

ECCE Physics Benchmarks Team Bi-weekly Meeting Report

August 2nd, 2021

Carlos Muñoz, Rosi Reed

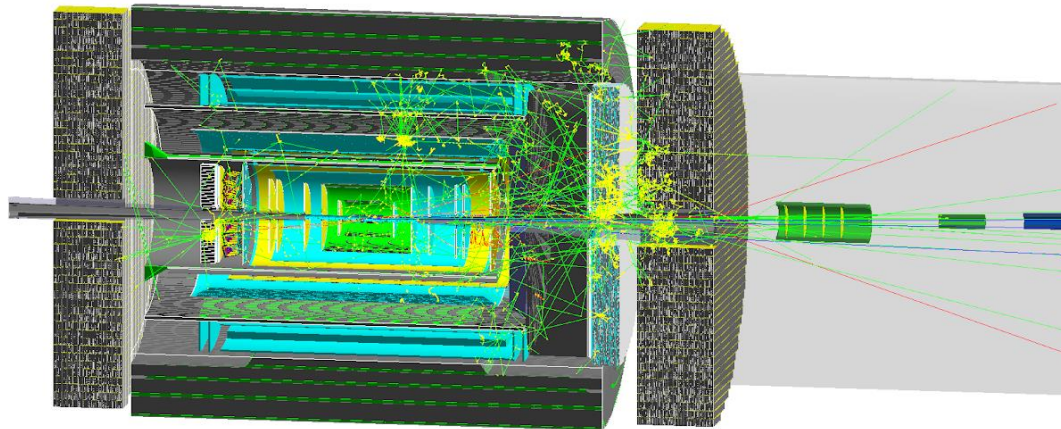


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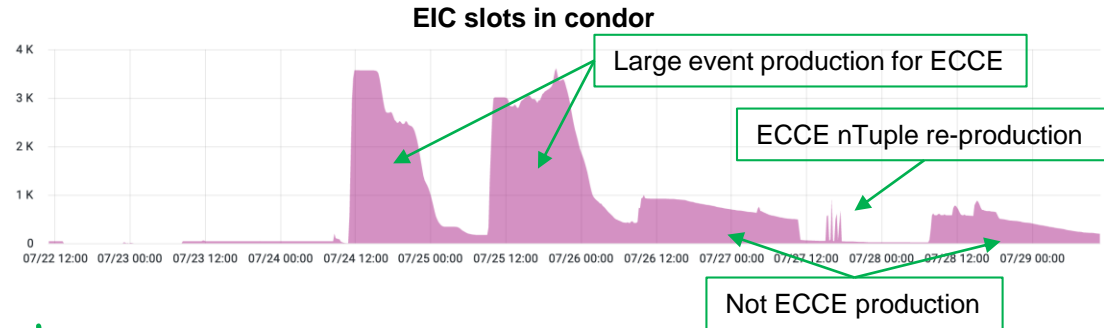
Simulation working group: 1st campaign

Data Produced:

- BNL, JLab and Bates are all producing data
 - Software stack tag = **prop.2**
- From production requests, campaign 1 is about 160M events
- Completed:
 - 5M single pion events (on S3)
 - 5M single electron events (on S3)
 - 2x5M Pythia8 events at ep of 5x41 and 10x100 GeV (all on S3)
 - 5.6M DJANGO events
 - 4x20M Pythia6 events (20M on S3, other 58M pending transfer, 2M just finishing)
 - 2M LQGENEP (Leptoquark) events (EW&BSM WG)
- Diff & Tag and Exclusive are also running/setting up local productions through our framework
- In total, > 100M events have been produced out of 160M
- Files stored on S3 under: eicS3/eictest/ECCE/MC/prop.2



