Report from Jets & HF working group

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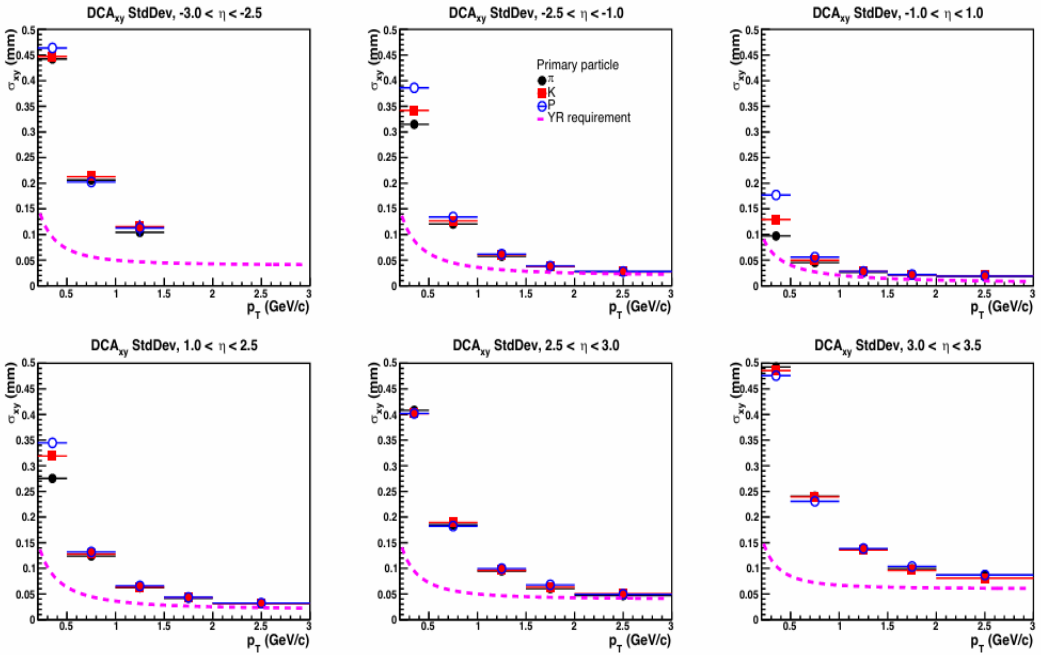
Progress report

- Had three working group meetings since the last update (one more is scheduled later today)
- A lot of work on/related to D^0 reconstruction:
  - **Track pointing resolution in DIS samples** (Rongrong Ma)
  - **Dependencies of D^0 topological variables** (Connie Yang)
  - **PYTHIA 8 charm production validation** (Amritanshu Thakur)
  - **D^0 reconstruction with BeAGLE e+Au samples** (Rongrong Ma)
  - **Machine Learning for D0 reconstruction in ep collisions** (Shyam Kumar)

Track pointing resolution in DIS samples

Rongrong Ma (BNL)



Event sample:

- ep @ 10x100 NC DIS; $Q^2 > 1$
- Primary tracks • Truth PID

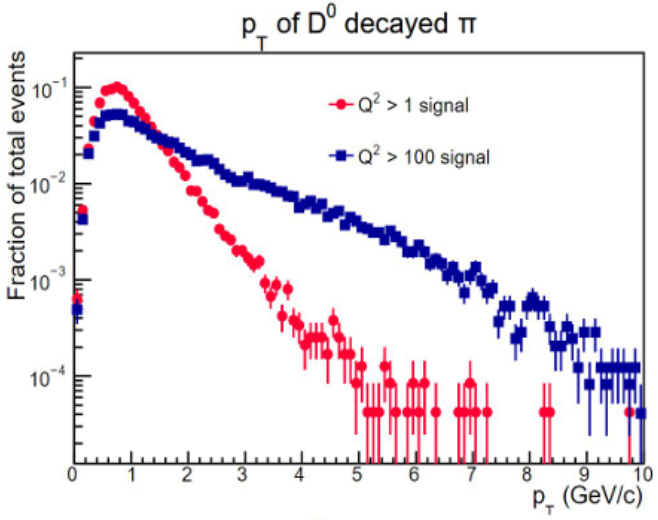
Table 8.5: Requested vertex position resolution.

