ECCE Physics Benchmarks Team IB Meeting Report

July 18th, 2021

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LEHIGH UNIVERSITY

Physics Team Working Groups

- Inclusive reactions: Tyler Kutz (MIT), Claire Gwenlan (Oxford)
- Electroweak and BSM: Sonny Mantry (UNG), Xiaochao Zheng (UVa)
- Semi-inclusive reactions: Ralf Seidl (RIKEN), Charlotte Van Hulse (IJCLab Orsay)
- Jets and Heavy Flavor: Cheuk-Ping Wong (LANL), Wangmei Zha(USTC)
- Exclusive Reactions: Rachel Montgomery (Glasgow), Julie Roche (OU)
- Diffractive & Tagging: Wenliang Li (W&M), Axel Schmidt (GWU)
- Simulations: Cameron Dean (LANL), Jin Huang (BNL)

Simulation Working Group

- 3rd ECCE Simulation Workshop: https://indico.bnl.gov/event/12245/
  - Post-production analysis
  - Recording posted at Indico
- What next? Meeting w/ detector group for next campaign
  - W. 1130 am EDT: https://indico.bnl.gov/event/12484/
- Some small bug correction is ongoing – more production files will be launched
- **Please check out the current production files**! Need to ensure things make sense
- Produce ~10M evts/day → 150M event campaign will take ~2 weeks

Inclusive Working Group

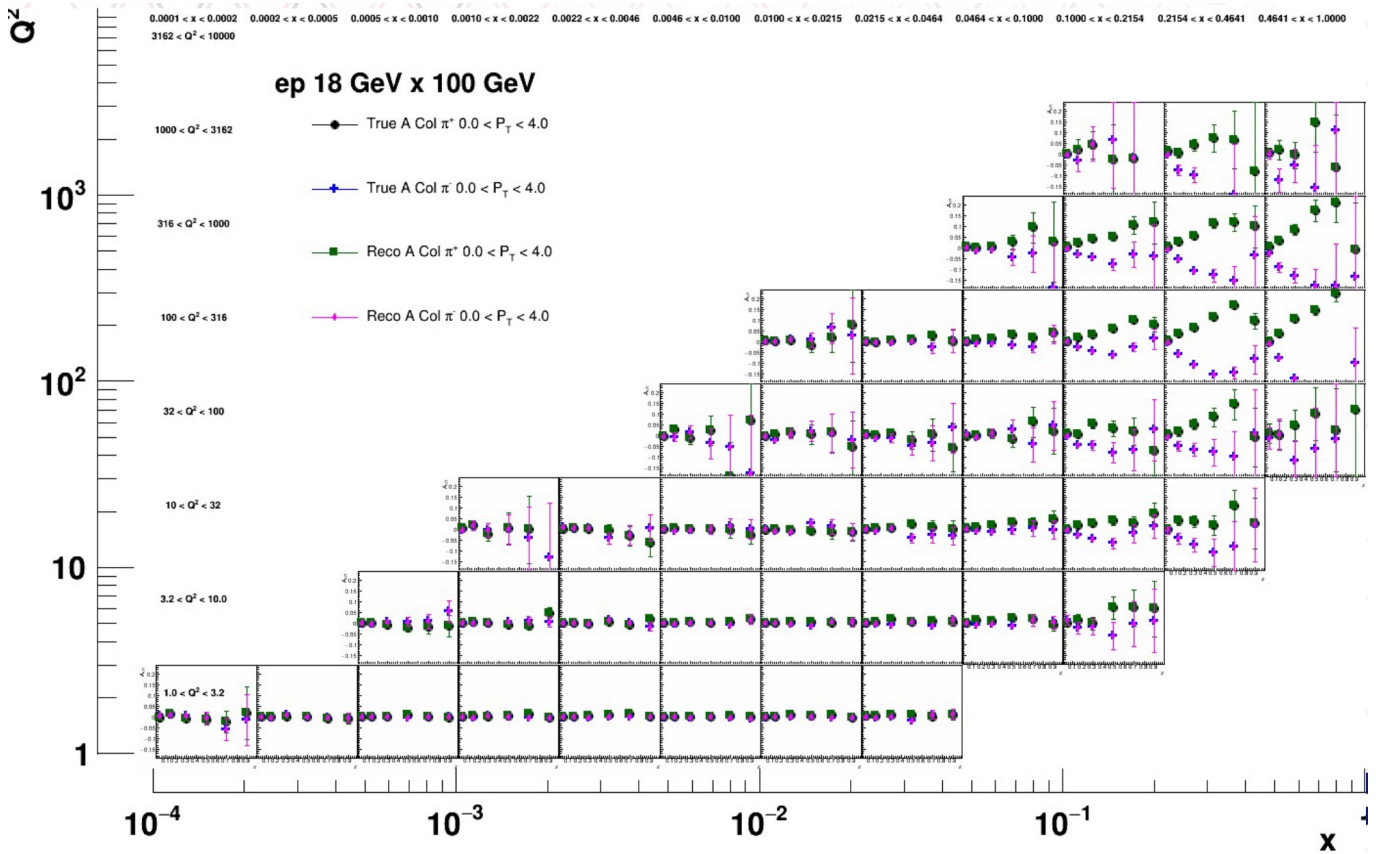
- Monitoring resolutions as detector changes are made
- Will use single-electron sample from first production for EW/inclusive fast smearing
- Next priorities:
  - DIS reconstruction analysis module
  - PID studies
- Have started working with diffractive & tagging on inclusive A^p_1 (using same framework as double-tagged A^n_1)

