ECCE Physics Benchmarks Team IB Meeting Report

May 5th, 2021

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Outline

- Team Organization

- Communication within the team

- Working Group Reports
  - Simulations
  - Semi-inclusive
  - Jets/HF
  - Exclusive
  - Diffractive & Tagging
  - BSM & Electroweak

- Summary & Outlook

Physics Team Working Groups

- **Inclusive reactions:**
  TBD, TBD
- **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)

Communication channels

Wikipage: https://wiki.bnl.gov/eicug/index.php/ECCE_Physics

Mailing list: ecce-eic-phys-l

Mattermost channels: instant messaging

Discourse: forum-style format

Physics & Working Groups Meetings

Physics Team: Mondays at 9:30 AM & 9:00 PM

- Jets & HF: Tuesdays at 11:00 AM

- Exclusive Reactions: Fridays at 10:00 AM

- Diffractive & Tagging: Wednesday May 5 at 12:00 PM (regular slot TBD)

- BSM & Electroweak: April 26 & April 29 (regular slot TBD)

- Simulation Office Hours: alternating between Tuesdays 2PM and Mondays 8PM

Physics Working Group Meetings

https://indico.bnl.gov/category/346

Events overview

< 3 May 2021 – 9 May 2021 >

Mon 3 May	Tue 4 May	Wed 5 May	Thu 6 May	Fri 7 May
09:30 ECCE Physics Meeting	11:00 ECCE Jets and HF Meeting	12:00 ECCE Diffractive and Tagging Kick-off Meeting		10:00 Exclusive Reactions Working Group Meeting
21:00 ECCE Physics Meeting	14:00 Simulation Office Hours 📍 https://ljclab.zoom.us/j/94840187278			

➢ All meetings are organized under the same indico category

➢ Calendar can be exported to your favorite format (eg. Google calendar, etc)

Announcements/reminders sent to ecce-eic-phys-l mailing list

Open tasks

Open Tasks

Wiki: https://wiki.bnl.gov/eicug/index.php/Open_Tasks

Diffractive and Tagging

Conveners: Wenliang Li (W&M), Axel Schmidt (GWU)

- Task 1: DVMP φ Electroproduction in collaboration with the Exclusive Group. Intended generator: DVMP.
- Task 2: Shared task with Exclusive group, reproduce tagged diffractive J/psi study.
- Task 3: Implementing EMCal design for ZDC into Fun4all ASAP. EMCal design of ZDC is our recommendation to establish baseline study.
- Task 4: ZDC also required a tracker design.
- Task 5: Studies of e+Au and e+Pd tagged diffractive studies.
- Task 6: ep elastic Study.
- Task 7: u-channel omega production: ω->3γ
- Task 8: We recommend Simulation Team to implement the proper electron and proton orientation and crossing angle for IP6 and IP8.
- Task 9: Diffractive Dijets

BSM and Precision Electroweak

Conveners: Sonny Mantry (UNG), Xiaochao Zheng (UVa, xiaochao@jlab.org)

- Task 1: Parity-violation physics (*ongoing*)
  - Apv(e) and extraction of weak mixing angle and $F\_1,3^gZ$
  - Apv(p) and extraction of structure functions $g\_1,5^gZ$
- Task 2: Charged lepton flavor violation (*ongoing*); Ref: Yellow Report v1.1 page 219-220;
- Task 3: Sensitivity study of Ae+e- and possible extraction of AA coupling and F_3^gZ;
- Task 4: Develop simulation and the physics case of "charged current chiral structure" and "heavy-photon and neutral-lepton searches"; Ref: YR v1.1 page 221
- Task 5: Develop the physics case of "General BSM physics searches"; Ref YR v1.1 page 222
- Task 6: Possibly: related ECCE to neutrino physics, YR v1.1 Section 7.5.2.

