

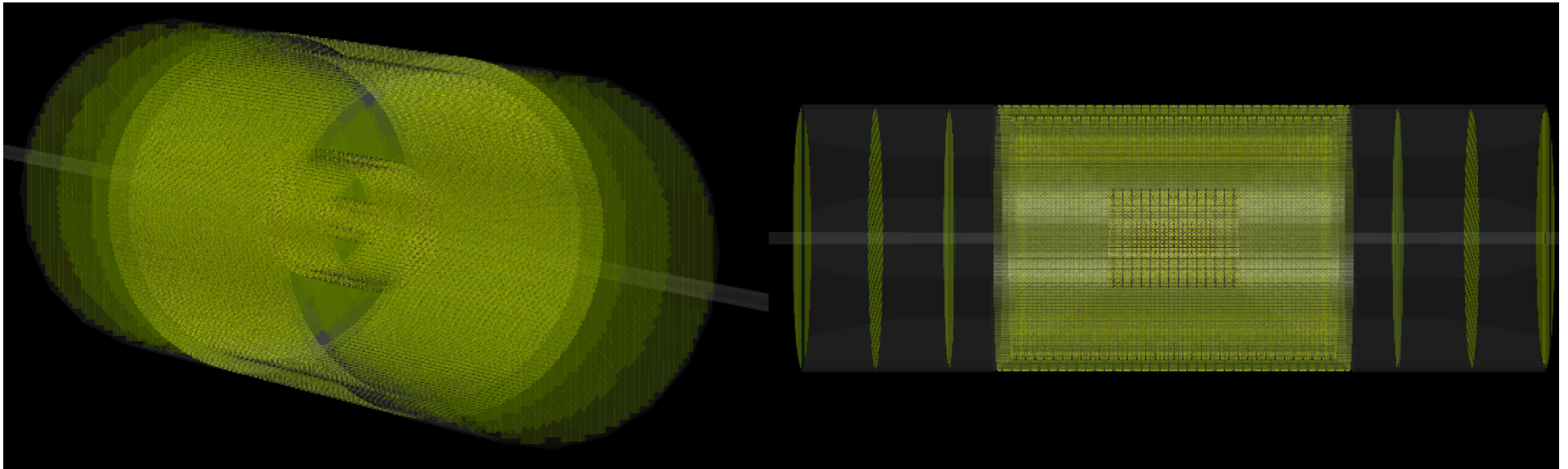
Tracking studies in Berkeley

Ernst Sichtermann, Miguel Arratia (through 2019)
Winston DeGraw, Youqi Song, Jose Soria, Dhruv Dixit,
Fernando Torales Acosta, Barbara Jacak



goals

Explore performance of all-Si tracker



- Geometry defined by Yue Shi Lai and Ernst Sichtermann
- All Si barrel layers, forward disk layers
- Currently based on ALPIDE MAPS technology (next-gen sensor R&D underway)
- Support structures, beam pipe, water cooling pipes now implemented in geometry



Questions we are addressing

- ◆ Where do jets from DIS on small- x partons go?
(make sure tracker can handle the relevant jets)
- ◆ What is momentum resolution for all-Si tracker?
- ◆ Compare all-Si with hybrid gas-Si tracker
(use TPC-Si as the hybrid example)
- ◆ What is the tracking efficiency for all-Si tracker?
- ◆ What is the impact of the C-fiber cone?



Simulation tools used

Pythia for e-p collisions (generator level studies)

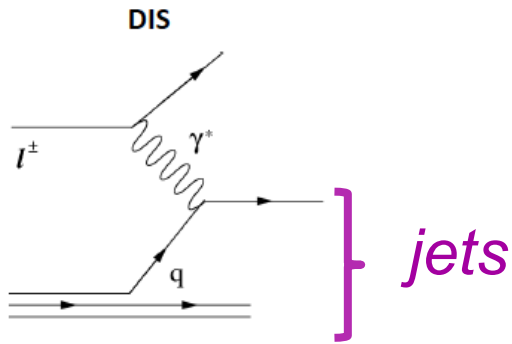
Fast MC (smearing level)

