ECCE Physics Benchmarks Team IB Meeting Report

May 24th, 2021

Carlos Muñoz, Rosi Reed

Outline

- Physics Team Structure

- Communication Channels

- Second Simulation Tutorial

- Simulation Working Group

- Physics Priorities

- PWG Updates

Physics Team Working Groups

- **Inclusive reactions:**
    Tyler Kutz (MIT), 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

- Open Tasks https://wiki.bnl.gov/eicug/index.php/Open_Tasks

Mailing list: ecce-eic-phys-l

Mattermost channels: instant messaging

Discourse: forum-style format

Physics Working Group Meetings: https://indico.bnl.gov/category/346/

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: Wednesdays at 12:00 PM
- BSM & Electroweak: Tuesdays at 9:30 AM, Wednesdays 9:00 PM
- Inclusive Reactions: **Kick off meeting today** at PM + Wednesday 9:00AM
- Simulation Office Hours: Alternating between Tuesdays 2PM and Mondays 8PM
- Announcements/reminders sent to ecce-eic-phys-l mailing list

Second Simulation Tutorial

Second Simulation Tutorial Friday May 21st

- Slides and Recording can be found at: https://indico.bnl.gov/event/11719/

Topics and Speakers:

- Computing resources for ECCE - Cristiano Fanelli (MIT)

- Simulation workflow: from MC input samples to output DSTs - Cameron Dean (LANL)

- Structure/content of eval trees and DST files - Jin Huang (BNL)

- An example of physics analysis using the evaluators - Ralf Seidl (RIKEN)

- How to create/modify and analysis module for your study- Joe Osborn (ORNL)

- An example of a physics analysis workflow including the far-forward region - Wenliang Li (W&M)

- General Q&A (Computing + Simulations Team)

Simulation working group

1st test production completed ! (3 sets of 1M events for testing purposes)

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

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

Sim+Computing team cross check production results at **MIT BATES vs BNL SDCC**
- Test results for SIDIS track p_T spectrums are identical
- Next is to check possibilities of a simulation set to run at MIT

A large sample ($\gg$1M tracks) electron line shape scan run w/full detector sim -T. Kutz
- **Inclusive measurements can be factorized** with line shape in full sim event generator in fast simulation → high stat. inclusive sample
- Major improvement over the YR

PWG/DWG are **encouraged to run directly** which speed up the development cycle
- See Bill (Wenliang) Li's talk @ sims workshop as an example

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

Processes / Topics	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^+, $\sigma_{\gamma A}^{tot}$	charged curr. DIS, $\sigma_{\gamma A \to hX}$		$\sigma_{\gamma A}^{elast}$	$\sigma_{\gamma A}^{diffr}$

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

Inclusive WG

Kick-off Meeting is today at 2 pm EDT:
https://mit.zoom.us/j/92661341001

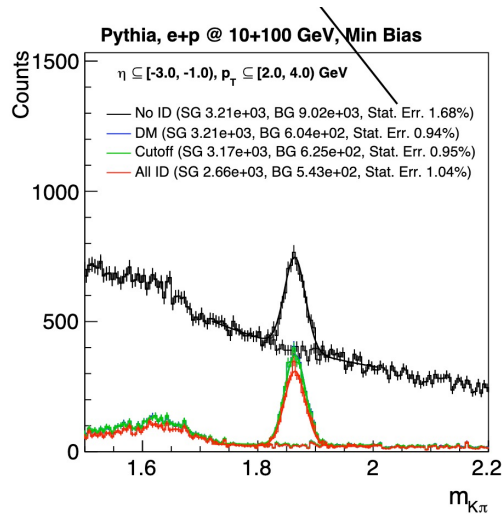New convener Tyler Kutz (tkutz@mit.edu, MIT) – Please contact him if you want to contribute to the Inclusive group.

