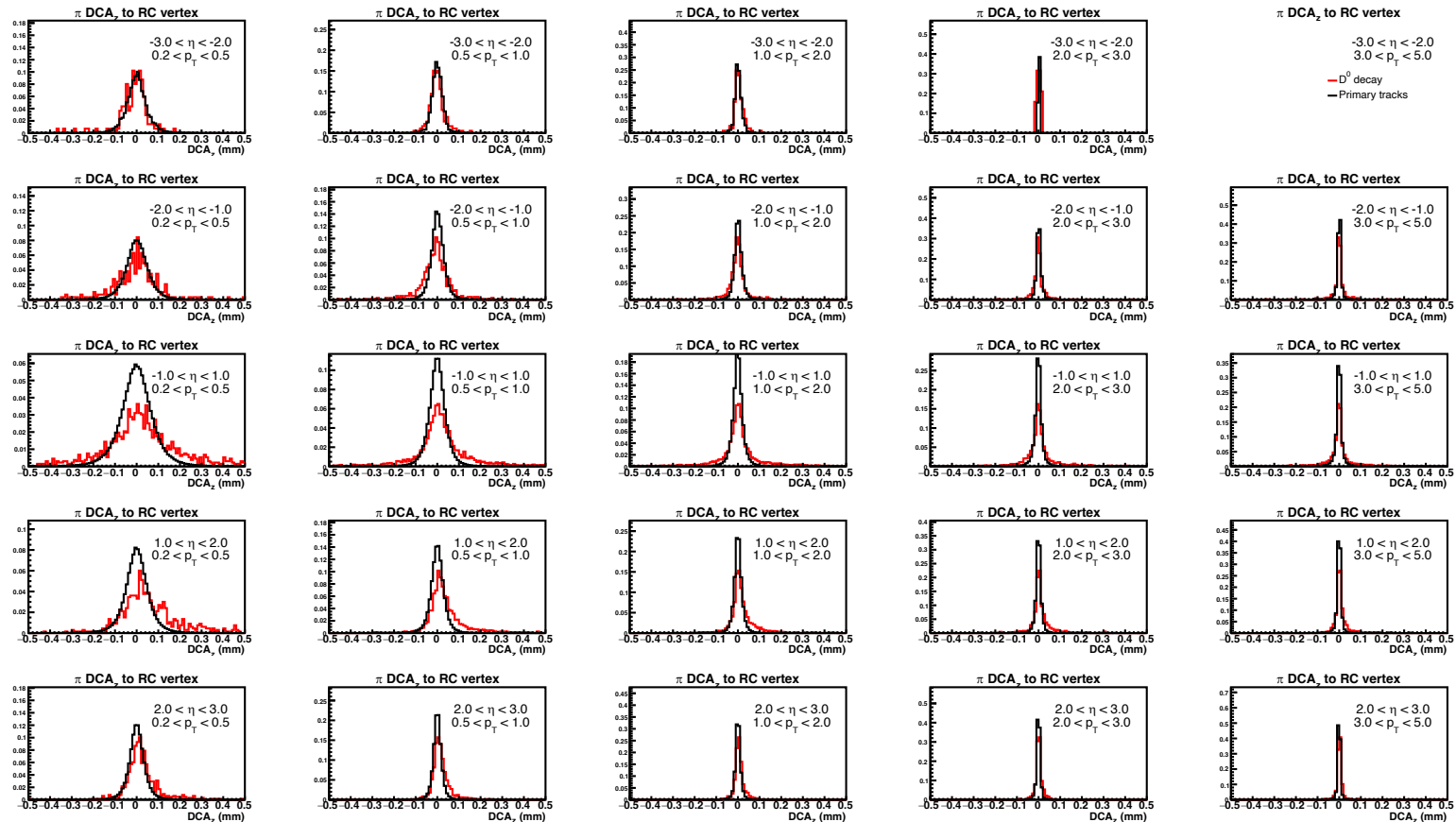


Compare topological variables