EICroot with Full Geant simulation

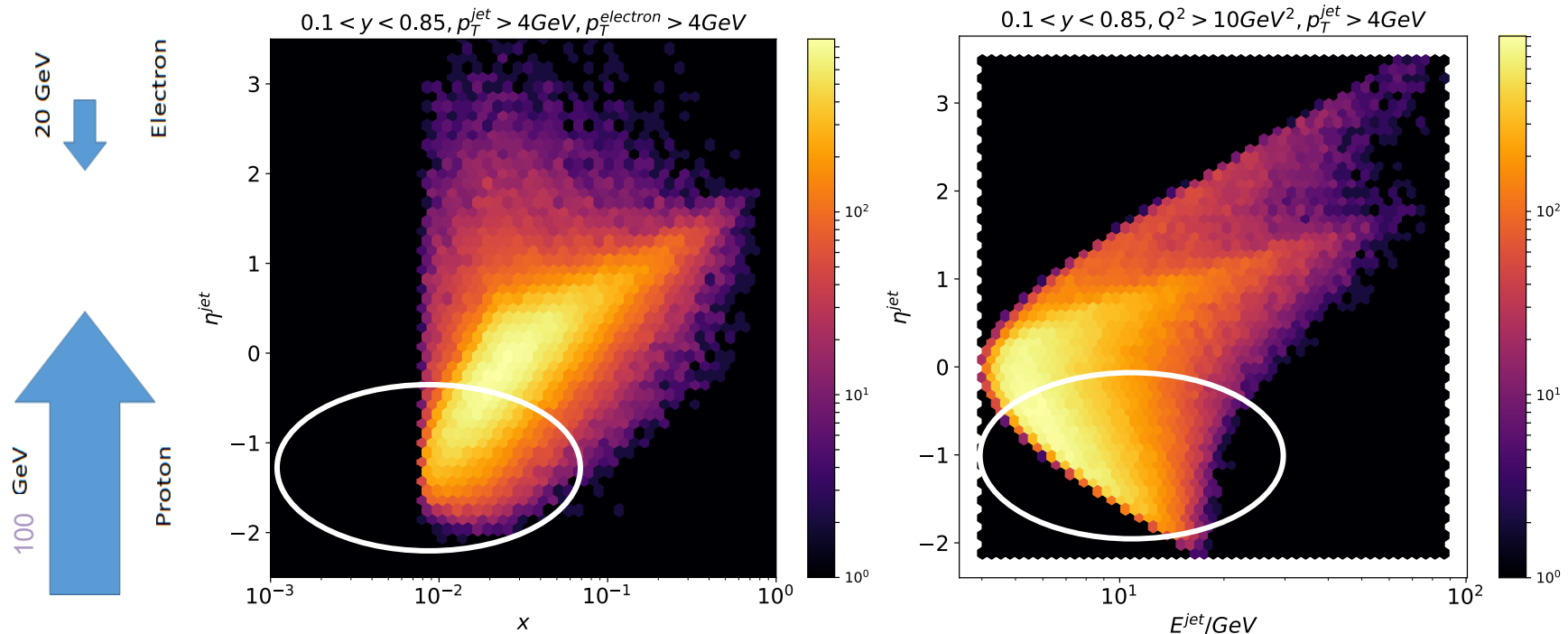
Fun4all



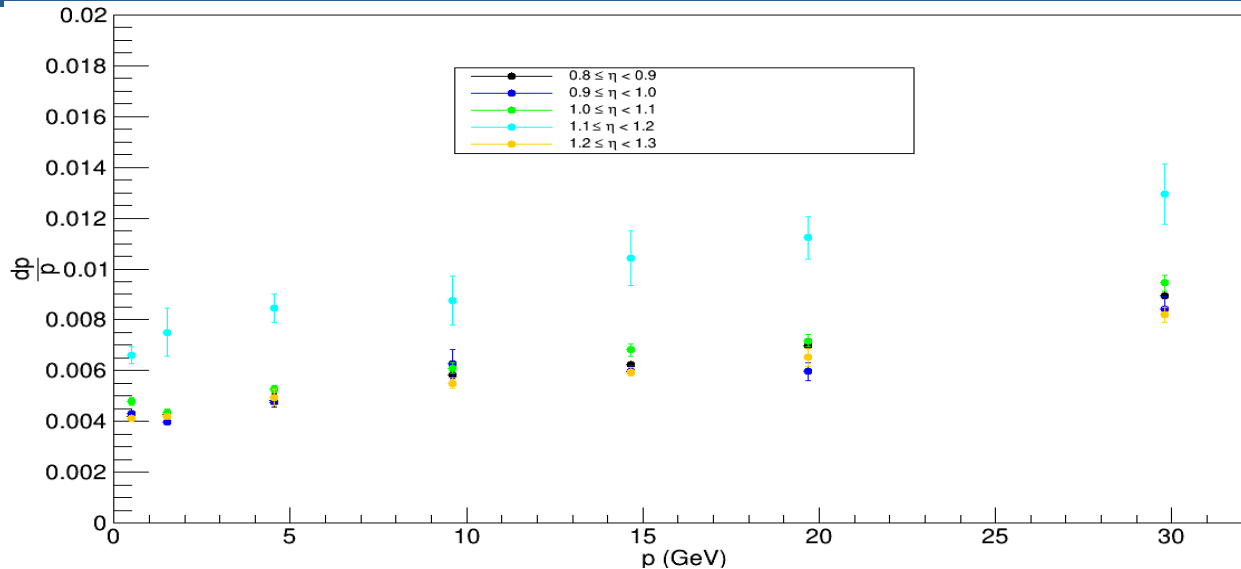
Probe matter with jets



Measure jets from small-x quarks
 Low energy jets at $-1 < \eta < -2$
 Small number of particles
 need efficiency at mid-backward interface



