

Jets and Heavy Quarks PWG Summary

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Jets and Heavy Quarks PWG

~86 members are currently subscribed to our mailing list,

Weekly group meetings on Mondays at noon ET, c.f. indico.bnl.gov/category/290

If a topic interests you, it is *not* too late to join the effort,

Contact any of us directly, or via

<http://www.eicug.org/web/content/yellow-report-physics-working-group>

Jets and Heavy Quarks PWG Goals

Physics measurement	Channel
Longitudinal spin structure Sivers asymmetry, special focus on gluons	Inclusive jet and dijet measurements Jet, lepton-jet and di-jet measurements
Electroweak structure functions, charged currents TMDs, nuclear broadening, energy loss	Jets, flavor separated jets, Longitudinally polarized reactions ep, parity violating asymmetries D-jets and photon/lepton tagged jets, ep, eA
Longitudinal and transverse (TMD) fragmentation, shapes and splitting functions Energy loss and hadronization	Inclusive jet measurements -> hadrons in jets, energy flow, angularities 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

Jets and Heavy Quarks Parallel Sessions

Lively parallel sessions yesterday, dedicated to Jets and Heavy Quarks, joint with the inclusive and SIDIS working groups, and joint discussion with physics and detector working groups,

Joe Osborn (ORNL)

[Jet substructure studies for the EIC](#)

Ivan Vitev (LANL)

[Calculations of heavy meson production at EIC](#)

Miguel Arratia (UCR)

[Jets for 3D imaging](#)

Matt Kelsey (LBNL)

[Charm and bottom at EIC](#)

Xiaoxuan Chu (BNL).

[Charged Current in unpolarized ep collisions](#)

Bowen Xiao (CCNU)

[SIDIS summary of inclusive and jet related topics](#)

Cheuk-Ping Wong (LANL)

[LANL open heavy flavor and quarkonia simulation](#)

[updates for the EIC Yellow Report preparation](#)

Ciprian Gal (SBU)

[Electroweak and BSM physics at the EIC](#)

Steve Sekula (SMU)

[Charm-tagging in Charged-Current Interactions at EIC](#)

