ECCE Physics Benchmarks Team IB Meeting Report

August 30th, 2021

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Current Status

- 2nd campaign details being worked out → Start of single particle simulation hopefully by next week
- Most physics working groups using Truth PID

  ○ Meeting with PID group → Analyzers can use fastsim smearing for the moment
- Sanity Checks

  ○ This needs a little more work → Very analysis specific
- Top Physics Priorities → Start pushing for work-in-progress final plots
- Analysis notes in progress → Please contact Peter Steinberg if you need help

Reminder: 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]

Simulation Campaign 1 – Simulation WG

- Major campaign is complete, ~172.4M events in storage

  ○ Diff&Tag completed simulation round 5 (based on June concept)

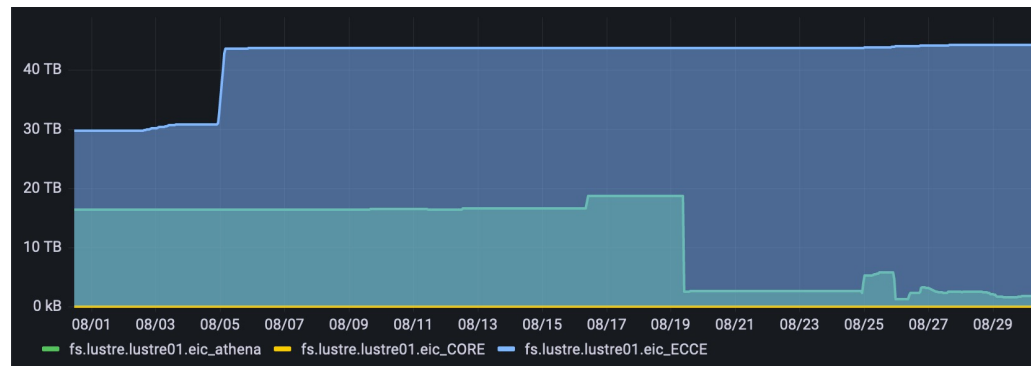- Problems and solutions:

1. Jet evaluator crashes

   ○ Event evaluator can process jets

2. Calo. Evals are not 100% tuned

   ○ ORNL team has a post-processor that can improve calos if needed

3. Some jobs crashed at Bates

   ○ Under investigation

Data stored on S3 for each EIC consortium. Green – ATHENA, Yellow – Core, Blue - ECCE

Simulation Campaign 1 – Simulation WG

PWG	Process	Generator	Beam Parameters	No. Events In Storage
General	Single Pions	Particle Gun	N/A	5M
General	Single Electrons	Particle Gun	N/A	5M
HF & Jets	HF	Pythia8	5x41 ep	4.9M
HF & Jets	HF	Pythia8	10x100 ep	4.7M
Inclusive (high Q2)	Neutral	Djangoh	10x100 ep	0.995M
Inclusive (high Q2)	Neutral	Djangoh	10x100 ep	0.988M
Inclusive (high Q2)	Neutral	Djangoh	10x100 ep	0.445M
Inclusive (high Q2)	Neutral	Djangoh	10x100 ep	0.073M
Inclusive+Electroweak	Charged	Djangoh	18x275 ep	0.983M
Electroweak	Charged	LQGENEP	18x275 ep	0.984M
Electroweak	Charged	LQGENEP	18x275 ep	0.984M

PWG	Process	Generator	Beam Parameters	No. Events In Storage
SIDIS	(SI)DIS	Pythia6	18x100	19.730M
SIDIS	(SI)DIS	Pythia6	18x100	3.962M
SIDIS	(SI)DIS	Pythia6	18x275	19.625M
SIDIS	(SI)DIS	Pythia6	18x275	19.540M
SIDIS	(SI)DIS	Pythia6	18x275	3.954M
SIDIS	(SI)DIS	Pythia6	5x41	19.5M
SIDIS	(SI)DIS	Pythia6	5x41	19.735M
SIDIS	(SI)DIS	Pythia6	5x41	0.991M
SIDIS	(SI)DIS	Pythia6	10x100	19.662M
SIDIS	(SI)DIS	Pythia6	10x100	19.672M
SIDIS	(SI)DIS	Pythia6	10x100	1.974M

Simulation Campaign 2 – Simulation WG

Second campaign almost ready to go. To-do's:

1. EECal position is updated to improve acceptance

- Requires moving mRICH and tracker stack, need DWG implement the changes in simulation

2. hpDIRC full sim also being updated to allow easier placement

3. dRICH geometry needs update to reduce size, hopefully by end-of-week

4. Formulate unified PID object

- Currently analyzers can use fast smearing from PID group

5. Implement 4D vertex distribution based on lastest EIC design

6. Feedback from PWG on using output from the last campaign

This sounds bad but these final tweaks are easy work; regenerate GDML files, add new functions to alter global positions etc