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Simulation working group

➤ **1ˢᵗ test production completed !**

    ✓ **3 sets of 1,000,000 events for testing purposes:**

Details at:
https://wiki.bnl.gov/eicug/index.php/ECCE_Simulations_Working_Group#Production_Status

Sample	Generator	Beam Parameters	Path	Notes
"Min-Bias"	Pythia6	ep, 10 GeV x 250 GeV	/sphenix/user/cdean/ECCE/DST_files/general/pythia6_ep/	Run using internal Fun4All generator
SIDIS	Pythia6	ep, 18 GeV x 100 GeV	/sphenix/user/cdean/ECCE/DST_files/SIDIS/pythia6/ep_18x100/	EIC-smear tree input
HF & Jets	Pythia6	ep, 10 GeV x 100 GeV	/sphenix/user/cdean/ECCE/DST_files/HFandJets/pythia6/ep_10x100/	EIC-smear tree input
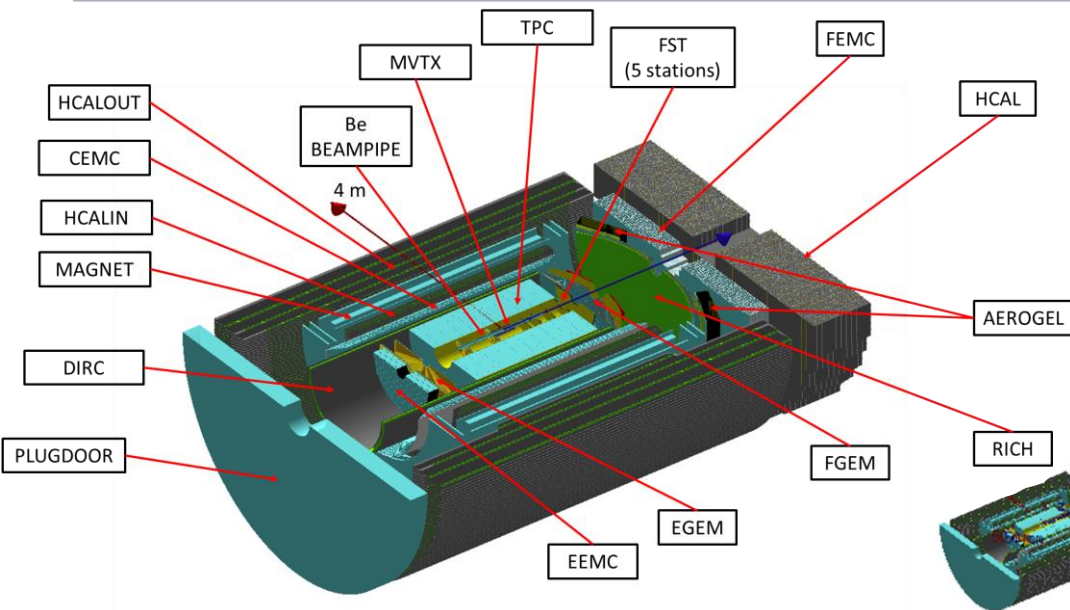
E = electron direction, F = forward/hadron direction, C = Central
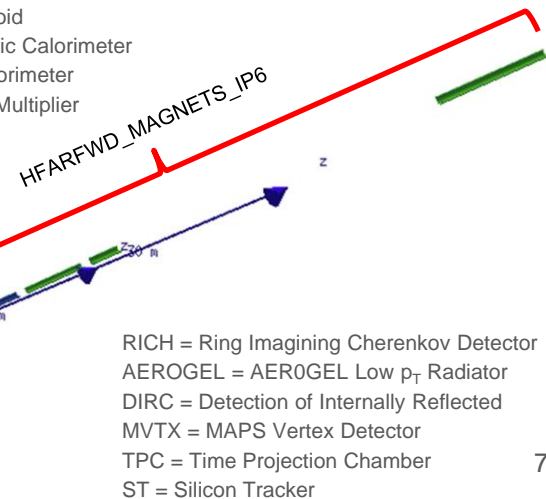
IN = Inside Solenoid
OUT = Outside Solenoid
EMC = Electromagnetic Calorimeter
HCAL = Hadronic Calorimeter
GEM = Gas Electron Multiplier