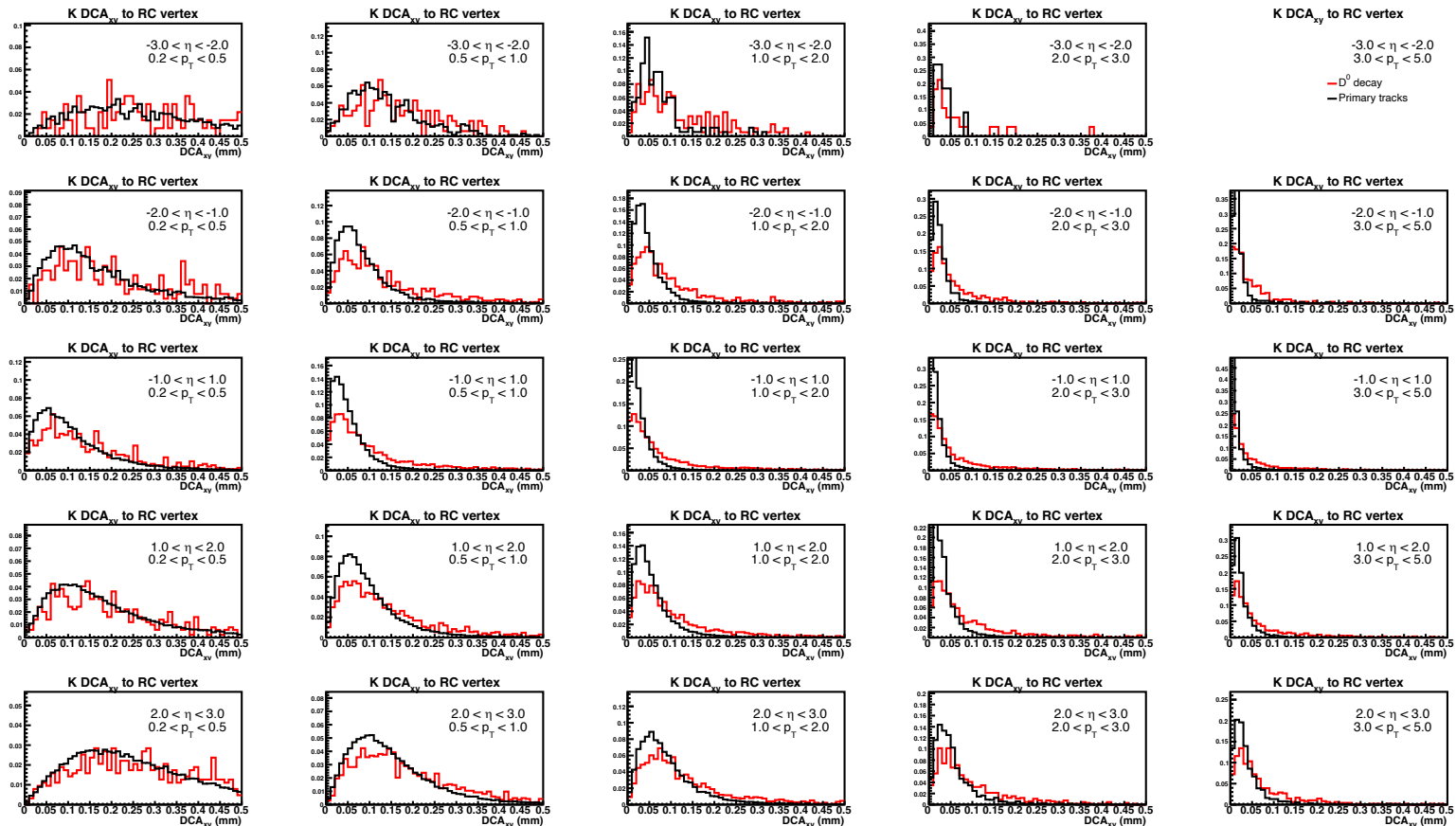
DCA_{xy} for pion: primary vs. secondary