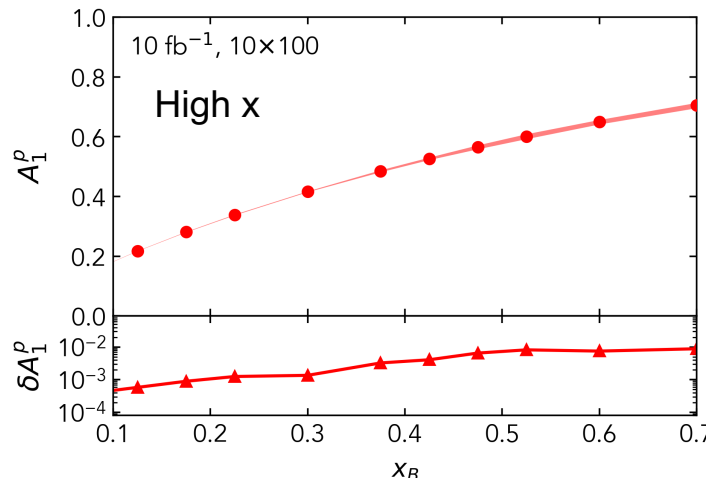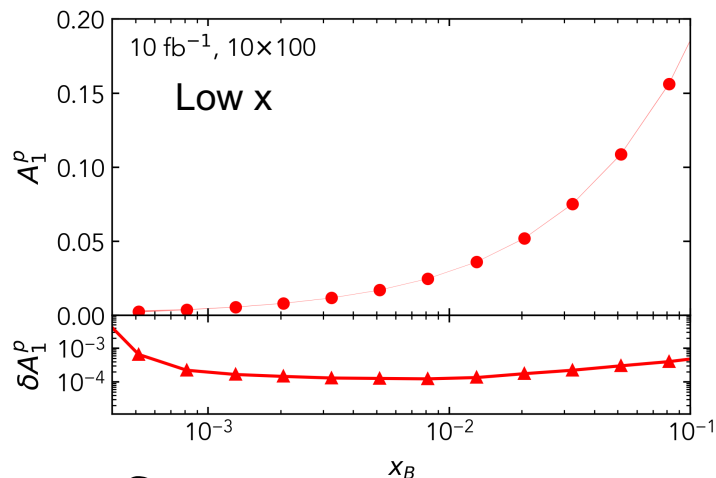- Aim to launch single-particle production next week

New additions from Campaign 1

- ~1M events with no magnetic field
- 30M more events from Electroweak group
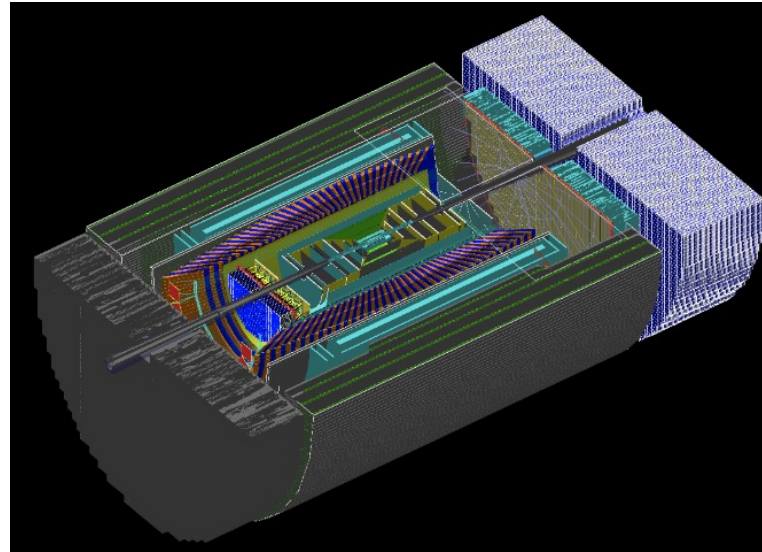
ECCE Campaign 2 concept (hpDIRC support cage has been added but is not shown here). dRICH can been seen to overlap with other detectors

Inclusive Working Group

A_1^p

Caveats:
- Statistical uncertainty only
- Unfolding not yet applied → will increase uncertainty
- Using truth info to identify reco tracks

Goals for next week:
- Absolute inclusive NC cross sections for structure function extraction
- Unfolding

General comments:
- Still working on PID
- Pausing hadronic reconstruction studies until next simulation campaign

SIDIS Working Group

Progress on notes:

- (SI)DIS resolutions
- Sivers/Collins single spin asymmetries
- unpolarized TMDs

Checking usefulness of the EHCAL

- Backward hadrons produced @ low x → not the region where there is expected benefit from the hadronic methods
- Low-x → ~low Q^2 CC events (which use the JB method) do not play a significant role
- Perhaps useful in e/h separation for low-x events
  - Perhaps lack of signal in EECAL is sufficient?
  - Calo/eID experts?