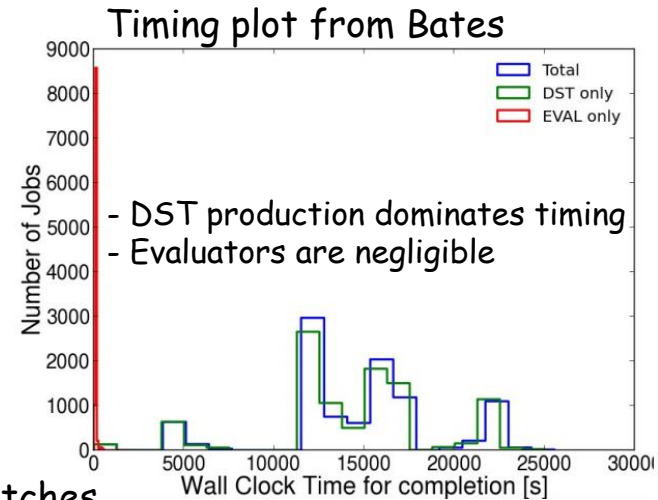
Simulation working group



Production notes:

Job efficiency is high:

- Single particle production was 99.94% successful
- JLab saw 89% of jobs succeed
- OSG saw 98.8% of jobs succeed (need to investigate difference)
- Crashes observed from the event evaluator & jet evaluator
- Current solution: Event and Jet evaluators are disabled in production
 - A second pass on the DSTs will be performed with the required patches (done for EventEvaluator on SIDIS sample: ~80M events)



Simulation working group: 2nd campaign

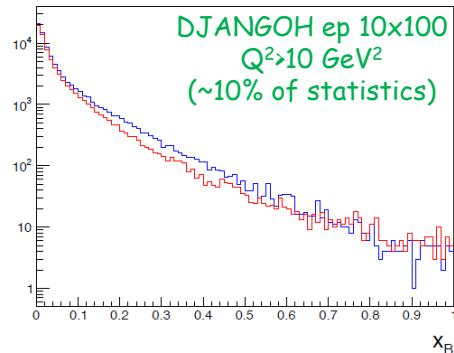
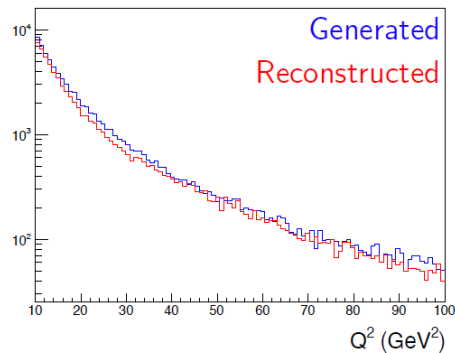
Item	Task	Required by	Assignee	Status	Goal
1	Discuss implementation/placement of ECCE	21/7/21	All	Complete	A meeting to discuss status of sub-detectors
2	Discuss latest ECCE detector status	28/7/21	All	Not started	A meeting to finalise final placement of sub-detectors
3	Complete detector subsystem simulation setup	30/07/2021	Detector WG	In progress	Each subsystem for ECCE has either a macro or a class we can import
3.1	tracking	30/07/2021	Xuan and Nilanga	In progress	
3.2	PID	30/07/2021	Greg and Xiaochun	In progress	
3.3	Calorimeter	30/07/2021	Friederike and Yongsu	In progress	
3.4	Far forward	30/07/2021	Michael, Igor and Yuji	In progress	
4	Relay changed production requirements for Campaign 2	2/8/21	Physics WG	Not started	Each PWG knows what generator they are using, they have files with generated events and they know how many events they want
5	Update top-level submissions with PWG info	2/8/21	Cameron	Not started	Each simulation will have their own ASCII file with production parameters.
6	Define production site tasks	2/8/21	Prod. Managers	Not started	Each site knows what their productions responsibilities are
7	Full detector integration in simulation and reconstruction	4/8/21	Simulations WG	Not started	Each subdetector compiles without complaint and is placed in ECCE with no overlap
8	Start 10M particle gun and/or SIDIS events	9/8/21	Prod. Managers	Not started	Particle gun gives a quick check of some performance (i.e. tracking), SIDIS gives us global acceptance and more tracks per event
9	Analyse 10M particle gun events and SIDIS events	12/8/21	Physics, Computing V	Not started	See "More information" for "Start 10M particle gun and/or SIDIS events" task
10	Meet with PWGs regarding particle gun and SIDIS simulation	13/8/21	Detector & Physics W	Not started	See "More information" for "Start 10M particle gun and/or SIDIS events" task
11	Physics Generation Campaign 2	13/8/21	Simulations WG	Not started	Full scale, production of Multi-100M event set