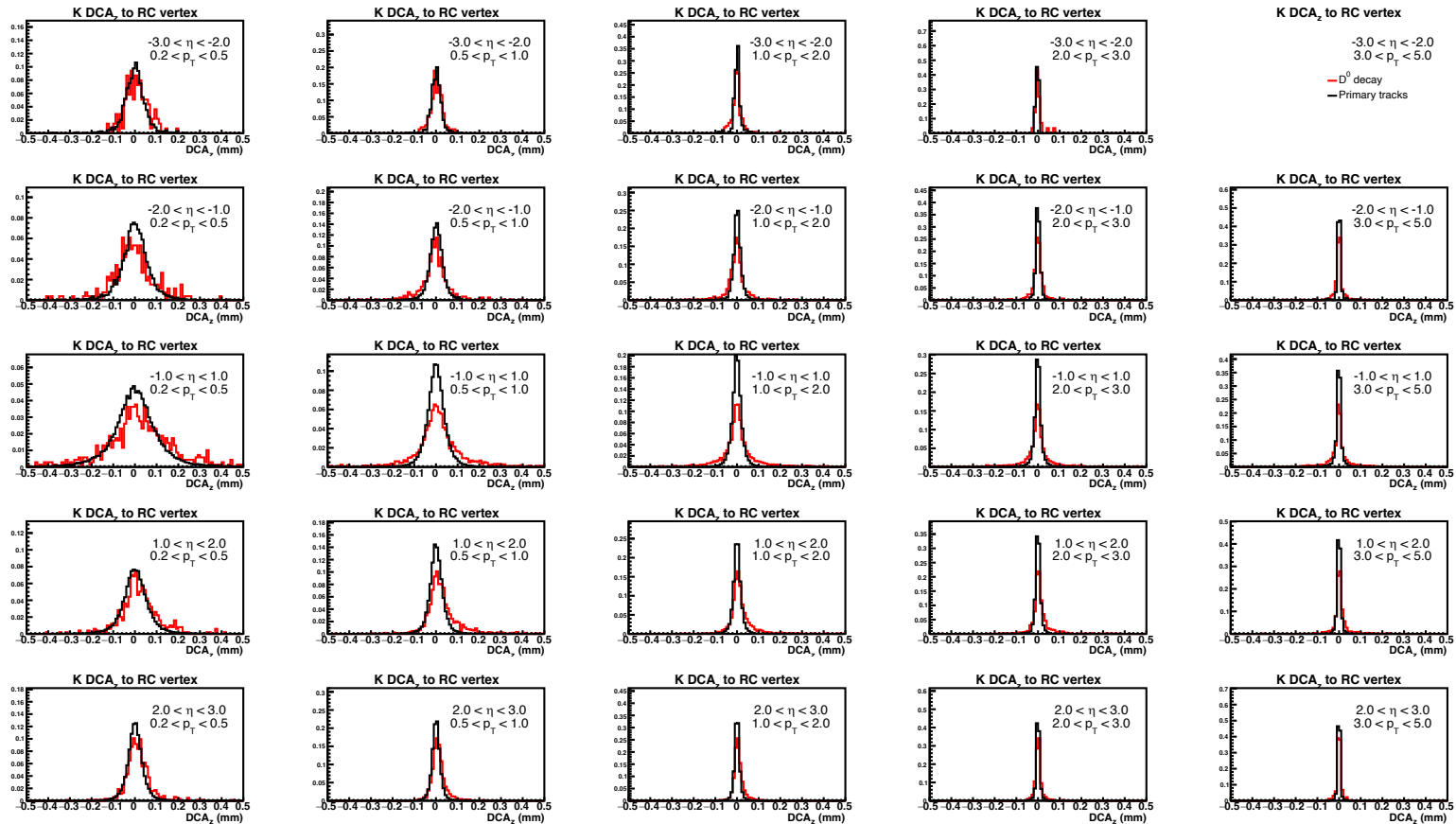
DCA_Z for pion: primary vs. secondary



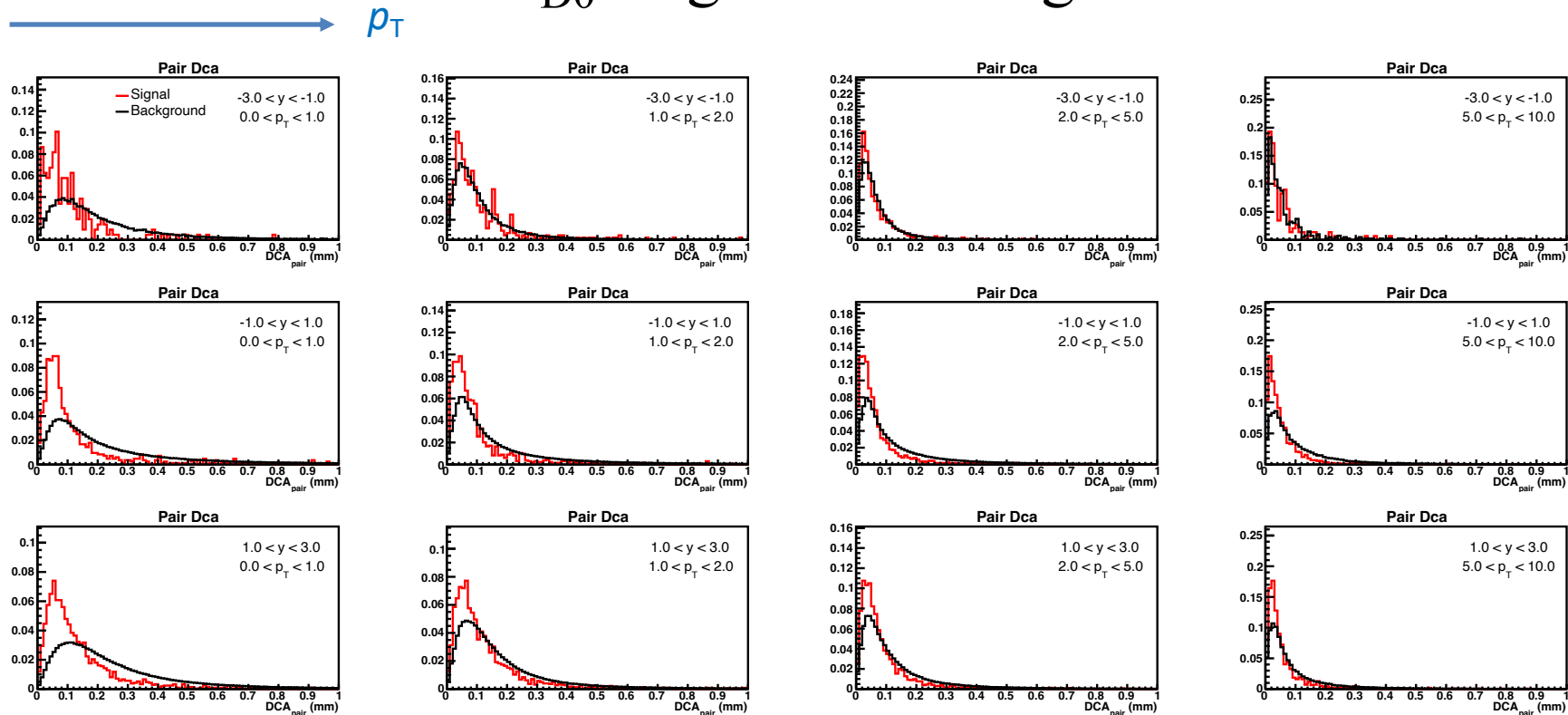
DCA_{xy} for Kaon: primary vs. secondary