Diffractive and Tagging Working Group

Simulation Campaign Data Output Path:

- Google data sheet for reporting:
  https://docs.google.com/spreadsheets/d/1VFthz9dogk1DCxgdEtdiuPmTbxXhwVgyXeqCbPmswRw/edit?usp=sharing

- **Simulation Round 5 (Last simulation round)**
  - **Using coresoftware build: ana.23 (Frozen on 22/August)**
  - **Big change: IP8 Simulation ready**
  - **Expand in statistics, but there is no Round 6**
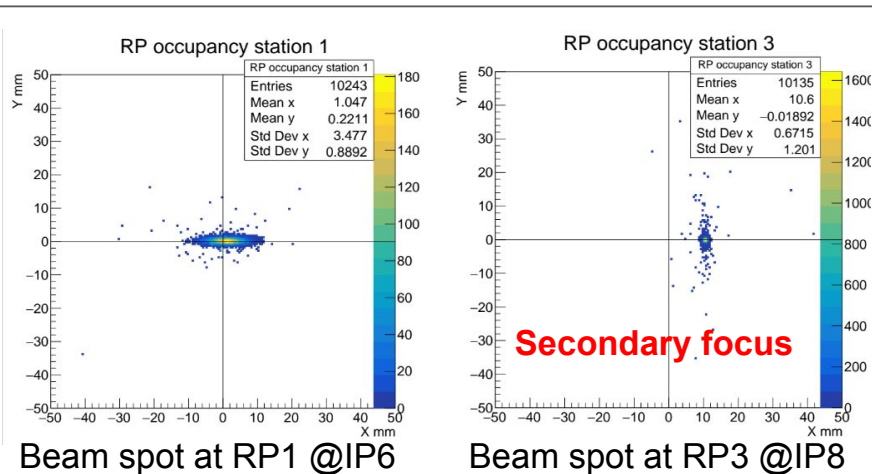 - **Total: 3M Events (98 Gb)**

Diff & Tagg Group

Exclusive Group

Simulation round 5 (r5)		
Process		
Pion FF	DEMP	300000
Pion Structure function Study	EIC_mesonMC	23000
KaonFF KLambda	DEMP	300000
KaonFF KSigma	DEMP	300000
SRC e+A (Florian)	BeAGLE	20000
Neutron Spin Structure (Dien and Jackson)	Djangoh_ep	300000
u-Channel pi0 (Bill)	DEMP	30000
e+A diffractive (Mark & Peter) e+Pb	BeAGLE	300000
e+A diffractive (Mark & Peter) e+Pb	BeAGLE	300000
e+A diffractive (Mark & Peter) e+Zr:	BeAGLE	300000
e+A diffractive (Mark & Peter) e+Zr:	BeAGLE	300000
XYZ Meson photoproduction (Derek and Justin)	elSpectro	2000
XYZ Meson photoproduction twopi	elSpectro	300000
Exclusive Reactions eA-4x41-DVCS-ph	MILOU3D	100000
Exclusive Reactions ep-10x100-DVCS-GK	MILOU3D	100000
Total		**2975000**

Diffractive and Tagging Working Group

Roman Pot Occupancy Study

Beam spot at RP1 @IP6

Beam spot at RP3 @IP8

Secondary focus

XYZ meson study@ IP6

e+Zr →e⁺e⁻@ IP6

Beam study results: good validation to Fun4all Far Forward configurations: magnets + detectors
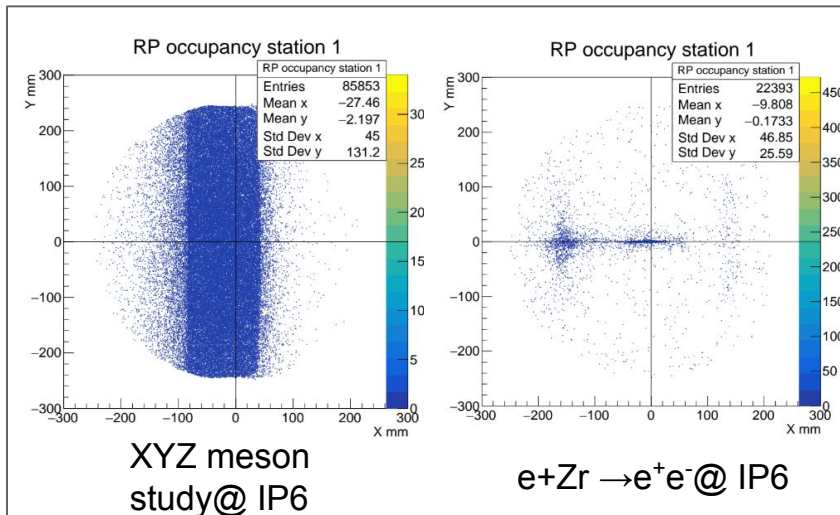
**Selection of physics process occupancy**