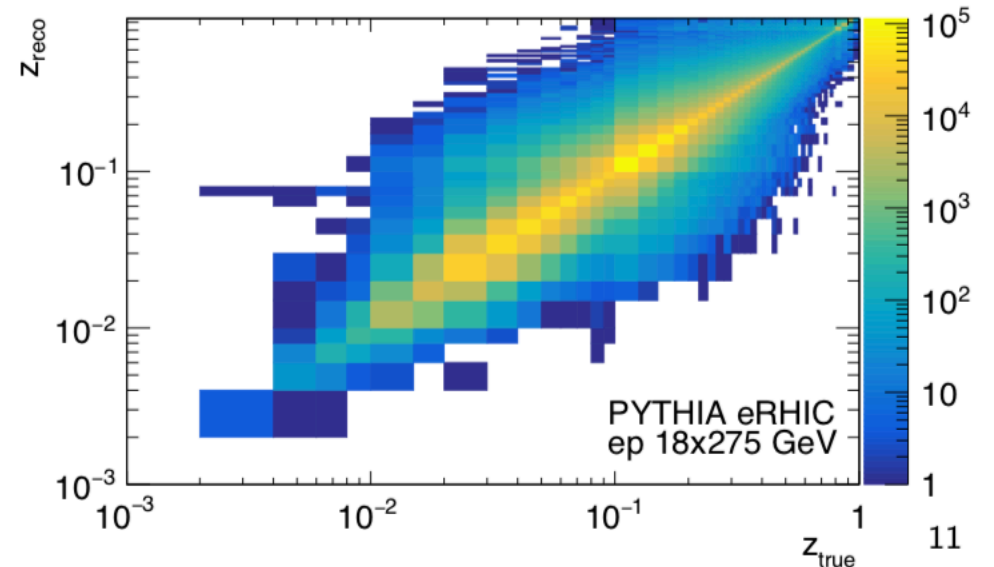
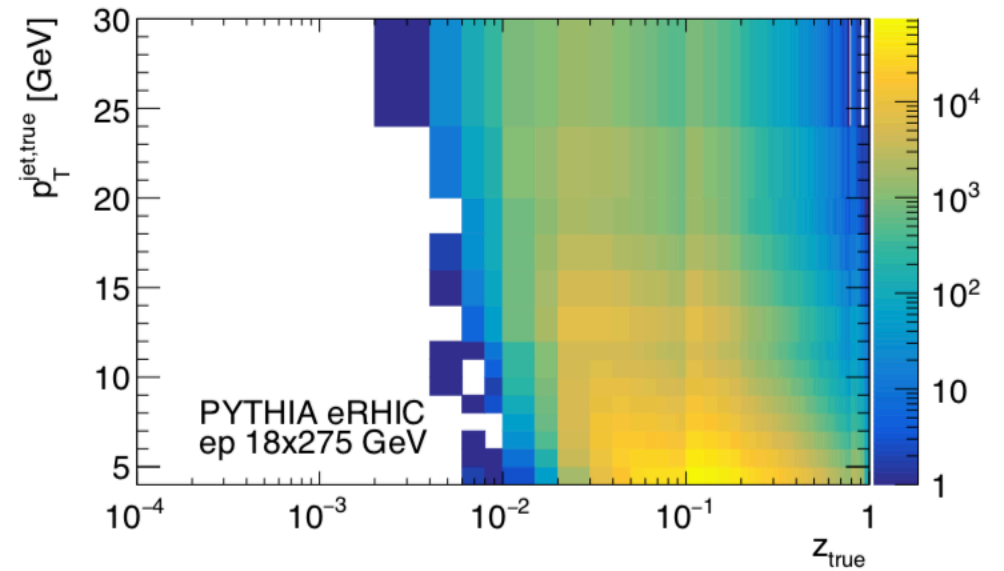
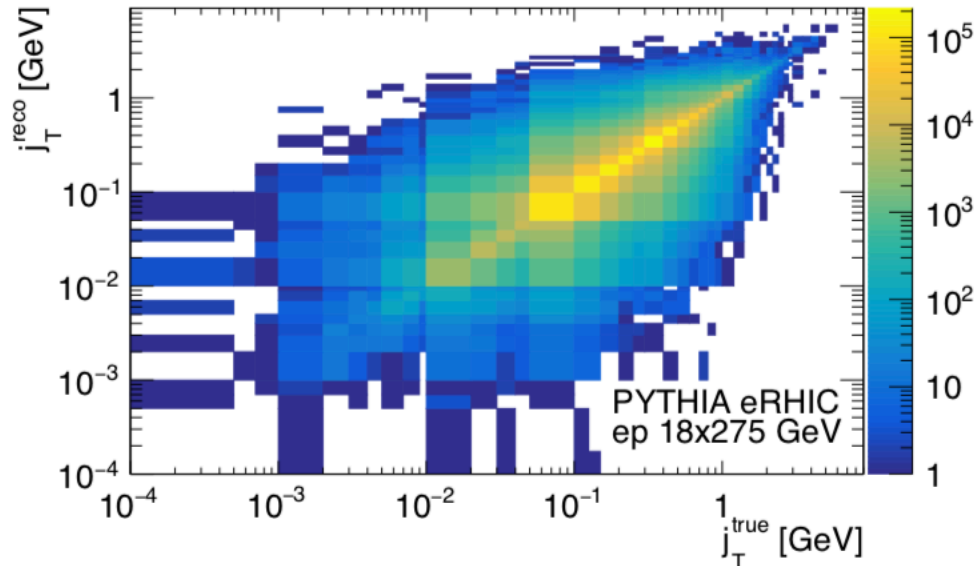
Conveners

[Discussion Input](#)

Jet example:

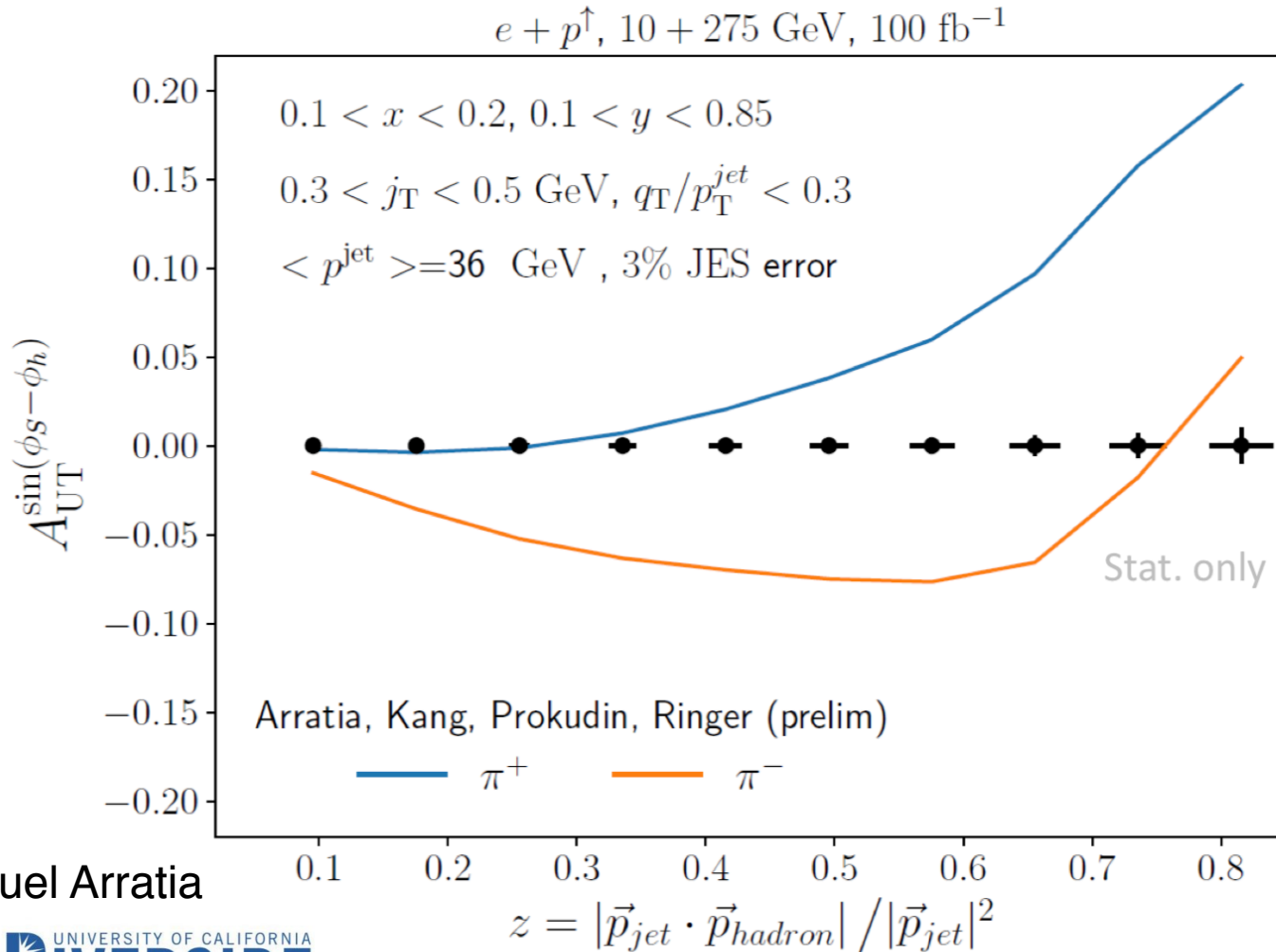
Hadronization Kinematics

- Hadronization kinematic reach is mostly limited by lower p_T threshold of particles
- Hadronization observables limited by jet momentum resolution



Jet example:

Hadron-in-jet theory prediction (new!)



- By measuring both photon axis and jet axis we control separately TMD PDF (q_T) and TMD FF (j_T, z).
- Goal is multi-differential quark-transversity study.