Kinematic Coverage

Impact plot
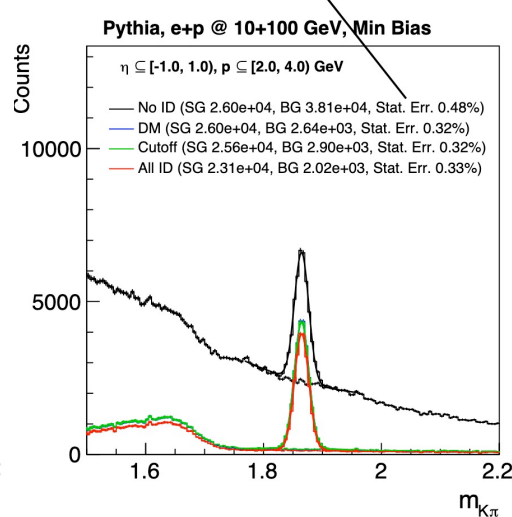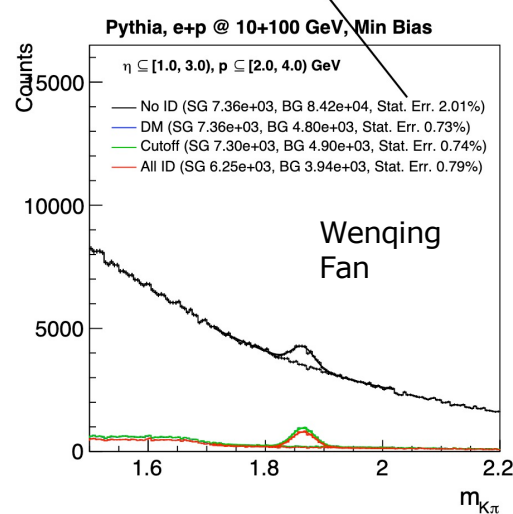
Jets & HF WG

https://indico.bnl.gov/event/11762/
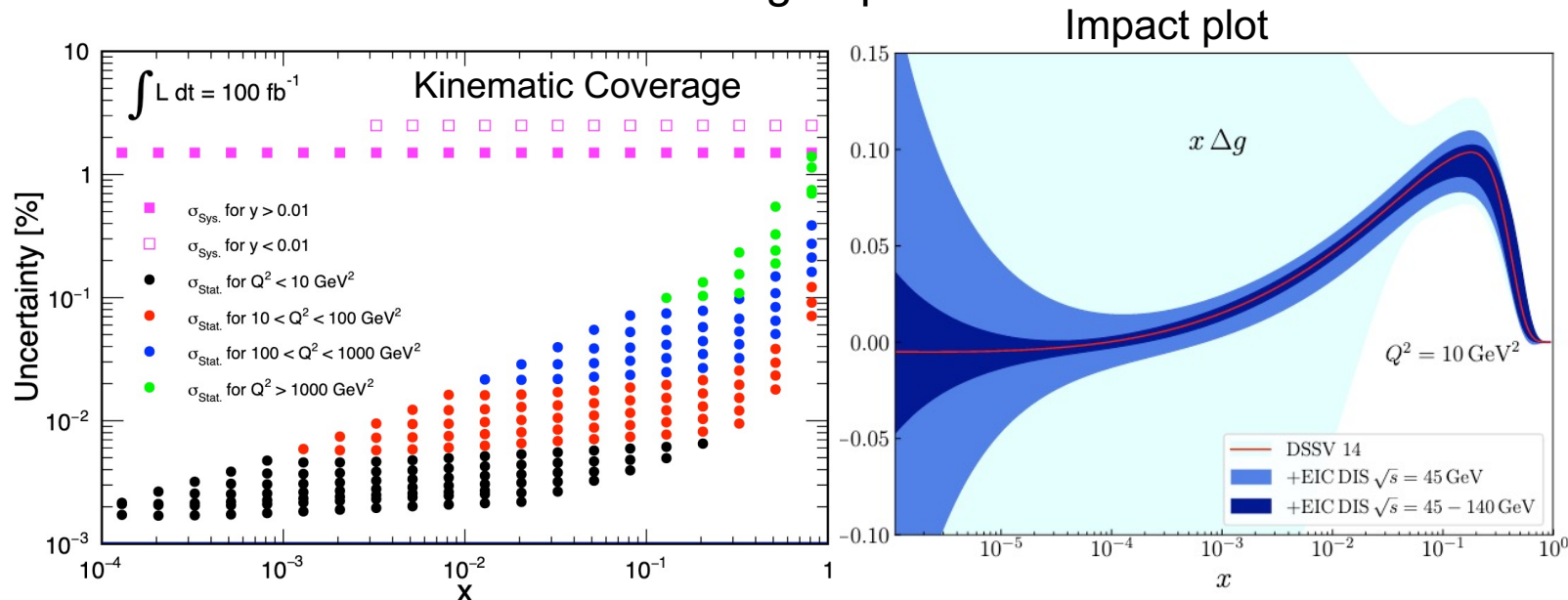
Studies of PID for D^0 (Check out slide for Λ_c and other details)