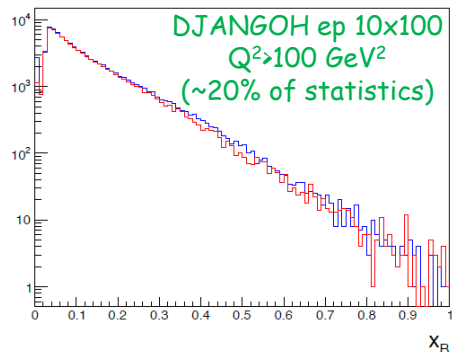
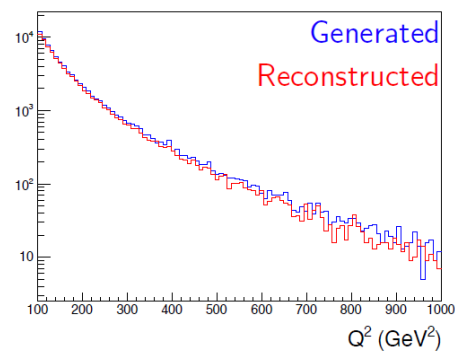
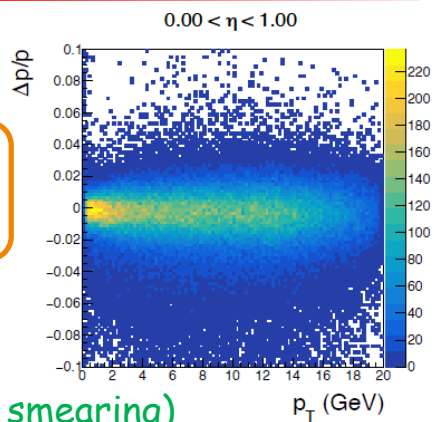
New tutorial: [How to get the simulation data](#) (without of BNL/JLab account)

➤ **Reminder:** weekly Office Hours & very active Mattermost channels

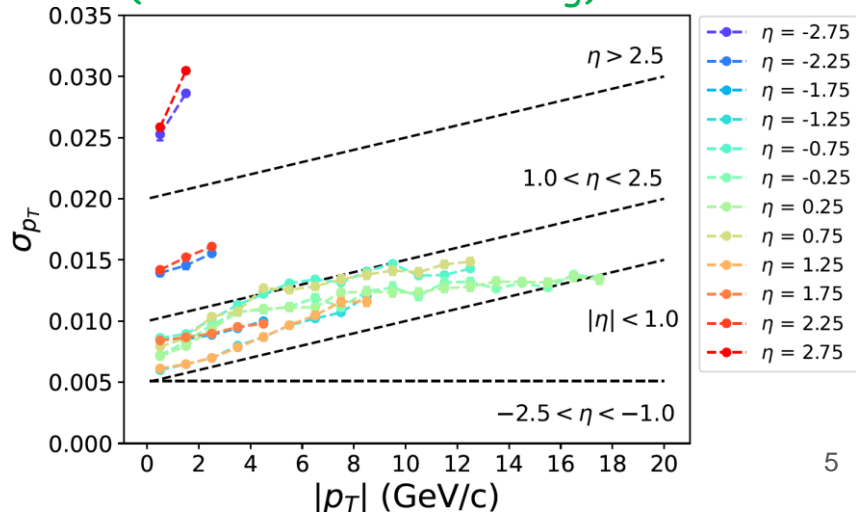
Inclusive reactions WG



First look at simulations (prop2)



Single e- sample (for resolution & smearing)



In progress/upcoming tasks:

- Validate fast smearing with full simulation results
- Study & implement PID (currently rely on truth info)
- Reconstruction method performance
- Cross-section analysis