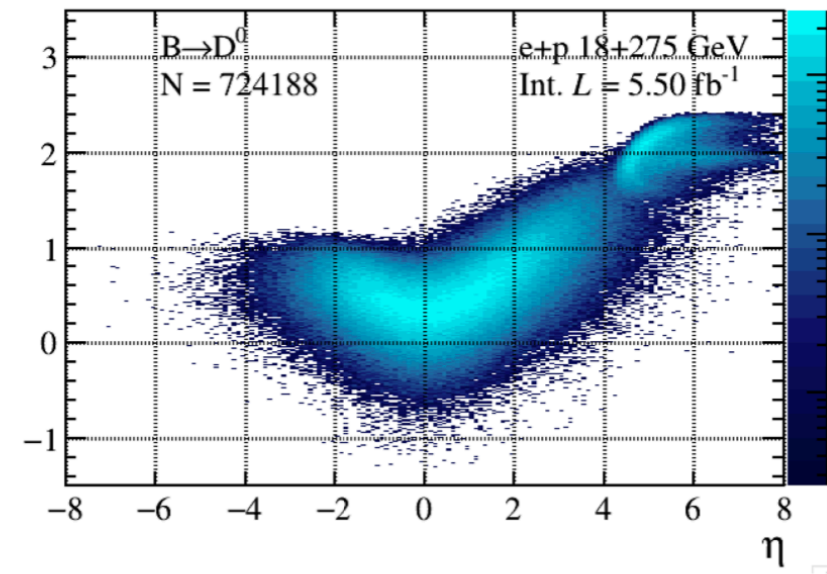
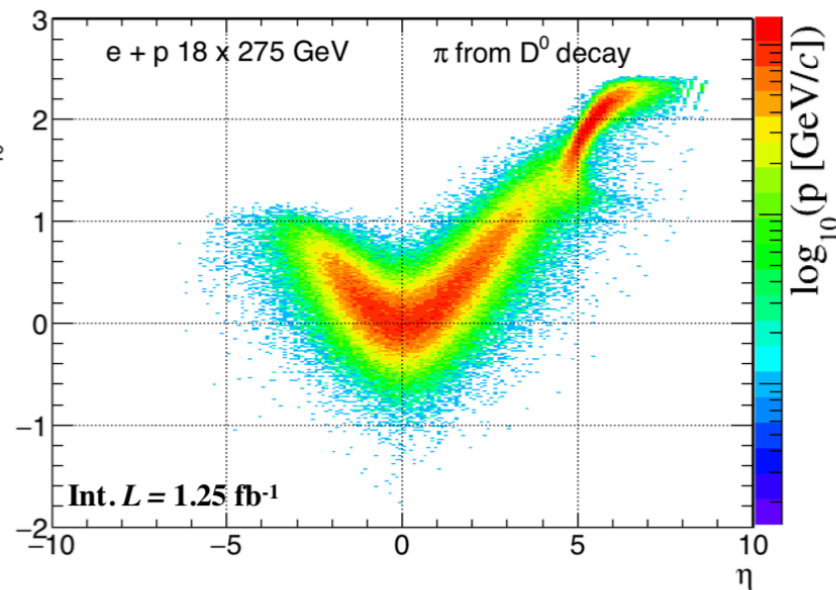
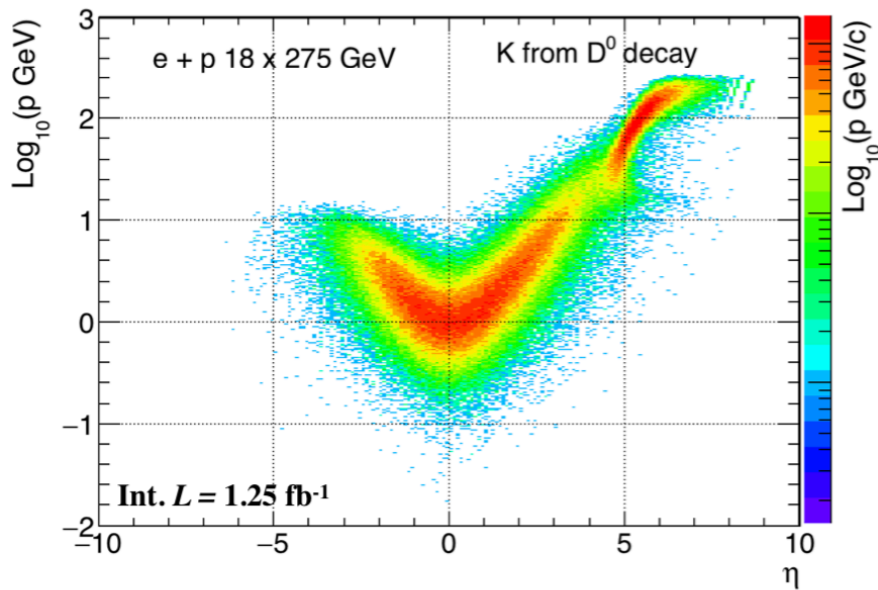
$$\frac{d\sigma}{dy_e d^2\vec{p}_T^e d^2\vec{q}_T dz_h d^2\vec{j}_T^h} =$$

$$\times \sigma_0 H_q(Q, \mu) \sum_q e_q^2 \mathcal{G}_q(z_h, \vec{j}_T, p_T^{\text{jet}}, R, \mu)$$

$$\times \int \frac{d^2\vec{b}_T}{(2\pi)^2} e^{i\vec{q}_T \cdot \vec{b}_T} f_q(x, \vec{b}_T, \mu) S_q(\vec{b}_T, y_{\text{jet}}, R, \mu)$$

HQ example:

Heavy-Flavor Decay Distributions



- Charm and bottom decay products within $|\eta| < 3$
- Similar distributions for other charm hadron decays and $B \rightarrow D^+/\text{Lepton}$ decays

Matt Kelsey et al (Pavia WS),
and complementary work.