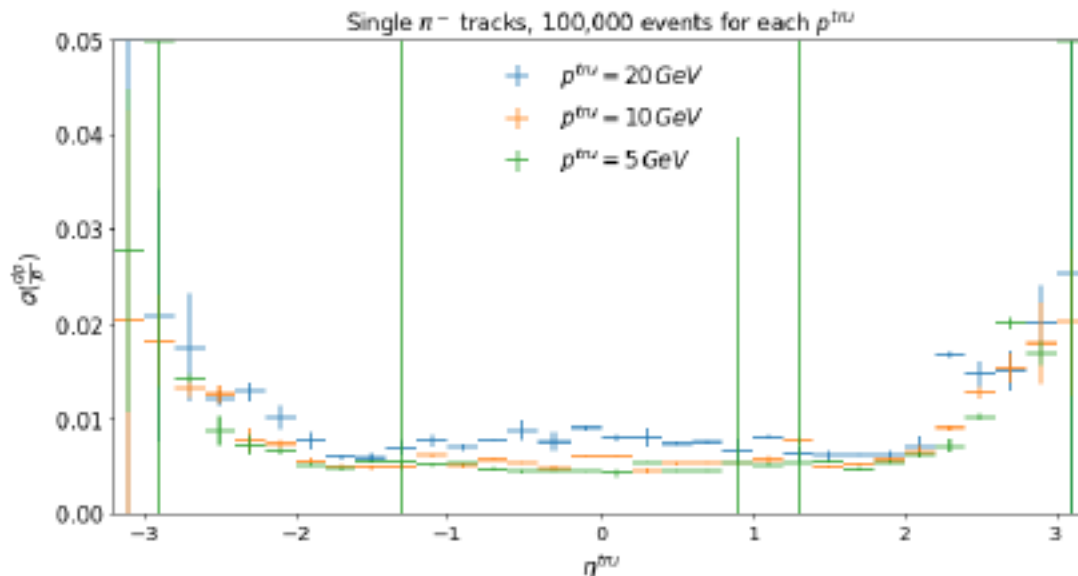
All-silicon tracker momentum resolution



Resolution looks good

Worse at $1 < \eta < 1.2$
(C fiber support cone!)

Fewer hits in those tracks



EICroot full simulations
Detector response w/ GEANT

Winston DeGraw, Youqi Song

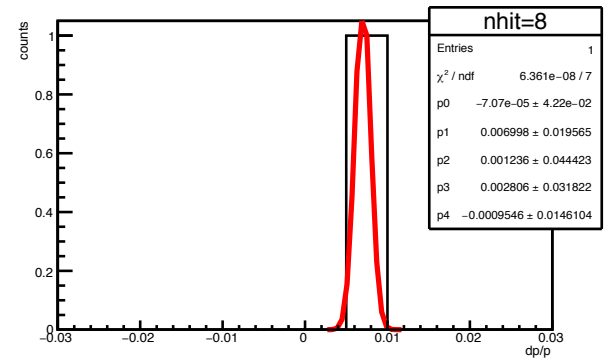
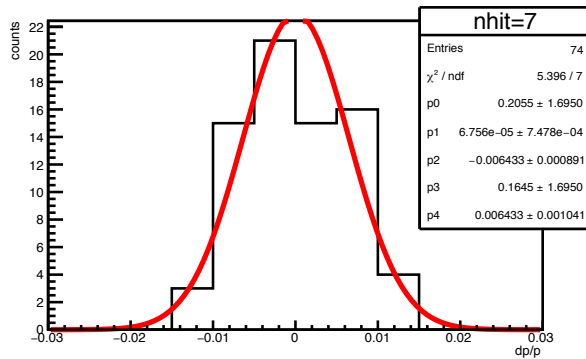
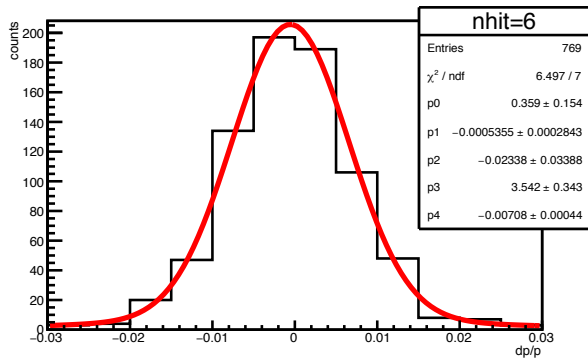
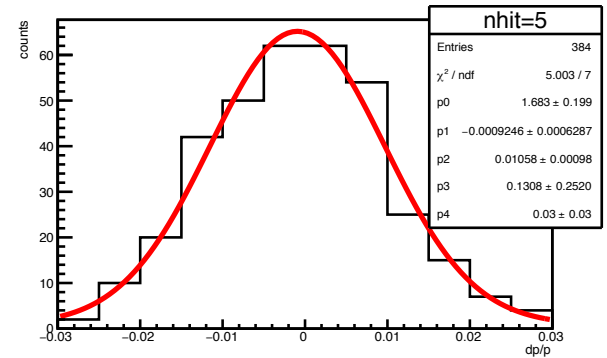
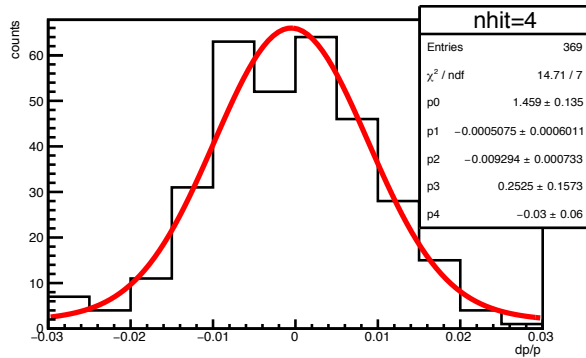
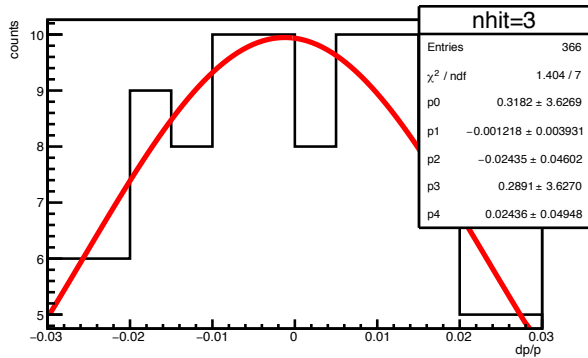


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Resolution degraded by loss of hits