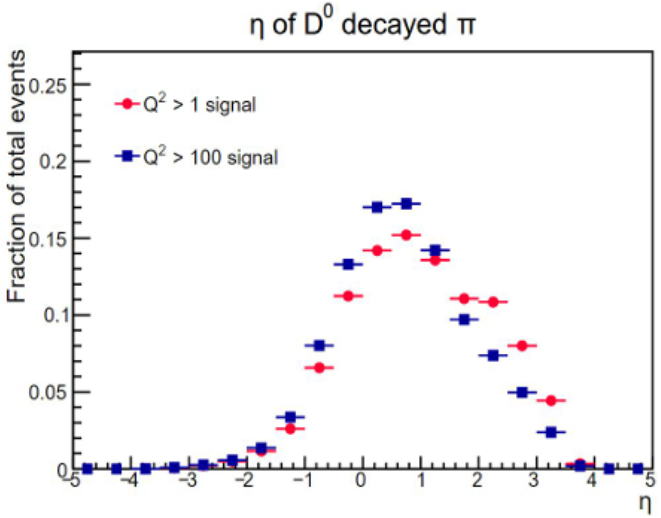
Pseudorapidity Range	Resolution
$-3.5 < \eta < -3.0$	N/A
$-3.0 < \eta < -2.5$	$\sigma_{xy} \sim 30/p_T \oplus 40\ \mu$m
$-2.5 < \eta < -1.0$	$\sigma_{xy} \sim 30/p_T \oplus 20\ \mu$m
$-1.0 < \eta < 1.0$	$\sigma_{xy} \sim 20/p_T \oplus 5\ \mu$m
$1.0 < \eta < 2.5$	$\sigma_{xy} \sim 30/p_T \oplus 20\ \mu$m
$2.5 < \eta < 3.0$	$\sigma_{xy} \sim 30/p_T \oplus 40\ \mu$m
$3.0 < \eta < 3.5$	$\sigma_{xy} \sim 30/p_T \oplus 60\ \mu$m

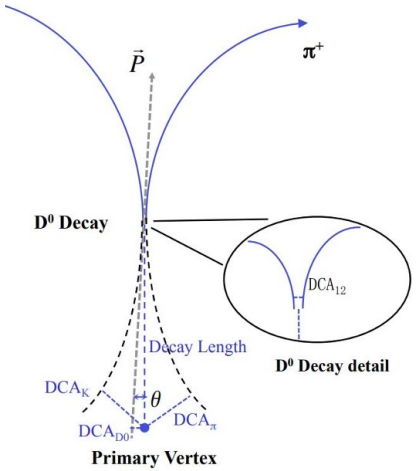
- Derived track pointing resolution in the xy plane does not fully meet YR requirements, especially at low p_T and high rapidity

D^0 topological variables vs. Q^2, p_T, and y (η)

Connie Yang, Deepa Thomas (UTA)







Goal: compare distributions of topological variables

- Between $Q^2 > 1$ and $Q^2 > 100$ samples
- In different pT and y (η) ranges

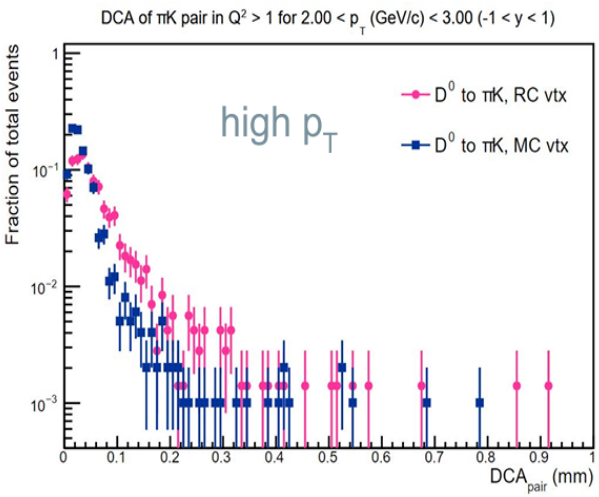
Findings:

- Q^2 dependence is correlated with p_T dependence.
  - Except DCAπ/K
- Strong p_T and y (η) dependence in all topological variables