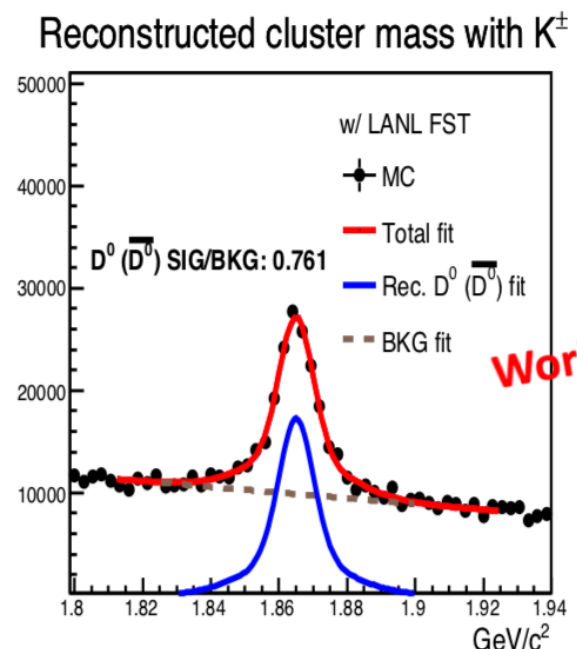
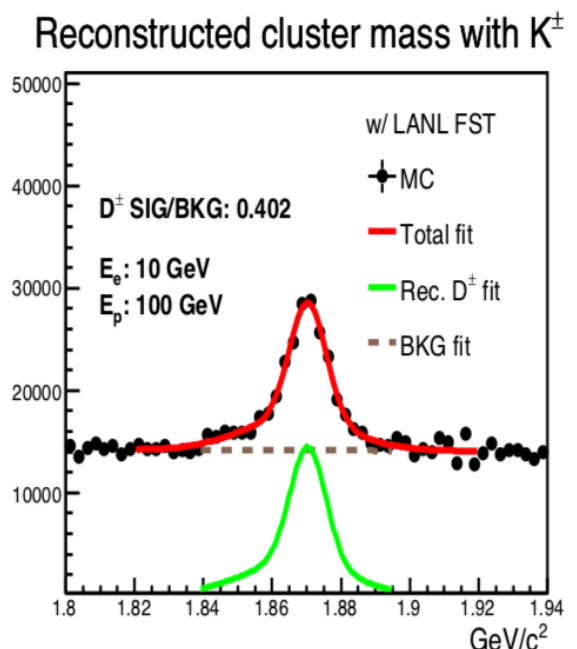
HQ example: Invariant Mass Reconstruction



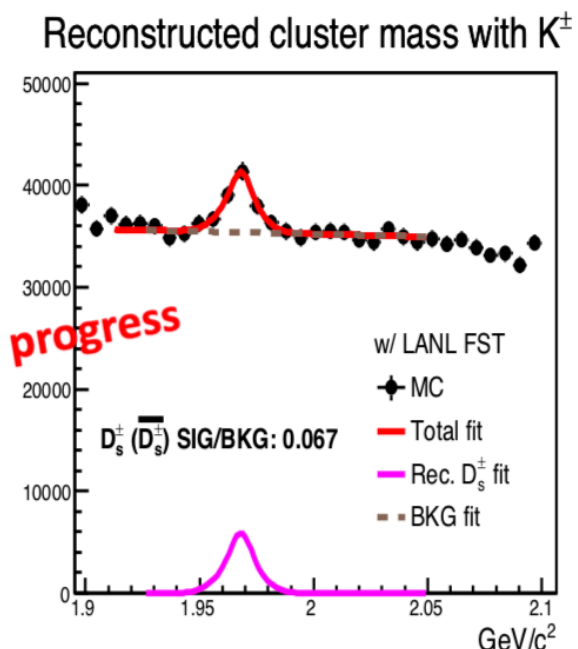
Reconstructed D mesons in PYTHIA8 simulation

- In 10 GeV electron and 100 GeV proton collisions with integrated luminosity: 10 fb^{-1} .
- Reconstructed D meson mass distributions.
 - Tracking η cut: 1 to 3 and track efficiency set at 95%.
 - The performances are based on 100% $K/\pi/p$ separation.
 - Charged track clusters that contain K^\pm with a decay length (DCA) cut.