DCA_Z for Kaon: primary vs. secondary

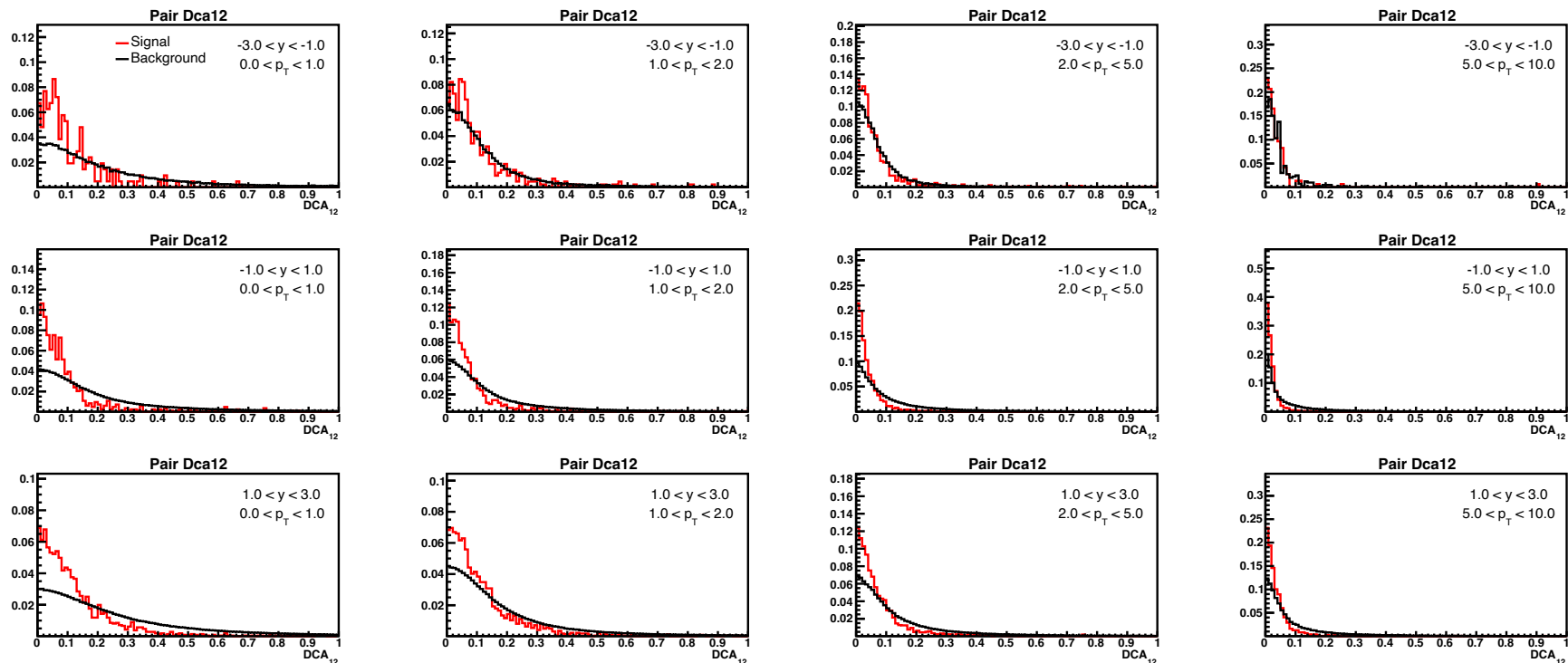


DCA_{D0} : signal vs. background



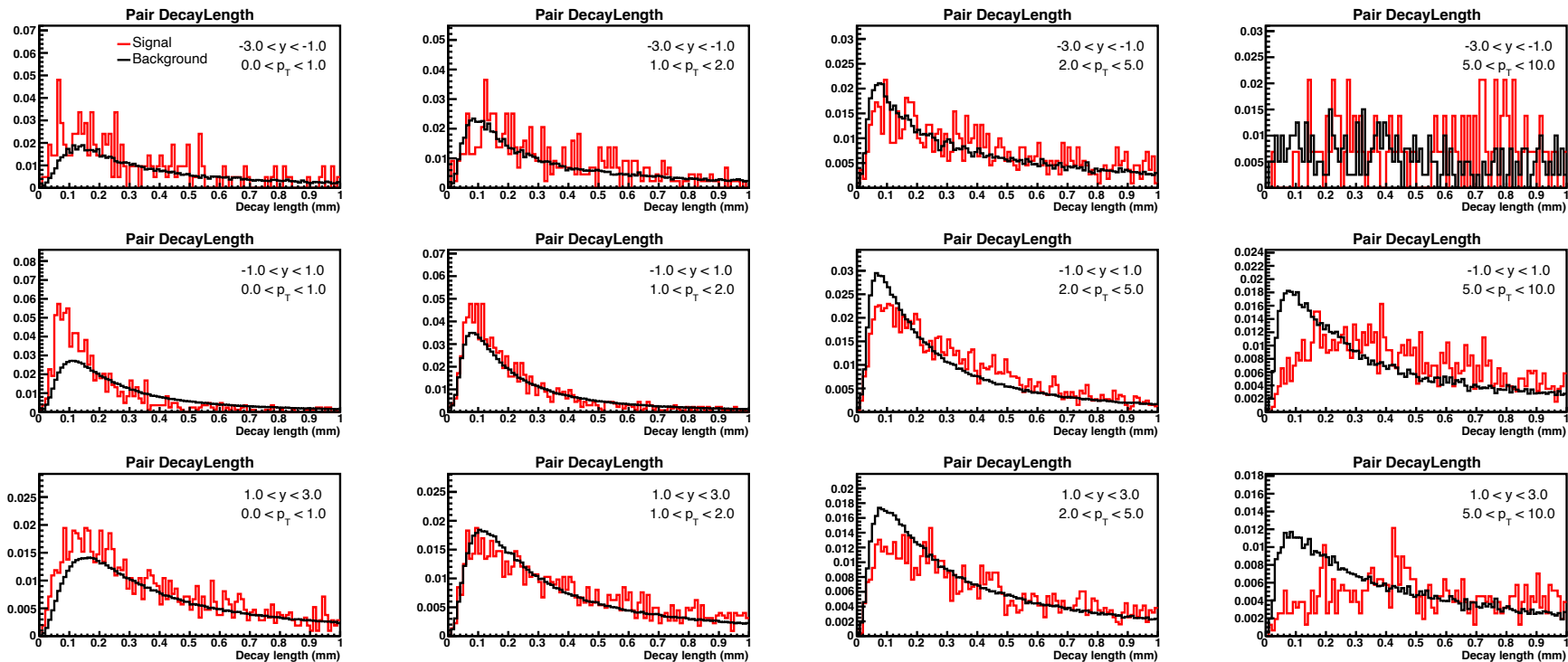
- $DCA_{\pi}, DCA_K > 20 \mu\text{m}$

DCA₁₂: signal vs. background



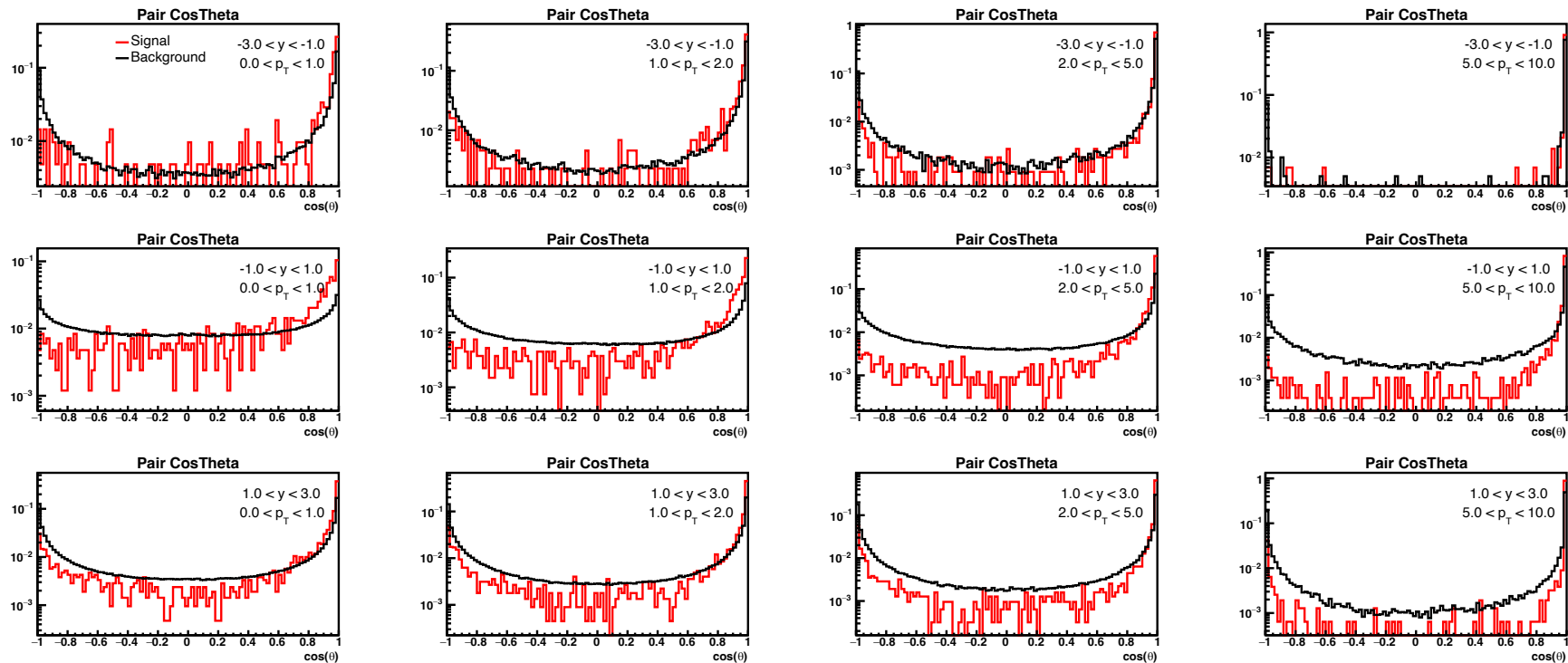
