Jets and Heavy Quark WG Summary

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Workforce and Engagement

- Conveners: Leticia Cunqueiro, Brian Page, Frank Petriello, Ernst Sichtermann, Ivan Vitev
- Currently we have ~71 members signed up to our mailing list
- If you see something which interests you, there is still time to sign up!
- Contact information can be found at: http://www.eicug.org/web/content/yellow-report-physics-working-group

Physics Deliverables and Channels

Physics measurement	Channel
Longitudinal spin structure	Inclusive jet and dijet measurements
Sivers asymmetry, special focus on gluons	Jet, lepton-jet and di-jet measurements
Electroweak structure functions, charged currents	Jets, flavor separated jets, Longitudinally polarized reactions ep, parity violating asymmetries
TMDs, nuclear broadening, energy loss	D-jets and photon/lepton tagged jets, ep, eA
Longitudinal and transverse (TMD) fragmentation, shapes and splitting functions	Inclusive jet measurements -> hadrons in jets, energy flow, angularities
Energy loss and hadronization	Heavy mesons cross sections in comparison to light mesons in ep, eA
Charm and beauty content of nucleons and nuclei	Heavy flavor-tagged jets, ep, eA
Flavor and mass dependence of parton showers	Heavy flavor-tagged jet substructure, ep, eA, quarkonia in jets
Extraction of fundamental parameters, hadronization constants, α_s	Global event shapes, thrust, angularities, N-jettiness

Parallel Session Contributions

Strong parallel session program with talks covering many aspects of Jet and Heavy Flavor physics as well as a fruitful joint session with the SIDIS group

Miguel Arratia – Jets for 3D Imaging
Yue Shi Lai – Heavy Flavor Reconstruction
Brian Page – Jet Angularities at the EIC
Frank Petriello – Double Longitudinal Spin Asymmetries with Jets
Tanmay Maji – The Angularity Event Shapes in DIS at the NNLL Accuracy
Haitao Li – Energy Energy Correlators for TMD Physics and Reduction of Uncertainties due to Hadronization
Xuan Li & Matt Durham – LANL Plans for Heavy Flavor, Quarkonia, and Jet Studies

Liang Zhang – Gluon Sivers Related Measurements
Felix Finger – TMD Measurements in Jets
Zelong Liu – Modification of Heavy Flavor in e+A Collisions at the EIC
Yiannis Makris – Hadrons in Jets

Detector Considerations

While studies to inform detailed detector requirements have not yet been completed, some general needs and points of emphasis have been identified:

- Heavy Flavor
  - Wide charged particle tracking acceptance ($-4 < \eta < 4$)
  - Low measurement thresholds to capture soft decay particles
  - Multi-particle decay channels
  - Minimize acceptance gaps
  - Positive and robust PID for $\eta > -1$ over wide momentum range
  - Precision vertexing up to 2.5 to 3.5 in η

- Jets
  - Tracking and calorimeter (EM and Hadron) coverage for $-4 < \eta < 4$
  - Low energy/momentum objects – tracking resolution superior to calorimeter
  - Minimize acceptance gaps
  - Robust PID over full tracking acceptance and particle momentum in jet environment

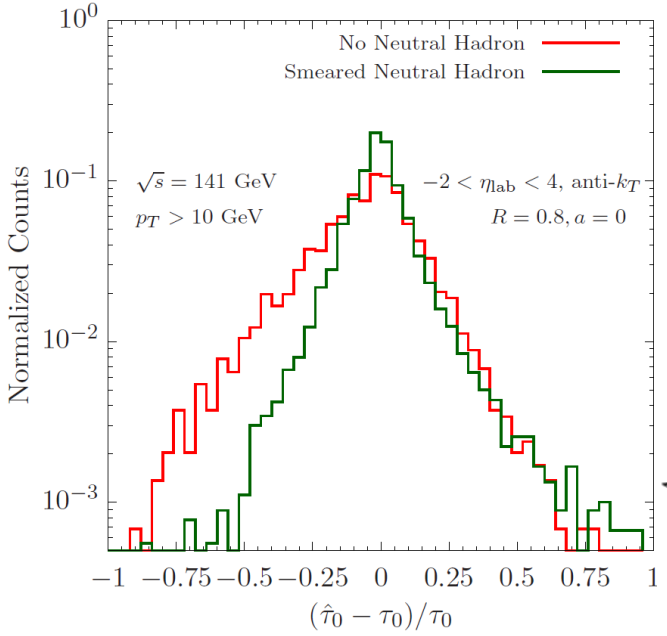
Useful discussion in joint session with Inclusive, SIDIS, and DWGs:

- Many overlapping requirements for JHQ and SIDIS groups
- Desire for several *internally consistent* detector mock-ups

Example: Jet Efforts

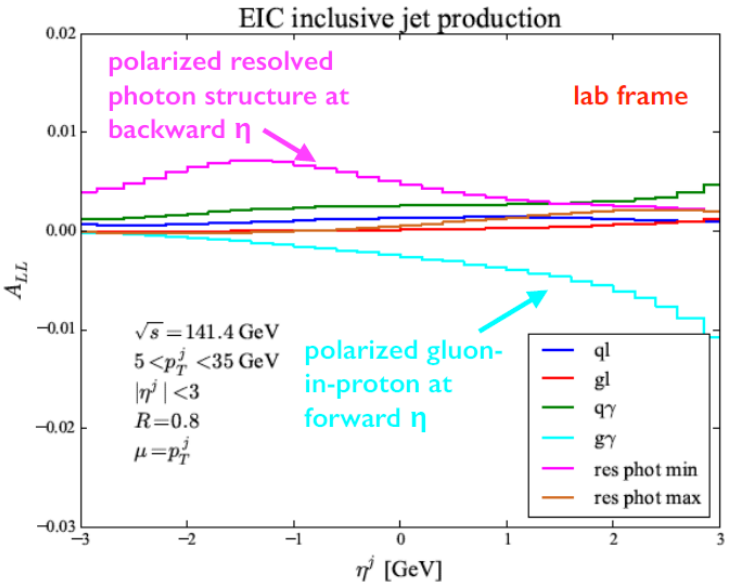
Angularity

- Effects of charged and EM particle smearing
- Track only measurement
- Smearing in jet clustering

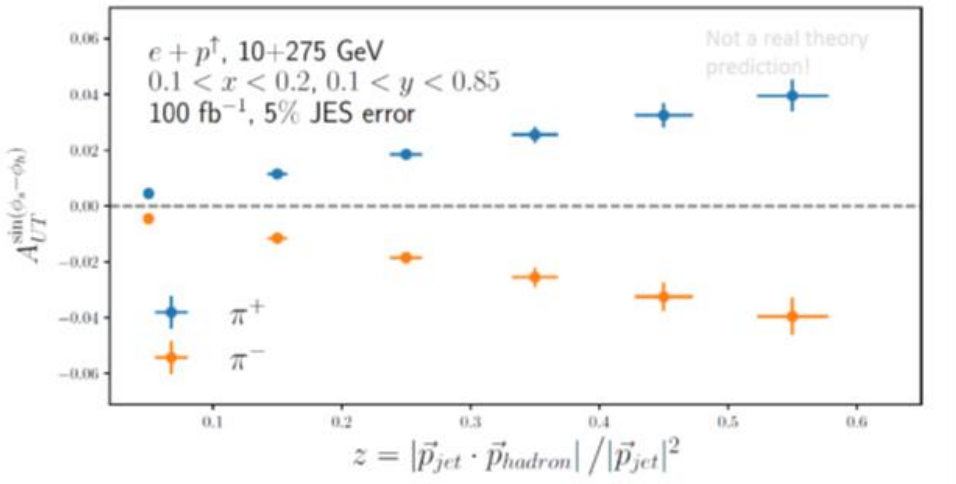


Inclusive Jet A_{LL}

- Detector Effects
- Impact on global fits
- Power corrections for low p_T
- Applicability of pQCD