BSM & Electroweak WG

➤ Working together with Inclusive WG:

- Electron resolutions obtained by inclusive WG will be used to smear EW events and perform physics analysis
- Developing further physics case and writing accompanying notes

DIS Cross Sections at EIC

Abstract

With EIC the first lepton-proton (and light ion) collider that utilize both polarized lepton and polarized proton beams, it's necessary to understand the polarized DIS cross section in terms of structure functions in its full form, without the use of abbreviations and minimize the use of approximations. Results for unpolarized, single-spin, and double-spin polarized cross sections are presented. The difference between electron and positron beam are also presented to show how a positron beam at EIC will help to better access the $F_3^{\gamma Z}$ and $g_1^{\gamma Z}$ structure functions, which are kinematically suppressed in the electron-only cross sections.

Timeline

May

- Generate MC events for all 9 ep and 6 eD energy combinations – done;
- first round of processing data – done for high-priority topics of NC;
- physics derivations – [done for all DIS cross sections](#);

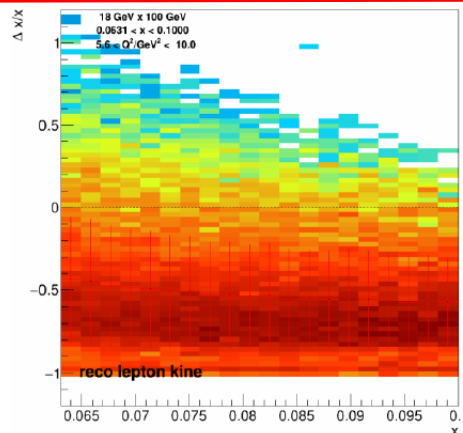
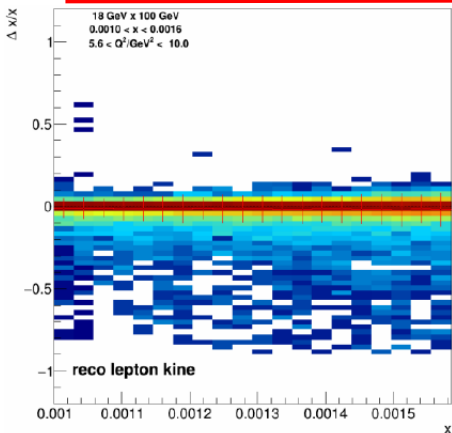
June – July

- Simulation for detector smearing – [not implemented, decided to wait for production](#);
- debugging djangoh for low W and rerun all simulations – done;
- unfolding – [done for asymmetries and \$\sin^2\theta_W\$, no detector smearing](#) – sent to JAM;
- background simulation – [will use June production single-particle gun results](#);
- discussing with theory + JAM group on how to fit $C_{1,2}$ – [likely continue into fall](#);

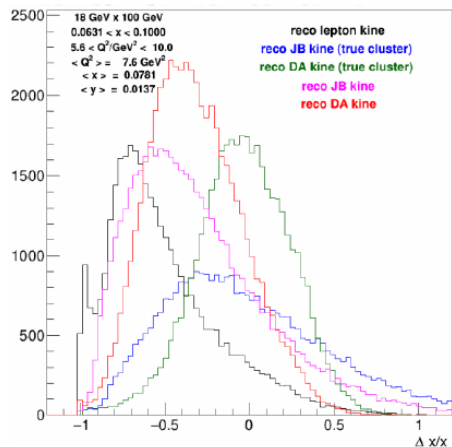
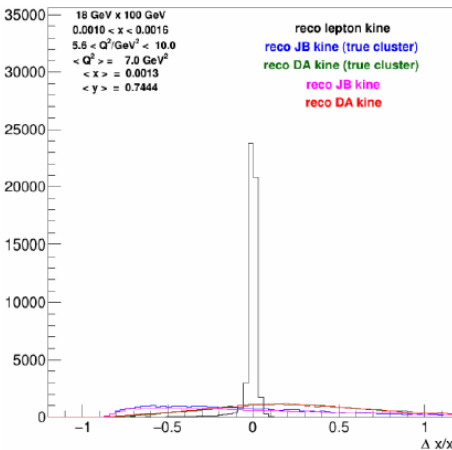
August

