Analysis Coordinator Report

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ePIC General Meeting

February 23, 2024

Next "Regular" Analysis Coordination Meetings

- Meeting time: Friday at 1030 am during usual General Meeting Slot
  - Zoom: https://lehigh.zoom.us/j/94442844026?pwd=WEhNUlgwRi9sU1QvTTUvT05tNXRwdz09
- Next Meetings:
  - Feb 23 - https://indico.bnl.gov/event/21726/ (tomorrow)
  - March 15 - https://indico.bnl.gov/event/21727/
  - March 29 - https://indico.bnl.gov/event/21728/
  - April 12 - https://indico.bnl.gov/event/22485/
- Analysis meetings are open to everyone!
- First Analysis-Asia Meeting this morning (Indico) focused on introductions

Analysis TDR Kick Off Meeting

- In order to focus the efforts of the physics teams we had a TDR kick off meeting Monday Feb 5
  - Indico at: https://indico.bnl.gov/event/21775/
  - Readiness of the Electron Finder
  - Readiness of the Vertexing
  - Status of PID LUTs
  - Physics processes and MC samples being used in simulation campaigns
  - PWG inputs
- Some open questions remain
  - Consolidation of physics generator needs
 - PID LUT performance for physics observables

Electron Finder

- Recent Progress (for more details: Daniel Brandenburg TDR talk)
  - Resolve elusive Track Projection issues
  - Optimization studies on E/p selection
  - Updates to Electron Identification
  - Baseline algorithms for DIS electron finding

- Highest Analysis group priority as realistic DIS lepton finding is crucial for
  - A large fraction of physics observables and benchmarks
  - To inform detector design
  - Current show stopper: Tracks are not being filled

- Look for notification regarding biweekly analysis meetings dedicated to electron finding!
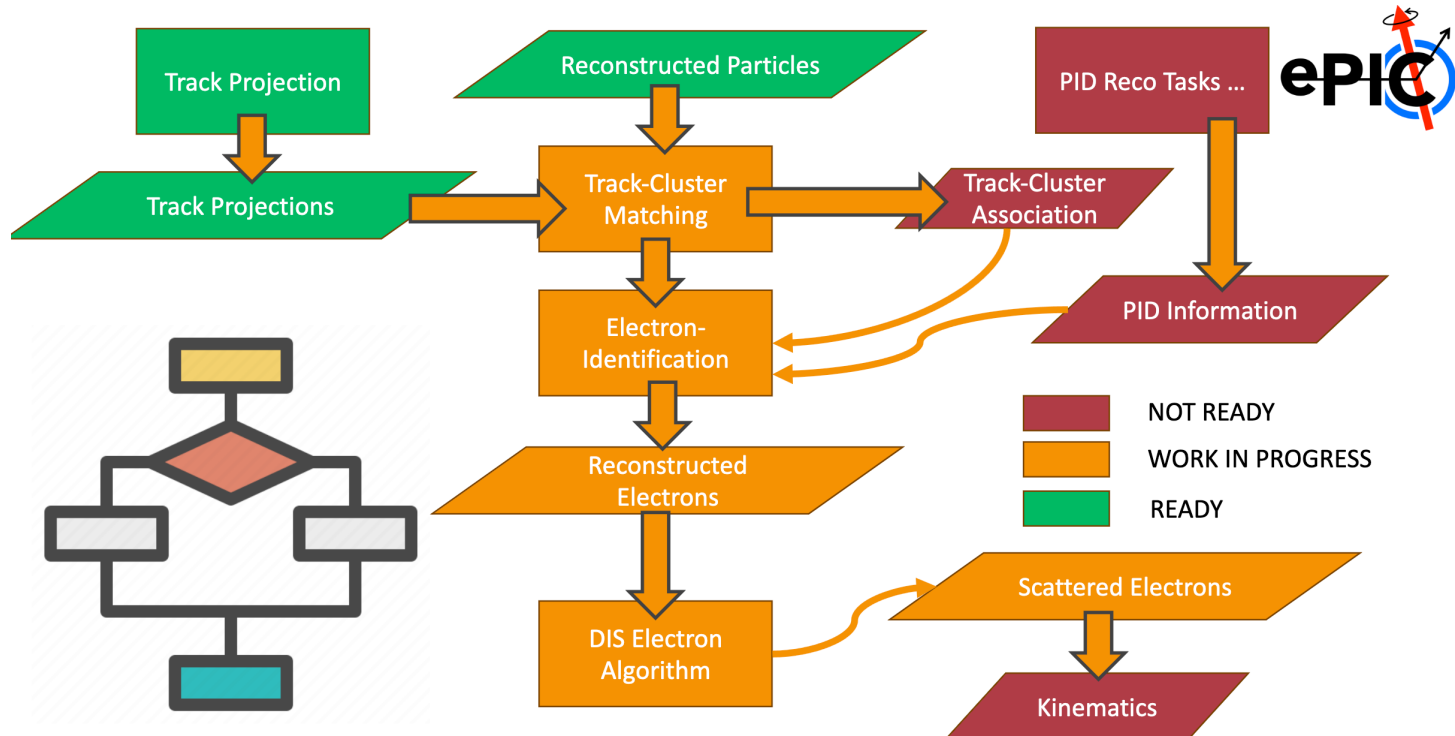
Readiness of Vertexing

