

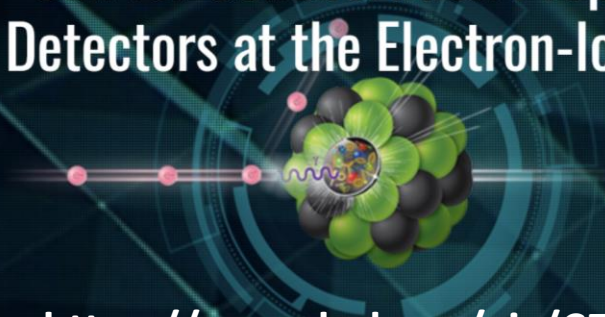
EIC Comprehensive Chromodynamics Experiment



Tanja Horn (for the SC)



Call for Collaboration Proposals for Detectors at the Electron-Ion Collider



<https://www.bnl.gov/eic/CFC.php>

Brookhaven National Laboratory (BNL) and the Thomas Jefferson National Accelerator Facility (JLab) are pleased to announce the Call for Collaboration Proposals for Detectors to be located at the Electron-Ion Collider (EIC). The EIC will have the capacity to host two interaction regions, each with a corresponding detector. It is expected that each of these two detectors would be represented by a Collaboration.

Detector 1 is within the scope of the EIC project and should be based on the "reference" detector described by the EIC User Group (EICUG) in the Yellow Report (YR) and included in the EIC Conceptual Design Report (CDR). This detector must satisfy the requirements of the EIC "mission need" statement based on the EIC community White Paper and the National Academies of Science (NAS) 2018 report. US Federal funds are expected to support most but not all of the acquisition of Detector 1. It is currently planned to be located at Interaction Point 6 (IP6) on the Relativistic Heavy-Ion Collider.

Detector 2 could be a complementary detector that may focus on optimizing particular science topics or address science topics beyond those described in the White Paper and the National Academies of Science (NAS) 2018 report. Detector 2 would reside at a different Interaction Point from Detector 1 and is currently not within the EIC project scope. Routes to make Detector 2 and a second interaction region possible are being explored.

From FAQ: <https://indico.bnl.gov/event/10974/contributions/46304/>

the impl
Interest

meet ALL the individual resolution requirements defined by the YR be rejected, or will they be evaluated on the broad physics reach and performance for physics observables?

The proposals for Detector 1 and Detector 2 will be evaluated on their physics reach, depth and the detector performance for the science goals described in the EIC White Paper and National Academies of Science (NAS) 2018 report and beyond. Individual resolution requirements might differ, but as the Yellow Report physics requirements have been obtained through fast simulations integrating all subdetector performances at once, performances close to what is described in the Yellow Report will be needed to reach the performance goals.



Call came out on
March 8, 2021

Documents
posted

Further
information in
the FAQ section

Will proposals that don't

ECCE Overview and Strategy

ECCE shares the vision of the Nuclear Physics community that the EIC science mission is best served by two detectors.

ECCE is investigating a detector based on an existing 1.5T solenoid in both EIC interaction regions, ready for the beginning of EIC accelerator operation.

ECCE consortium comprises 55 institutions assembled around the idea of developing an EIC detector envisioned to offer full energy coverage and an optimized far forward detection region.

ECCE consortium will respond to the EIC call for detector proposals with a plan to address the full range of EIC physics outlined in the NAS study and the Yellow Report, as the EIC project detector (“Detector 1”).

ECCE is open to all to participate - freedom of choice to also work on other proposals



ECCE
*EIC Comprehensive
Chromodynamics
Experiment*

<https://www.ecce-eic.org/>

We are open for all members of the EIC science community to join our effort.

Please contact:
Or Hen (hen@mit.edu)
Tanja Horn (horn@cu.edu)
John Lajoie (lajoie@iastate.edu)

for details on how you can get involved!