Backward

Mid-rapidity

Forward

Discussion on potential mapping of Jet/HF observables with key physics topics
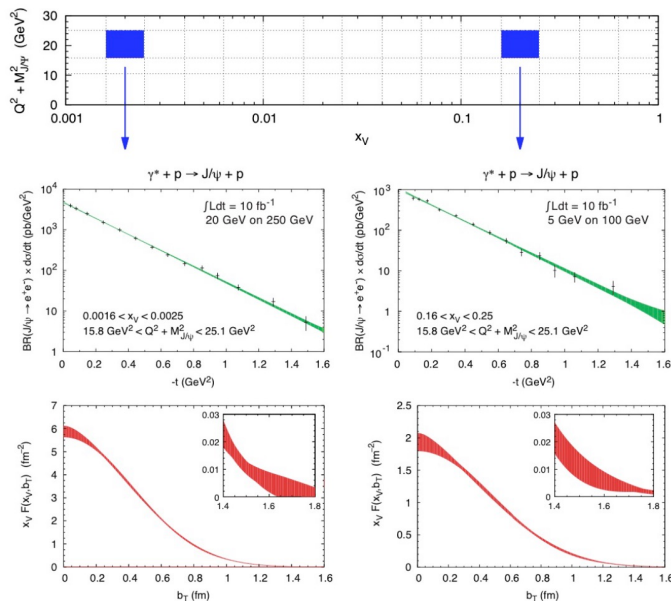
Exclusive Reactions WG

Simulations Tutorial caused cancelation of normal Friday Meeting

Selections from White paper of observables to be focused on for key physics topics
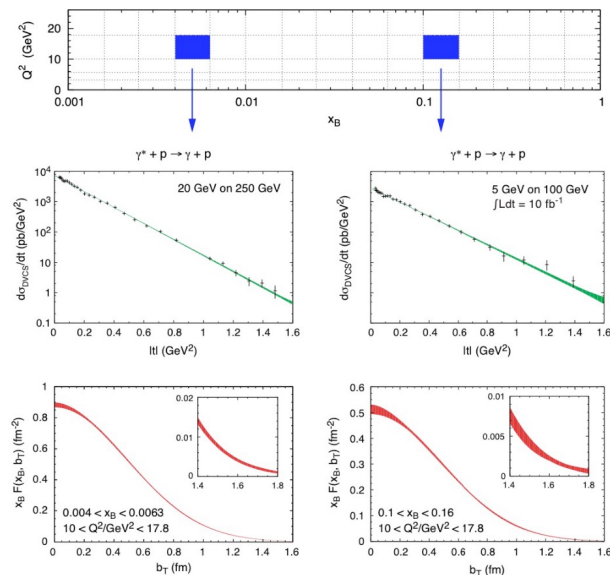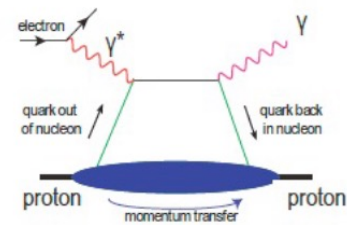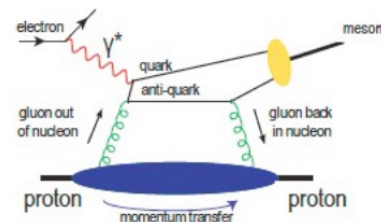
Diffractive & Tagging WG