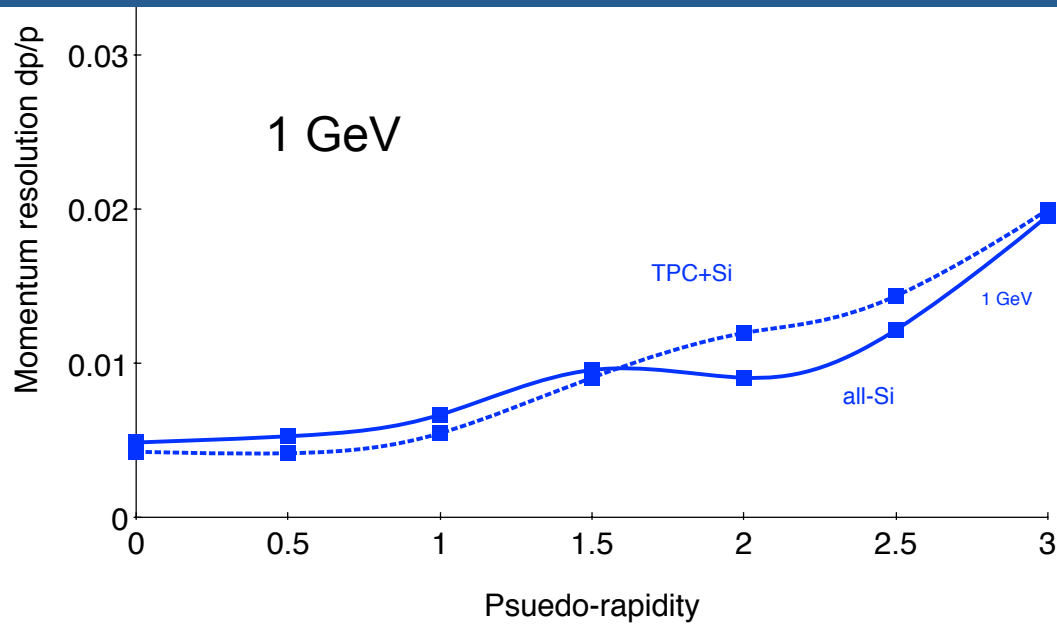


Youqi Song

Need 6 hits!

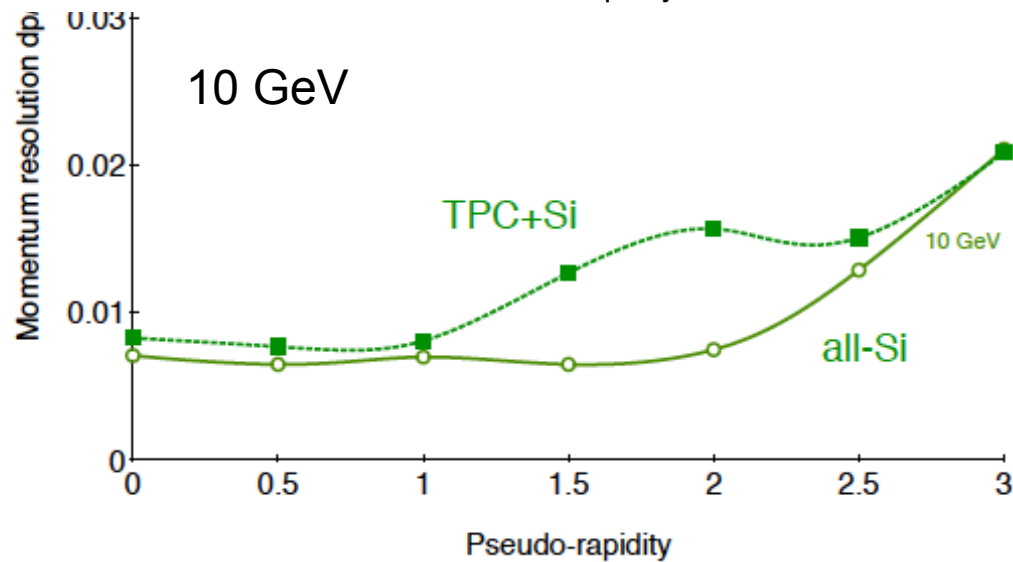


All-Si vs. hybrid tracker (BEAST magnet)