You can also sign up to the ECCE mailing lists [here](#). These include:

- ecce-eic-public-l** : ECCE consortium public announcements
- ecce-eic-ib-l** : Institutional board announcements
- ecce-eic-dei-l** : Diversity, Equity and Inclusion Team discussions and announcements
- ecce-eic-det-l** : Detector Team discussions and announcements
- ecce-eic-phys-l** : Physics Benchmark Team discussions and announcements
- ecce-eic-prop-l** : Proposal Team discussions and announcements



ECCE Highlights

Much activity – moving at a rapid pace to meet the global timeframe



☐ 26 February: first IB meeting



☐ 5 March: IB approves the Consortium Structure

☐ March 2021



☐ Team Conveners were selected



☐ Additional institutions joined the effort – now at 55 institutions



☐ Team Conveners added WG co-conveners



☐ Mailing lists were set up



☐ Indico pages were set up



☐ 2 April: Simulations Workshop was held



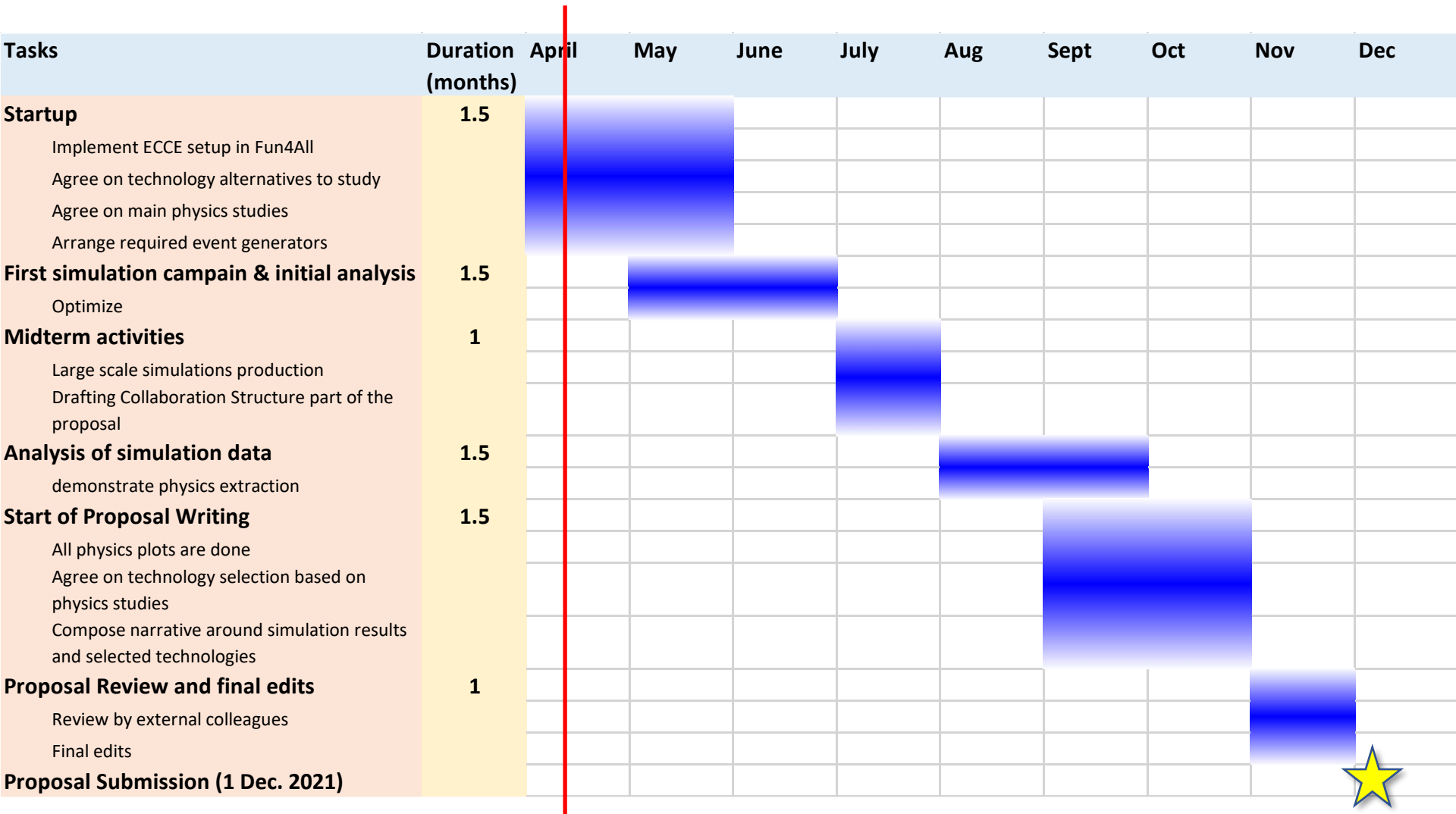
☐ 9 April: PWG/DWG meetings and simulation efforts

