



Analysis Coordinator Report

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Dipartimento di FISICA



ePIC Collaboration Meeting

January 12, 2024

Next “Regular” Analysis Coordination Meetings

- Friday at 1030 am during usual General Meeting Slot
 - Zoom: <https://lehigh.zoom.us/j/94442844026?pwd=WEhNUlgwRi9sU1QvTTUvT05tNXRwdz09>
- Jan 26 - <https://indico.bnl.gov/event/21725/>
- Feb 23 - <https://indico.bnl.gov/event/21726/>
- March 8 - <https://indico.bnl.gov/event/21727/>
- March 22 - <https://indico.bnl.gov/event/21728/>
- Meetings are open to everyone – we hope to see many of the new analyzers from the collaboration meeting at our next meetings!

TDR Kick Off Meeting

- In order to focus the efforts of the physics teams we will have a TDR kick off meeting Monday Feb 5 at 9 am EST
 - Agenda is in progress at: <https://indico.bnl.gov/event/21775/>
 - Discussion on the structure
 - Tools needed/further developed
 - Generators
 - Allocation of personpower
 - Individual PWG needs
- This meeting is open to all, we hope to see many people ready to discuss and more importantly contribute!
- We have room for a discussion at the end of this talk for preliminary input

Joint S&C and Physics Meeting

- Joint S&C and Physics Meetings are an opportunity to coordinate efforts between the two endeavors
 - Incredibly important for a successful TDR!
- Previous Meetings:
 - November 29: <https://indico.bnl.gov/event/21425/>
 - Discussion of validation, benchmarks and more
 - May 17: <https://indico.bnl.gov/event/19473/>
- Next Meeting: <https://indico.bnl.gov/event/21772/>
 - Agenda is in progress:
 - Generators
 - Physics specific TDR needs
 - Any points raised from Feb 5 meeting

PWG Updates

JETS + Heavy Flavor

- Conveners:
 - Olga Evdokimov (evdolga@uic.edu),
 - Brian Page (bpage@bnl.gov)

Meeting time: Wednesdays (biweekly) at 12:00pm ET

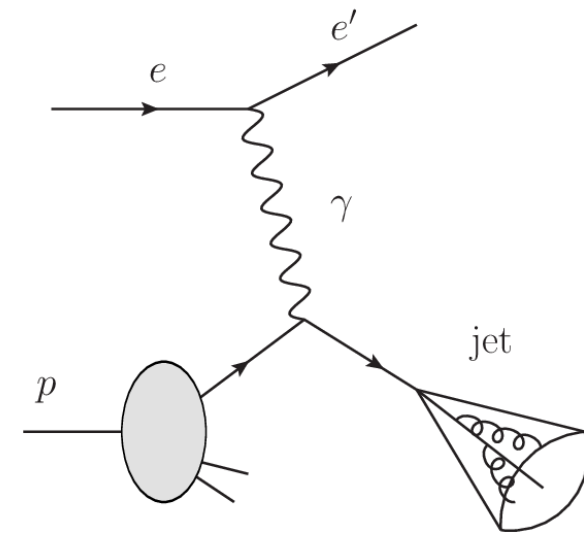
Mailing list: eic-projdet-jethf-1@lists.bnl.gov

Indico: <https://indico.bnl.gov/category/420/>

Mattermost:

https://eic.cloud.mattermost.com/signup_user_complete/?id=i8gnmob4stdrpjfrezhegxs3ew

Wiki page: <https://wiki.bnl.gov/eic-project-detector/index.php/JetsHF>



Tracking / Jet & HF Joint Session Tasks

- ❑ Jeet / Barak: Pull request for real seeded charge fix (**done and is merged: Pull request 1213**)
 - ❑ Populate and generate some plots / documentation to justify (see above)
- ❑ Jeet / Barak: Single particle simu with different species (proton, pion) to look at proton efficiency issue (**proton sample shows no dip in efficiency at negative eta – needs further thought**)
- ❑ Truth seeding fix (**progress has been made - more checks necessary; look at impact on primary vertex reconstruction**)
- ❑ Generate unburned DIS sample to look at DCA properties (**Xin confirms good vertex resolution when generated vertex sits at 0,0,0**)
- ❑ Xuan: Break D0 reconstruction down into steps: PID, DCA, etc (**Xuan will need some more time to modify her analysis to do this**)

Tracking / Jet & HF Joint Session Tasks

- ❑ Jeet / Barak: Pull request for real seeded charge fix (**done and is merged: Pull request 1213**)
- ❑ Populate and generate some plots / documentation to justify (see above)

Here is some statistics to validate this request:

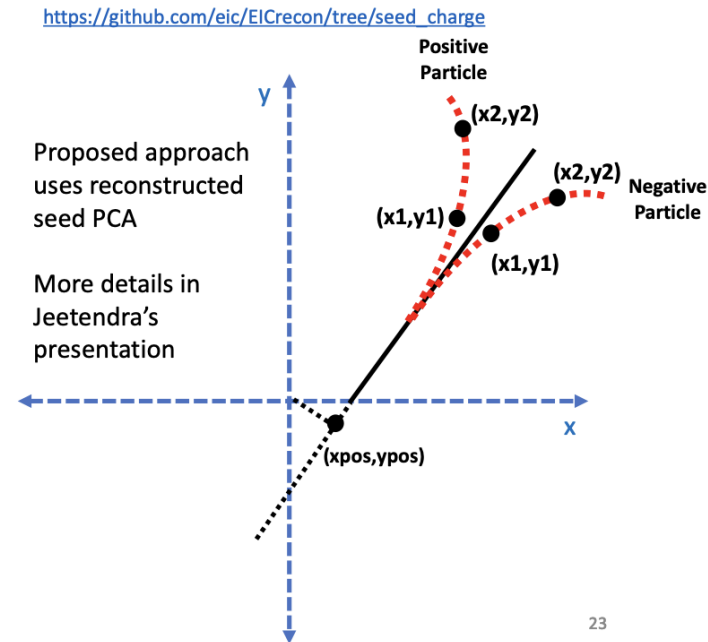
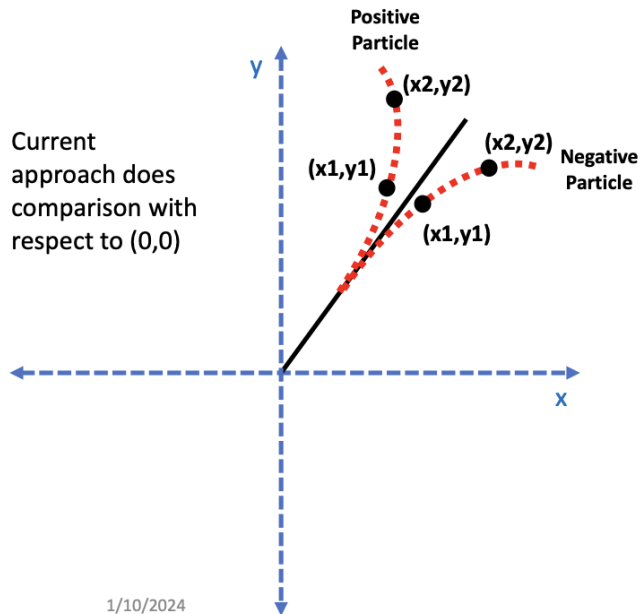
N=10k events, muon with eta -4 to 4, and momentum 0.5 to 20 GeV