SIDIS Working Group

- Test production for SIDIS output:
  - High Q^2, ~3.8 M DIS events, $Q^2>100$ GeV
  - Low Q^2, ~20 M DIS events, $1<Q^2<100$ GeV
- Tested track projections for identifying clusters from charged particles → works reasonably well but room for improvement
- Resolution studies ungoing
- Meeting between SIDIS conveners of ECCE/ATHENA (Anselm) to agree on common way of assessing systematics, cuts, contacting theorists for impact studies

SIDIS Working Group

Updated Collins asymmetries using ana.14 SIDIS simulations



Diffractive and Tagging Working Group

- Simulation Campaign Data (July 3rd, 2021)
- Not done with 50 cm shift
  - Pion FF
  - Pion Structure function Study
  - KaonFF
  - SRC e+A
  - Neutron Spin Structure
  - u-Channel pi0
  - e+A diffractive:
    - e+Pb
    - e+Au

Simulation Round 1 completed

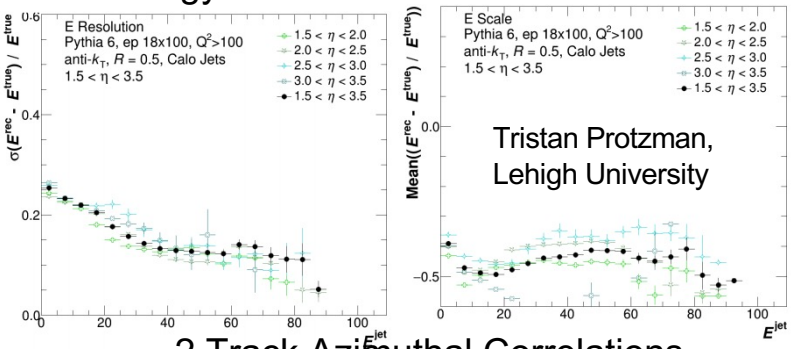
Study event generator stage

Exclusive Working Group

- DVCS ep (priority)
  - Trial simulating on JLab → almost good to go for large statistics jobs
  - Fun4All → still have issues w/proton in the forward region+roman pots
    - Currently using proton truth and smearing by hand
  - Working on cuts for event selection in analysis
- DVCS π^0 - A. Kim joining effort → have their own DVpi0 generator (A. Kim + V. Kubarovsky)
- DVCS eA (eHe at the moment)
  - Need to understand kinematics of output particle after Fun4All → work w/simulation team
- DVMP ep with DEEPSim (VT generator), for several meson production channels, BH and possibly TCS and DDVCS (priority)
- DVMP ep with lAger (for J/ψ check + excited J/ψ studies)
  - Need to incorporate lAger output w/Fun4All
- DVMP eA with Sartre
  - Entire chain is working for ϕ
  - Looking at diffractive eA J/ψ studies to determine which ion to run

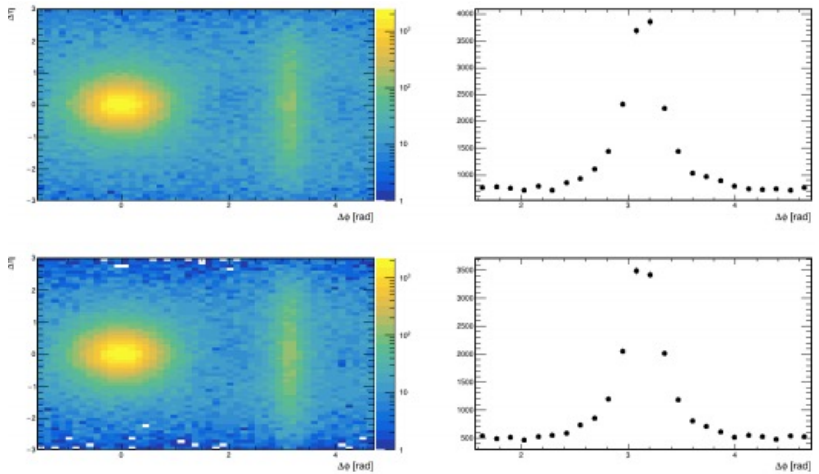
Jets and HF Working Group

Jet Energy Resolution



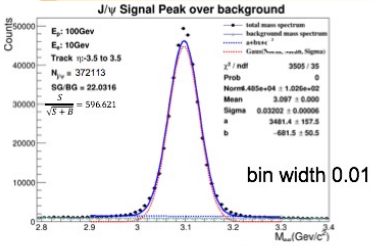
Tristan Protzman,
Lehigh University

2 Track Azimuthal Correlations



J/psi Reconstruction from First Simulation with Smearing

10 million events J/ψ peak(event filter)