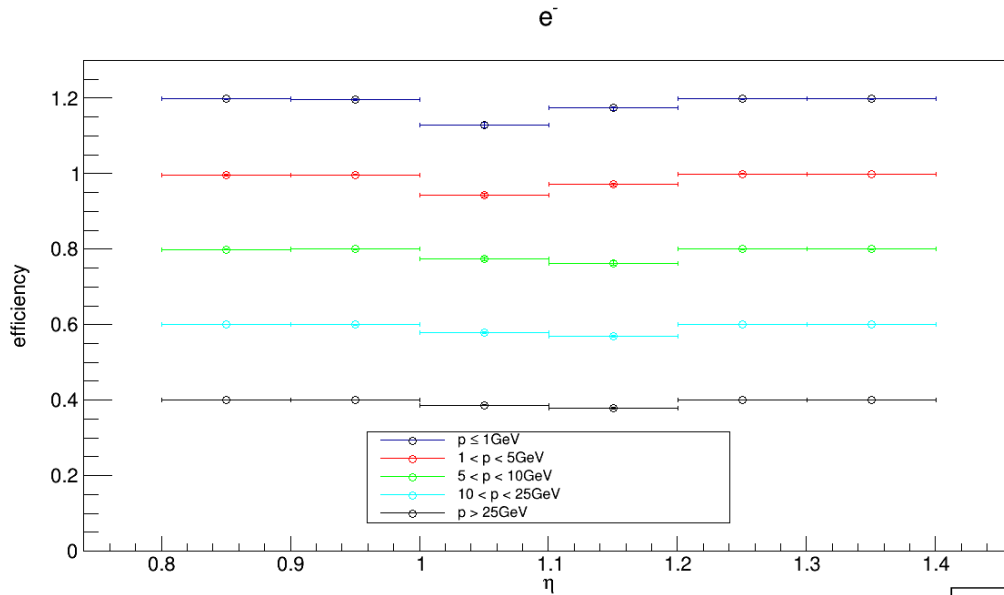


Ernst Sichtermann

Fast simulation

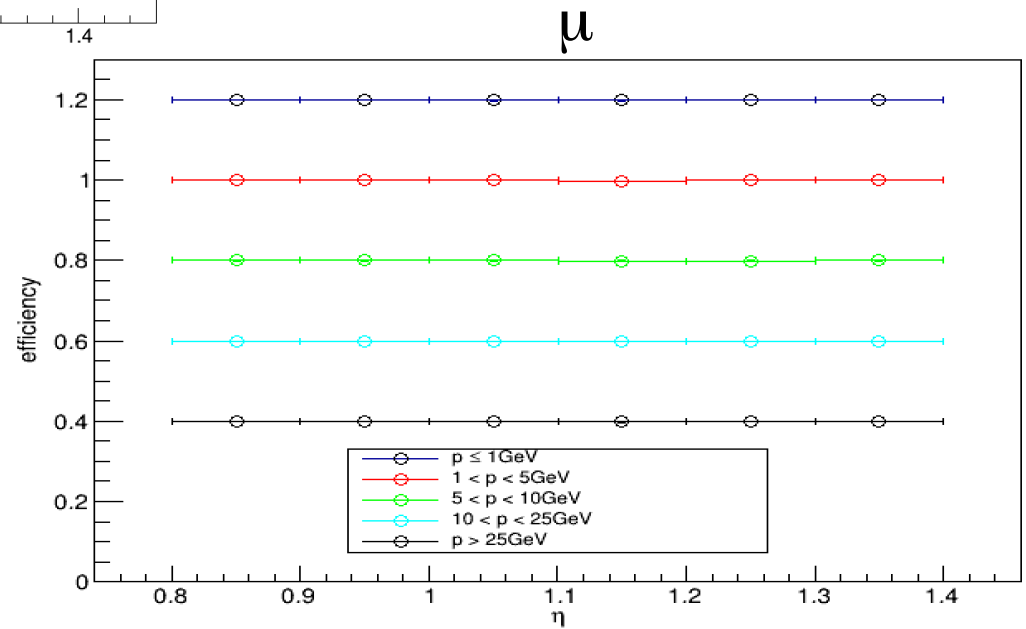


Tracking efficiency by particle type



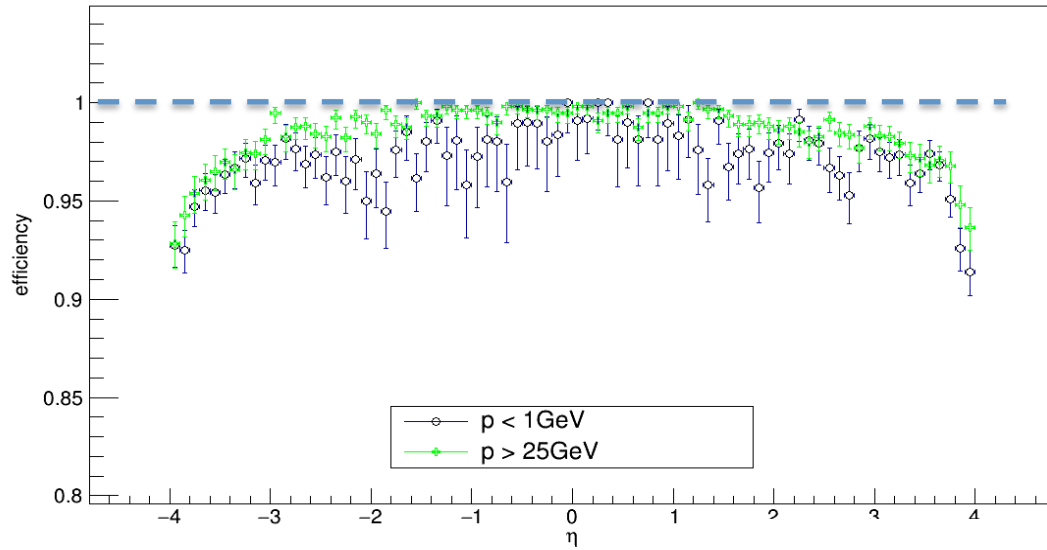
EICroot full simulations
Detector response w/ GEANT

