Status of (anti)nuclei measurements in Run 3

(900 GeV Pilot Beam June 22 and 13.6 TeV)

Internal workshop on Femtoscopy for (anti)nuclei studies

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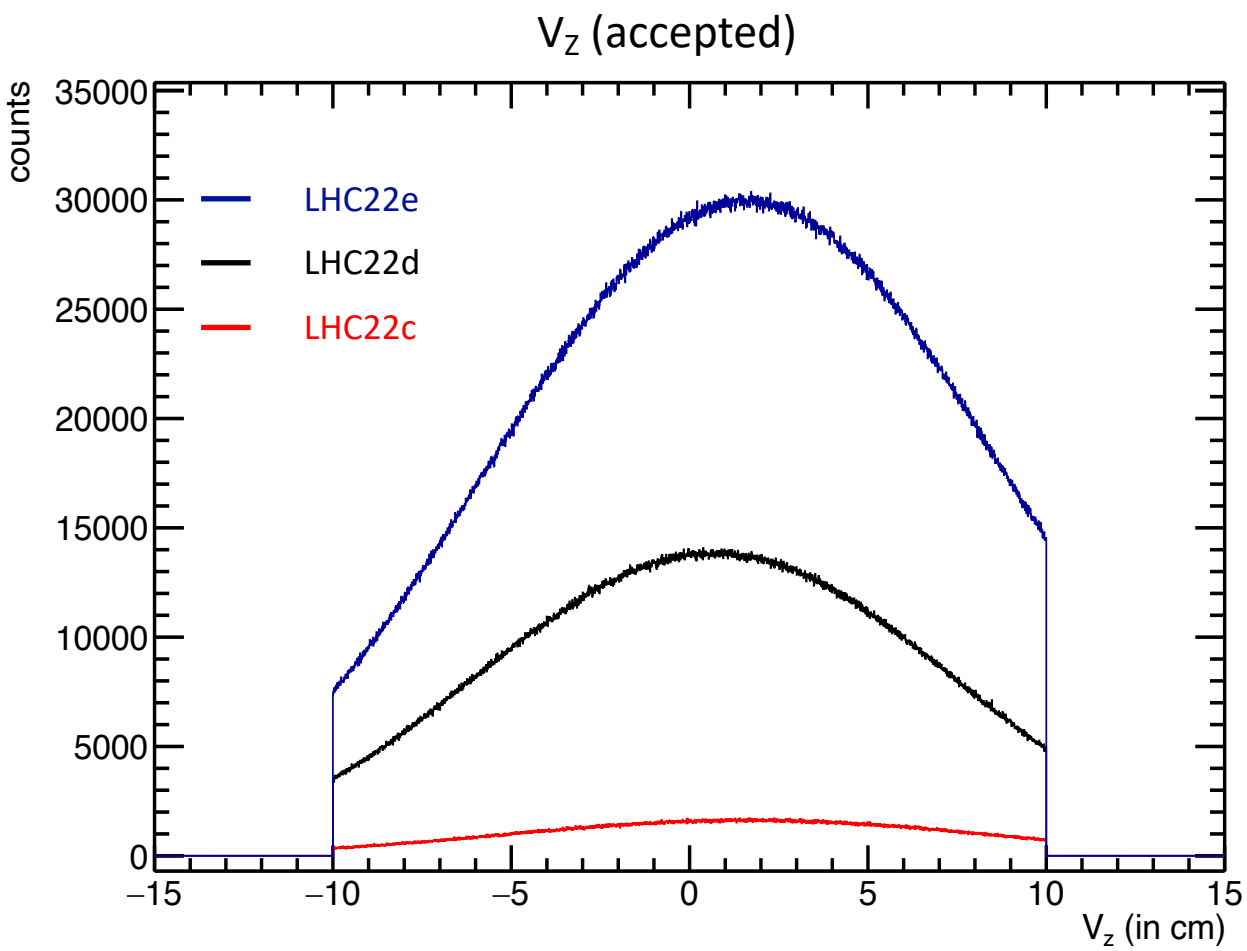
Datasets used

- **PILOT BEAM OCT21**
  - pp @ 900 GeV
    Selected N_{ev} = 3.8 M
  - Rec. pass: apass4 (testing on pass5)
- **PILOT BEAM JUNE22 (LHC22c+d+e)**
  - pp @ 900 GeV
  - Total N_{ev} = 76.08 M
    Selected N_{ev} = 66.2 M (87% acc.)
  - Rec. pass: apass1
- The analysis task is part of the **O2Physics** framework and is runned in **AliHyperloop**

  (https://alimonitor.cern.ch/hyperloop/train-run/36521)



(Anti) Deuteron yield extraction

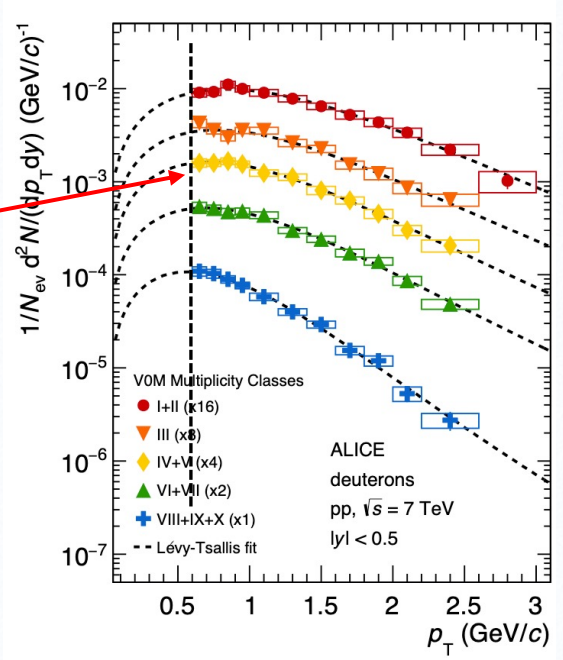
- The **(anti) deuteron yield** is estimated by fitting the $N\sigma_{TPC}$ and then integrating the fitting function.

- **Fitting function for raw yield estimation**:
  - $f = Gaus\ (d\ signal) + Pol1\ (bkg) + Gaus\ (p\ bkg) + Gaus\ (t\ bkg)$ } d
  - $f = Gaus\ (d\ signal) + Pol1\ (bkg) + Gaus\ (p\ bkg)$ } $\bar{d}$

Deuteron signal extraction (TPC PID)

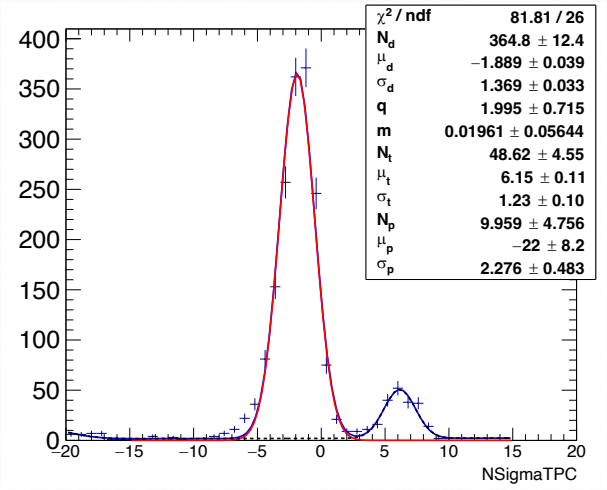
- Observe a clear deuteron signal at low p_T
- Ongoing: Overall signal model improvement (left/right exp tail)

Run 2: p_T>600 MeV/*c*

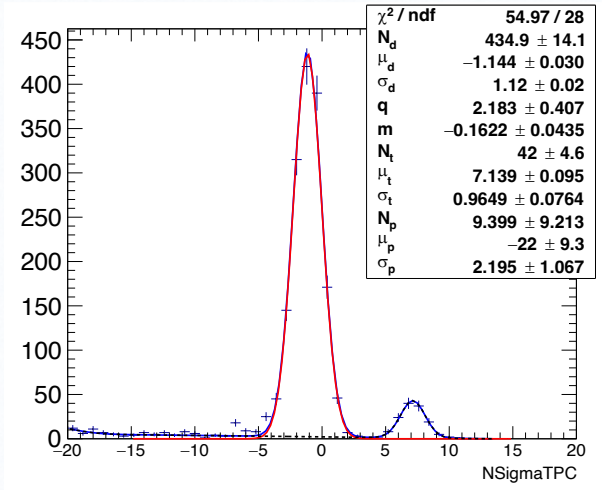


LHC22c+d+e (apass1)