- DCA_π, DCA_K > 20 μm

Decay length: signal vs. background



- $DCA_{\pi}, DCA_K > 20 \mu\text{m}$

$\cos\theta$: signal vs. background

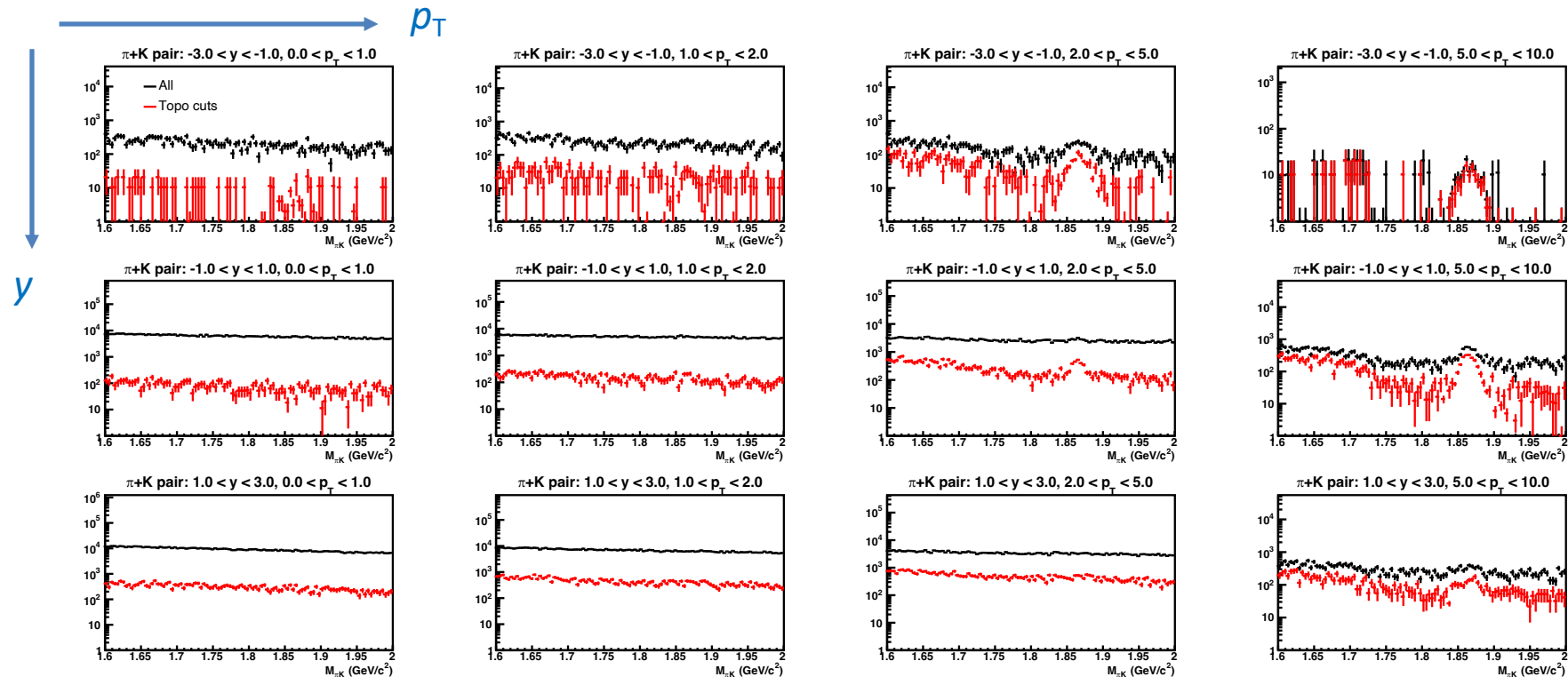


- $DCA_{\pi}, DCA_K > 20 \mu\text{m}$

D⁰ reconstruction

- Truth PID