- Current Status (for more details [Shujie Li, Xin Dong TDR Talk](#))
  - Most downstream algorithms still use tracking output with truth seeding to avoid:
   - duplicated tracks
    - other potential uncertainties.

- TDR Plans Tracking:
  - Reconstruction algorithm (to make real seed the default)
  - Tracking performance study

- TDR Plans Vertexing:
  - Understand and fix tracking and vertexing performance for off-axis tracks/events
  - Continue evaluation of vertexing performance
  - Refine vertex struct objects and their filling methods
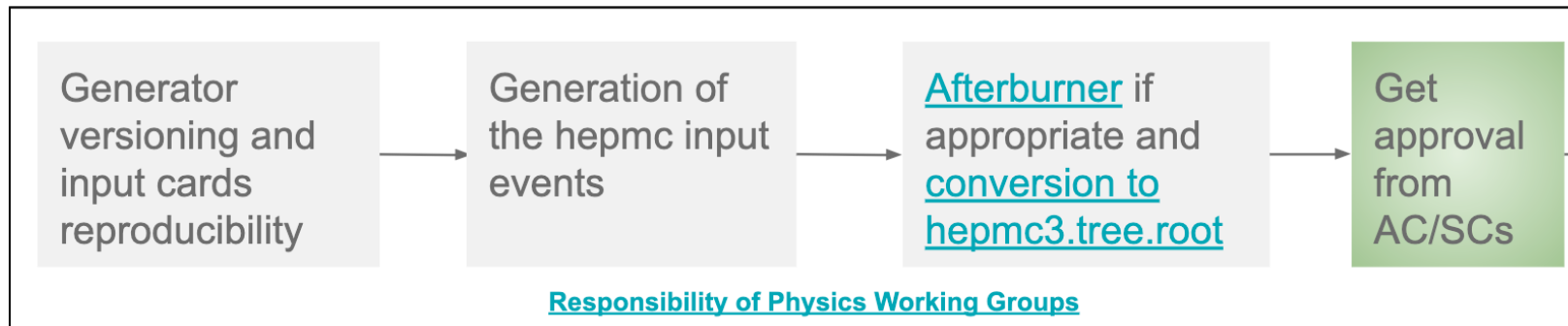
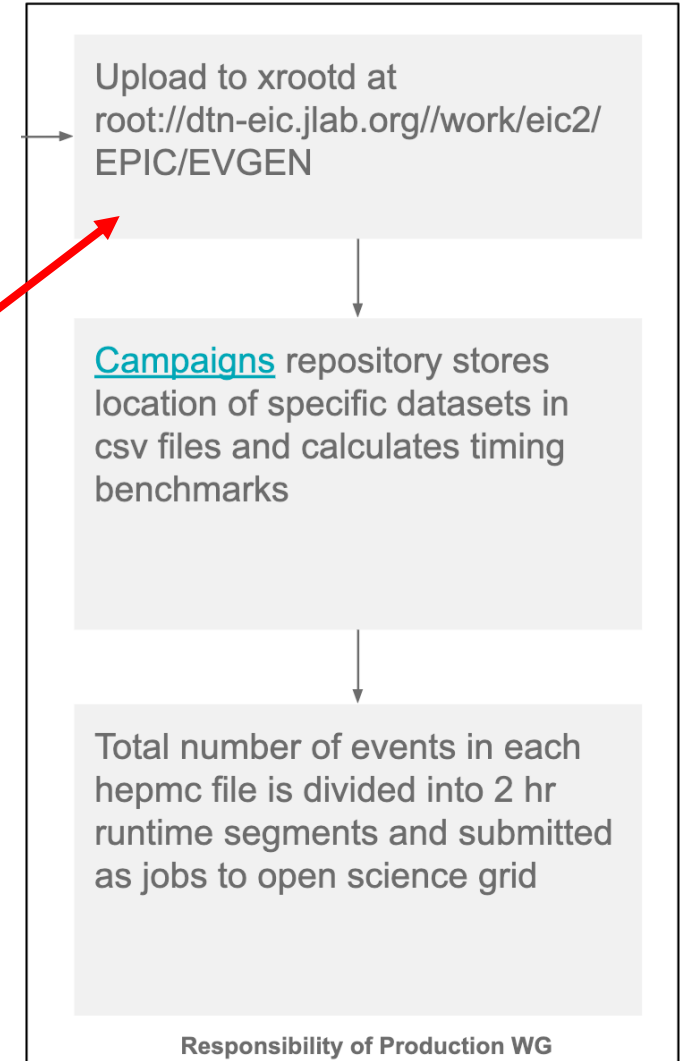**Track Reconstruction Workflow**
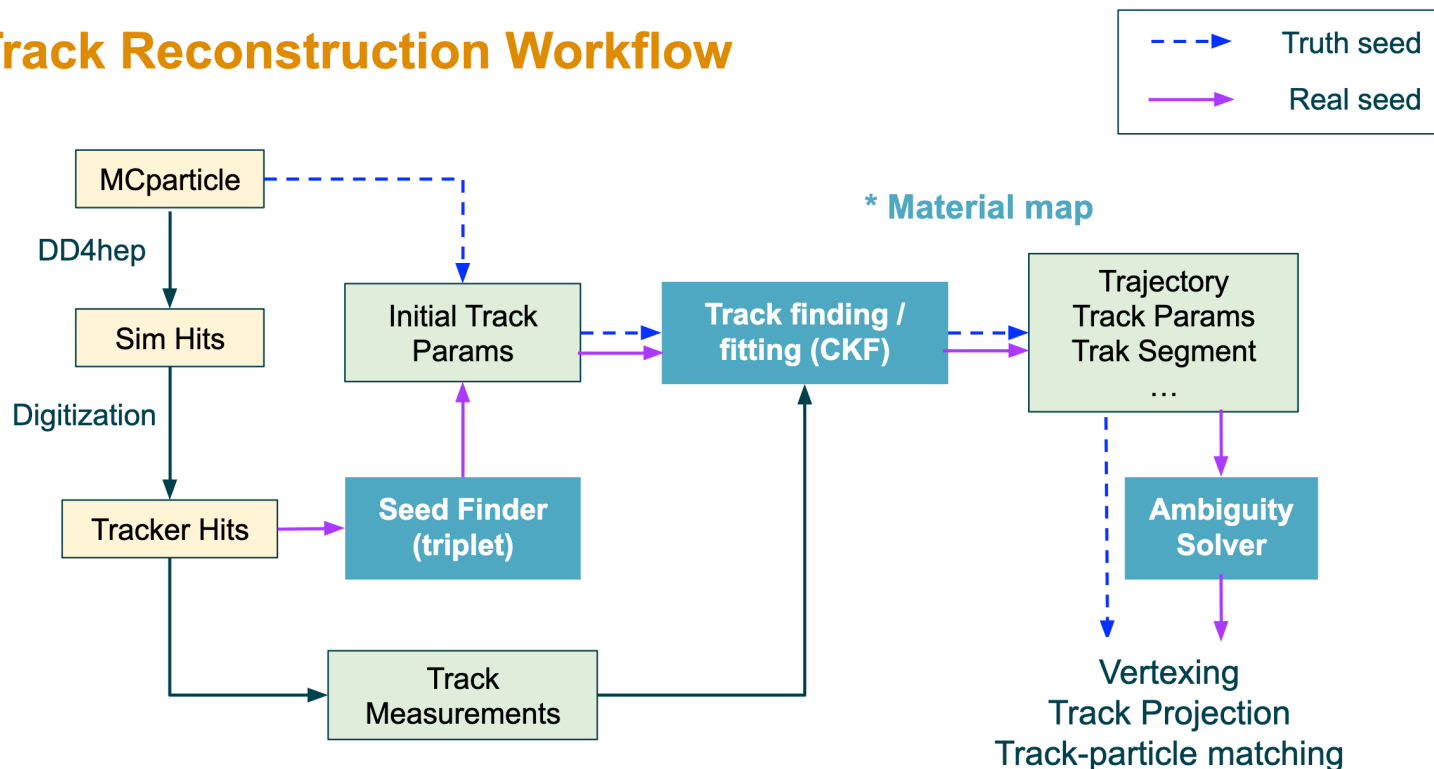
Status of PID LUTs

- Current Status (For more details: [Thomas Ullrich TDR Talk](#))
- PID Detectors: pfRICH, dRICH, hpDIRC, ToF
  - Currently all stand-alone software framework
  - Porting to DD4HEP/EICRecon underway
    - dRICH with IRT already available in EICrecon
- No fully worked out PID information in ePIC reconstruction software
  - Need PID for Physics analyses
- PID groups consensus: validated, debugged, realistic implementation in EICrecon can't happen on TDR time scale

- Solution is PID LUTs
  - Not for leptons
  - Run stand-alone sim to create the LUT
- Goal: LUT available for testing end of the month/early next month

Status of Generators

- Current Status (For more details [Sakib Rahman TDR Talk](#))

- Group of datasets (Physics Processes and Backgrounds) run every campaign

Generator versioning and input cards reproducibility	Generation of the hepmc input events	Afterburner if appropriate and conversion to hepmc3.tree.root	Get approval from AC/SCs

Responsibility of Physics Working Groups

- Event generators must meet the eligibility criteria for inclusion in production:
  - Output format (hepmc3.tree.root)
  - Version tracking
  - Effort consolidation.