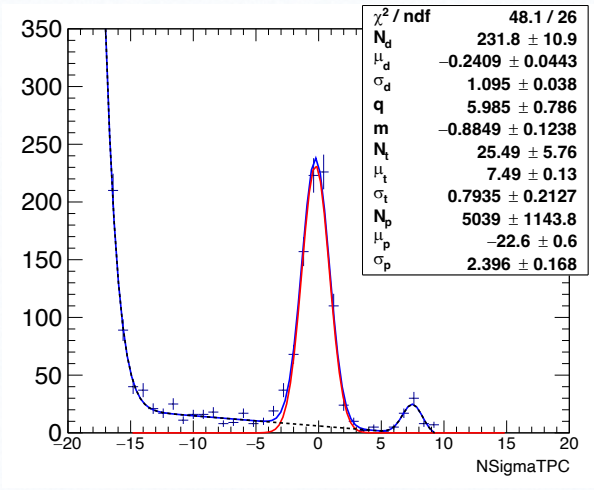
p_T = 0. 30-0.40 GeV/c



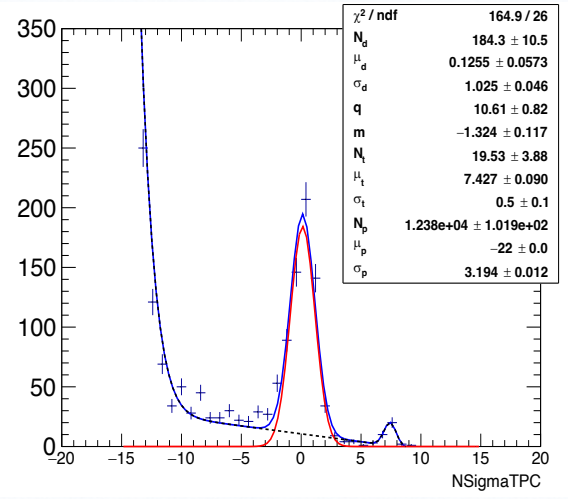
pT = 0.40-0.50 GeV/c



p_T = 0. 60-0.70 GeV/c



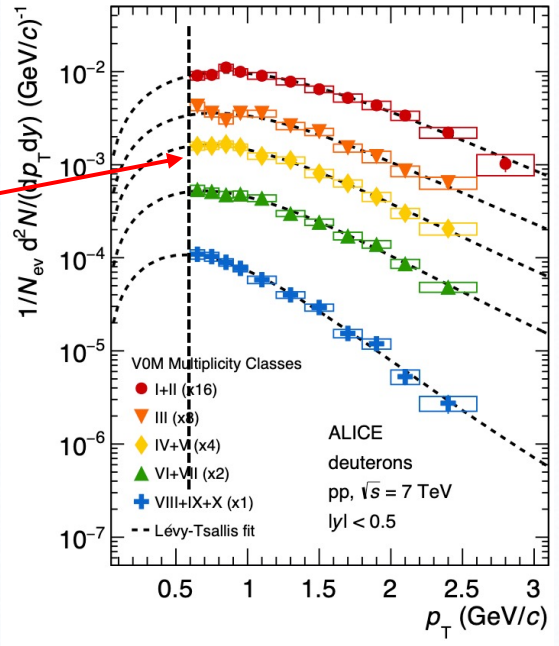
p_T = 0.70-0.80 GeV/c



Anti-deuteron signal extraction (TPC PID)

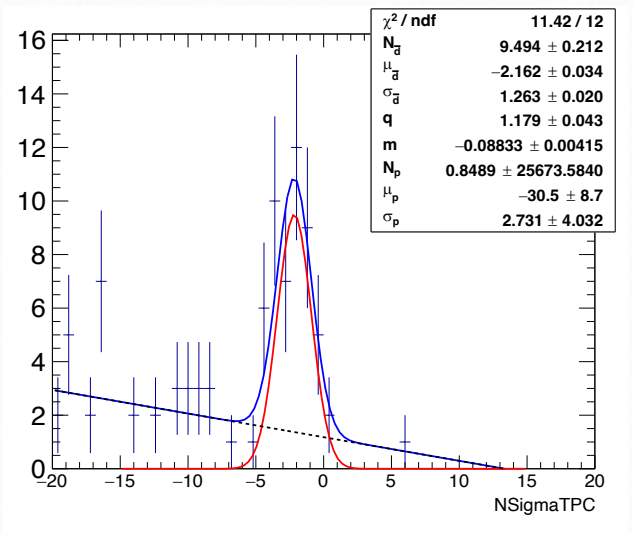
- Observe a clear deuteron signal at low p_T
- Ongoing: Overall signal model improvement (left/right exp tail)

Run 2: p_T>600 MeV/*c*

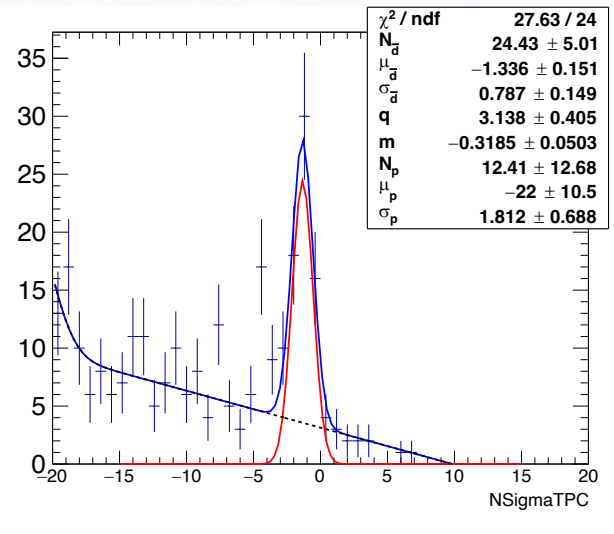


LHC22c+d+e (apass1)

p_T = 0. 30-0.40 GeV/c



pT = 0.40-0.50 GeV/c



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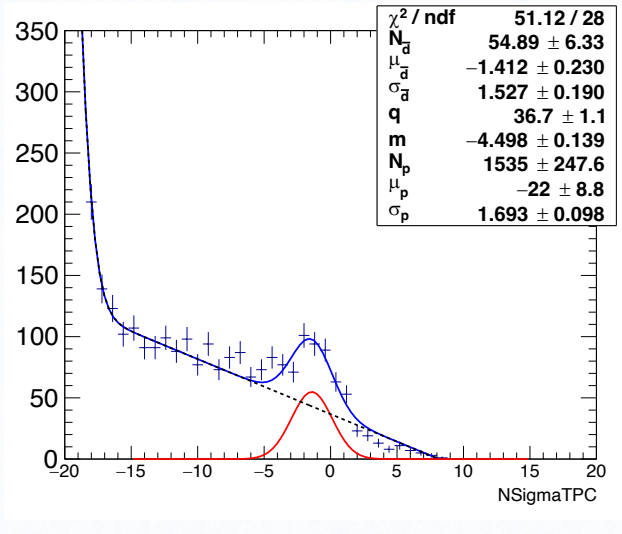
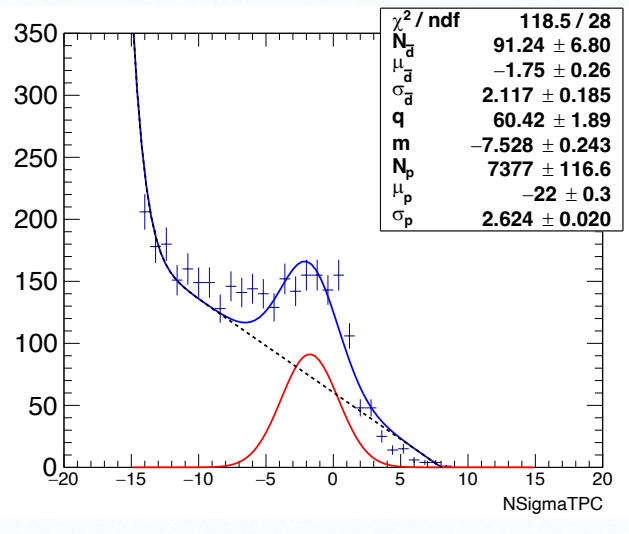