- Topological cuts
 - $DCA_{\pi} > 20 \mu\text{m}$, $DCA_{\text{K}} > 20 \mu\text{m}$
 - $DCA_{12} < 70 \mu\text{m}$
 - $DCA_{D^0} < 100 \mu\text{m}$
 - Decay length $> 50 \mu\text{m}$
 - $\cos\theta > 0.95$
- Take events with D⁰ that do not decay to the π +K channel as background, and scale them (x10.4) to approximate true background in DIS events
 - DIS : D⁰ events = 9:1
 - Potentially over-estimating the background

Invariant mass distribution

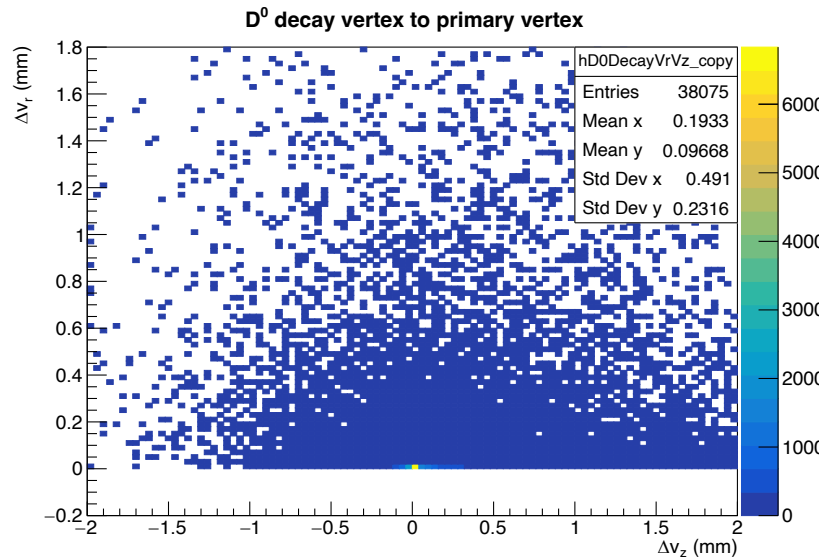
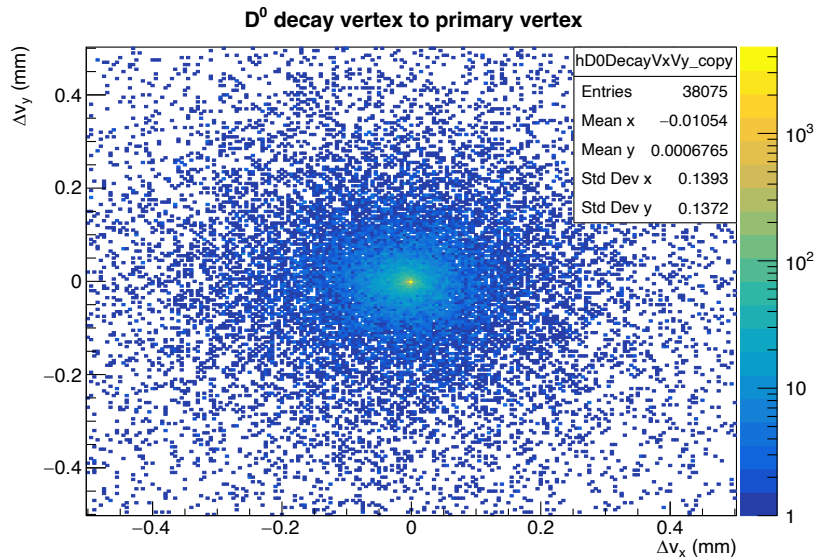