Upload to xrootd at root://dtn-eic.jlab.org//work/eic2/EPIC/EVGEN

Campaigns repository stores location of specific datasets in csv files and calculates timing benchmarks

Total number of events in each hepmc file is divided into 2 hr runtime segments and submitted as jobs to open science grid

Responsibility of Production WG

Joint S&C and Physics Meeting

- Joint S&C and Physics Meetings → coordination is key!
- February 14 ❤️: https://indico.bnl.gov/event/21772/
  - Focus on progress on physics processes and MC samples being used in simulation campaigns and consolidation of needs
  - Input from Physics WGs
    - Strawman proposals discussed – Report in next Analysis Meeting (tomorrow!)
  - Reconstruction News (Meeting Notes from PID WG)
    - PID info is to be created as a function of: p (GeV), η, φ (rad), q(+1/-1) defined at the vertex
    - At vertex is easier to implement than at the entry point to the PID system
    - Quality factor? Difficult in practice, perhaps later
    - The DSCs to provide weights/probabilities of the form: P_i^j(p, η, φ, q) where i is the generated particle type and j is the hypothesis

- Next meeting tentatively planned for 11 am ET Wed. March 13th
 - PWGs will report on analysis performance

PWG Reports at Analysis TDR Kickoff Meeting

SIDIS PWG

- Details at: [Stefan Diehl/Charlotte Van Hulse Report](#)

- Plots for TDR

  - Reconstruction of SIDIS variables - Artur Hoghmrtsyan, Connor Pecar
  - Unpolarised TMD PDFs - Gregory Matousek/Ralf Seidl; theory: Pavia group/Alexey Vladimirov
  - Collins and Sivers asymmetry - Ralf Seidl; theory Alexey Vladimirov, Daniel Pitonyak, Alexei Prokudin
  - A_{LL} asymmetry - Charlotte Van Hulse; theory Ignacio Borsa

NIMA 1056 (2023) 168563

R. Seidl, A. Vladimirov et al., NIMA **1049** (2023) 168017
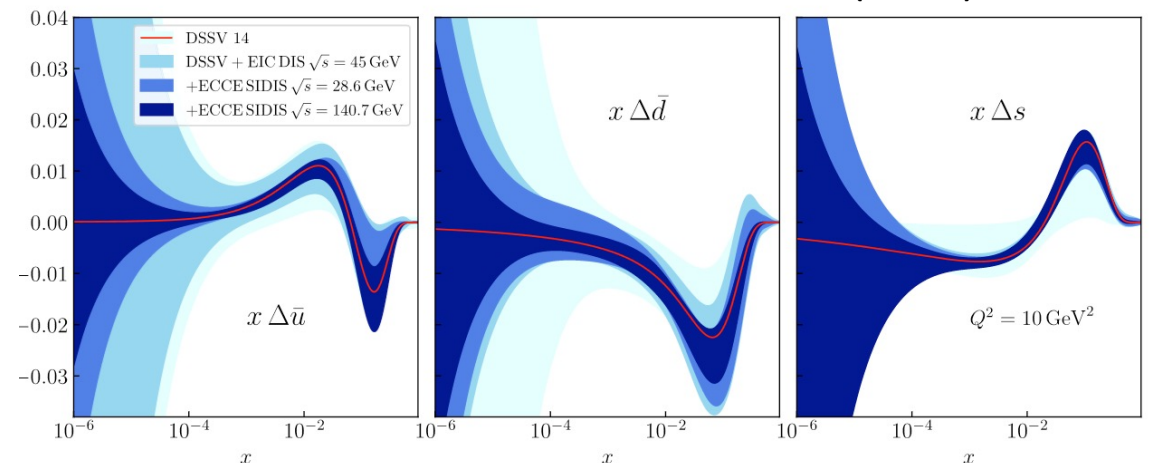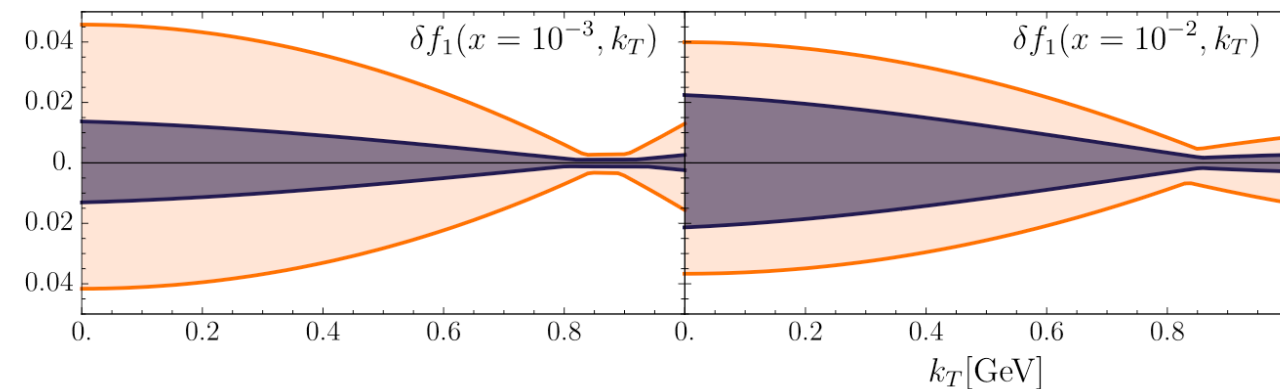
Exclusive+diff+tagging PWG