ECCE Anticipated Future Highlights

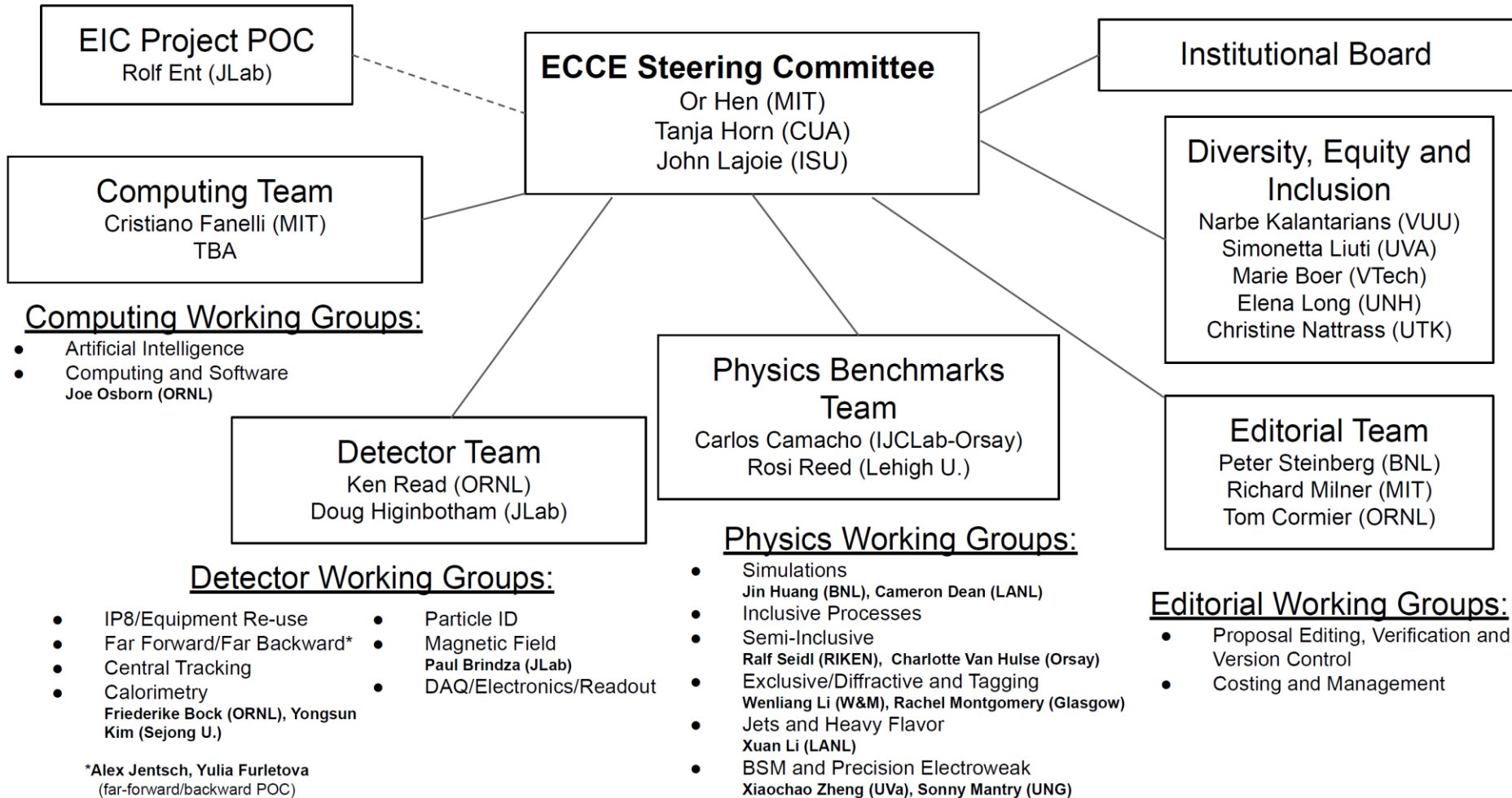
- ❑ April 1st - May 15th [1.5 months]:
 - Finish implementing ECCE setup in Fun4All.
 - Agree on technology alternatives to study with Fun4All.
 - Agree on main physics studies to be done
 - Arrange required event generators.
- ❑ May 15st - July 1st [1.5 months]:
 - First simulation campaign & initial analysis.
 - Debug the many things that won't go right the first time :)
- ❑ July 1st - Aug. 1st [1 month]:
 - Large scale simulations production.
 - Drafting 'collaboration structure' part of the proposal by writing team.
- ❑ Aug. 1st - Sep. 15th [1.5 months]:
 - Analysis of simulation data to demonstrate physics extraction.
 - Presentation at August 2-6 EIC UG meeting
- ❑ Sep. 15th - Nov. 1st [1.5 months]:
 - All physics 'plots' are done.
 - Agree on technology selection based on physics studies results.
 - Compose narrative around simulation results and selected technologies.
- ❑ Nov. 1st - Nov. 30th [1 month]:
 - Proposal review by external colleagues.
 - Final edits