Xuan Li et al (Pavia WS),
and complementary work.



Work in progress



HQ example:

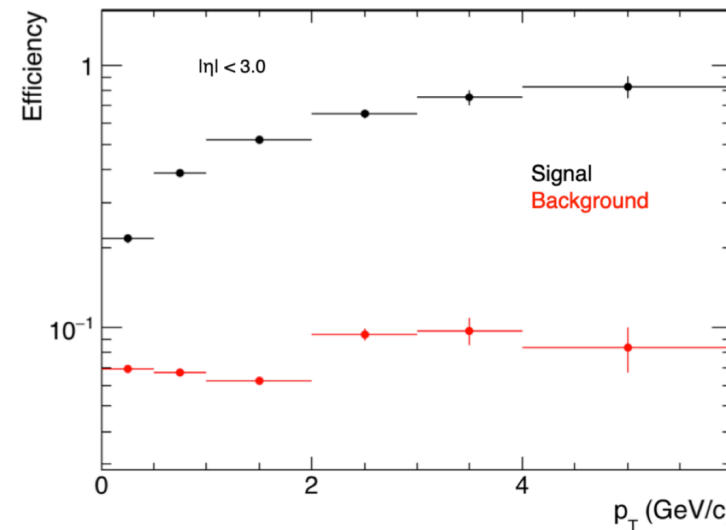
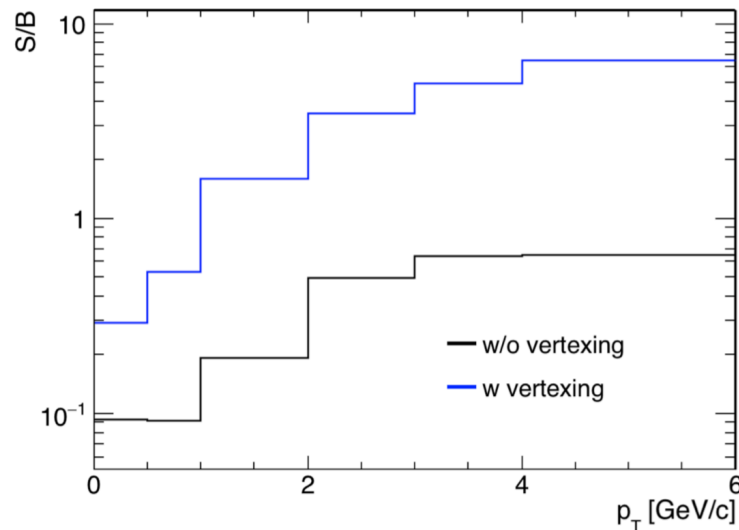
Vertexing

Interested parties from Birmingham, LANL, LBNL, ... are taking active part in the Tracking DWG
are contributing actively to GEANT-based / full simulations,

Fast HQ simulations have started to consider vertexing beyond fixed-number smearing/assumptions
to take into account event-topology by fitting vertices.

D^0 S/B and Efficiency

Matt Kelsey et al (Pavia WS).



- Reiterating nice improvement of D^0 S/B with vertexing
 - Factor of 10(2) for high(low) p_T
- Modest signal efficiency with “by-eye” cuts

Jets and Heavy Quarks - Closing Comments

Not discussed in this summary,

- Theory calculations of heavy meson cross-sections,
- Quarkonia and exotics,
- Charm jet-tagging in charged-current interactions,

Near-term future,

- Complete, document, and archive “kinematic maps”,
- Further evaluate detector needs,

Looking ahead towards the EICUG collaboration meeting and 3rd workshop,

- Develop physics projections for key measurements,
- Iterate detector needs,

Note: The [2020 APS-DNP Fall Meeting](#) will feature an EIC mini-symposium,
This year’s [abstract submission](#) deadline will be June 26, 2020