RICH = Ring Imagining Cherenkov Detector
AEROGEL = AER0GEL Low p_T Radiator
DIRC = Detection of Internally Reflected
MVTX = MAPS Vertex Detector
TPC = Time Projection Chamber
ST = Silicon Tracker

Simulation working group

➤ **1st Simulation Workshop:** April 2

ECCE Simulation Workshop

📅 Friday 2 Apr 2021, 07:00 → 16:45 US/Eastern

Description | This is the first ECCE simulations workshop. It is intended as a workshop for students and postdocs who will be actively engaged in ECCE simulations.

📎 Chat Archive 1.txt | Chat Archive 2.txt | Chat Archive 3.txt | ECCESimulations0... | Recording Part1.mp4

Recording Part2.mp4 | Recording Part3.mp4

➤ **2nd Simulation Workshop:** May 21 (9AM – 12:30PM EDT)

- Overview of computing resources for ECCE
- Structure of DST simulation outputs
- Detector and event evaluators
- How to build an analysis module for your study
- Examples of physics analysis workflows

> Event will be recorded for future reference

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

Semi-inclusive reactions WG

Checking simulations outputs from
1st test campaign:

➢ With TrackEvaluator resolution/migration
   plots can be produced

➢ Everything working to produce 4D coverage
   plots like Fig. 8.29 of YR as a function of z,
   P_{hT} and ϕ_s, ϕ_h for all energy configurations
   (more statistics needed, of course)

➢ Physics studies (Sivers/Collins measurements)
   need EventEvaluator (currently not working:
   simulation WG looking into it)

18 GeV x 275 GeV
18 GeV x 100 GeV
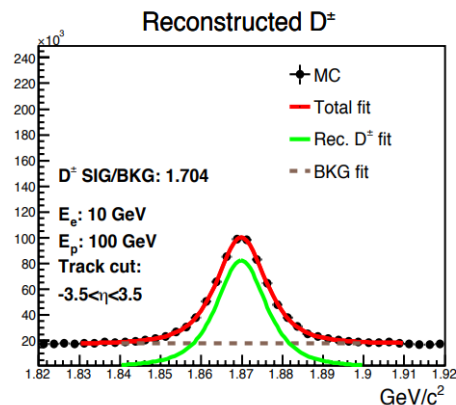10 GeV x 100 GeV
5 GeV x 100 GeV
5 GeV x 41 GeV
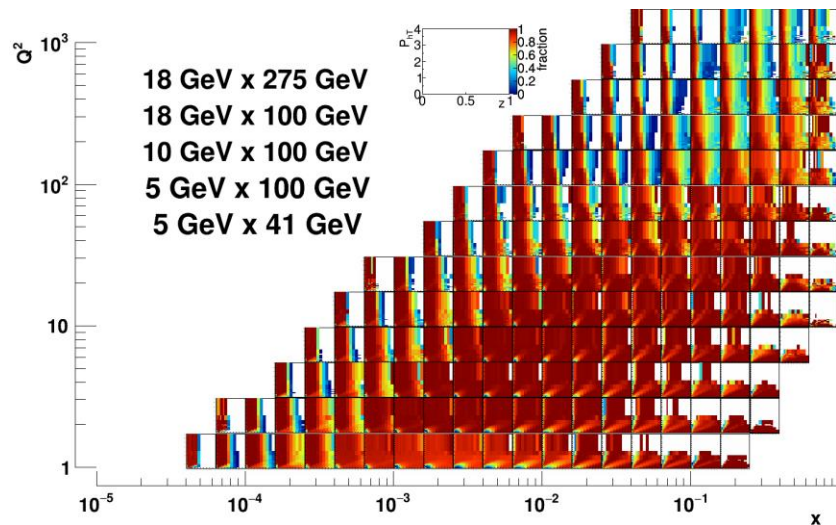
YR Fig. 8.29