ECCE Timeline

Today, 12 April



Consortium Structure

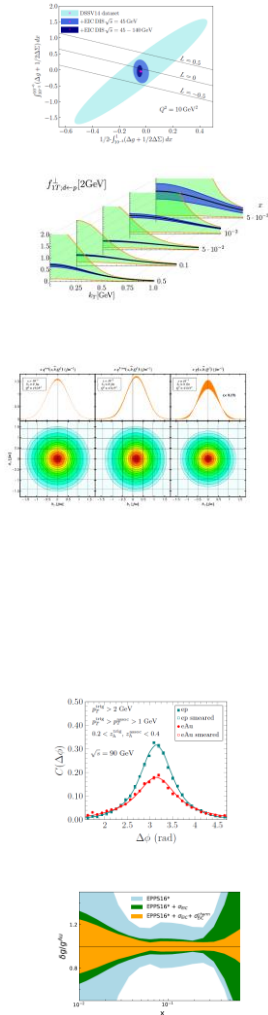


Much activity since 26 Feb IB meeting, e.g., added: Computing Team, EIC Project POC, Team conveners added WG co-conveners (ongoing)

Physics Studies Focus: a first look

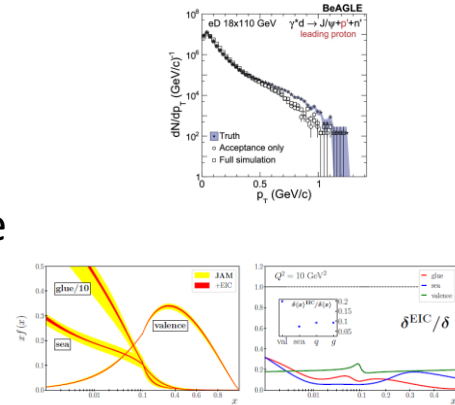
Plots to demonstrate EIC NAS Study, White Paper

- Origin of Nucleon Spin
- Confined motion of partons
- 3D imaging quarks and gluons
- Nucleon mass
- High gluon densities in nuclei
- Quarks and gluons in the nucleus