Exclusive Working Group

- Priority studies:
  - DVCS ep (MIT, OU)
  - DVMP ep (VT, UoY, UConn)
- Last meeting:
- https://indico.bnl.gov/event/11995/
- TCS update ("inverse" of DVCS)
- DVMP update

  - Use generators lAger and VT
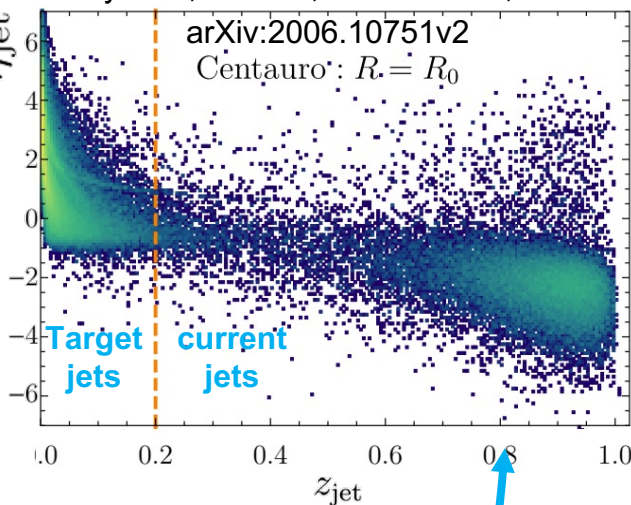
  - Work ongoing

Jets and HF Working Group

Jet Finding using Centauro Algorithm

Properly capture the current jet and separate it from the beam remnant jets

Pythia6, 10x100, $Q^2 > 10$ GeV^2, R=0.8
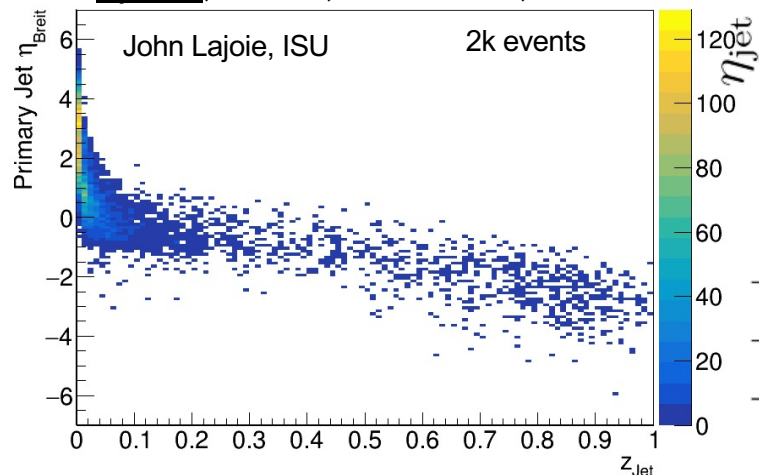
Pythia8, 10x100, $Q^2 > 10$ GeV^2, R=0.8

$$d_{ij} = \frac{\left[(\Delta f_{ij})^2 + 2f_i f_j (1 - cos\Delta\varphi_{ij})\right]}{R^2}$$

$$d_{iB} = 1$$

$$\bar{\eta}_i \equiv -\frac{2Q}{\bar{n}\cdot q}\frac{p_i^\perp}{n\cdot p_i}$$

$$f(\bar{\eta}_i) = \bar{\eta}_i$$

- Goal: performance plots for TMD study
- Initial simulation study using ECCE detector setup close to July concept
- Initial results with 2000 events show agreement to the Centauro paper

Presentation: https://indico.bnl.gov/event/11776/contributions/53296/attachments/36727/60372/Jets%20in%20DIS%20Events%20using%20ECCE.pptx

EW and BSM Working Group

EW+BSM (combined with Inclusive WG):

- Validate fast smearing with fun4all
- Investigate hadron/electron ratios
- Unfold counts from final state
- Start cross section extraction
-      For both EW and inclusive

All are ongoing, progress is needed for final results

Conclusions/Outlook

- First large simulation campaign completed → Input into 2nd campaign

  - Final physics plots?

  - Comments to Sims team
- Second campaign final configuration nearly complete

  - Hopefully start single particle simulation next week

  - Campaign requires ~150M events → 2 weeks production time
- Start generating top physics priority plots at least in work-in-progress form