Winston DeGraw

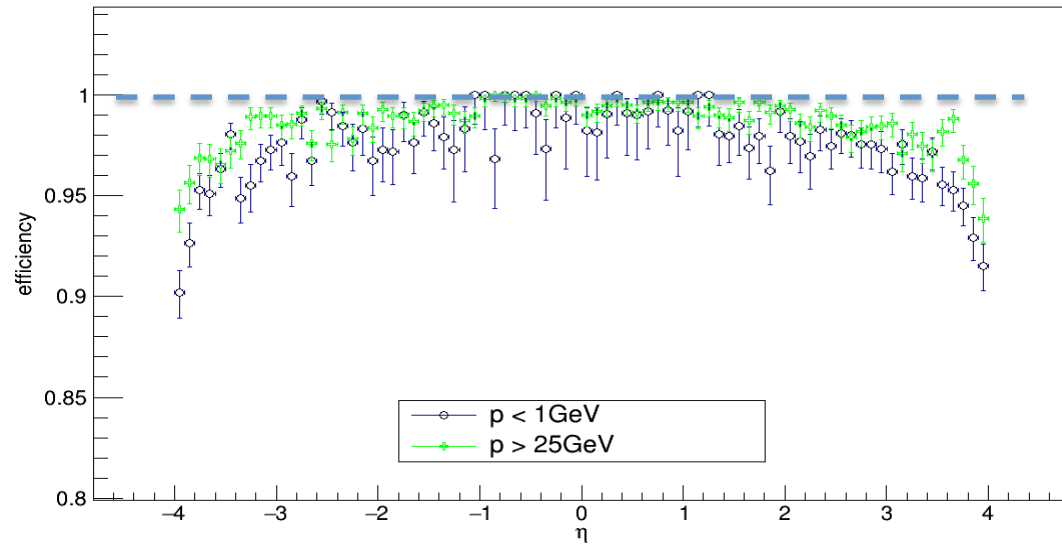


Tracking Efficiency

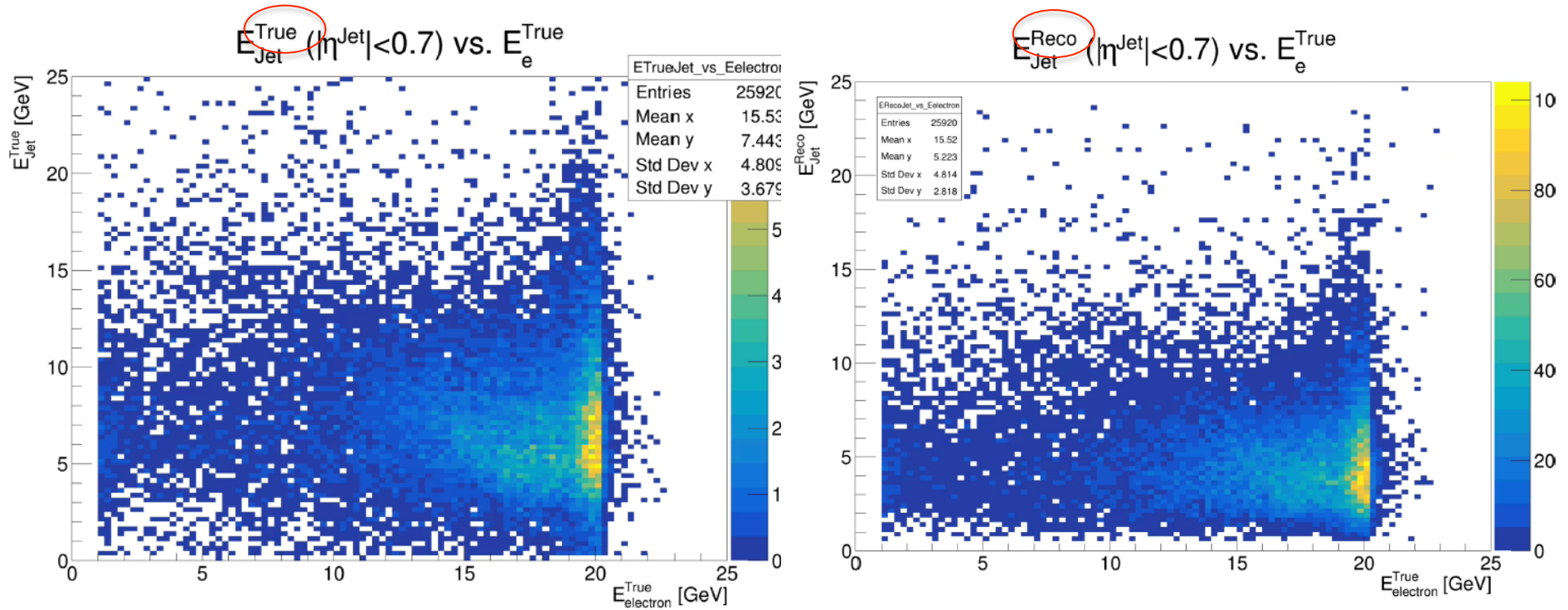
π^-



π^+



Jets with Fun4all (sPHENIX geometry)