- fast smearing study using June production – almost done;
- practice extraction of $\sin^2\theta_W$ from ep asymmetries independent of JAM – ongoing;
- fitting asymmetries from two energies to get $F_{1,3}^{\gamma Z}$ – ongoing;
- implement June production fast smearing – not started yet, see above → repeat unfolding of asymmetries and fitting of $\sin^2\theta_W$;
- study pi/e ratio and PID requirement – ongoing;
- systematic study related to polarimetry and helicity-correlated effects – ongoing;
- check fast smearing with full simulation – not started yet;
- CLFV study – not started yet

Semi-inclusive reactions WG



Track-cluster matching: $R^2 = (\Delta\eta^2 + \Delta\phi^2) < 0.05$



First look at simulations (prop2)

- Using EventEvaluator
- PID still uses PGD values

- Expected degradation of resolutions at low y seen;

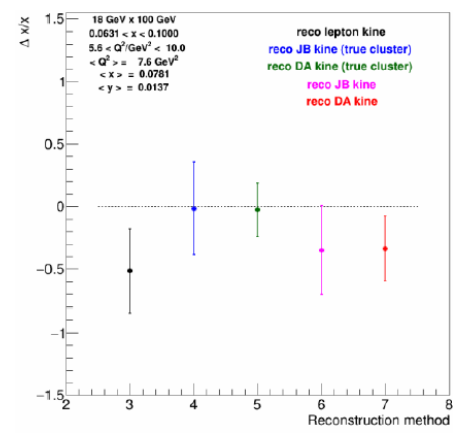
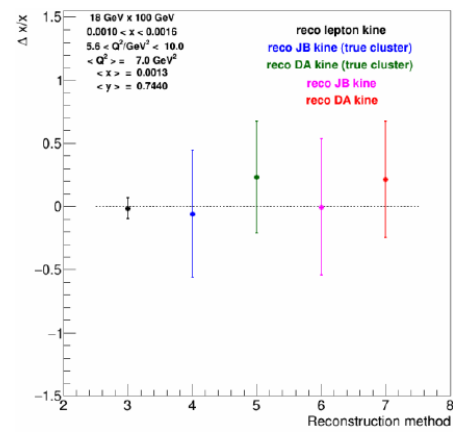
- Can be slightly recovered by DA method

- (might still need optimization on track-cluster finding)