Info

- Code: https://github.com/marrbnl/ePIC/tree/main/HF_reco/helix
- D0 sample: /gpfs/mnt/gpfs02/eic/rongrong/D0/Geo202409_Real_default

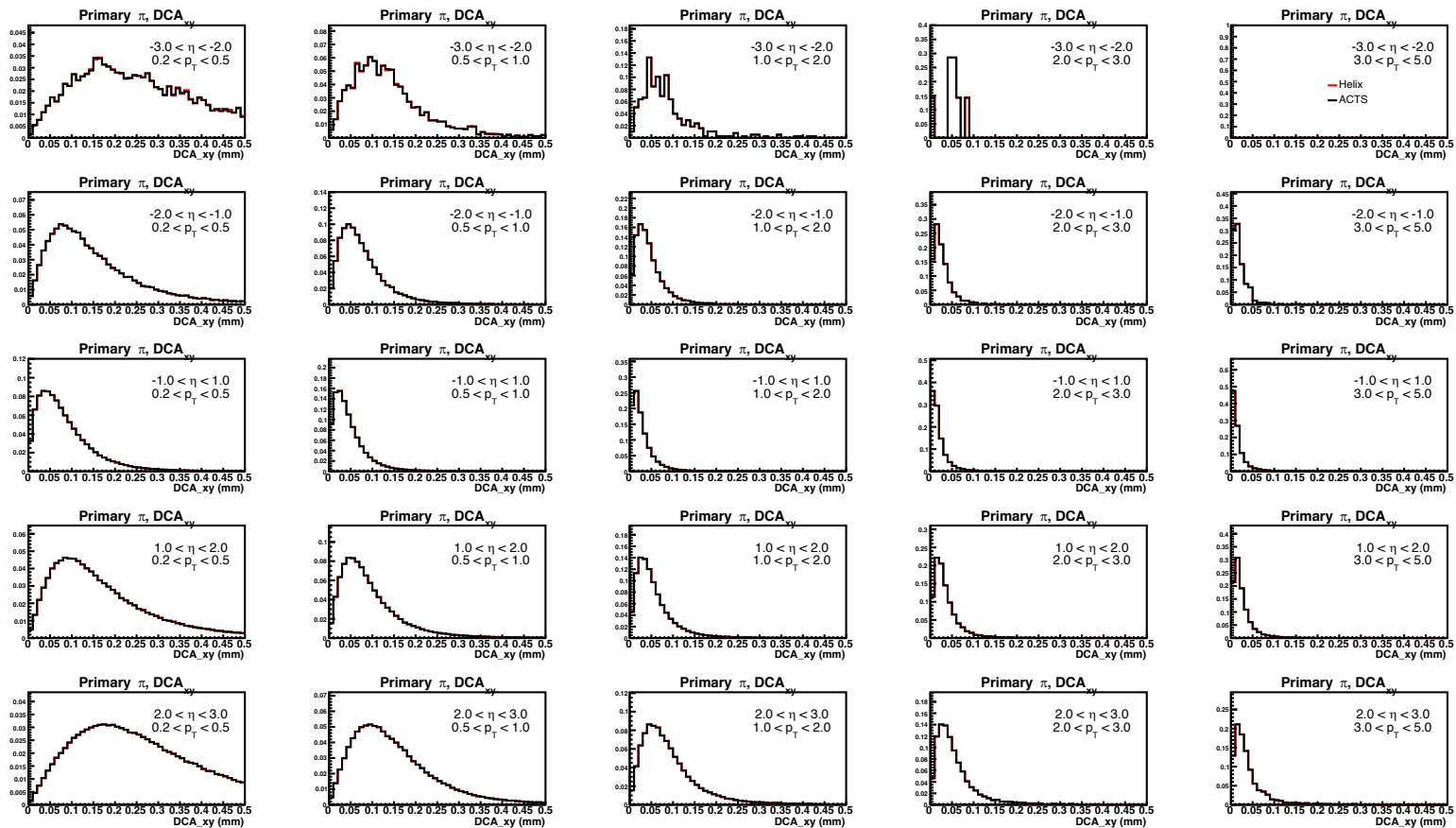
Backup

D^0 decay vertex w.r.t. primary vertex



- MC information

DCA_{xy} for primary pion: ACTS vs. helix



DCA_z for primary pion: ACTS vs. helix