Update at Simulations Tutorial (How to add a ZDC) -
https://indico.bnl.gov/event/11719/contributions/49425/attachments/
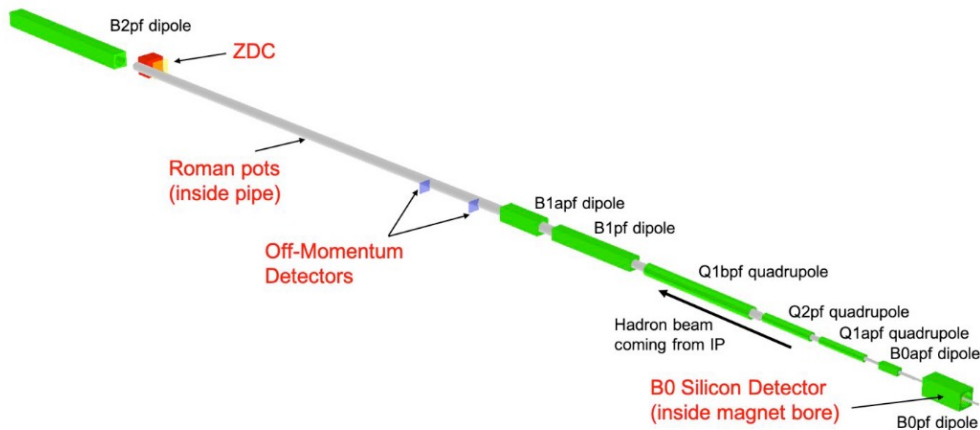34696/56346/ECCE_Simulation_Tutorial_Diff_Tagg.pdf

Slide from
Diffractive&Tagging
meeting on May 19

https://indico.bnl.gov/event/11893/
Diffraction: A Killer App for IP8 - Mark Baker (MDBPADS)
• Thoughts on secondary focus for IP8

Discussion Wenliang Li (College of William andMary)

All detector are there in fun4all
• macros/common/G4_hFarFwdBeamLine _EIC
• Bottle neck: there is no design for these detectors
• ZDC can be used for hit study and is the priority (design by May 30)
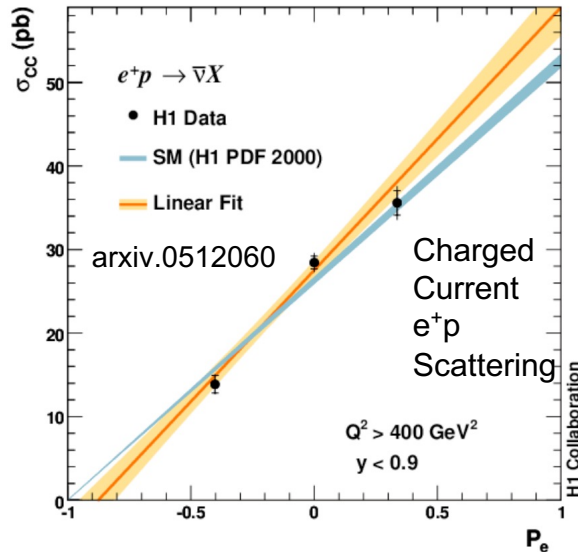
BSM & Electroweak WG

PV physics: focus on Apv(e)

- ep: $F_{1,3}$ (γZ)

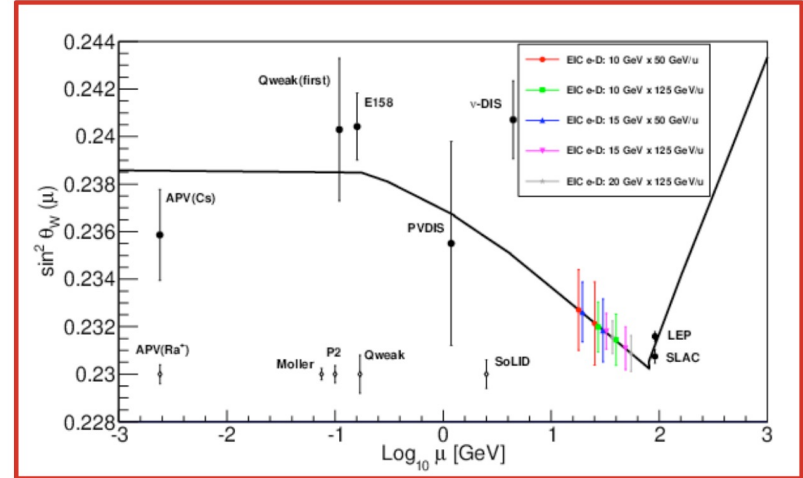- eD: $F_{1,3}$ (γZ), $\sin^2\theta_W$, C_1, C_2