Fernando Torales Acosta

Full simulations
Detector response w/ GEANT

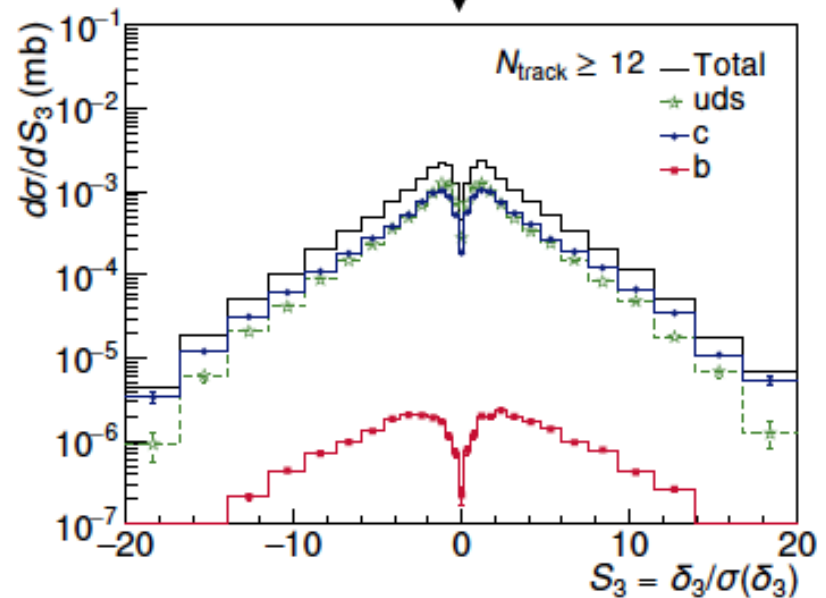
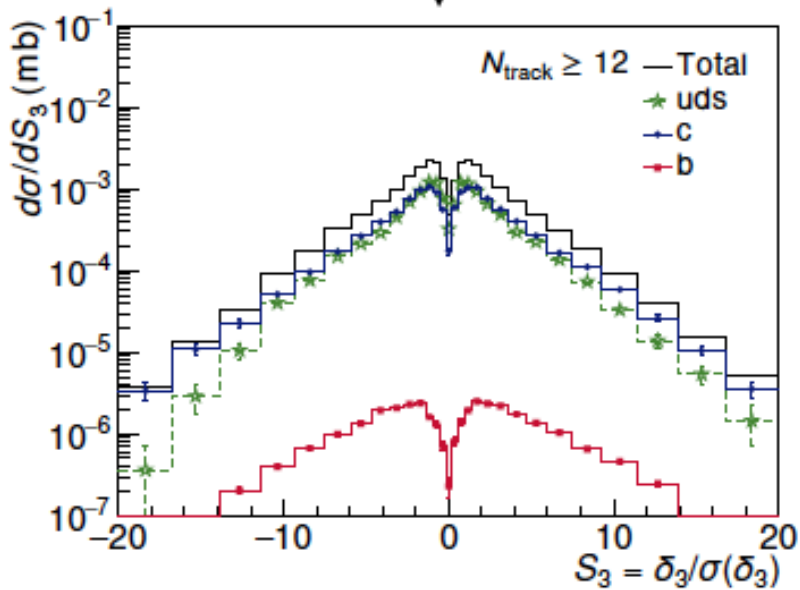
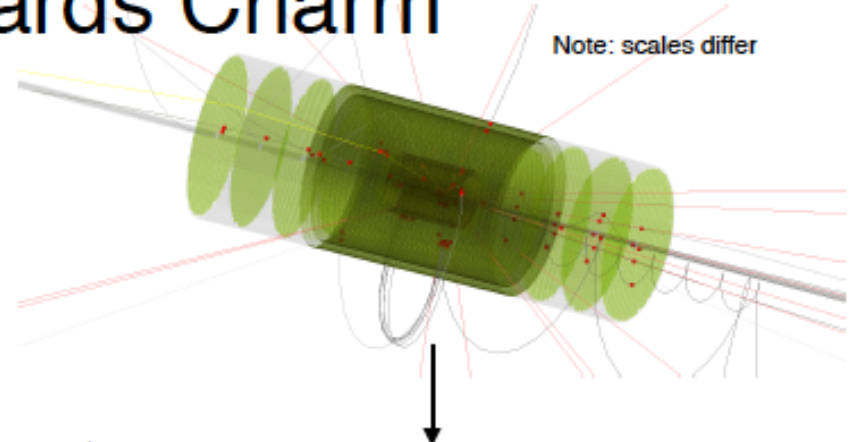
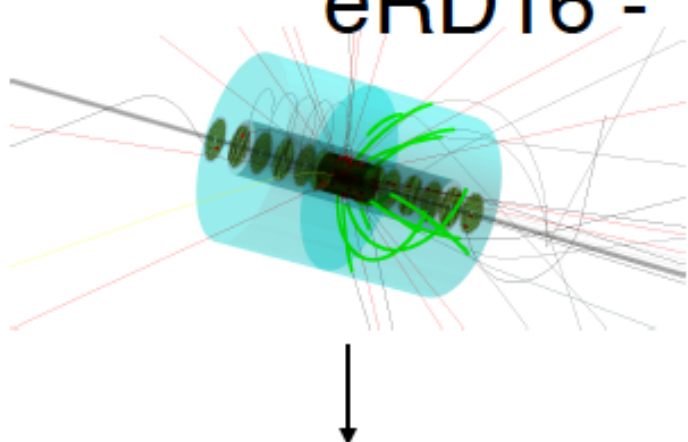


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eRD16 - Towards Charm



- Here, quark direction from scattered electron (i.e. limited sensitivity to photon-gluon fusion), and point-to-point distance and significance (i.e. full vertex reconstruction),
- Very similar distributions for TPC+Si and all-Si; consistent with vertex performance that is driven by the inner-most barrel layers, and overall acceptance expectations.

Measurement of the Charm and Beauty Structure Functions using the H1 Vertex Detector at HERA

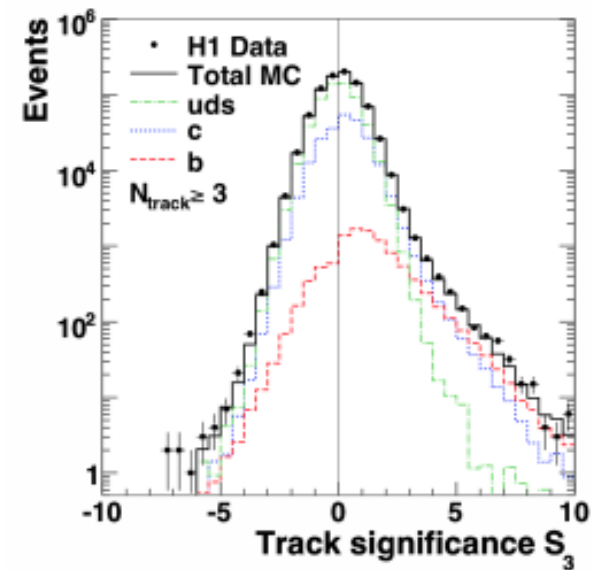
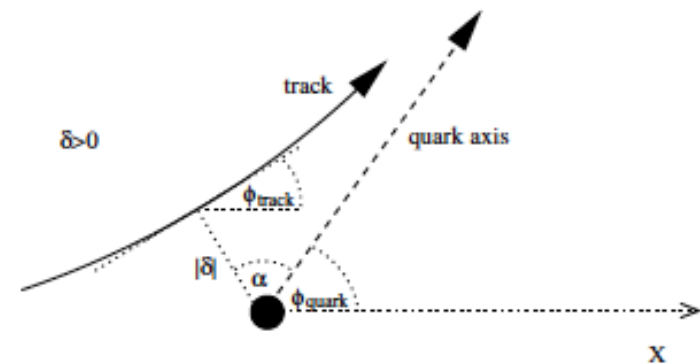
H1 Collaboration