- Details at: [Raphael Dupre/Rachel Montgomery Report](#)

- Contributes to all 3 NAS questions
  - How does the mass of the nucleon arise? How does the spin of the nucleon arise? What are the emergent properties of dense systems of gluons?

- Several analyses are active and reporting progress:
  - DVCS ep; DVCS eHe; u-channel meson production; coherent and incoherent VMP on eA; meson form factors

- Several other analyses have started recently/starting soon
  - DVMP π^0 (ep); DVMP J/Ψ (ep); Meson SF; TCS; XYZ spectroscopy

- Answering the NAS questions
  - Υ channels, J/Ψ near threshold and meson SF $\rightarrow$ mass of the nucleon
  - DVCS measurements to access the spin of the nucleon
  - Diffractive process to probe the dense system of gluons

Inclusive PWG

- Details at: [Tyler Kutz/Claire Gwenlan Report](#)

- TDR Goals

  - Electron ID

  - Resolutions (electron energy, kinematic variables)

  - Corrections, stability/purity

  - Physics studies

    - Neutral-current reduced cross sections,

    - Double-spin asymmetries: A^p_1, A^{3He}_1, A^n_1

    - Systematics…

- Multiple physics analyses may need same studies, corrections

 - Do not have stringent generator requirements…coordinate w/other PWGs (such as EW/BSM)

Jets+HF PWG

- Details at: [Brian Page/Olga Evdokimov Report](#)

- TDR Goals
  - Jet reconstruction performance – Brian eta ~Feb
  - Vertex reconstruction/dca resolution – Xin, UIC students
  - Sivers asymmetry – Brian eta ~Feb
  - Colins asymmetry – Kevin eta ~Feb
  - Other possible/additional options: angularity, jet charge
  - Physics benchmarks with HF, most problematic: can't do in full sim yet (tracking/secondary vertices)

- Collaboration Meeting
  - 2 very productive workfests!
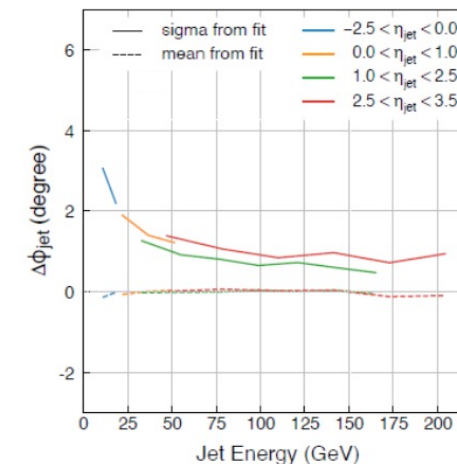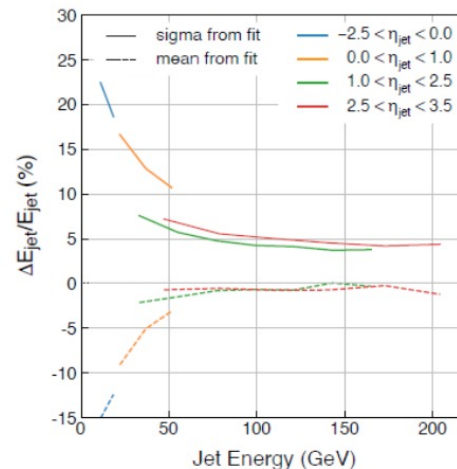
BSM + Precision EW PWG