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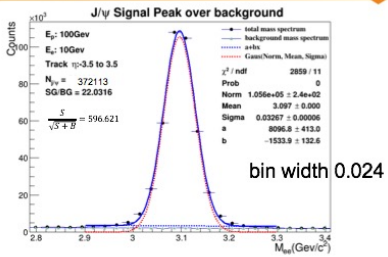

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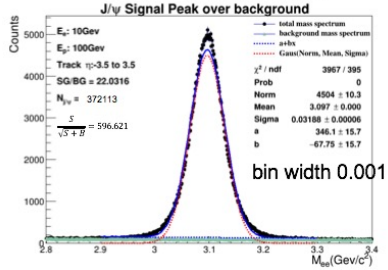

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10million events
reaction selection
Matrix2B1.5T
Luminosity: 13.189 fb^{-1}
gaussian function may not fit the data well.

EW and BSM Working Group

- **Electroweak physics supporting notes:**
  - **Resolution and electron ID studies**
    - see inclusive WG notes
  - **Beam parity quality control**
    - Uncertainty on helicity-asymmetry measurements (beam “parity-quality” control)
  - **Physics studies**
    - Extraction of $\sin^2\theta_W$ from eD 18x100
    - Extraction of $F_1^{\gamma Z}$, $F_3^{\gamma Z}$ from ep (2 energies combined) + eD (2 energies combined)
    - Possible limit on BSM physics in AV and VA channels (g_{AV}, g_{VA} analysis)
      - Collaboration with theory groups (JAM and SMEFT);
    - Analysis of $e \rightarrow \tau$ (CLFV);
    - Analysis of CC physics (mass limit on right-handed W-).

Conclusions/Outlook

- First large simulation campaign is in process
  - Mix of full/fast sim for efficiency → allows subsystem development to continue
  - **Please look at the data!**
- Next physics/detector meeting Wed 1130 am EDT
  - Determine configuration for next campaign
- First PWG results trickling in
- Campaign requires ~150M events → 2 weeks production time
- Call for analysis notes as supplementary documents for proposal

Back-Up

Physics Priorities

Physics group is working on the outline of the proposal **requires prioritization**

Some discussion can be found at: https://indico.bnl.gov/event/11937/

Table from Yellow Report – Map observables to main physics topics

Topics \ Processes	Inclusive	Semi-Inclusive	Jets, Heavy Quarks	Exclusive	Diffractive, Forward Tagging
Global properties & parton structure	incl. SF	h, hh	jet, Q	excl. $Q\overline{Q}$	incl. diffraction, tagged DIS on D/He
Multidimensional Imaging		h	jet, di-jet, jet+h, Q, $Q\overline{Q}$	DVCS, DVMP, elast. scattering	
Nucleus	incl. SF	h, hh	jet, di-jet, Q, $Q\overline{Q}$	coh. VM, di-jet, h, hh, D/He FF	diffr. SF, incoh. VM, di-jet, h, hh, nucl. fragments
Hadronization		h, hh, jet+h	jet, Q, $Q\overline{Q}$		
Other fields	incl. SF with e^+, $\sigma^{tot}_{\gamma A}$	charged curr. DIS, $\sigma_{\gamma A \to hX}$		$\sigma^{elast}_{\gamma A}$	$\sigma^{diffr}_{\gamma A}$

Physics Priorities

Simulation assumption will be a luminosity of 10 fb^{-1}

- Imaging and parity → 100 fb^{-1}

Early science (first results) under assumptions:

- 10 x 250 GeV, ~5 fb^{-1} polarized e-p (g1 at low x) and ~2.5 fb^{-1} e-A (% diffraction)

Focus on physics topics, as oppose to processes:

- **Mass**
- **Imaging** (Momentum and Spatial)
- **Spin & Flavor**
- **Saturation**
- **Emergent properties**
- **Hadronization**
- **BSM**

Top Physics Priorities

Inclusive
- F2A @ low-x [Saturation, nuclei]
- A1p vs. x [Spin & Flavor, nucleon]
- A1n vs. x [Spin & Flavor, nucleon]
- Twist-3 gTq vs. x [Spin & Flavor]

SIDIS
- Quark Sivers function [Momentum imaging, nucleon]
- Sea quark helicities via SIDIS A1 A_{LL} measurements [Spin & Flavor, nucleon]

Electroweak and BSM
- Parity violating asymmetries
- Charged Lepton Flavor Violation

Heavy Flavors and Jets
- In medium correction for heavy flavor [Hadronization, nuclei]
- Di-hadron correlations [Saturation, nuclei]

Exclusive
- DVCS ep [Position Imaging, nucleon]
- DVCS eA [Position Imaging, nuclei]
- J/ψ production in ep [Position Imaging, nucleon]

Diffractive & Tagging
- A1n from double tagged ^{3}He [Spin & Flavor]
- Diffractive meson (J/ψ) production [Saturation]
- Pion structure [Mass]
- Kaon FF [Mass]

In addition there are lower priorities – these may change as simulations progress