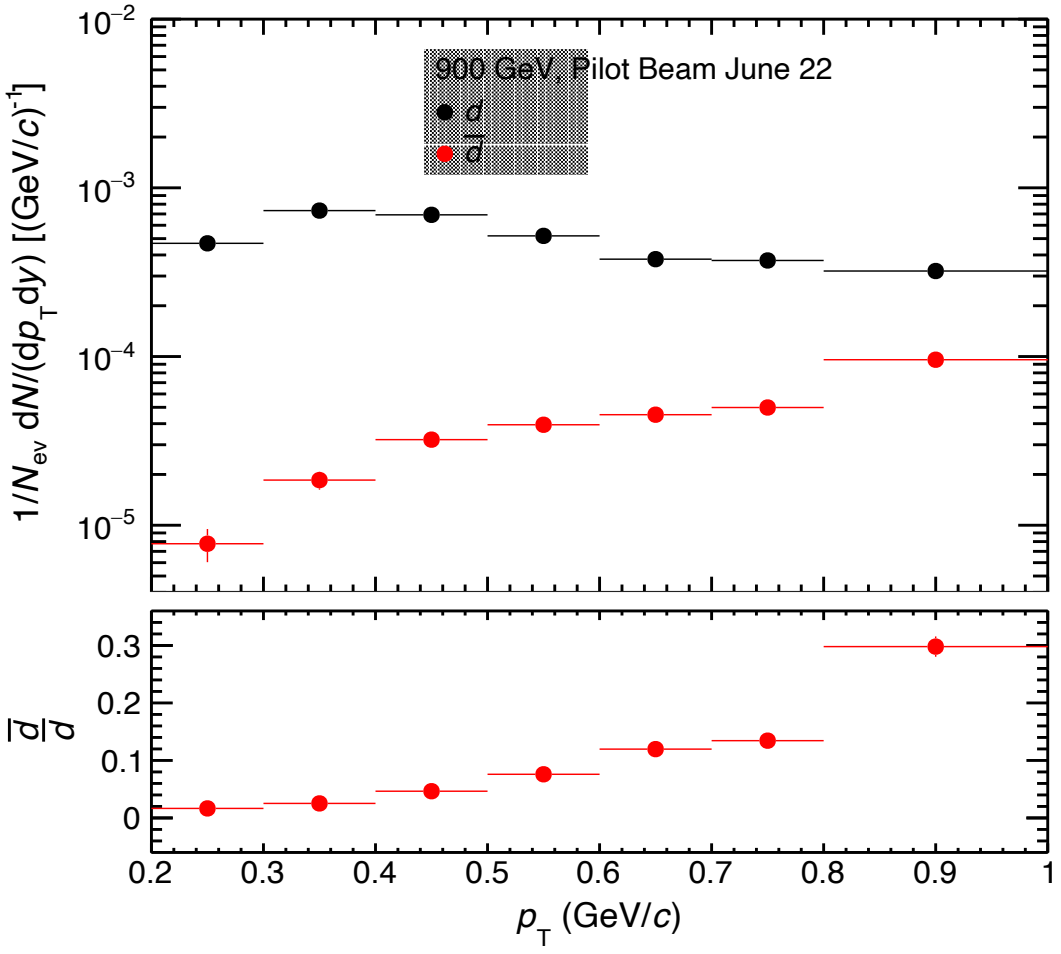
p_T = 0.70-0.80 GeV/c



(anti-)Deuteron raw yield (TPC PID)

Waiting for the MC production cycle with injected nuclei:

- perform secondary corrections for deuteron spectra
- Correction for efficiency X acceptance



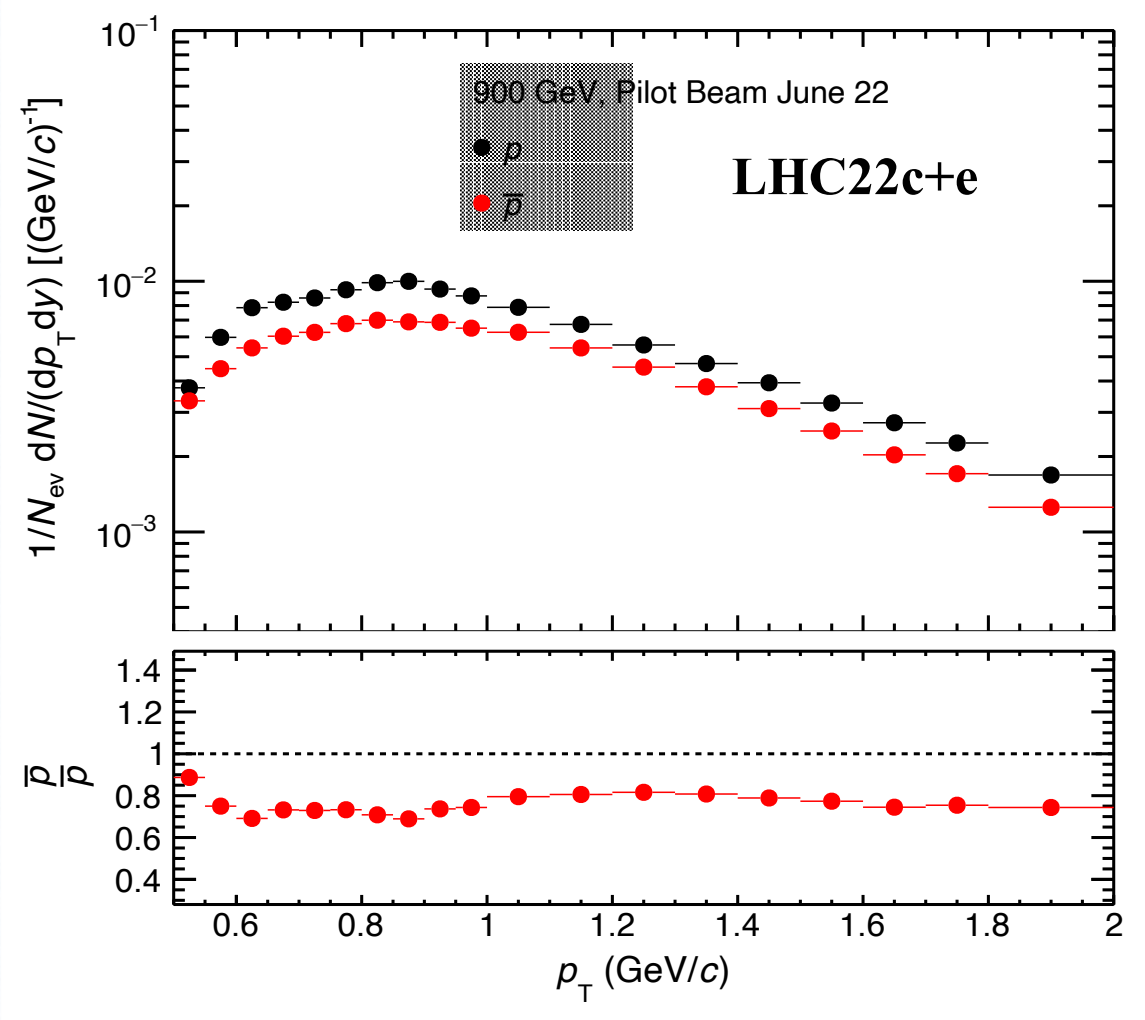
(Anti) Proton yield extraction

- The (**anti**) **proton yield** is estimated by fitting the $N\sigma_{TOF}$ and then integrating the fitting function.
- **Proton**:
  - $p_T \in (0.45, 0.50)$ GeV/c : $f = Gaus(signal) + Pol1(bkg) + Gaus(bkg)$
  - $p_T \in (0.5, 1.0)$ GeV/c : $f = DoubleGaus(signal) + Pol1(bkg) + DoubleGaus(bkg)$
  - $p_T \in (1.0, 2.0)$ GeV/c : $f = Gaus(signal) + Pol1(bkg) + Gaus(bkg)$