Abstract

Inclusive charm and beauty cross sections are measured in e^-p and e^+p neutral current collisions at HERA in the kinematic region of photon virtuality $5 \leq Q^2 \leq 2000 \text{ GeV}^2$ and Bjorken scaling variable $0.0002 \leq x \leq 0.05$. The data were collected with the H1 detector in the years 2006 and 2007 corresponding to an integrated luminosity of 189 pb^{-1} . The numbers of charm and beauty events are determined using variables reconstructed by the H1 vertex detector including the impact parameter of tracks to the primary vertex and the position of the secondary vertex. The measurements are combined with previous data and compared to QCD predictions.

Accepted by Eur. Phys. J. C.

- Key concept, ordering of signed-significance of individual tracks w.r.t. beam-line constraint,



Next steps

Import all-Si tracker into Fun4all

Compare to Si+TPC with sPHENIX & BEAST magnets

Implement more detailed detector infrastructure

(using approach from Leo Greiner)

Collaborate on optimization



California Consortium



UC MRPI funding for ½ student per campus per year + workshops

Work is underway!

UCB: jet probes of gluon matter (arXiv:1912.05931)

UCR: calorimetry R&D/tests at STAR & jet fast simulations

UCLA: Hcal R&D/tests at STAR

UCD: Forward physics, collaborating on eSTARlight with Klein @ LBNL

LLNL & LANL collaborating on simulations



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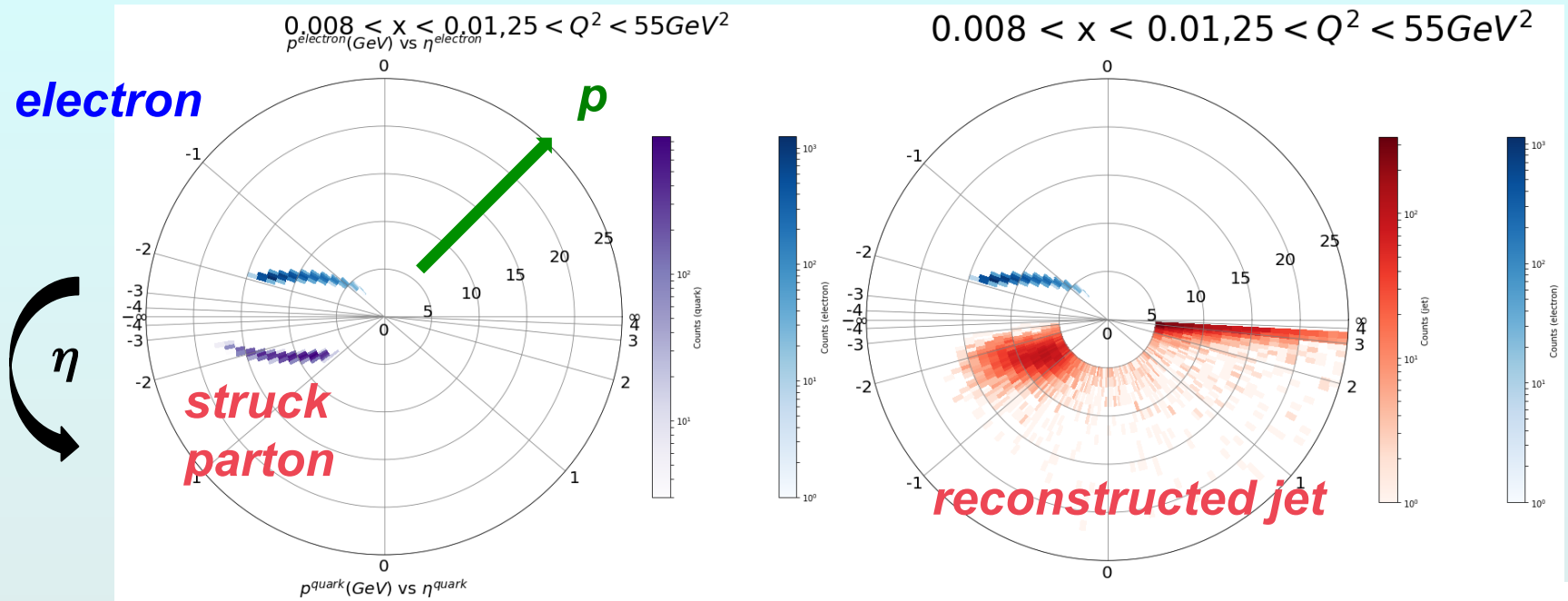
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Backup



Probe CNM with tagged jet in e+A

e+p, DIS; Pythia 8. Require $W^2 > 4 \text{ GeV}^2$,



Youqi Song, M. Arratia

Smearing is larger for single hadrons; more so for low Q^2