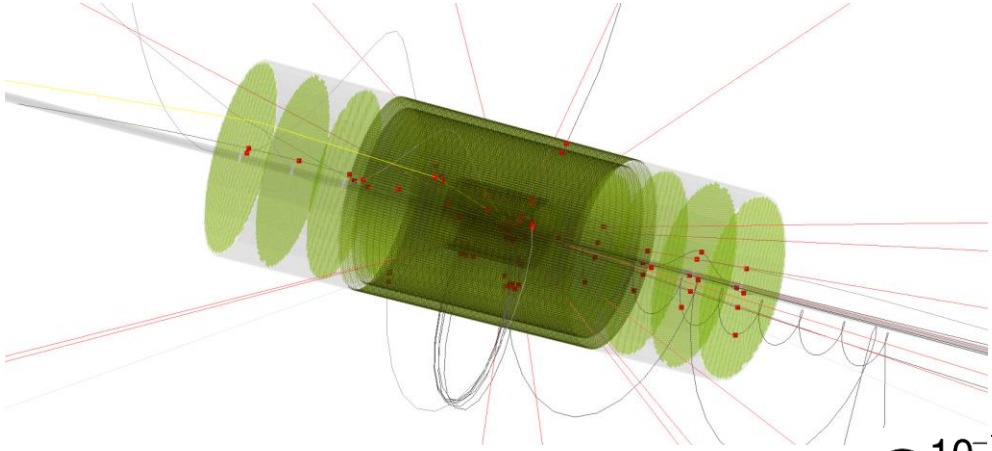
Boughezal, FP, Xing (2018)



Jets for 3D Imaging

- Detector Effects
- PID requirements
- Study potential of lower COM Energy

Example: Charm Tagging



Yue-Shi Lai (LBNL), Wednesday:

Tapered all-silicon EIC tracker concept

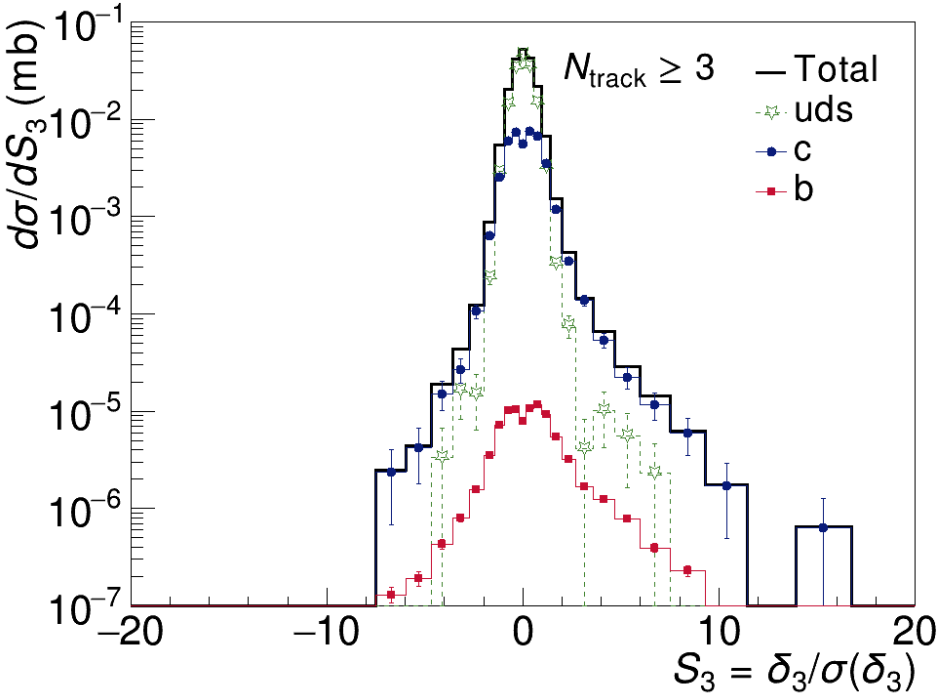
- Originated by eRD16 generic EIC detector R&D effort
- Six barrel layers complemented with 2x6 tapered disks with 20x20µm MAPS