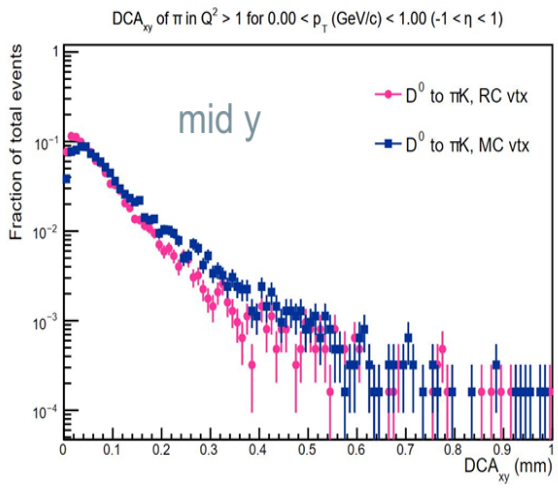
Vertex reconstruction effects on D^0 topological variables

Connie Yang, Deepa Thomas (UTA)

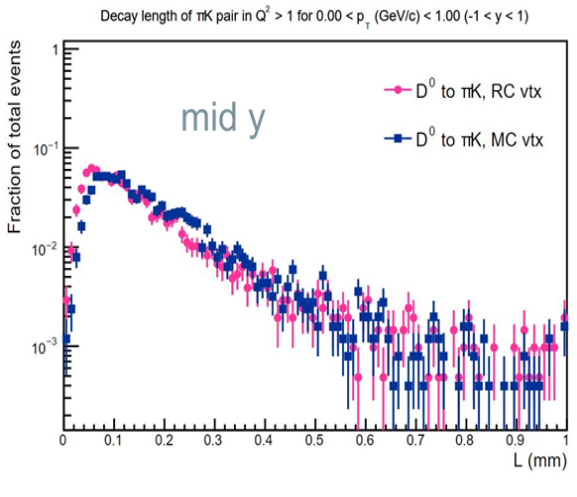
DCA_{D0}



DCA_{π}



Decay Length

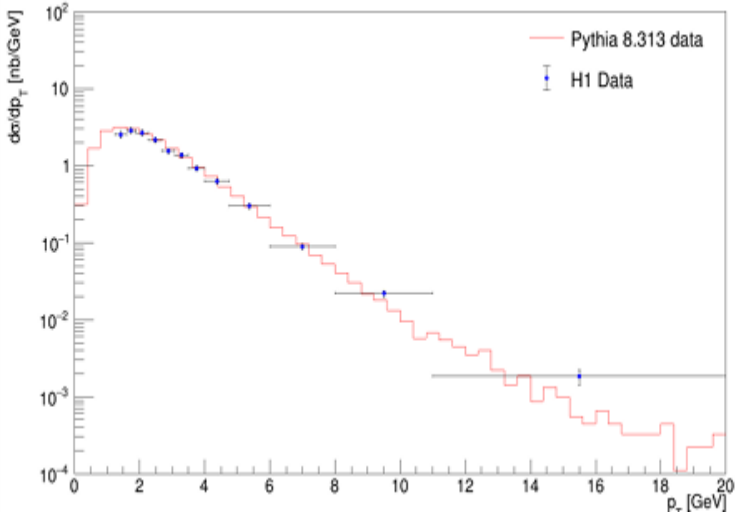


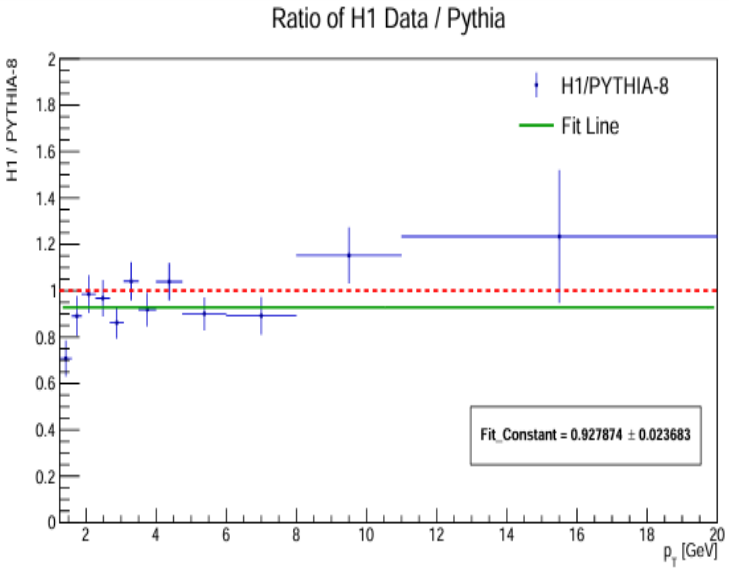
Wider for reco than gen (normal)

Wider for gen than reco!!