- Details at: [Ciprian Gal/Michael Nycz Report](#)

- Planned Input (plots) to TDR
  - Muon Identification - Andrew Hurley (UMass Amherst)
  - Weak mixing angle: $\sin^2\theta_W(Q^2)$ projection - Michael Nycz (U of Virginia)

- Coordinate w/Inclusive group for generators/efficiently use person-power

- Recent (in-person) workshop at the Institute for Nuclear Theory!
  - [Workshop](#)
  - Engagement with the community
  - Support for ongoing efforts

[Neutral-current electroweak physics and SMEFT studies at the EIC](#)
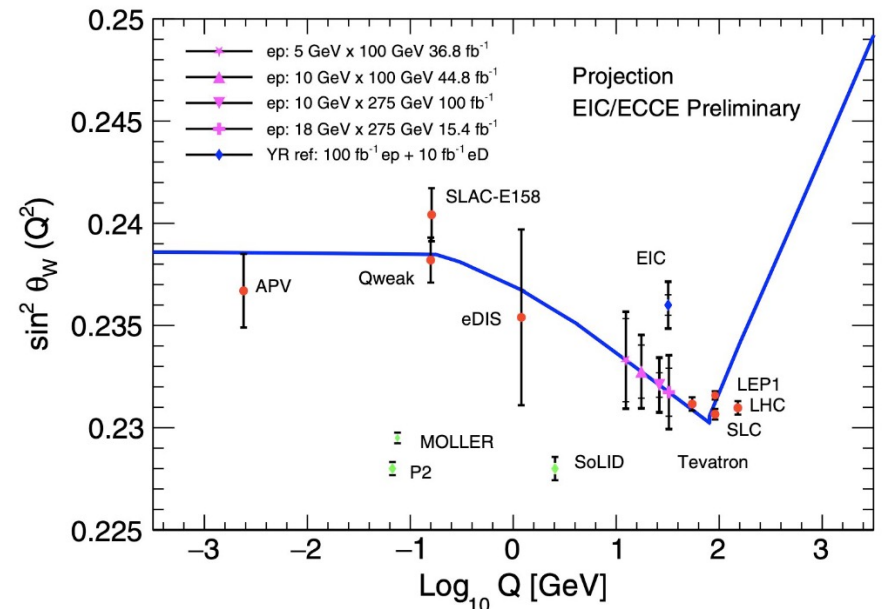
Summary/Next Steps

- Next Analysis Meeting – TDR updates, PWG reports
  - [Zoom Link](#)
  - Feb 23 10:30 am - https://indico.bnl.gov/event/21726/ (tomorrow)
- Analysis TDR Kick-off
  - Status of tools, PWG inputs
- Joint S&C Analysis Meeting to follow up → Roughly ~1x per month
  - Depending on reviews, holidays, conferences, etc
- Many specialized "cross-cutting" meetings since the collaboration meeting → Progress on TDR readiness
- Many tasks require person-power! Contact us if you/student wants to join! Or come to our analysis meetings!
- Stay tuned for dedicated electron-finder analysis meeting

PWG Contact Information

Inclusive PWG

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

Focus: on measurements that involve detecting, identifying, and measuring the kinematics of the scattered electron

Meeting time: Mondays (biweekly) at 12pm ET
Mailing list: eic-projdet-Inclusive-l@lists.bnl.gov
Indico: https://indico.bnl.gov/category/417/
Mattermost: https://chat.epic-eic.org/main/channels/inclusive-physics
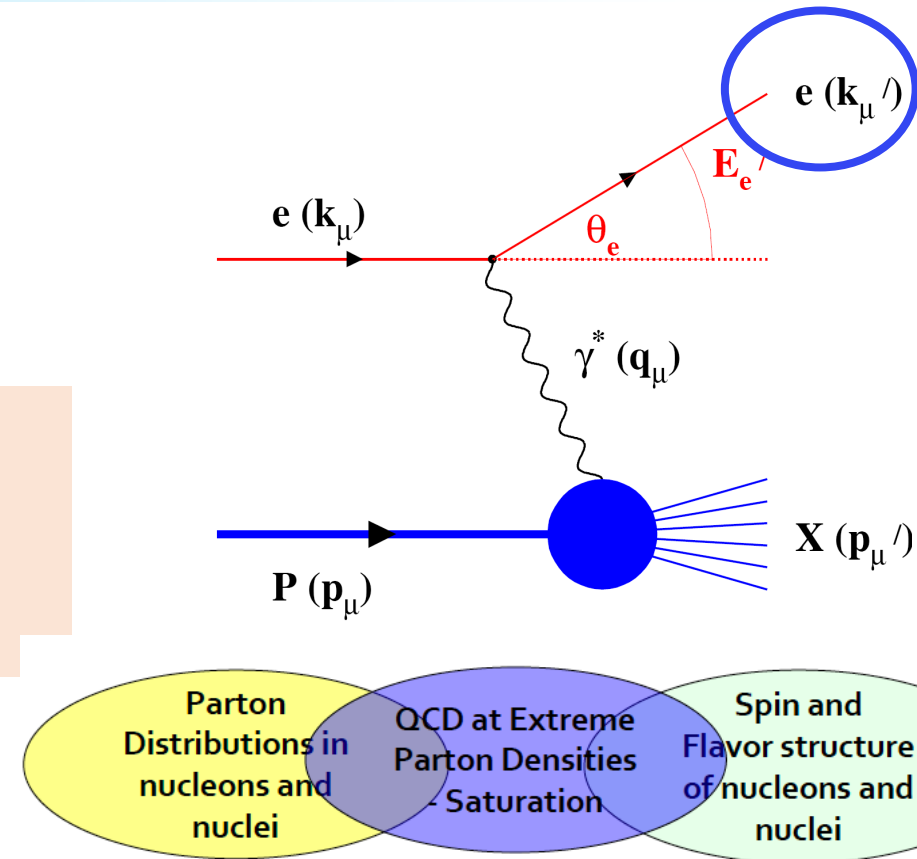
SiDIS PWG