Regular WG meetings will start soon:
stay tuned for announcements

Jets & HF working group

Key Plots/Measurements for Detector Proposal

Reconstructed $D^{\pm}$

- MC
- Total fit
- Rec. $D^{\pm}$ fit
- BKG fit

$D^{\pm}$ SIG/BKG: 1.704

E_e: 10 GeV
E_p: 100 GeV
Track cut:
$-3.5 < \eta < 3.5$

- Species: D^0, $D^{\pm}$, $D_s^{\pm}$, B, B_s, λ_c, λ_b

- Measurements
  - Mass spectrum: resolution, efficiency, S/B
  - R_{eA} vs z_h: light vs HF, pseudorapidity dependence
  - Jet p_T spectrum: light vs HF jet separation

Other Suggestion?

➢ Brainstormed on possible analyses & plots to feature in the proposal

➢ Discussed initial MC sample for test simulation campaign on 1st week of May

Projected hadron R_{eA} vs z_h

Track η: -3.5 to 3.5
$\sqrt{s}$ = 63.2 GeV
e+p Int. Lumi.: 10 fb^{-1}
e+Au Int. Lumi. : 500 pb^{-1}

$B^{\pm}$
$D^{\pm}$
$\pi^{\pm}$

Pythia, e+p @ 10+100 GeV, Min Bias

$\eta \subseteq [1.0, 3.0)$, $p \subseteq [0.2, 2.0)$ GeV

1.4 T (SG 1.05e+03, BG 1.13e+04, Stat. Err. 5.16%)
3 T (SG 8.51e+02, BG 3.90e+03, Stat. Err. 3.95%)
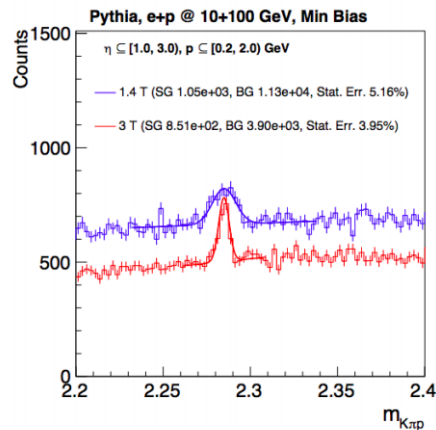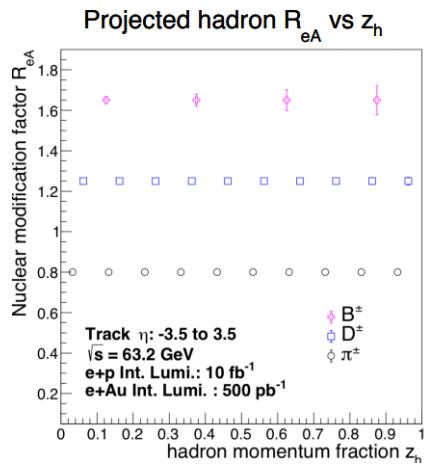
1.4T to 3T

- **SG drops because of the acceptance**
- **BG drops because of a better momentum resolution (narrower signal region) and fewer low p_T tracks**

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Exclusive Reactions WG

- Acceptance in Backward region
- Acceptance of Far-Forward detectors
- Muon detection
- Tracking resolution
- Limitation of the 1.5 T solenoid

Key parameters to consider based on YR studies

Channels to study within the WG:

- DVCS and p^0 off the proton — Igor Korover
- DVCS off the neutron (deuteron with spectator *p* tagging) — Rachel Montgomery?
- DVCS off Helium — Rachel Montgomery?
- Color transparency — Holly Szumila-Vance
- DVMP ρ, ϕ, J/ψ electroproduction & tagged diffractive J/ψ (ep & eA)