Negative muon at (0,0,0)
Total seeds: 25774
Wrong charge seeds (pre-fix): 301 (1.2%)
Wrong charge seeds (post-fix): 224 (0.87%)

Negative muon at (1,0,0) mm
Total seeds: 25521
Wrong charge seeds(pre-fix): 5407 (21.1%)
Wrong charge seeds(post-fix): 230 (0.9%)

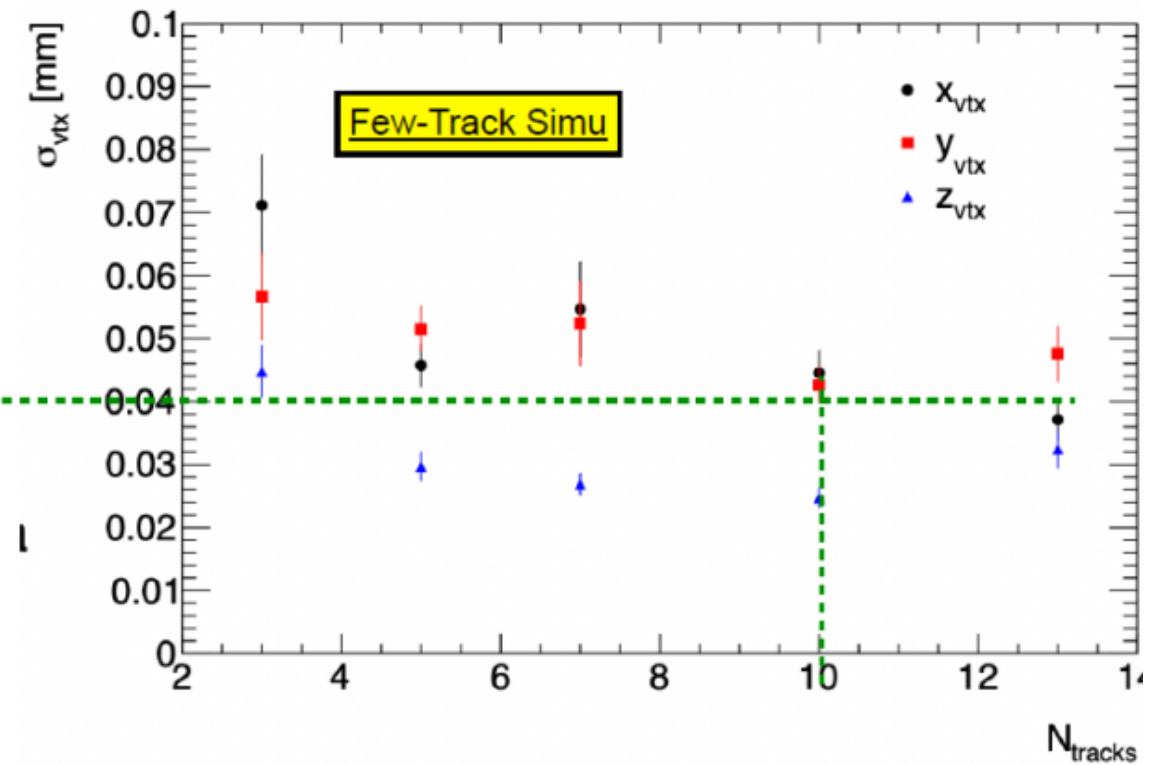
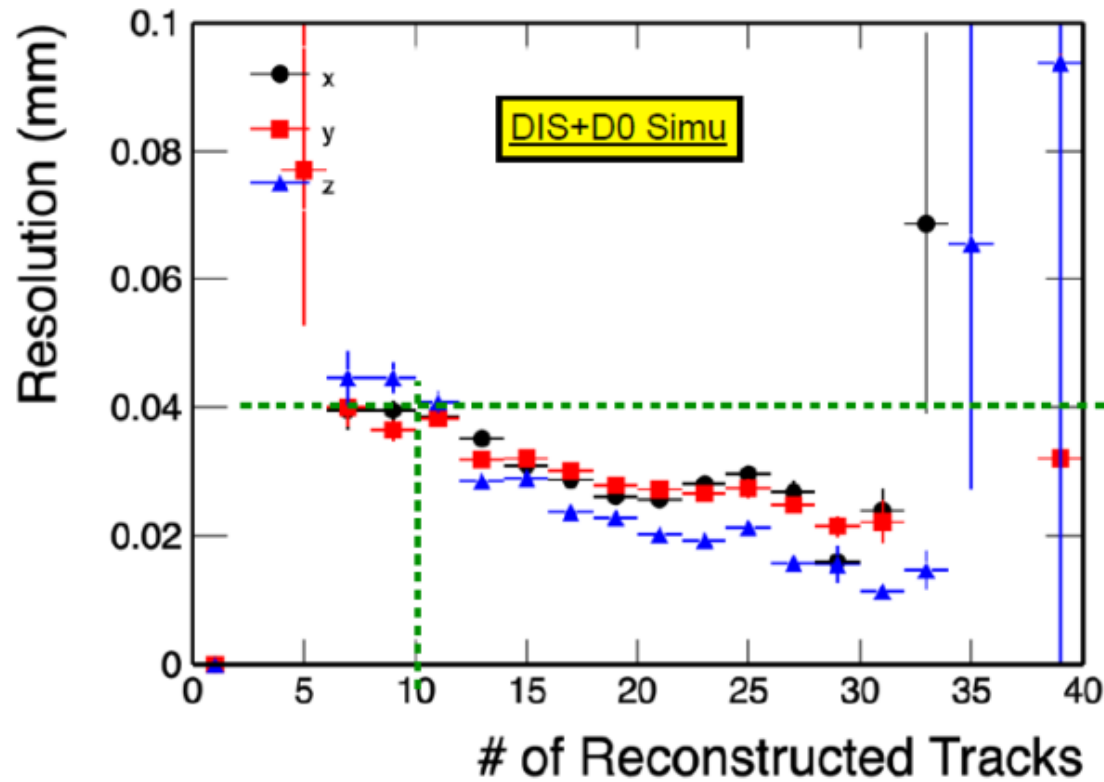
Positive muon at (1,0,0) mm
Total seeds: 27688
Wrong charge seeds(pre-fix): 5376 (19.4%)
Wrong charge seeds(post-fix): 368 (1.3%)

This shows that the results are stable for particle generated at $z=0$.
for particles generated off the beam axis, the results improve significantly for both positive and negative muon.