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

Focus: on measurements that require detecting, identifying and measuring a final state hadron or hadrons in addition to the scattered electron

Meeting time: Tuesdays (biweekly) at 8:30am ET
Mailing list: eic-projdet-semiincl-l@lists.bnl.gov
Indico: https://indico.bnl.gov/category/418/
Mattermost: https://chat.epic-eic.org/main/channels/semi-inclusive
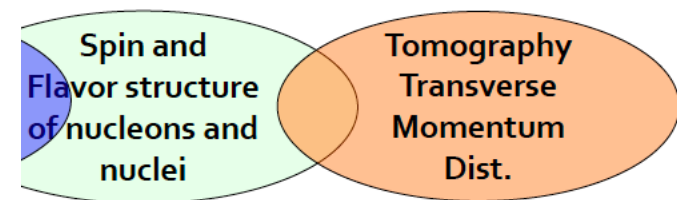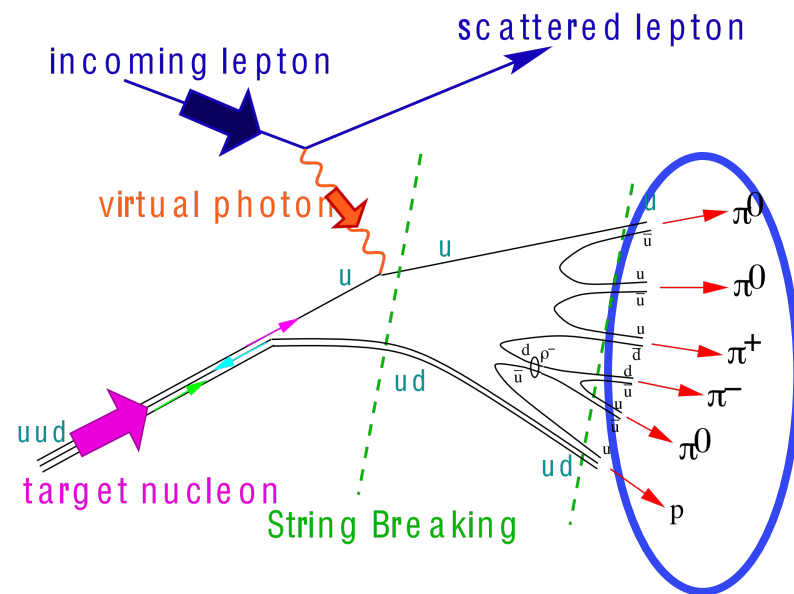
Exclusive + Diffraction + Tagging PWG

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

Focus: on measurement that require detecting the scattered proton/ion, whether it remains intact or not, together with all the final state produced particles, in addition to the scattered electron