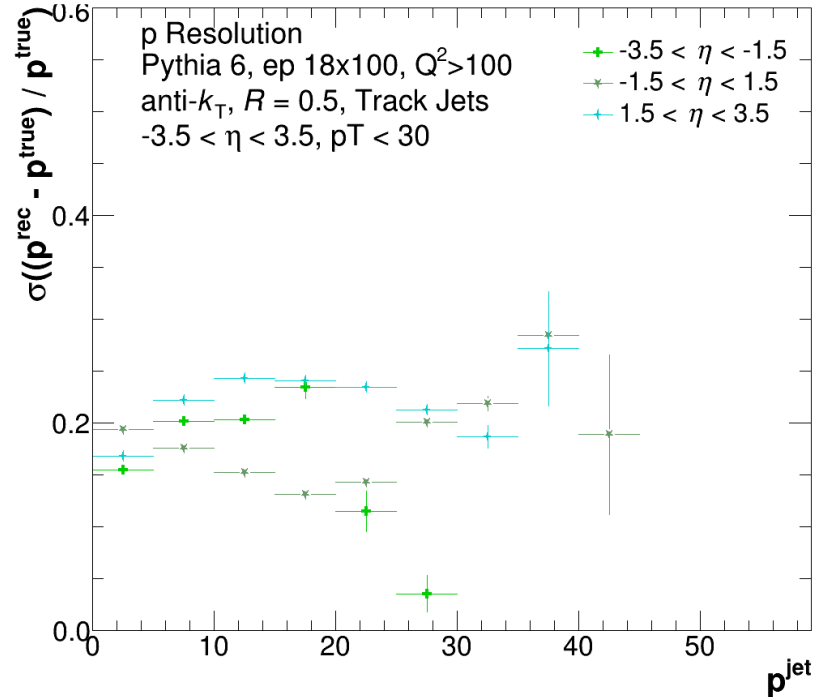
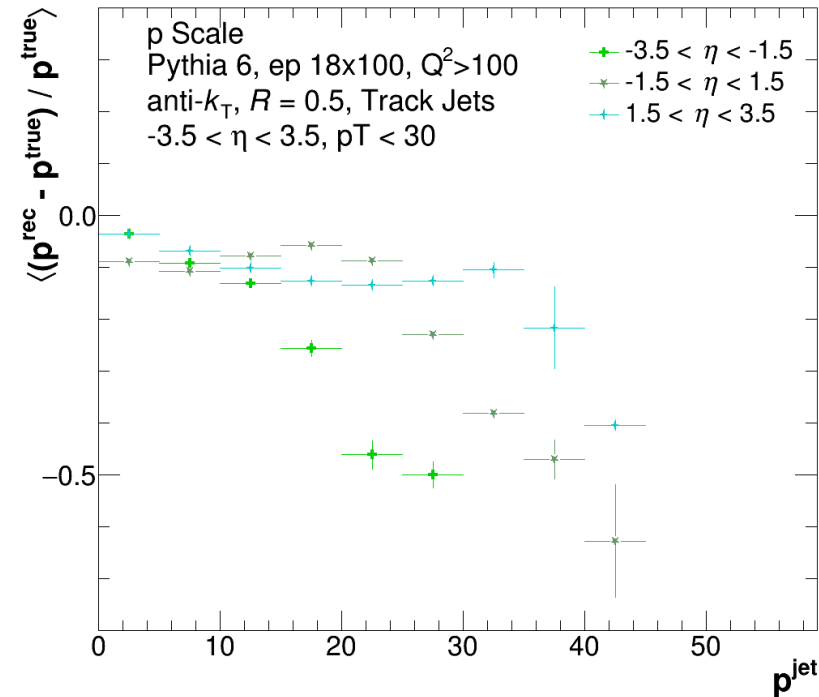
- SIDIS variables show similar behavior as DIS variables, but deviations generally moderate;

- Azimuthal angles are particularly robust

- (good azimuthal asymmetries)



Jets & HF working group



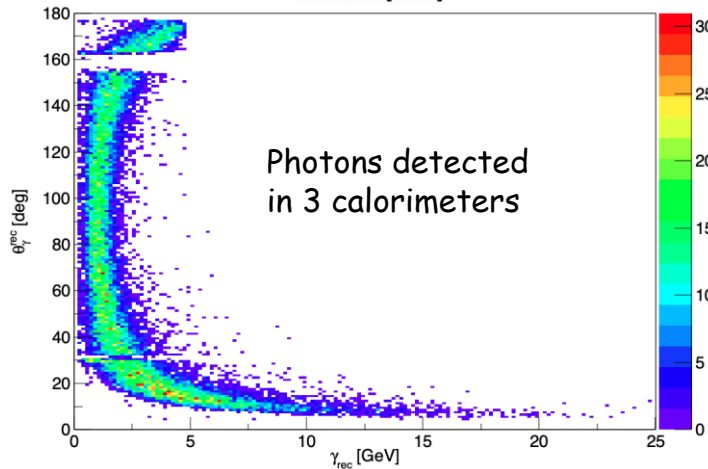
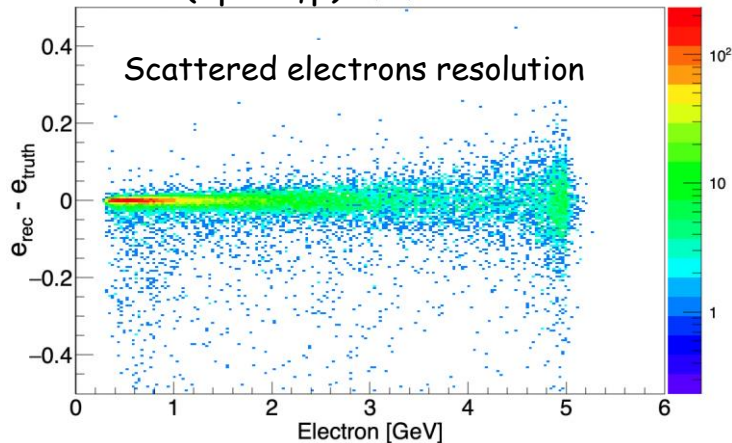
First look at simulations
(prop2)