Tracking / Jet & HF Joint Session Tasks

- Generate unburned DIS sample to look at DCA properties (Xin confirms good vertex resolution when generated vertex sits at 0,0,0)



Tracking / Jet & HF Joint Session Tasks: Particle Flow

- ❑ Particle Flow To-Do:
 - ❑ Visualizer - Virginia
 - ❑ Started work on visualization - **need access to hits which make up cluster, cannot proceed without** (Familiarized herself with analyzing simu output)
 - ❑ Downstream analysis to benchmark
 - ❑ Think of plots for validation (JES/JER, PES/PER, Kinematics, Multiplicity, performance of cluster splitting, performance of track/cluster matching, angular resolution)
 - ❑ Code review - active debugging (In progress, memory issues)

- ❑ Refactor Jet Factories to OminFactory and PODIO (In progress)

- ❑ Start Physics benchmarks
 - ❑ Angularity (track only)
 - ❑ EE-correlators (Renee) (Ran tutorial on analyzing simu output)

Inclusive PWG

- Conveners:
 - Claire Gwenlan (claire.gwenlan@physics.ox.ac.uk)
 - Tyler Kutz (tkutz@mit.edu)

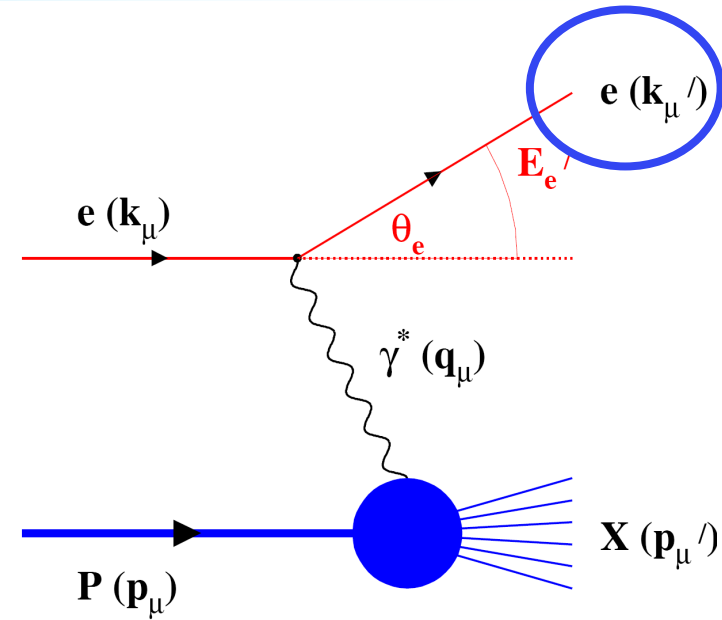
Meeting time: Mondays (biweekly) at 12pm ET

Mailing list: eic-projdet-Inclusive-I@lists.bnl.gov

Indico: <https://indico.bnl.gov/category/417/>

Mattermost:

<https://eic.cloud.mattermost.com/main/channels/inclusive-e-physics>



SIDIS PWG

- Conveners:
 - [Charlotte Van Hulse](mailto:charlotte.barbara.van.hulse@cern.ch) (charlotte.barbara.van.hulse@cern.ch)
 - [Stefan Diehl](mailto:stefan.diehl@uconn.edu) (stefan.diehl@uconn.edu)

Practical information:

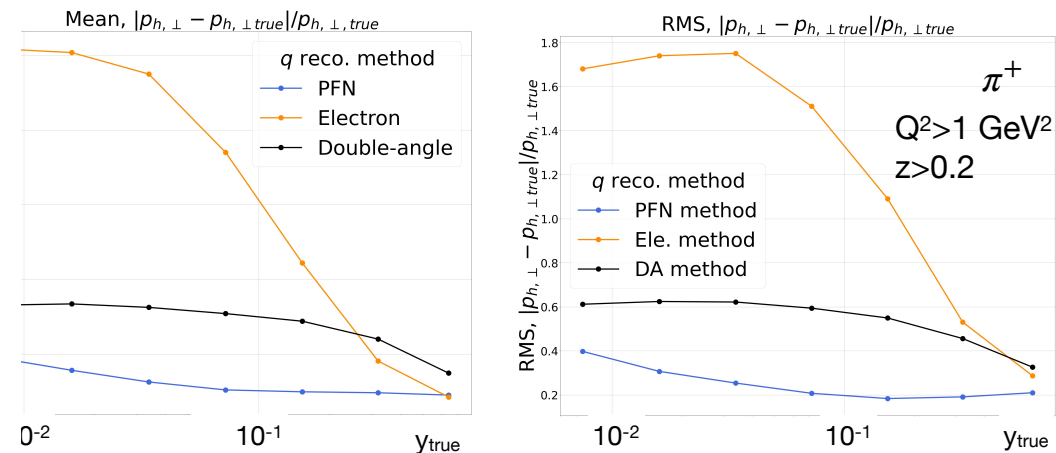
- bi-weekly meetings on Tuesday at 08h30 ET
(<https://indico.bnl.gov/category/418/>)
- mailing list: eic-projdet-semiincl-l@lists.bnl.gov
- mailing list subscription: <https://lists.bnl.gov/mailman/listinfo/eic-projdet-semiincl-l>
- wikipage: <https://wiki.bnl.gov/EPIC/index.php?title=SIDIS>
- mattermost: <https://chat.epic-eic.org/main/channels/semi-inclusive>

SIDIS PWG

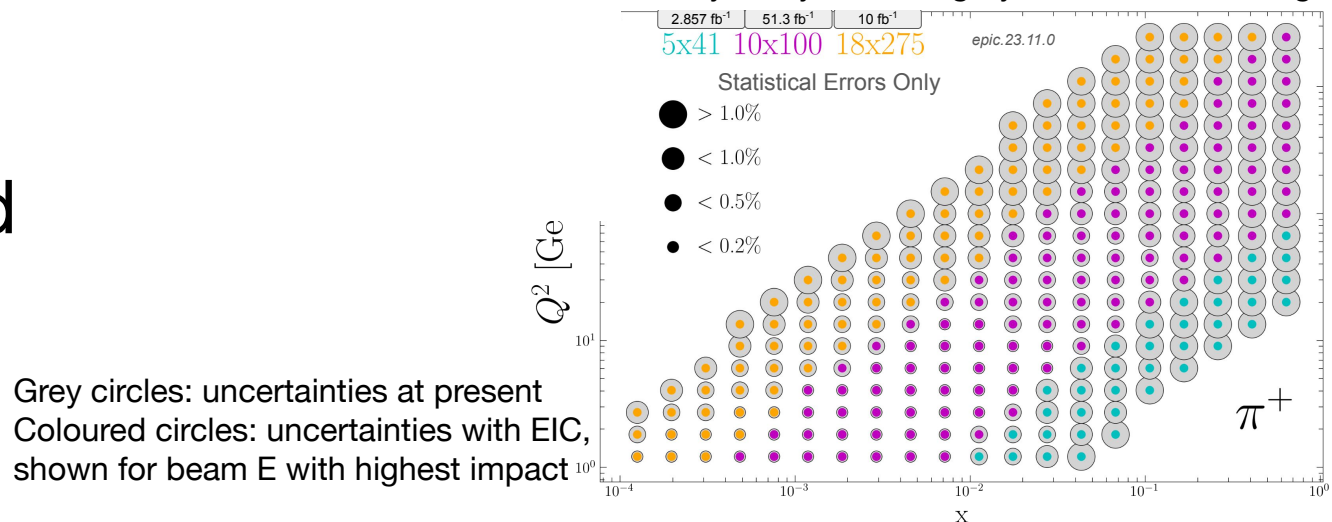
Ongoing studies:

- Reconstruction of SIDIS variables with ML, important at low y
- Reprocessing of unpolarized TMD PDFs
- Reprocessing of ALU asymmetries
- Planned studies:
 - Studies of radiative effects
 - Studies of PID
 - Reprocessing of Collins and Sivers asymmetries
 - Studies of quarkonium to access gluon TMDs

SIDIS reconstruction via ML, Connor Pecar



Imaginary study from Gregory Matousek + Pavia group



Exclusive + Diffraction + Tagging PWG

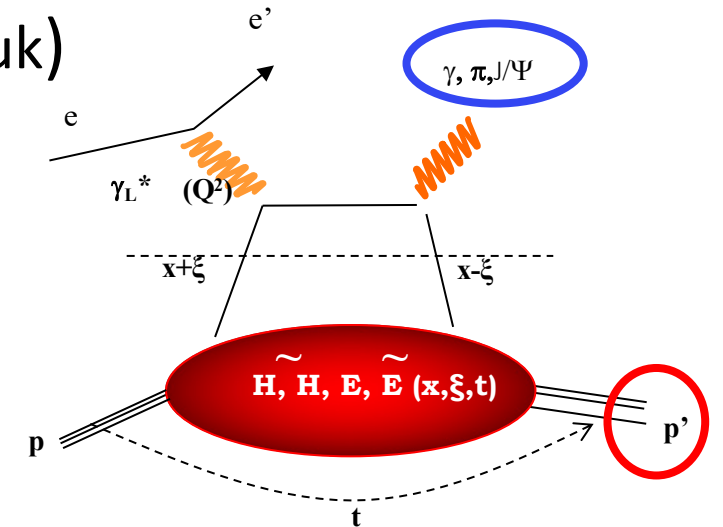
- Conveners:

- Raphael Dupré (raphael.dupre@ijclab.in2p3.fr)
- Rachel Montgomery (Rachel.Montgomery@glasgow.ac.uk)

Meeting time: Mondays (biweekly) at 12pm ET

Mailing list: eic-projdet-excldiff-l@lists.bnl.gov

Mattermost: <https://indico.bnl.gov/category/419/>



Exclusive + Diffraction + Tagging PWG

- We meet on Mondays at noon ET roughly every couple of weeks
 - Feel free to join and contribute to the activities – we have a lot of work to do and more people to help would be very very welcome
 - Mailing list: eic-projdet-excldiff-l@lists.bnl.gov
 - Indico: <https://indico.bnl.gov/category/419/>
 - Contact e-mails:
 - raphael.dupre@ijclab.in2p3.fr
 - Rachel.Montgomery@glasgow.ac.uk
- We cover a very wide array of physics topics and reactions
 - Example topics: Tomographic imaging of quarks/gluon in nucleon/nuclei, partonic spin and orbital angular momentum, diffraction and gluon saturation...
 - Example reactions: DVCS, DVMP, TCS...
 - All detector sub systems are crucial to our physics program and especially FF region!
- **Lots** of exciting physics, we are working on developing analysis for the above topics and more

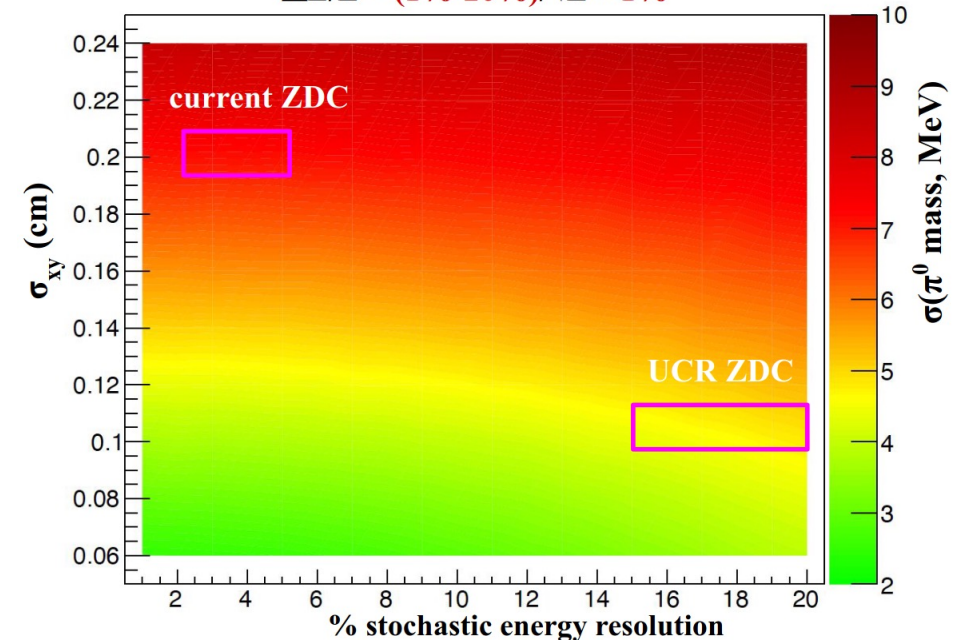
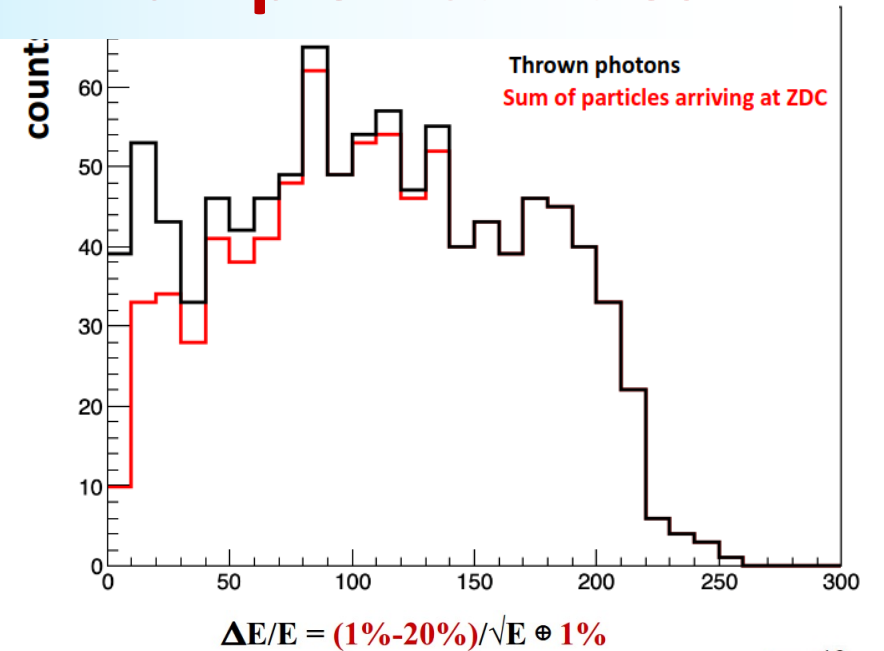
Exclusive + Diffraction + Tagging PWG - Workfest