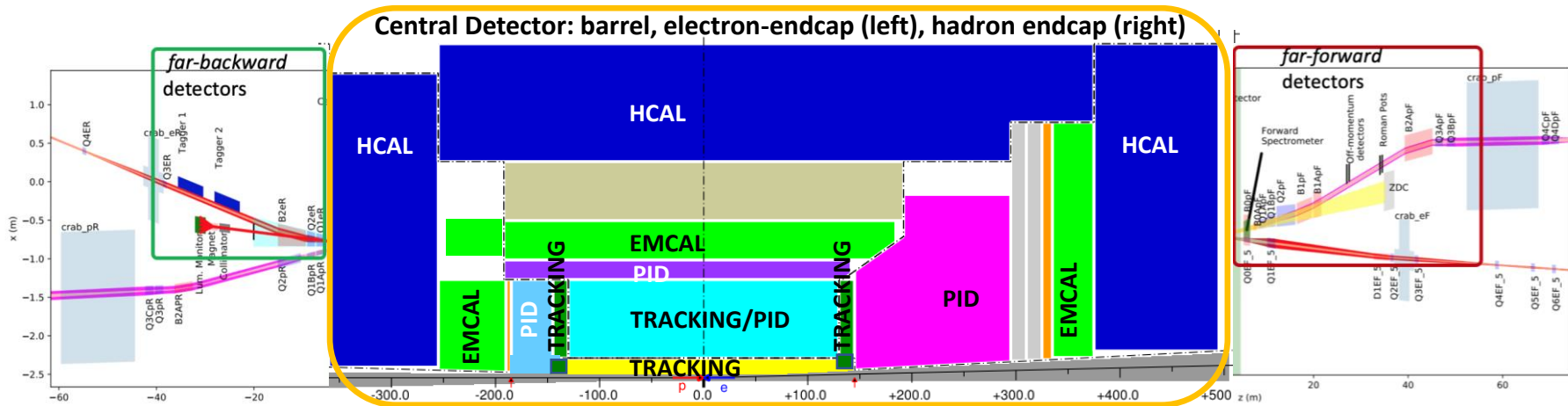
Plots to show unique ECCE strengths

- Light-ion tagging
- Pion/Kaon structure
- Diffractive jets?
- nuclear modifications and in-medium evolution
 - D/D* reconstruction and heavy-flavor in jets.
 - showcasing ECCE lower pT-cutoff due to the 1.5T field



EIC detector – general features

EIC Central Features Detector 2D: 3 integrated regions: Far-backward, Central, Far-forward



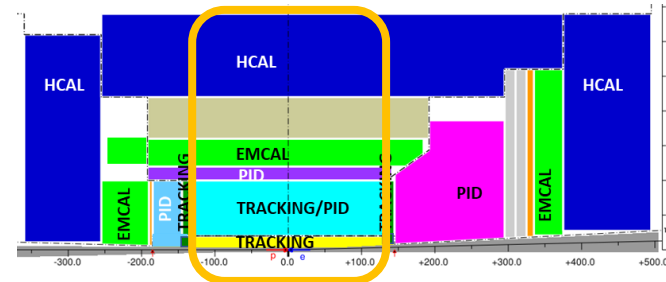
Detector Technologies from Yellow Report

system	system components	reference detectors	detectors, alternative options considered by the community			
tracking	vertex	MAPS, 20 um pitch	MAPS, 10 um pitch			
	barrel	TPC	TPC surrounded by a microR-WELL tracker	MAPS, 20 um pitch	set of coaxial cylindrical MICROMEGAS	
	forward & backward	MAPS, 20 um pitch	GEMs with Cr electrodes			
Ecal	barrel	Pb/Sc Shashlyk	SciGlass	W powder/ScFi	W/Sc Shashlyk	
	forward	W powder/ScFi	SciGlass	Pb/Sc Shashlyk	W/Sc Shashlyk	
	backward, inner	PbWO ₄	SciGlass			
	backward, outer	SciGlass	PbWO ₄	W powder/ScFi	W/Sc Shashlyk	Pb/Sc Shashlyk
h-PID	barrel	High performance DIRC & dE/dx (TPC)	reuse of BABAR DIRC bars	fine resolution TOF		
	forward, high p	fluorocarbon gaseous RICH	double RICH combining aerogel and fluorocarbon	high pressure Ar RICH		
	forward, medium p	aerogel				
	forward, low p	TOF	dE/dx			
	backward	modular RICH (aerogel)				
e/h separation at low p	forward	TOF & aerogel & gaseous RICH	adding TRD			
	backward	modular RICH & TRD	Hadron Blind Detector			
HCal	barrel	Fe/Sc	RPC/DHCAL	Pb/Sc		
	forward	Fe/Sc	RPC/DHCAL	Pb/Sc		
	backward	Fe/Sc	RPC/DHCAL	Pb/Sc		