Analysis:

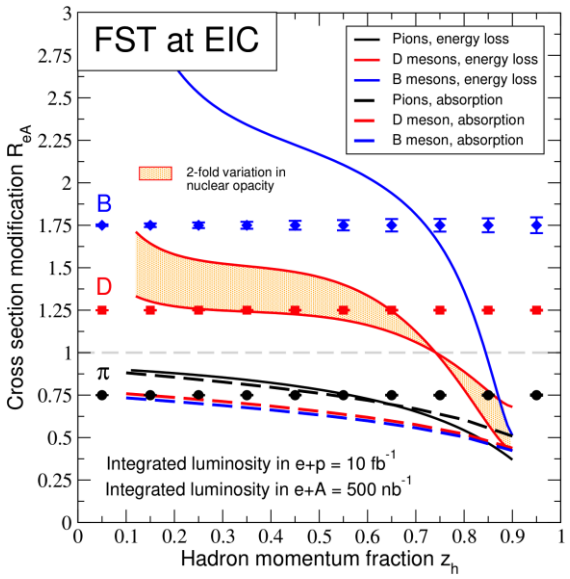
- Pilot study of charm-tagging a-la H1@HERA, EPJ C65 (2010) 89,
- Signed and ordered displacement technique,
- GEANT (full) simulation,
- GENFIT/RAVE tracking and vertexing,
- Jet reconstruction using FASTJET
- Done for both TPC+Si and all-Si concepts

Outcomes:

- EIC demonstration of charm-tagging,
- Performance driven by the innermost vertex layers; similar for both concepts
- Similar performance for 10x10µm and 20x20µm MAPS pixel sizes

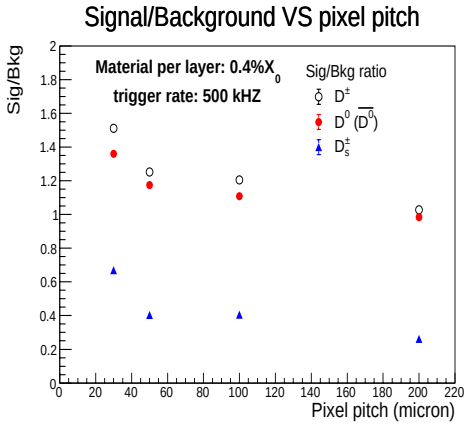


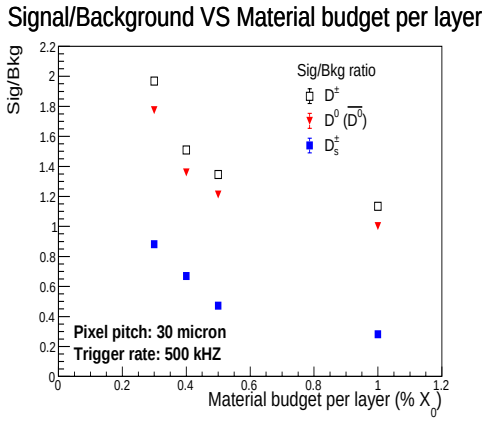
Example: Heavy Flavor Meson Reconstruction



Modification of heavy flavor in nuclei

Goal: update physics plots and tracking & vertexing requirements





Existing studies

Starting points form existing studies: Pixel pitch size < 100μm, material budget < 1% X_0 per layer, momentum resolution dp_T/p_T 1% - 10 %, transverse impact parameter resolution b_T < 75μm, rapidity coverage -4 < η <4 (driven by mid to forward)

Work plan: narrow down the technology parameter requirements, evaluate trade offs in resolution (momentum, position) near edges of acceptance, updates in full simulation

Additional effort from this meeting – Quarkonia/exotics and detector requirements

J/psi, psi', X(3872) in eA collisions