- Joint workfest with eA study group, far forward and far backward detector groups
- Main focus from our physics perspective was
 - Action plan for plots
 - Hands on time for benchmark/analysis progress
- "TDR plots" and wider write up of Exclusive/Diffractive/Tagging physics summary:
 - Reviewed published plots in past and strategy moving forward
 - Assigned people to topics, although **more people are more than welcome to join and existing or new topic if interested to contribute**
 - Topics so far:
 - **Diffractive PDFs (we added this one after strategy discussion); DVCS and π^0 in ep; DVCS in eHe; vector mesons in eA; vector mesons in ep; Meson form factors and structure functions; Tagged DIS on light nuclei; u-channel DVCS/DVMP; XYZ spectroscopy; elastic ep; vector mesons in light nuclei**
- Benchmark/analysis
 - Kong led a tutorial session on setting up a benchmark analysis
 - **Analysers got to work during the session**
 - **We expect progress on the above topics in coming months**

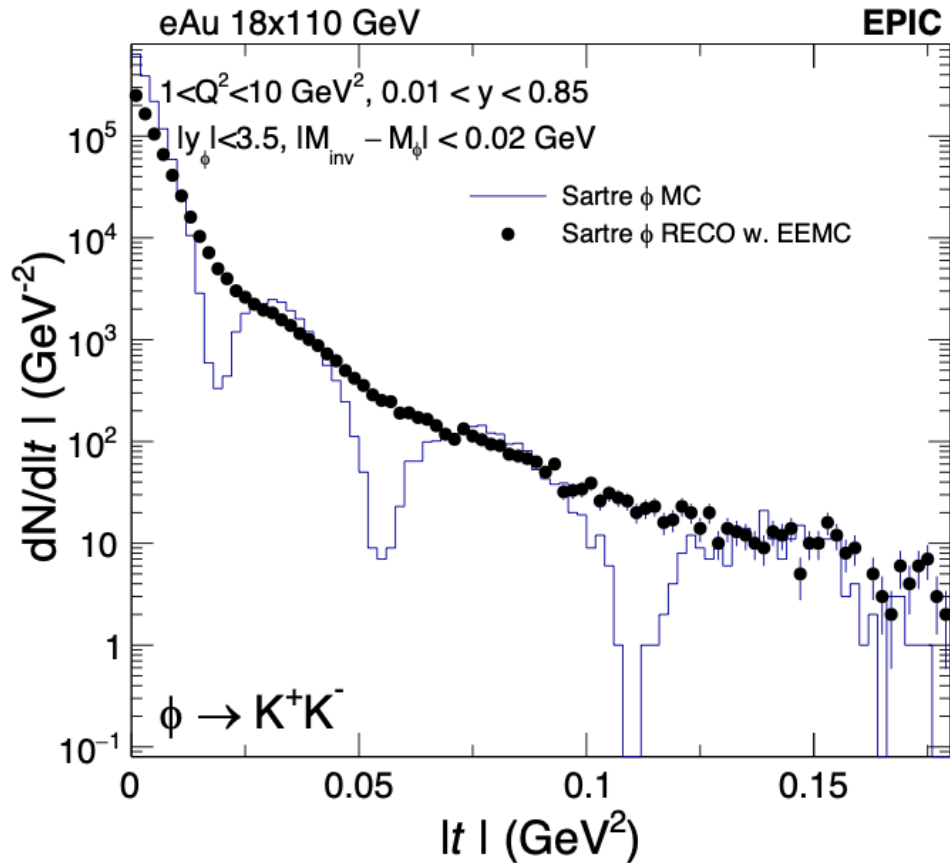
Exclusive + Diffraction + Tagging PWG - Example Activities

Backward meson production

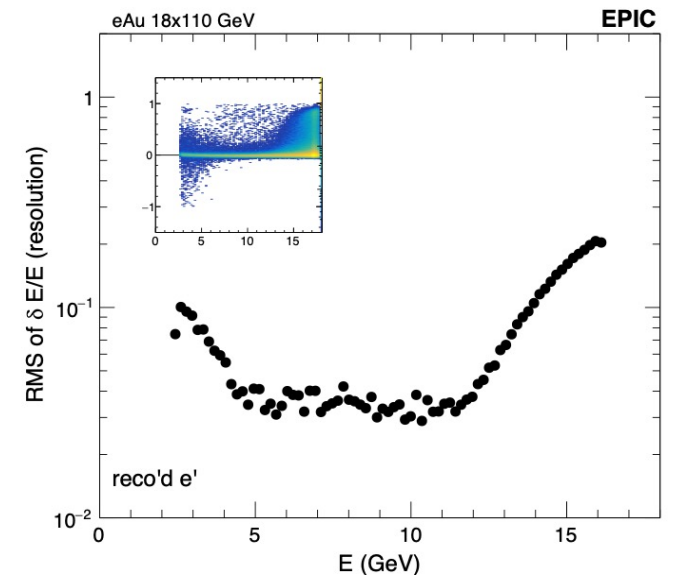
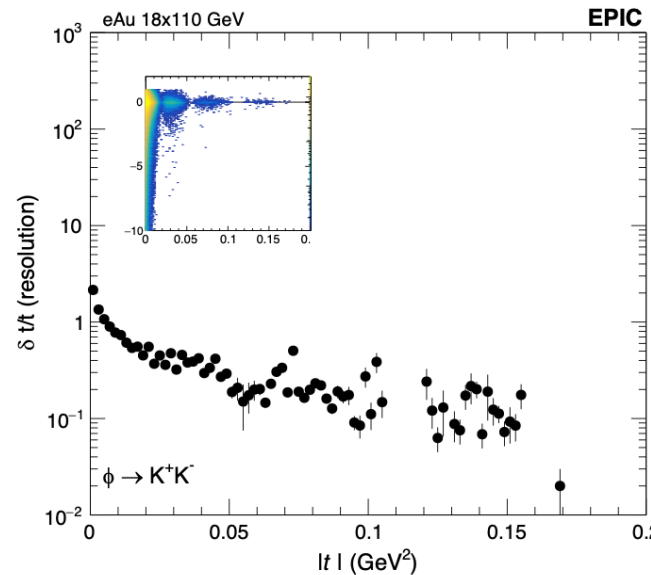
- Previous work on rho now looking at pi0
 - Study performed by Z. Sweger
 - In this kinematic photons are hitting the ZDC
- A specific study was developed to compare different ZDC designs
 - Demonstrated that spatial resolution is the main driver for the reconstruction of high energy pi0
- Author also developing benchmark for backwards physics which will be a useful test for B0 and ZDC