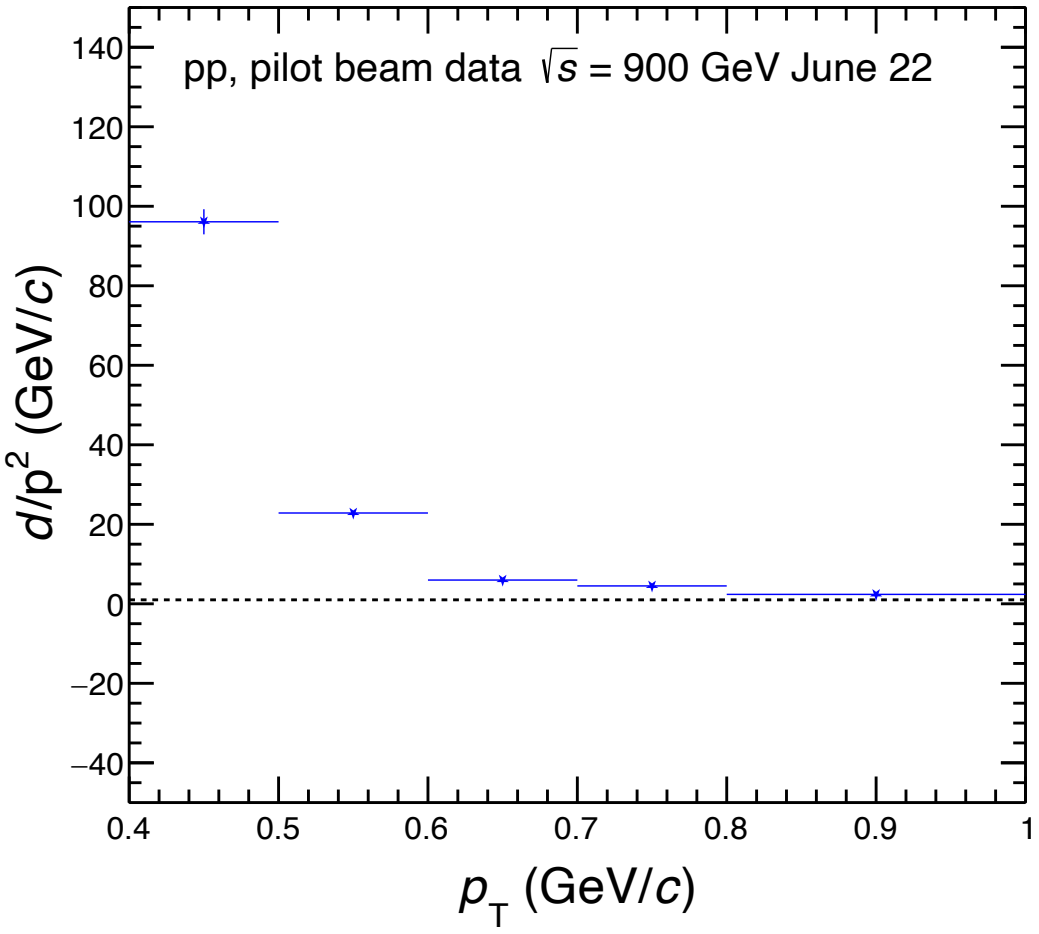
- **Antiproton:**
  - $f = Gaus(signal) + Pol1(bkg) + Gaus(bkg)$

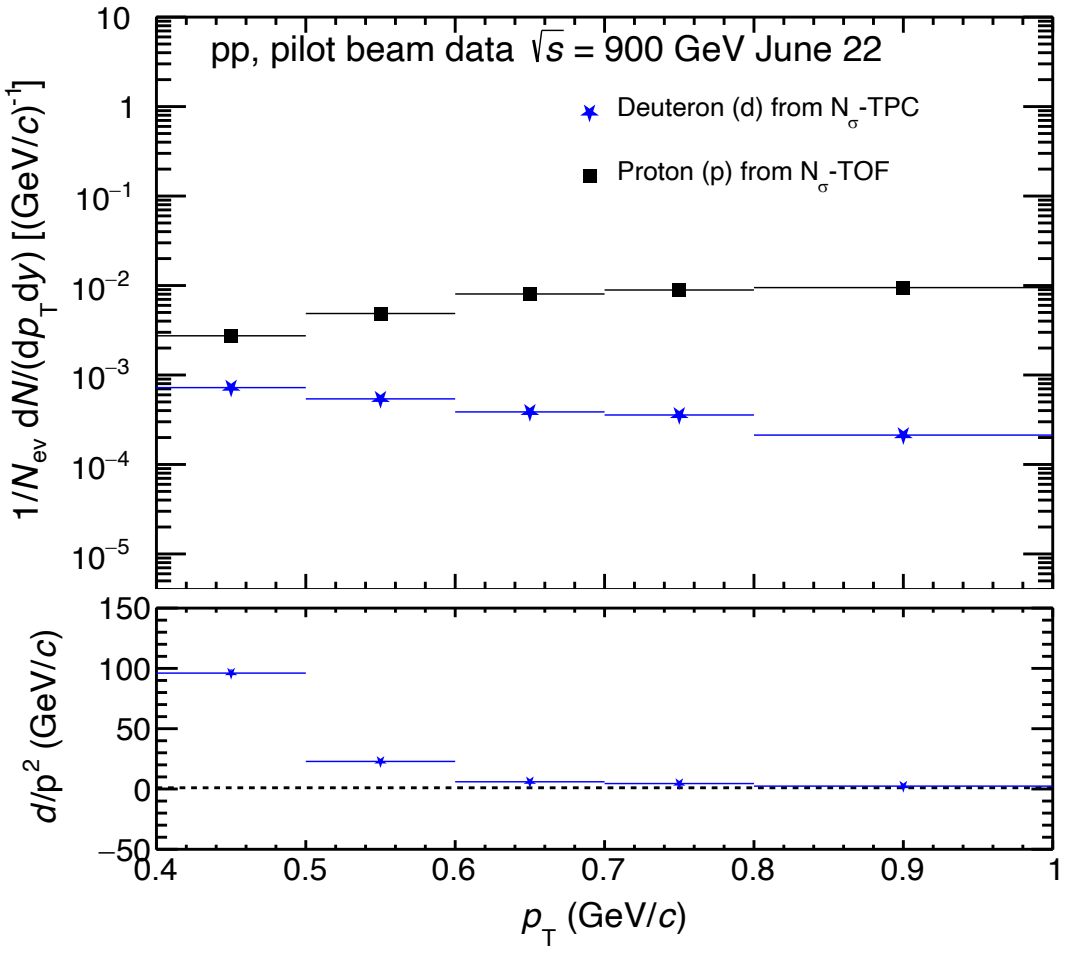
Antiproton/proton raw yield (TOF PID)

- First look into (anti) proton yield using pilot beam (June 22) data
- The observed (anti)proton to proton ratio lies between 0.7 to 0.8 for $p_T > 600$ MeV
- Investigating more to improve the signal extraction in low-p_T region