In progress/upcoming tasks:

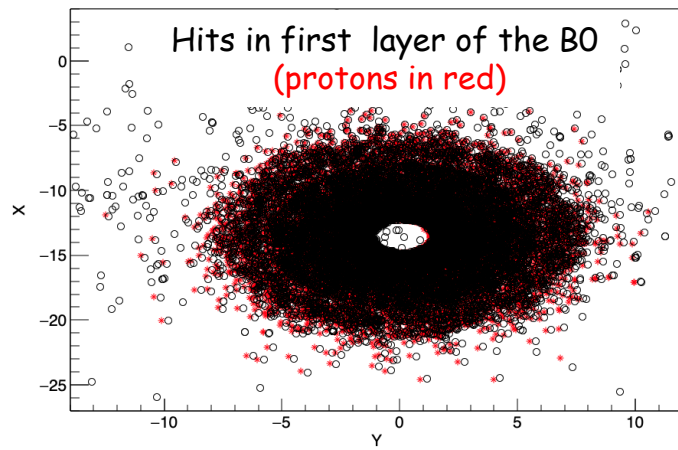
- Crosscheck tracking performance with tracking WG
- Optimize kinematic cuts
- Ongoing work on calorimeter-only jets

Exclusive Reactions WG

DVCS ($ep \rightarrow e\gamma p$): Milou3D - GK model



- Priority studies:
 - DVCS ep (MIT, OU)
 - DVMP ep (VT, UoY, UConn)
- Key reactions for extraction of GPDs
- Crucial for multi-dim. imaging of quarks and gluons inside nucleon
- Also studying:
 - DVCS eA (currently eHe) (UoG)
 - DVMP eA, currently ϕ production due to its greater sensitivity to gluon saturation effects than J/Psi (OU)
 - Coherent J/ ψ production with eA (BNL) and related studies into incoherent backgrounds and p_{\perp} resolutions
 - Possible future study into color transparency

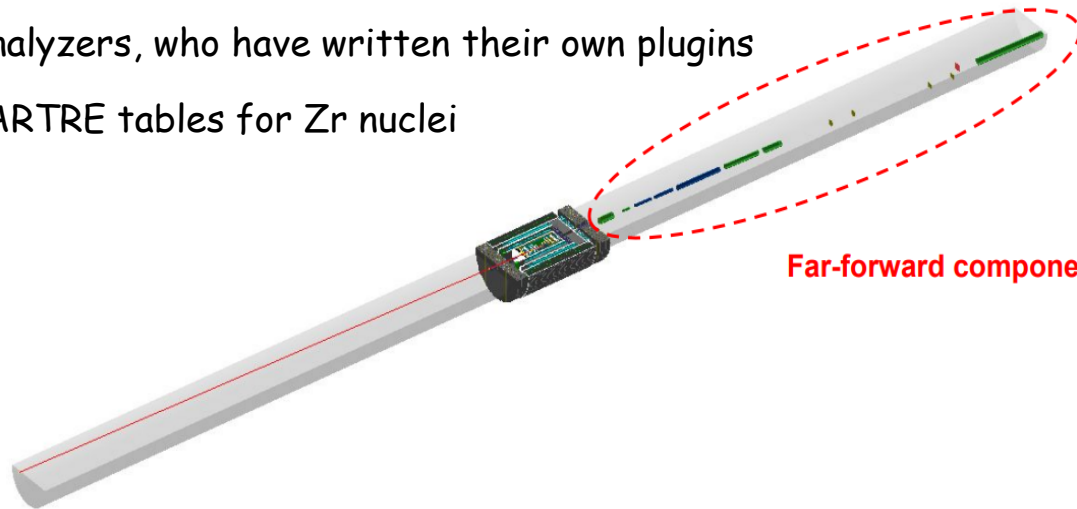


5 GeV x 41 GeV

Diffractive & Tagging WG

Second round test (20k events) has been processed at JLab.