Meeting time: Mondays (biweekly) at 12pm ET
Mailing list: eic-projdet-excldiff-l@lists.bnl.gov
Indico: https://indico.bnl.gov/category/419/
Mattermost: https://chat.epic-eic.org/main/channels/phys-exclusive-diffractive
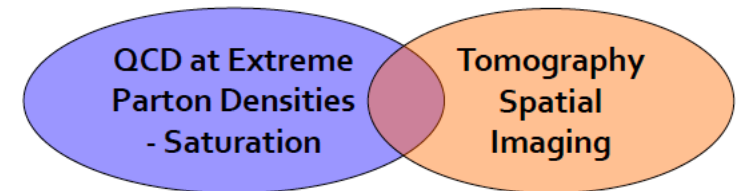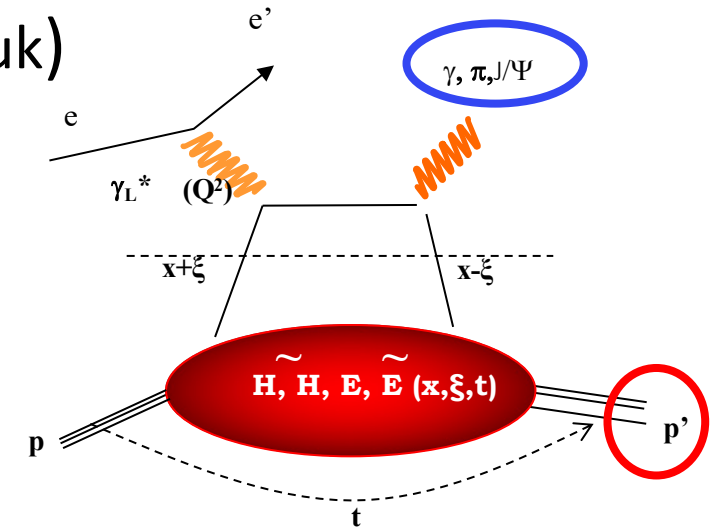
JETS + Heavy Flavor

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

Focus: on measurements that involve high momentum exchanged processes, which could produce a spray of final state particles or hadrons that have one or more heavy quark constituents
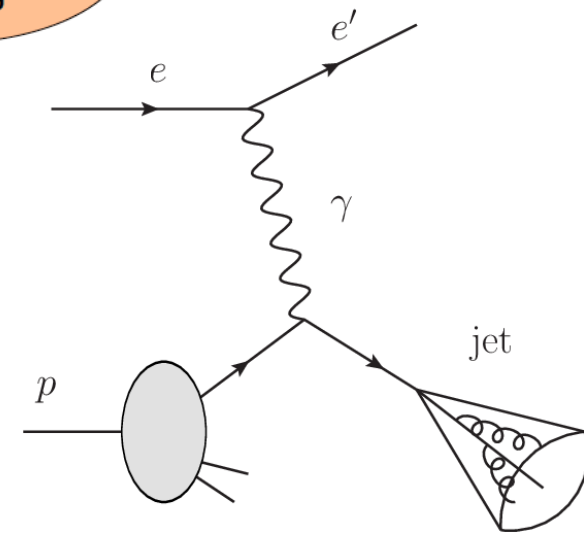
Meeting time: Wednesdays (biweekly) at 12:00pm ET
Mailing list: eic-projdet-jethf-l@lists.bnl.gov
Indico: https://indico.bnl.gov/category/420/
Mattermost: https://chat.epic-eic.org/main/channels/phys-jets-hf
Wiki page: https://wiki.bnl.gov/eic-project-detector/index.php/JetsHF

Beyond Standard Model + Precision Electro-Weak PWG

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

Focus: on measurements of the cross-sections, helicities of electroweak gauge bosons that can lead to a better understanding of quark-level electroweak couplings and the potential for measurements beyond the standard model

Beyond
EIC «core science»
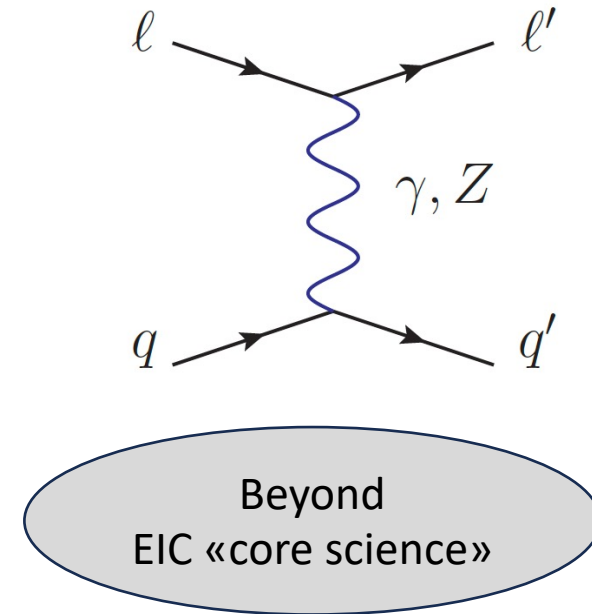
Meeting time: Mondays (biweekly) at 12pm ET (together with the Inclusive PWG)
Mailing list: eic-projdet-bsmew-l@lists.bnl.gov
Indico: https://indico.bnl.gov/category/421/
Mattermost: https://chat.epic-eic.org/main/channels/ew-bsm