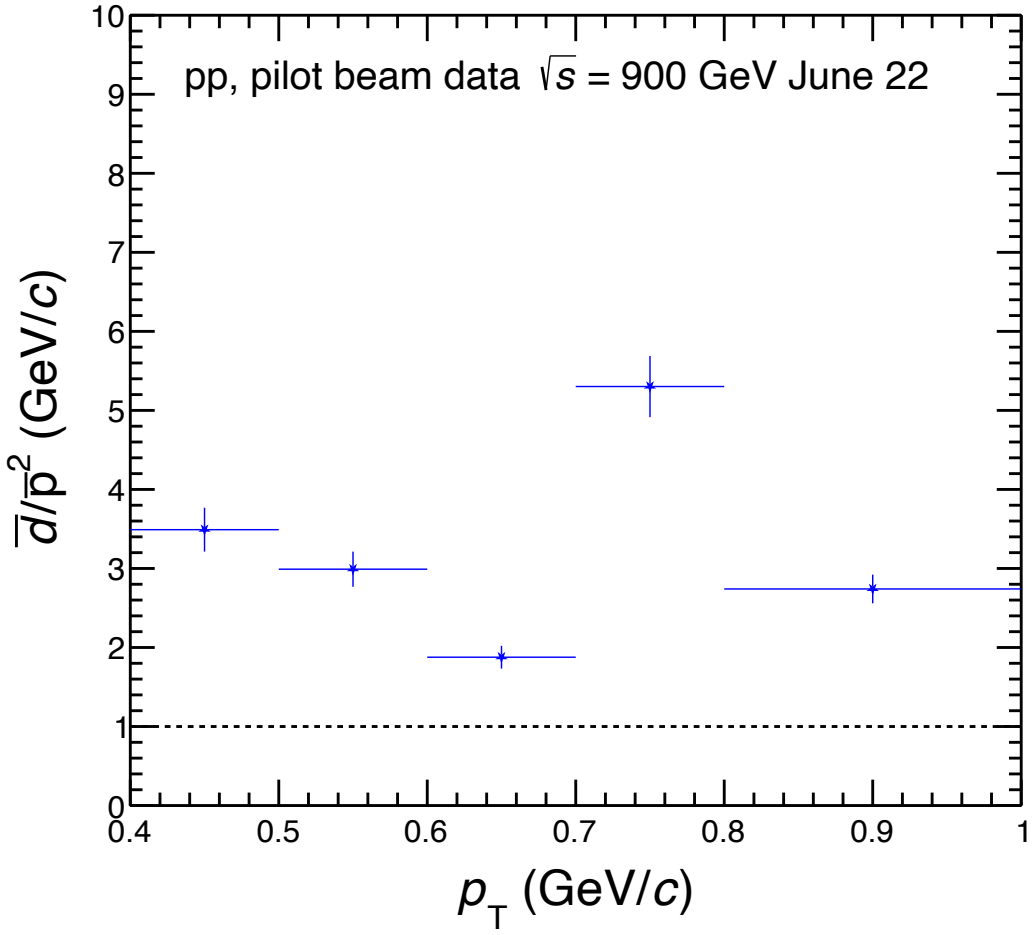


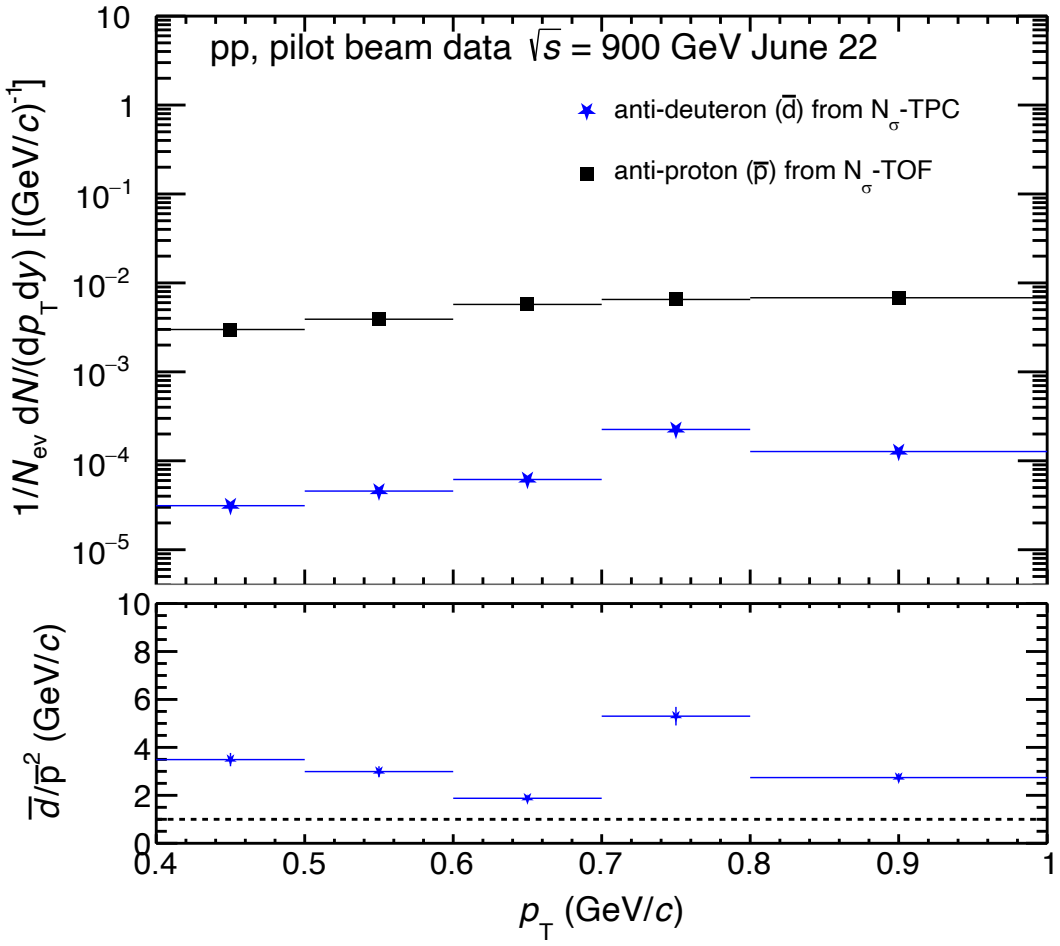
d/p^2 spectra ratio (TPC(d), TOF(p))





$\overline{d}/\overline{p}^2$ spectra ratio (TPC(anti-d), TOF(anti-p))





DCAxy/DCAz distributions

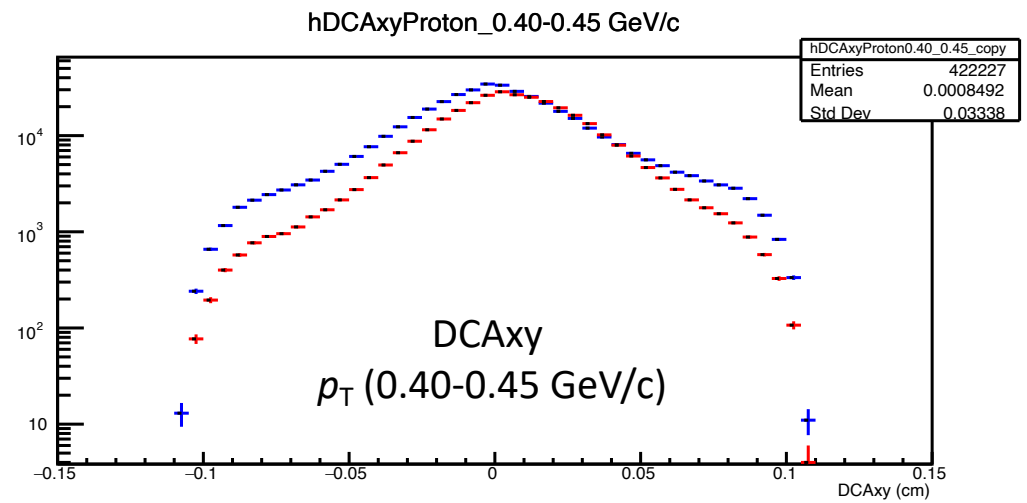
Preliminary study is required to extract primary/secondary corrections (on the available data/MC)

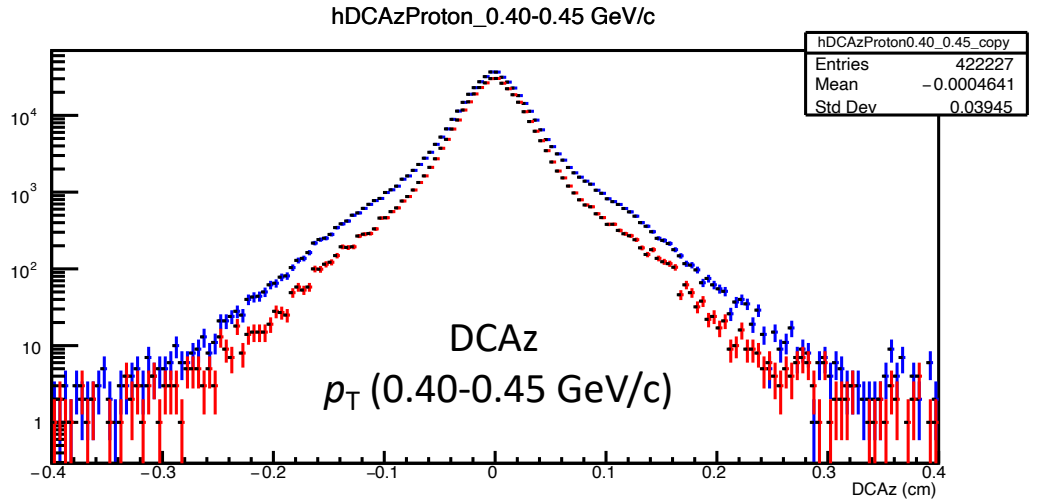
Same selection criteria are considered for both DATA and MC