- Analyzers are checking and giving feedback
- No 50 cm shift yet, but Far Forward coordinates have been flipped
- Third round to launch soon
- Far forward evaluator to be finished by the end of the week
 - Not used by analyzers, who have written their own plugins
- Working on generating SARTRE tables for Zr nuclei



Far-forward component flipped from +x to -x

Analysis notes

 32 accompanying notes in preparation (from Physics WGs)

3.2.1 1. Inclusive processes

3.2.1.1 a. Resolution studies:

1. Resolution studies: Comparison of different reconstruction methods (lepton, Jacquet-Blondel, double-angle)
2. Resolution studies: Resolutions at different kinematics (relevant for fast-smearing studies)
3. Background simulation studies: Purity/contamination, uncertainties
4. Physics analysis: Unpolarized structure functions F_2, F_L
5. Physics analysis: Low Q^2 studies
6. Physics analysis: Polarized structure function g_T

3.2.2 2. Semi-inclusive DIS

1. Kinematic DIS and SIDIS resolutions
2. Sivers/Collins simulation and results
3. SIDIS helicity simulation and results
4. Di-hadron simulation and results
5. Spin-independent TMDs simulation and results

3.2.3 3. Exclusive processes

1. DVCS (eP)
2. DVCS (He)
3. DVMP (J/Ψ)
4. DVMP (π^0)

3.2.4 4. Diffraction & tagging

1. Meson form factors
2. Meson structure functions
3. Neutron spin structure
4. Diffractive J/Ψ in eA
5. U-channel π^0 production
6. Short-range correlations in quasi-elastic eA

3.2.5 5. Jets and heavy flavor

1. D and B meson R_{eA}
2. Charmonium R_{eA}
3. Jet R_{eA}
4. HF mass distribution (\rightarrow mass resolution, S/B)
5. JER, JES, jet angular resolution

3.2.6 6. BSM & precision electroweak

1. Extraction of $\sin^2 \theta_W$ from eD 18×100
2. Extraction of $F_1^{\gamma Z}, F_3^{\gamma Z}$ from ep (two energies combined) and eD (two energies combined)
3. Possible limit on BSM physics in AV and VA channels (g_{AV}, g_{VA} analysis) – collaboration with theory groups
4. Analysis of $e \rightarrow \tau$ (CLFV)
5. Analysis of CC physics (mass limit on right-handed W^-)
6. Beam parity quality control: uncertainty on helicity-asymmetry measurements

Summary & Outlook

- First simulation campaign almost completed; preparations to start 2nd campaign real soon
- All working groups actively looking at the data and implementing analysis codes
- **Still time to join the Physics Team and start doing analysis:**
 - [New tutorial](#) on how to access the simulated data
 - [1st, 2nd and 3rd simulation workshops](#), with recordings and slides posted
 - Weekly 'Office Hours' + [Mattermost](#) & [Discourse](#) communication channels

Back-Up

Timeline

- First Simulation Campaign (April 1st - May 15th)
 - Initial simulation runs using existing implementation
 - Finish implementing ECCE setup
 - Agree on technology, main physics observable and arrange required event generators
- First Analysis Campaign (May – June 15th)
 - Determine statistics
 - Iterate: simulation \leftrightarrow analysis
- Final Production (June 15th – August)
- Second Simulation Campaign (July 15th – September 1st)
 - Analysis of simulation data to demonstrate physics extraction
 - Drafts of physics plots
- Proposal Writing (September 1st – October 15th)
 - All physics 'plots' are done
 - Compose narrative around simulation results and selected technologies
- Proposal Deadline – **December 1st**