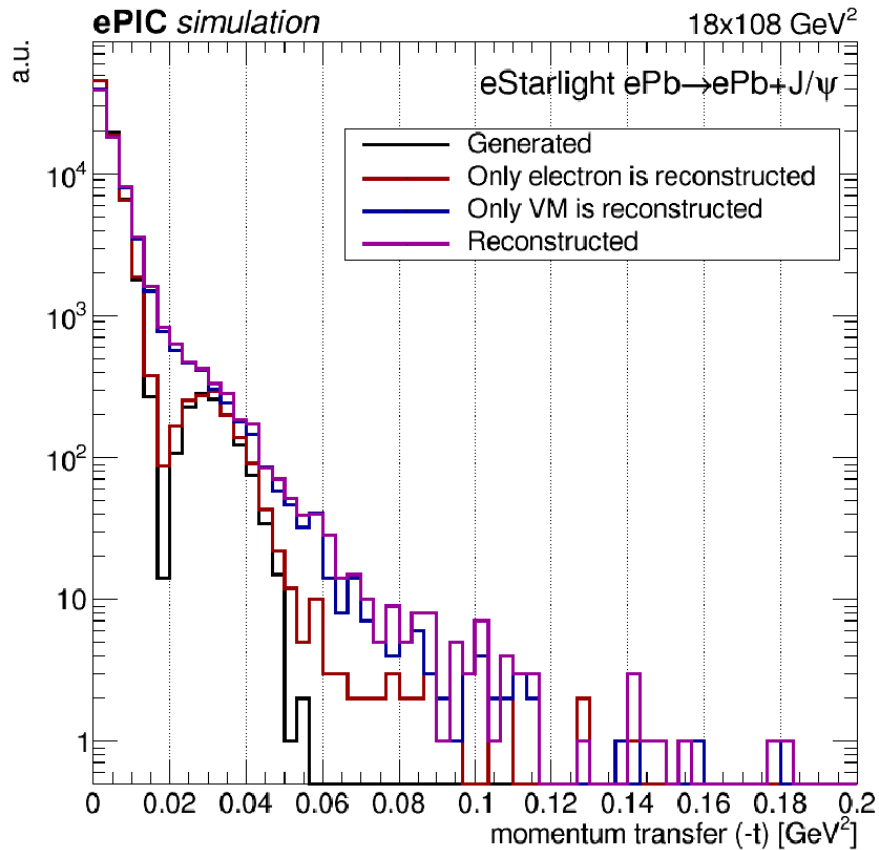
Exclusive + Diffraction + Tagging PWG - Example Activities



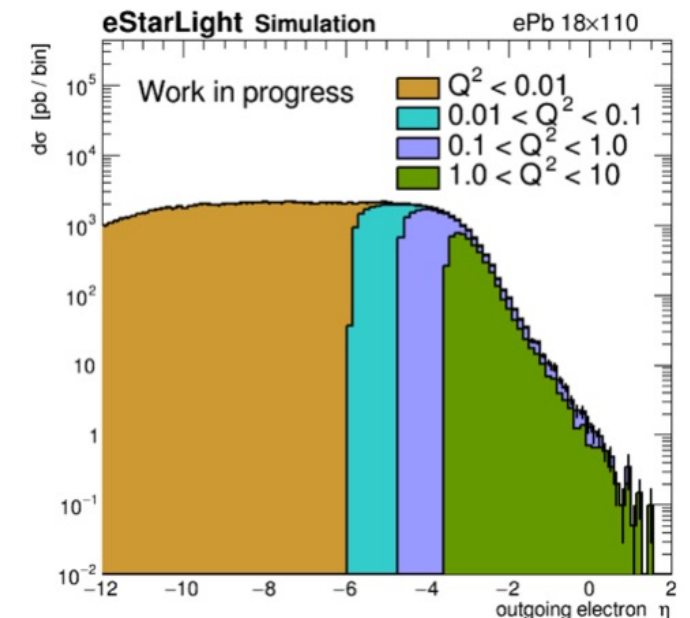
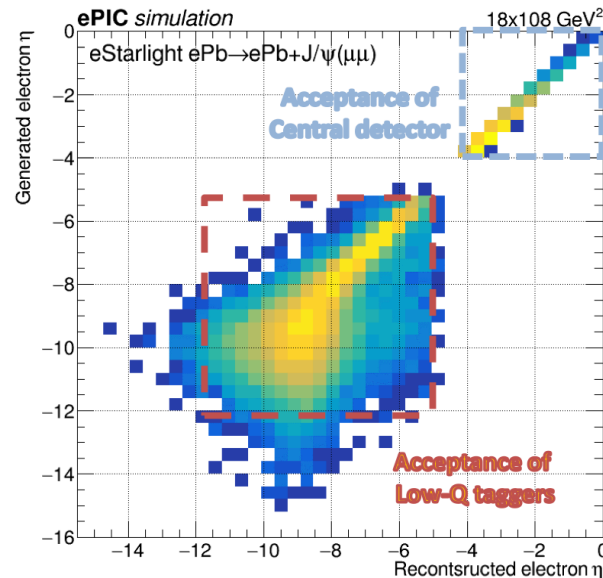
- Diffractive vector meson production
- K. Tu (BNL), diffractive phi in eAu
- **Benchmark in monthly campaigns**
- Example benchmark plots shown



Exclusive + Diffraction + Tagging PWG - Example Activities



- Diffractive vector meson production
- M. Pitt, Z. Citron, E. Mautner (Ben-Gurion University)
- Looking in to low Q^2 to improve t resolution
- Different ranges of Q^2 for VM production correlated to electron rapidity $\eta_{e'}$
- ^{16}O , ^{63}Cu , ^{90}Zr , ^{208}Pb , several energies, and several mesons ρ , ω , Υ , J/ψ , ϕ
- J/ψ ePb shown as example
- Adding low Q^2 tagger increases acceptance by factor 5
- Also working on incoherent background veto studies with heavy nuclei