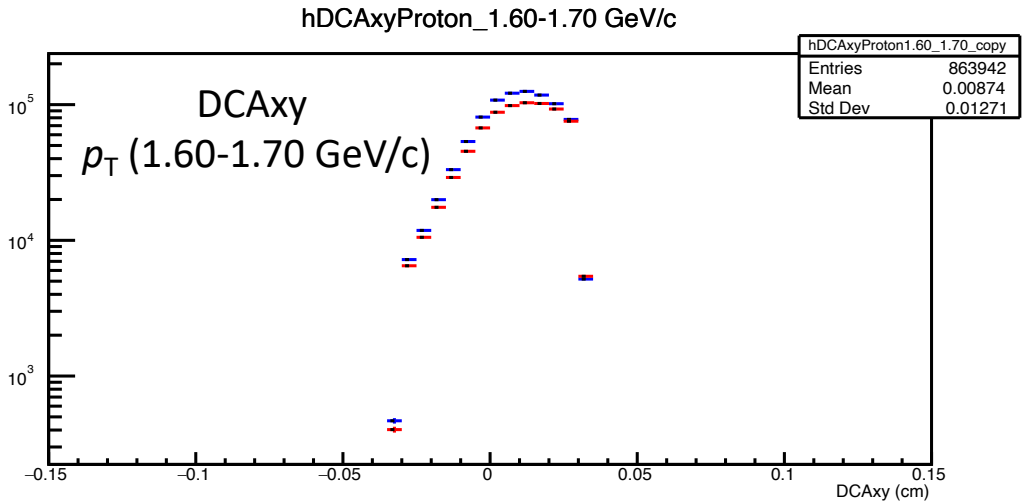
- $\boldsymbol{p}/\,\boldsymbol{\bar{p}}$, $\boldsymbol{d}/\,\boldsymbol{\bar{d}}$: LHC22c+d+e (only raw data is considered)

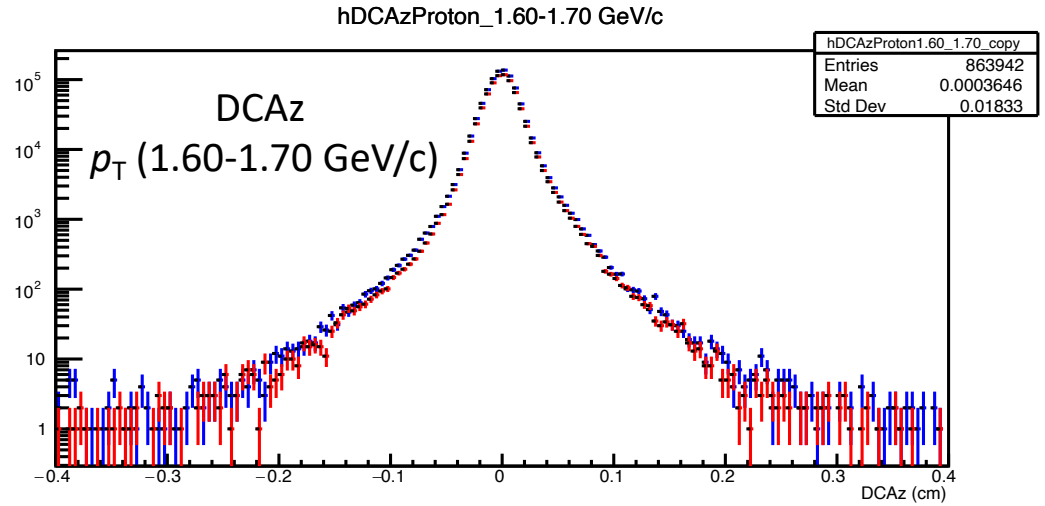
- **Data vs MC** (p and $\bar{p}$ only): OCT21_pass4 + anchored MC (LHC22c5)
  - Normalized: For every p_T interval,
    - MC = MC raw
    - DATA = DATA raw x (MC integral / DATA integral)

p vs pbar (raw) [LHC22c+d+e]