CLFV (e → t): limit on leptoquarks

- e+p → τ+X, potential to set limit on e→τ transition

CC physics: CC xsec vs. Pe

https://arxiv.org/abs/1612.06927

arxiv.0512060
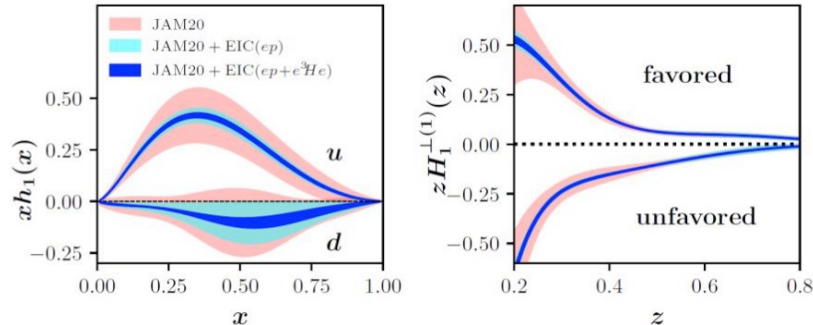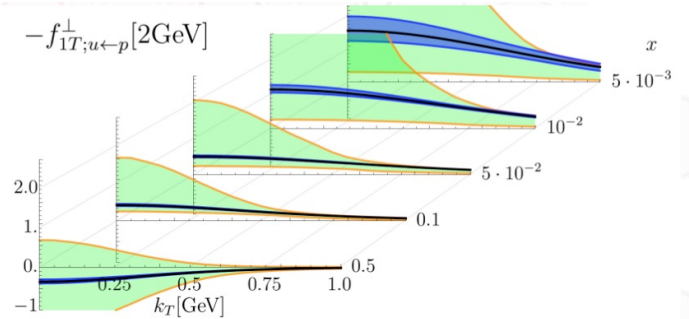
Charged
Current
e+p
Scattering

SDIS WG

Redo these YR analyses
- Need to take into account crossing angle and related acceptance/smearing effects
- Determine systematics via variation between perfect and smeared options
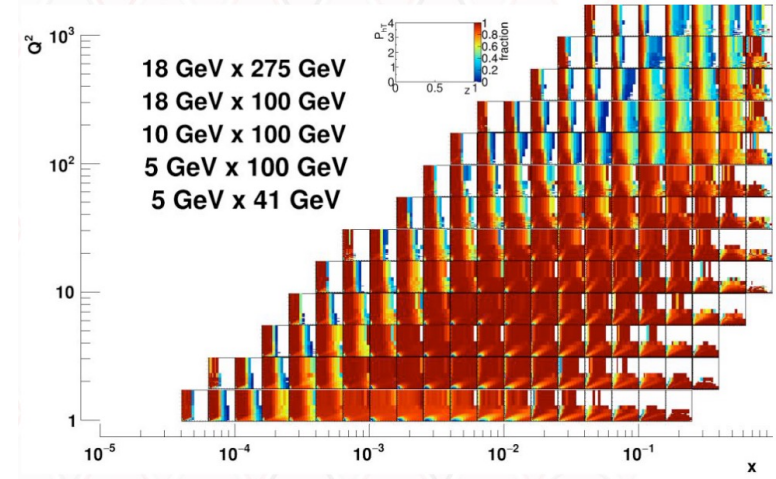- Extrapolate from some x-Q^2 bins to all as input for impact studies

YR 8.29 – Figure can be made now

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 7.53 (Sivers)

YR 7.54 (Transversity)

15

Summary & Outlook

- Much work is being done with all physics working groups meeting regularly
  - https://indico.bnl.gov/category/339/calendar
- Second Simulation Tutorial with details at:
  - https://indico.bnl.gov/event/11719/
- Observables need to be mapped to physics topics for the proposal
  - Span physics of the NAS Report and WP, based on observables from YR
- Next Physics Meeting will be right after the IB Meeting!
  - https://indico.bnl.gov/event/11611/

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 ←→ 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**