  (*in collaboration with Diffractive group*) — J. Frantz, J.Roche, S. Fegan, P. Steinberg

- Timelike Compton Scattering — *Open*
- Exclusive meson production by charged current (e+p -> υ_e p⁻p) — *Open*

Diffractive & Tagging WG

Physics Topics

- **Inclusive diffraction**
  - Steering card ready,

- **Coherent vector meson photo- and electro-production**
  - Steering card ready,

- **κ/π Structure Function**
  - **K/π PID**
  - DEMP pregenerated data ready,

- **u-channel π^0 Production**
  - **Acceptance**
  - DEMP pregenerated data ready,

- **SRC Related studies: (C, D, He4, H3)**

All processes will contribute to the ZDC design and the Roman Pot

BSM & Electroweak WG

- PV physics (ongoing):
  - Managed to compile and run previous Djangoh code, physics analysis ongoing.

  Ref: https://arxiv.org/abs/1612.06927

  - Working with simulation team to produce smearing matrix using current ECCE detector configuration
  - Eventually will run full simulation once all physics outputs are defined
  - Goal:
    - Apv(e) $\rightarrow sin^2\theta_W$ (YR Fig.7.102); $F_1^{\gamma Z}, F_3^{\gamma Z}, C_{1q,2q}$
    - Apv(p) $\rightarrow g_1^{\gamma Z}, g_5^{\gamma Z}$

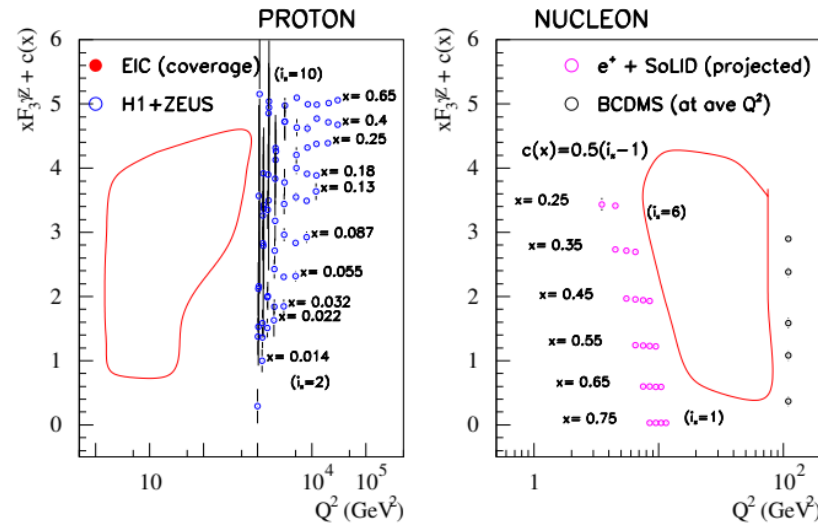- Charged Lepton Flavor Violation (just started):
  - working with simulation team on e$\rightarrow \tau$

- (planning): CC chiral structure, CC physics

- Long term: A(e$^+$e$^-$) $\rightarrow$ C_{3q} $F_3^{\gamma Z}$

Possible plot on $F_3^{\gamma Z}$ with 10 GeV + 100 GeV e$^-$p vs e$^-$D & e$^-$D vs e$^+$D :

Summary & Outlook

➢ Most working groups have started regular meeting

➢ Plan to use the meetings to facilitate efficient communication between the detector and physics working groups

(later this morning we will meet with the Calorimetry WG)

➢ Test simulation campaign underway (first samples being checked-out by working groups)

➢ June 15: 1st large simulation production (with few selected detector configurations)

➢ July 15: 2nd (and last) simulation production (optimized based on the analysis of 1st campaign)

Lots of open tasks for new collaborators to join !

Next simulation workshop: May 21
(great opportunity to new students and postdocs to get involved)