PYTHIA 8 charm production validation

Amritanshu Thakur.
Lokesh Kumar (Panjab)



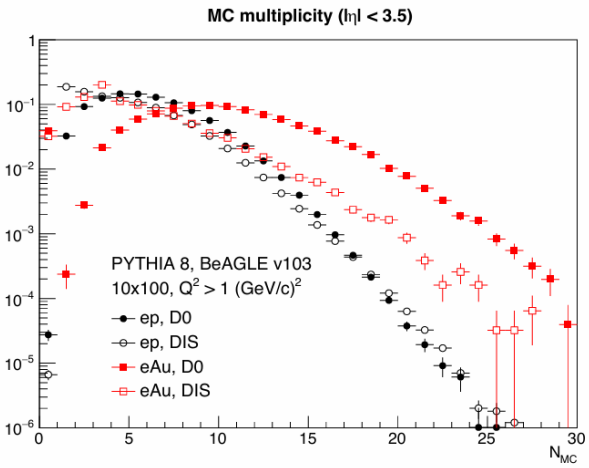


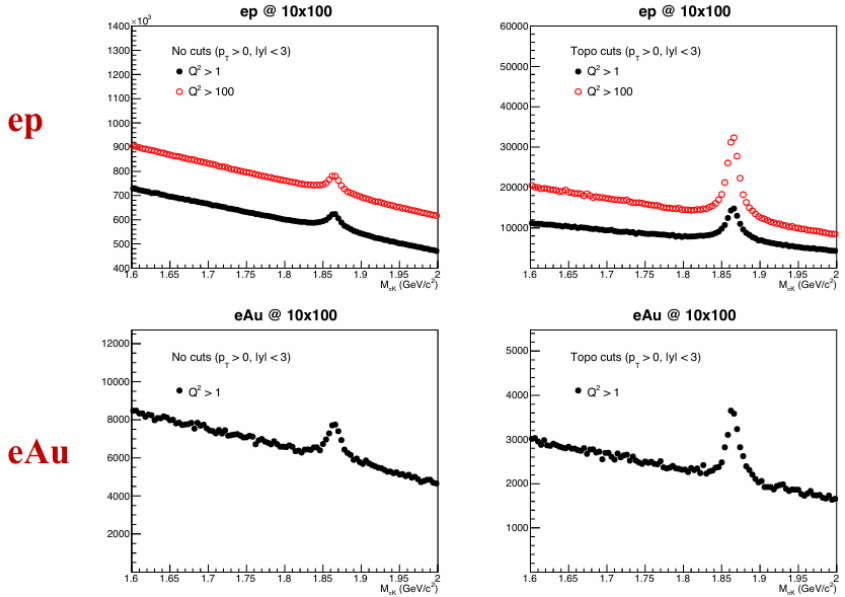
- Comparing HERA data[1] with the PYTHIA 8.313 predictions for D* meson cross-sections

[1]H1 Collaboration, et al., EPJC 71(2011): 1-26

D^0 reconstruction with BeAGLE e+Au samples

Rongrong Ma (BNL)





- **BeAGLE**v103, e+Au collisions @ 10x100 $Q^2 > 1$
- With beam effects: afterburner for eAu 10 x110 config

Samples:

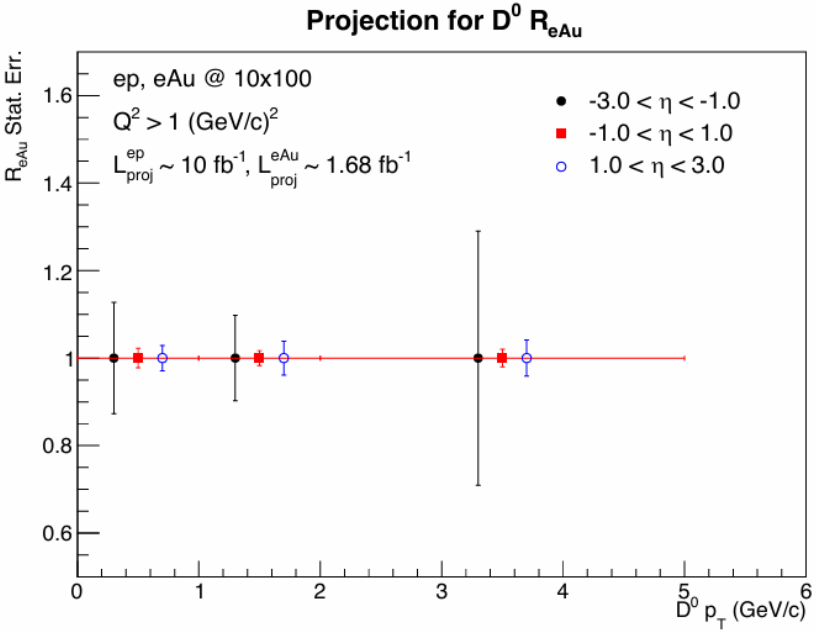
- HF-enriched sample (L = 0.29 fb^{-1})
- DIS sample

- Clear D^0 mass peaks even before ML optimization
- Includes realistic PID

D^0 reconstruction with BeAGLE e+Au samples

Rongrong Ma (BNL)

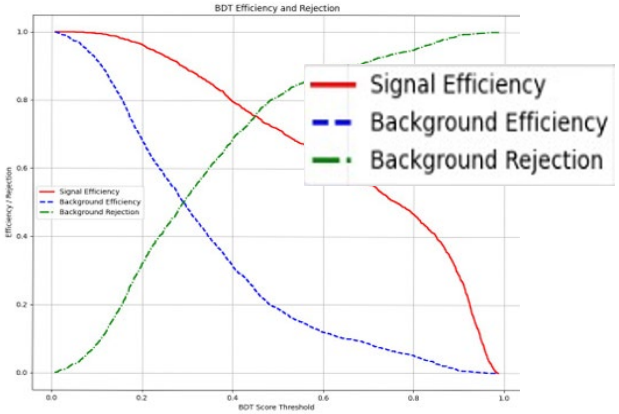
- First outcome of e+AU study:
  - Realistic projections for the R_{eAu} statistical error for the early science program
- TBD: apparently different tracking performance compared to ep events. Differences in software and/or geometry?

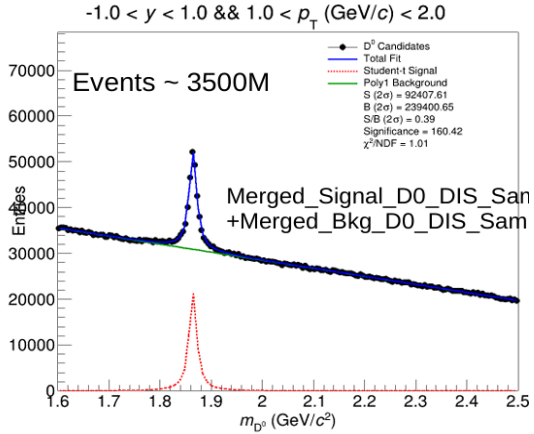


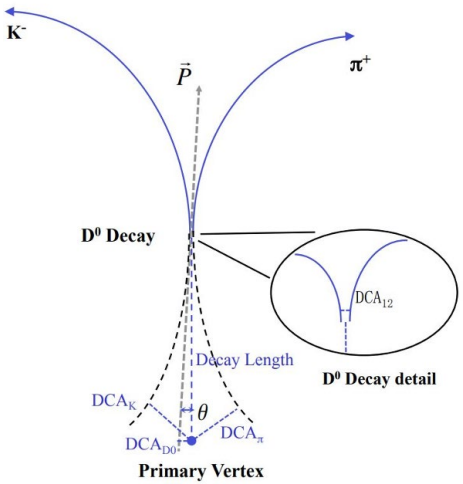
Shyam Kumar,
Annalisa Mastroserio,
Domenico Elia (INFN Bari)

ML for D^0 reconstruction in ep collisions

- ML Algorithm: BDT (Boosted Decision Tree) Binary Classifier
  - hipe4ml package https://doi.org/10.5281/zenodo.5070131







- Implemented the Bayesian approach for optimization
- Estimating the realistic signal/background and significance is in progress
- Future plans: Scan the BDT cut to get the best results
  - Implement a similar model for Λc+ reconstruction
  - Estimate the Λc+/D0 ratio using machine learning