Exclusive + Diffraction + Tagging PWG - Example Activities

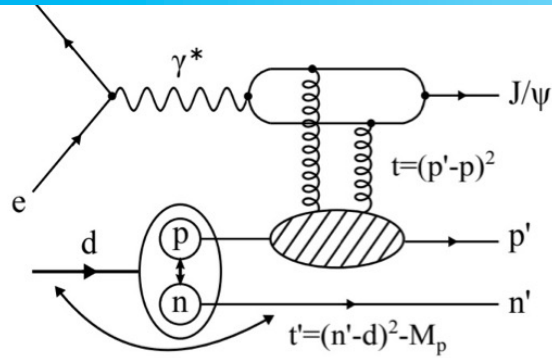
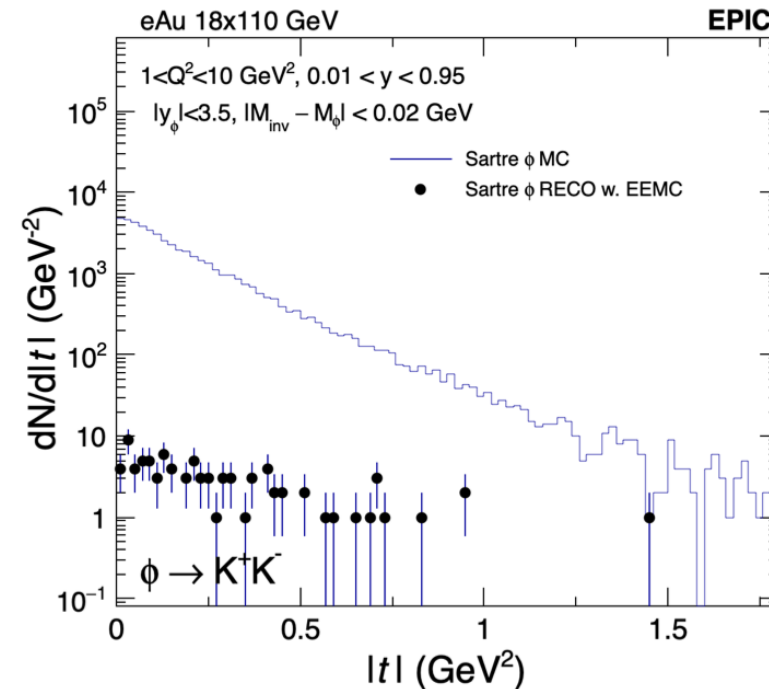
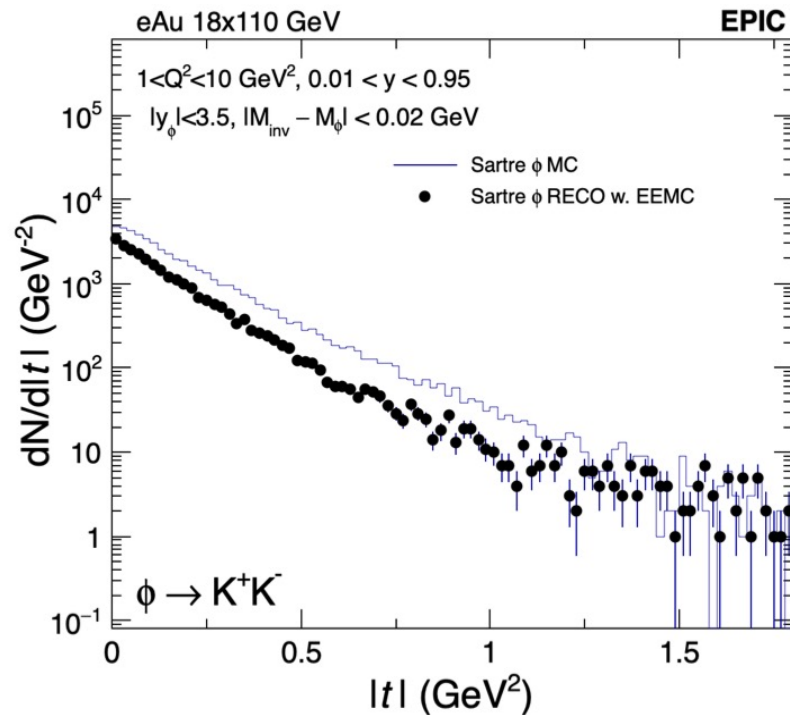


Figure 1: Diagram of incoherent diffractive J/ψ productions in electron-deuteron scattering

- K. Tu, A. Jentsch (BNL) (see Tu et al (2020), Jentsch et al (2021))
- Coherent vector meson electro-production in electron-deuteron collisions
- Study was useful to check several FF region ePIC simulation and bugs
- Detecting coherent light ion is very challenging
- Studying if deuteron breakup veto in FF region can help
- Authors and others looking into FF veto program in general