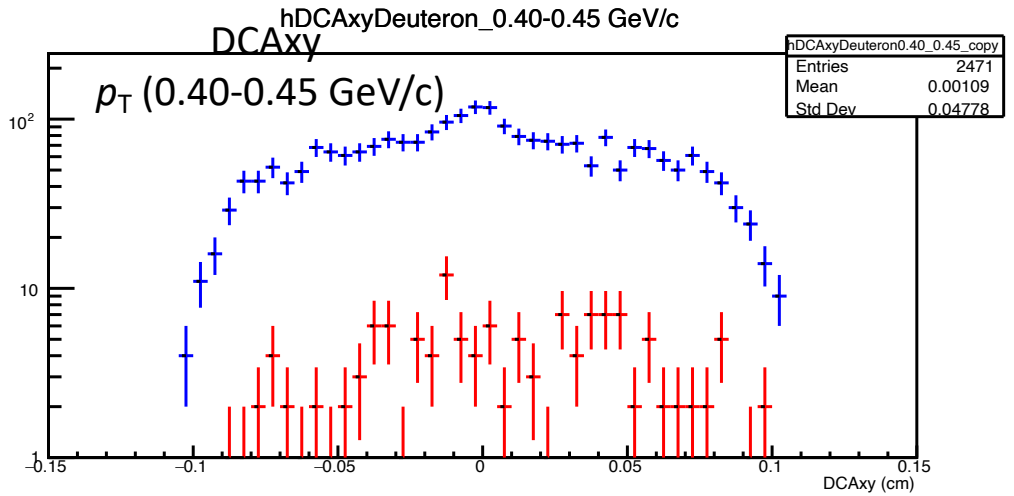


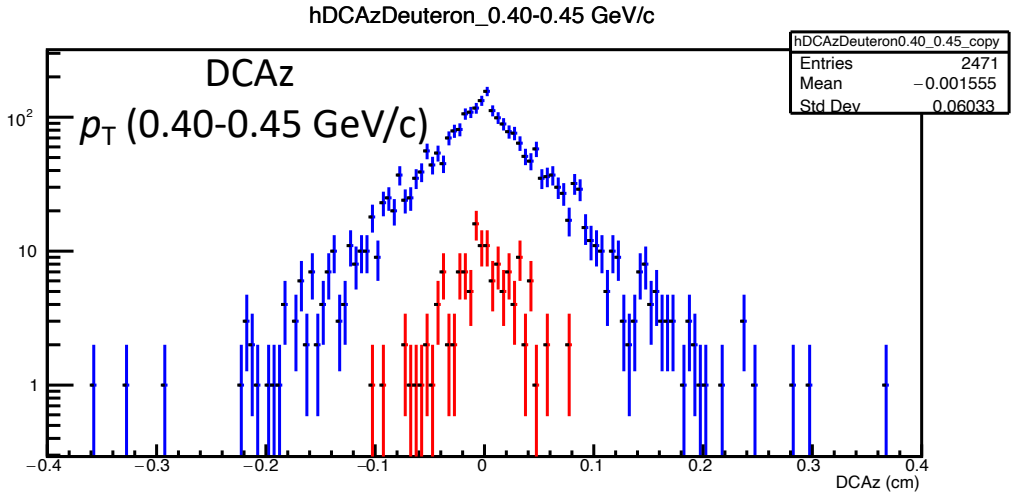


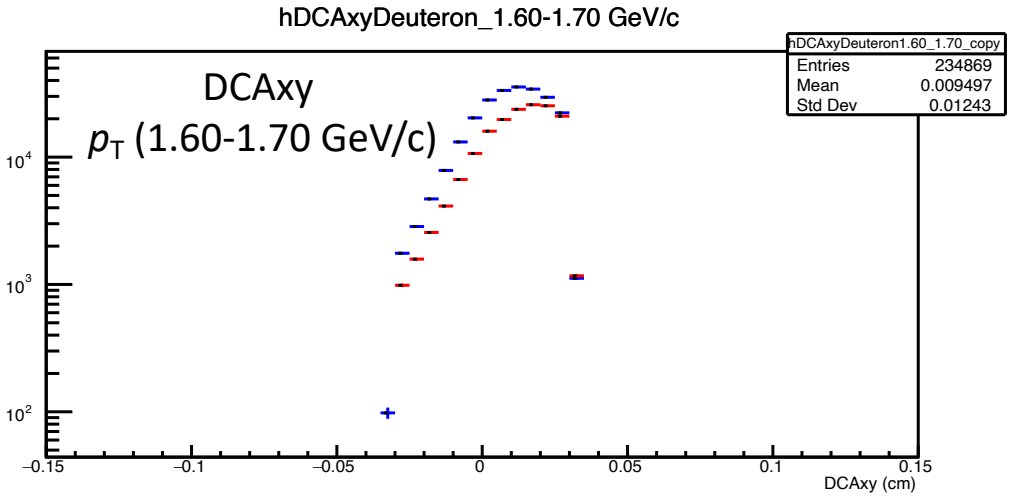


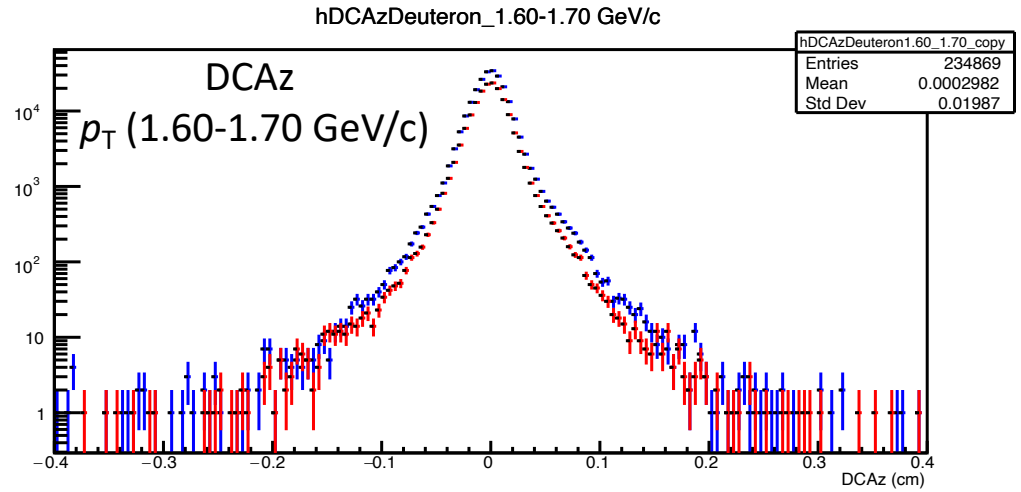


d vs dbar (raw) [LHC22c+d+e]

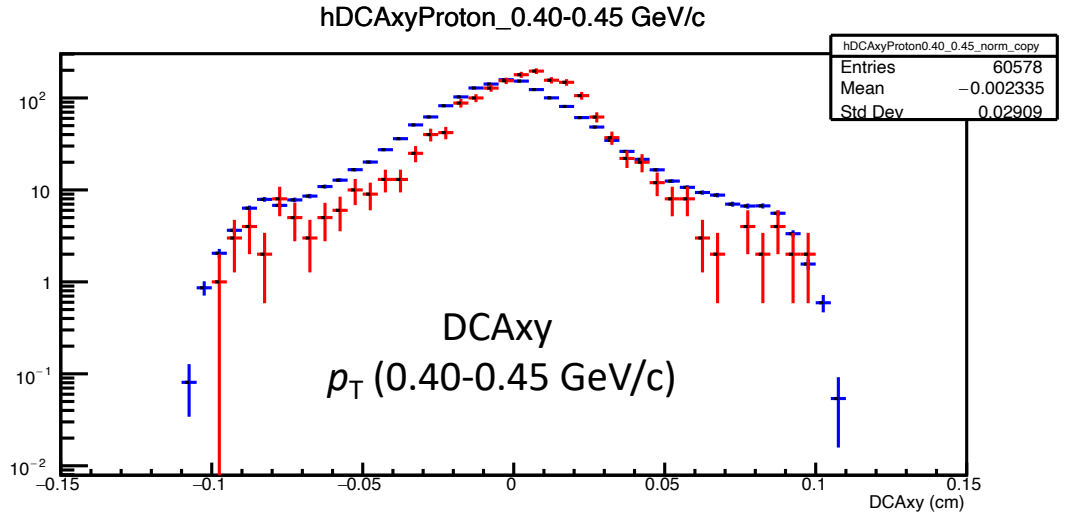


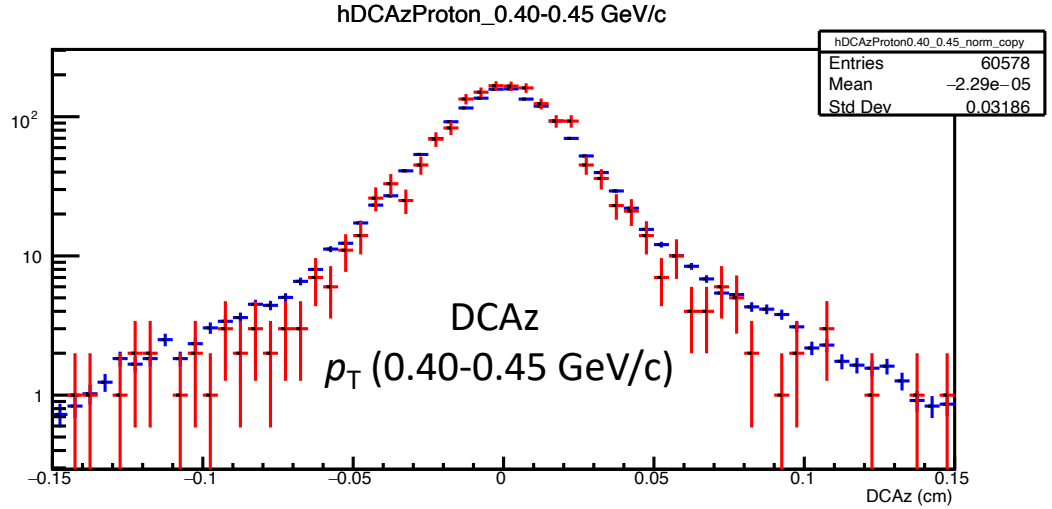


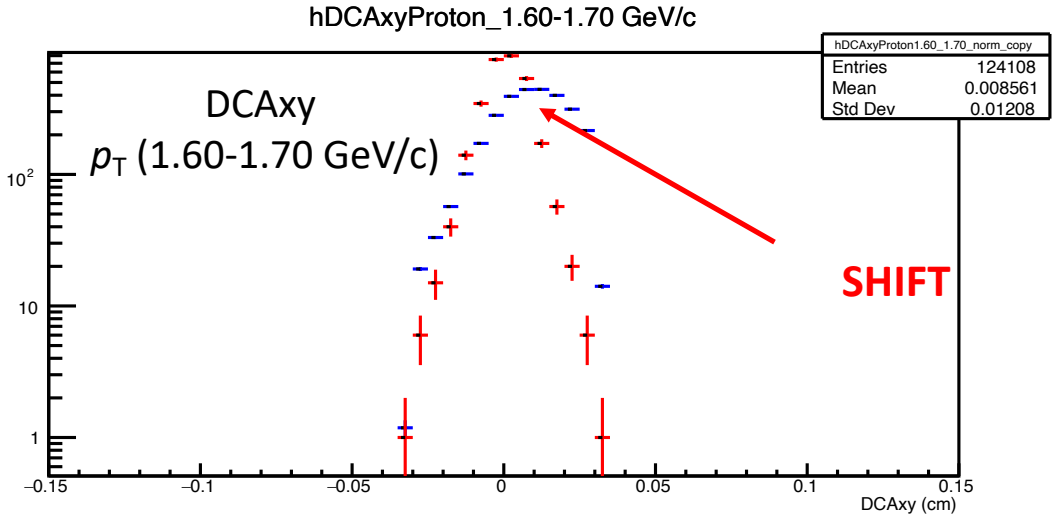


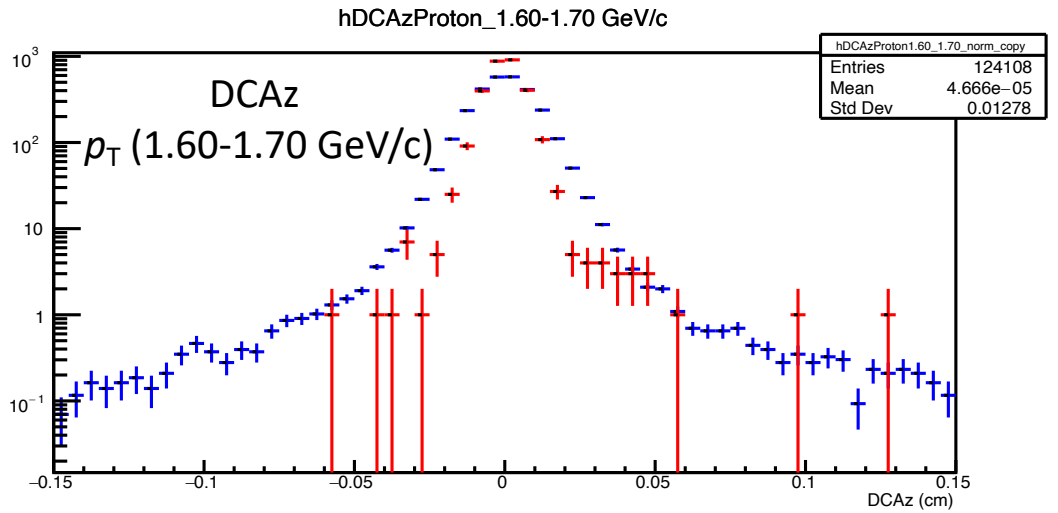


p: (norm.) DATA vs MC [OCT21/LHC22c5]