Before veto

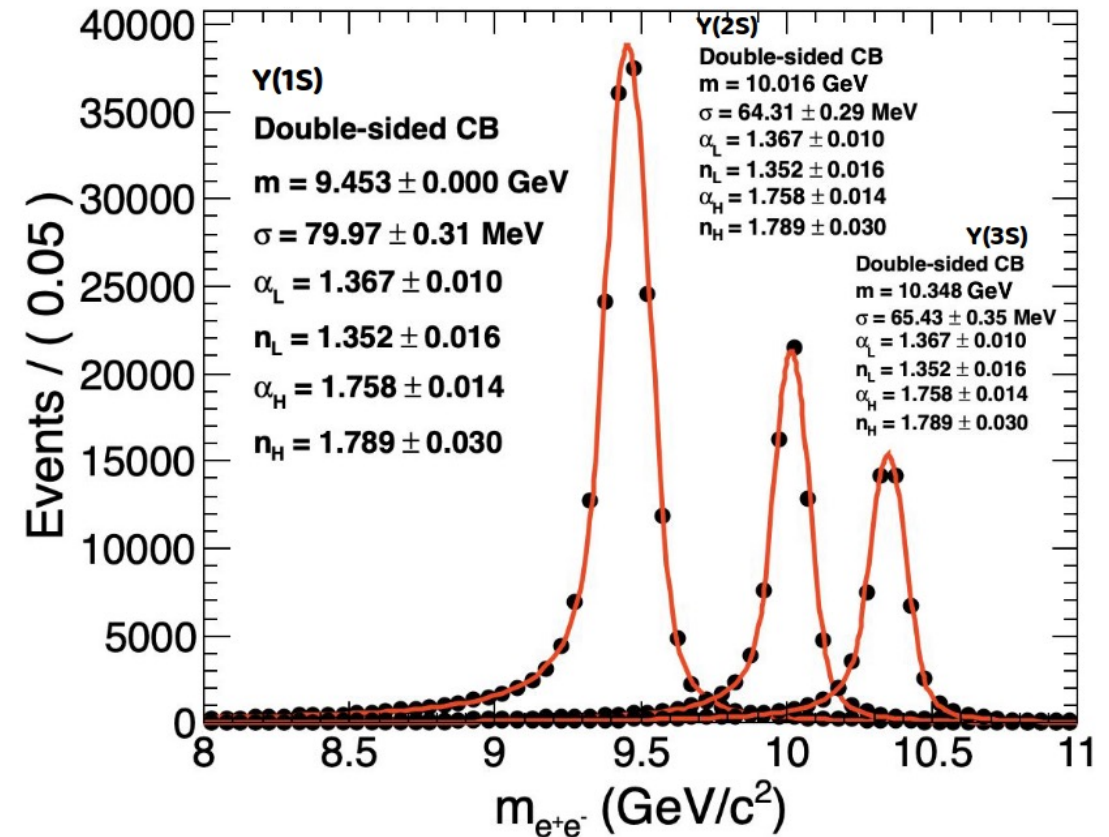


With veto
 (in this
 example 100
 times
 reduction
 power
 starting from
 low to high t)

Exclusive + Diffraction + Tagging PWG - Example Activities

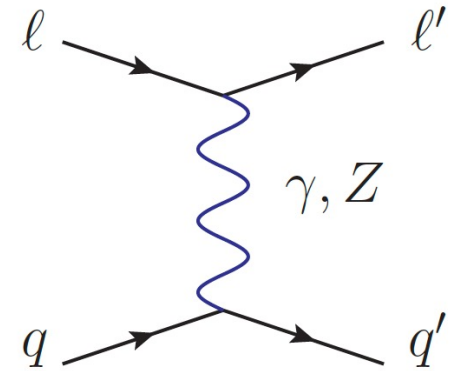
Coherent production of Upsilon

- Looking at the possibility to separate the Upsilon states
 - Study by Saehram Yoo
- Process studied at low Q
 - Using the far backward detectors
- The separation appears reasonable
 - Study to be followed on as tracking and PID get more realistic



Beyond Standard Model + Precision Electro-Weak PWG

- Conveners:
 - Ciprian Gal (ciprian@jlab.org)
 - Michael Nycz (dfe3ks@virginia.edu)



Meeting time: Tuesdays (biweekly) at 8:30am ET

Mailing list: eic-projdet-semiincl-1@lists.bnl.gov

Indico: <https://indico.bnl.gov/category/421/>

Mattermost: <https://eic.cloud.mattermost.com/main/channels/ew-bsm>

Beyond Standard Model + Precision Electro-Weak PWG

Bardh: Djangoh NC simulations

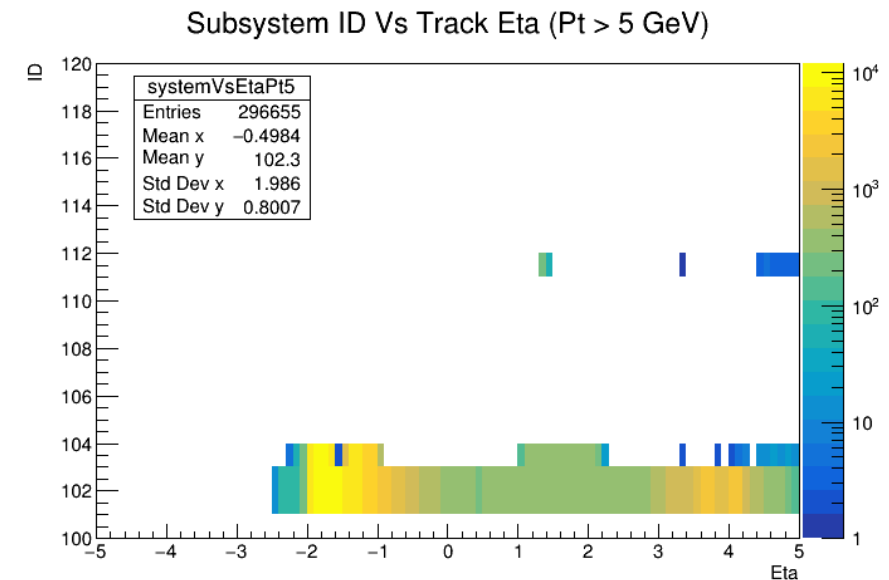
- The generator is now working after many iterations within the collaboration
- Will create some slides with the steps that got it to work and make them available for everyone
- Making comparison plots of Djangoh and PYTHIA NC output to see differences

Andrew: initial study of single muons and pions in the regions of interest for CLFV

- Identifying events where muons don't leave any tracks or energy in the detector
- Set basic cuts that could identify muons and exclude pions
- Run the same algorithm over MinBias events to see how well it does rejecting non-muon backgrounds
- Look at p_T distributions for the MinBias events and single muons to see differences

Electron Finder Update for January

- Some updates were not ready for Dec campaign, but progress:
 - Production team (Sakib) and Wouter helped me get some test productions going with modified code, to identify/fix issues before February campaign
 - Utilize Ohio Super Computer resources for studies (no overlap with existing productions)
- Ready for review / inclusion in February campaign
 - ‘baseline’ electron finder algorithm – based on E-pz cuts
 - Optimized electron identification based on ongoing studies
 - Updates to track projections (see figure)
 - TrackClusterMatch (infrastructure needed by many milestones)
- New groups participating – Thank you!
 - Tristan Protzman (Lehigh)
 - Bernd S. and Babu P. (Temple)



Track projections show ID (detector id) at eta values that should not be possible

Thanks to Tyler K., Brian P. and OSU students for working on this. We will have a dedicated meeting with experts to help resolve this issue – stay tuned

Preliminary TDR readiness discussion

- Physics TDR-readiness open Workshop: **morning (ET) 05 February**
 - An email will be circulated soon – aim for a **bottom-up approach**
- TDR will contain a chapter on physics performance
 - Aim is to show that we can do the core physics we promise
 - ~10 plots, ~50 pages – to be discussed
 - **Tight timescale**: we should have the bulk of the plots by **June**
- Extended physics paper to be published on the **same TDR timeline**
 - This is an ePIC Collaboration deliverable
 - Will contain a more comprehensive physics case and details
- **Discussion item 1**: Plots need to be based on realistic simulation
 - What's realistic to achieve on this challenging timescale?
 - E.g. vertexing, PID, calorimetry ready for doing physics?
- **Discussion item 2**: prioritization of topics for the TDR physics chapter
- **Discussion item 3**: structure of the extended physics paper
 - Tied to NAS physics highlights? vs tied to the YR requests vs tied to PWGs vs ... ?



Suggestions?
salvatore.fazio@unical.it
rosijreed@lehigh.edu

Next ePIC collaboration meeting/EICUG



Stay tuned:

<https://indico.bnl.gov/event/20727/>

July 22 – 28

It is not too early to inform me of required local resources!