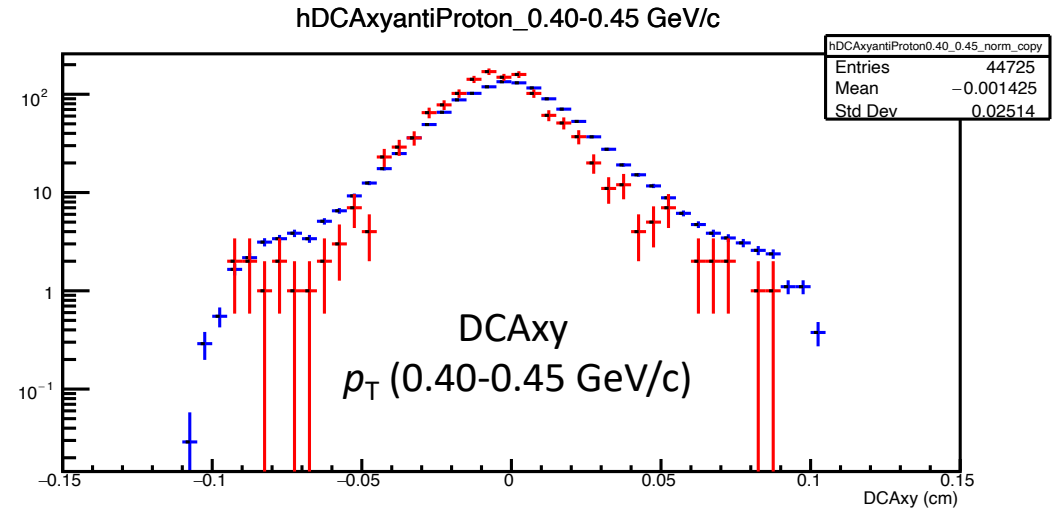


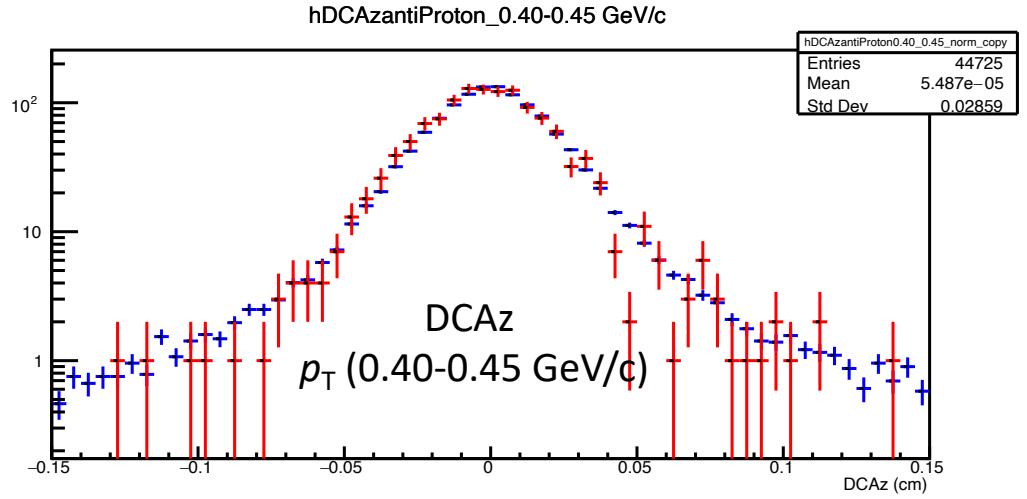


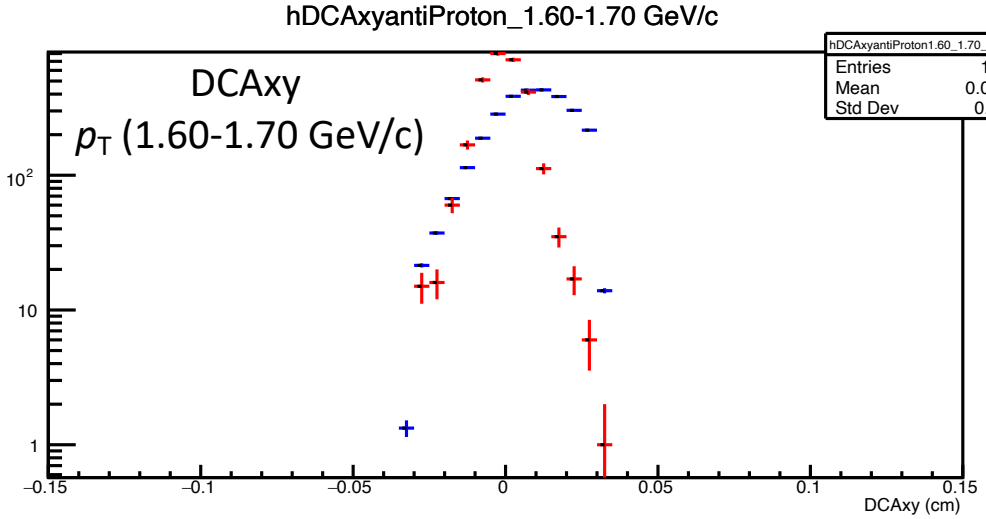


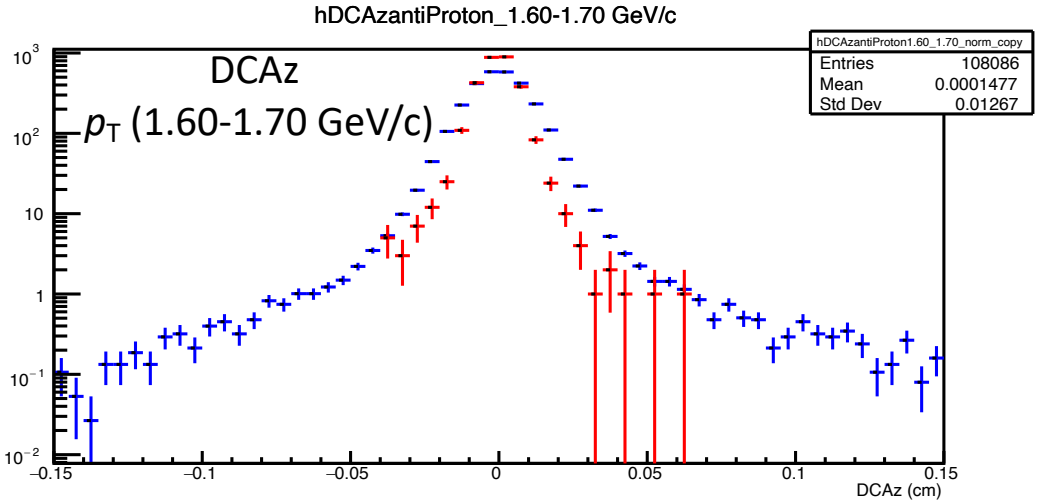


pbar: (norm.) **DATA** **vs** **MC** [OCT21/LHC22c5]









What's next?

- Ongoing: understand what is happening at low-p_T for protons in TOF (scenario is still same for newly reconstructed (apass2) datasets of LHC22cde)
- Working on MC with injected nuclei (Nicolo Jacazio)
- Ongoing: Improving PIDs through TPC parameterization
- Estimate secondary/primary fraction within the O2Physics workflow
- Extract the *efficiency x acceptance* for LHC22(c+d+e)
- Waiting for the availability of Pilot beam June 22 anchored MC general purpose data
- Started running the analysis on 13.6 TeV datasets (LHC22fmoprt)
  - Looking for ^{3}He and triton (anti)nuclei

Thank you for the attention