ECCE Detector – central barrel

FOR CENTRAL BARREL NEED:

- **Tracking** resolution pT
- **Tracking** resolution vertex
- **Electron PID** (e/h separation)
- **Hadron PID**
- Solenoid (**reuse**) **bore diameter fixed**: 2.8 m – constraint for detector technology selection



ECCE CENTRAL BARREL STRAWMAN

Tracking: Silicon barrel tracker

- Compact
- Allows to focus on projectivity – no impact of nonuniformity of magnetic field in central region

Electron PID: SciGlass (backup: W/Sc (Pb/Sc) shashlik)

- SciGlass remains to be demonstrated
- Several backup options – lower resolution though

h-PID: hpDIRC & AC-LGAD

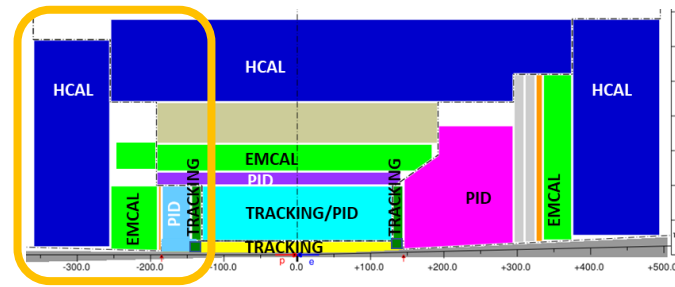
- Compact
- AC-LGAD never been shown for barrel configuration
- AC-LGAD backup: dE/dx (needs more space)

HCAL: magnet steel (**reuse**) - Fe/Sc

Space budget:

Function	Maximum [cm]
Tracking (incl. 5 cm support)	50
Hadron particle identification	10
Low energy particle identification	15
EM Calorimetry	50
PID & EMCal support structure	15
Total	140

ECCE Detector – electron endcap



FOR ELECTRON ENDCAP NEED:

- **Tracking** resolution
- **Electron Detection with high precision**
- **Hadron PID**

ECCE ELECTRON ENDCAP STRAWMAN

Tracking: MAPS, Micro Pattern Gaseous Detectors (MPGD)

Electron Detection: PWO&SciGlass

- Inner part: PWO crystals (reuse some)
- Outer part: SciGlass (backup PbGl)

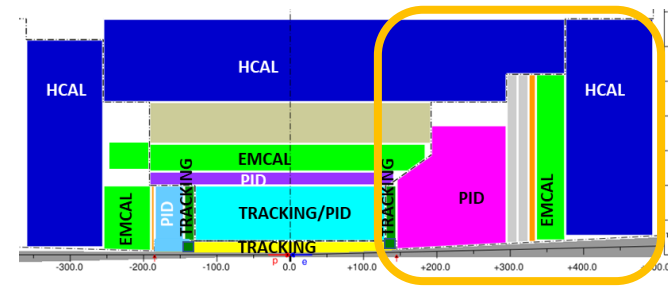
h-PID: mRICH

- From yellow report

HCAL: Steel from magnet or Pb/Sc or Fe/Sc

- Not instrumented and only serve as flux return?
- Instrumented with reduced thickness – lower particle energies

ECCE Detector – hadron endcap



FOR HADRON ENDCAP NEED:

- Tracking forward resolution
- h-PID
- Reasonable electron PID
- Good hadron calorimetry and desire for high resolution calorimetry

ECCE HADRON ENDCAP STRAWMAN

Tracking: MAPS, Micro Pattern Gaseous Detectors (MPGD)

h-PID: dRICH&TOF

e/h separation: TOF & aerogel

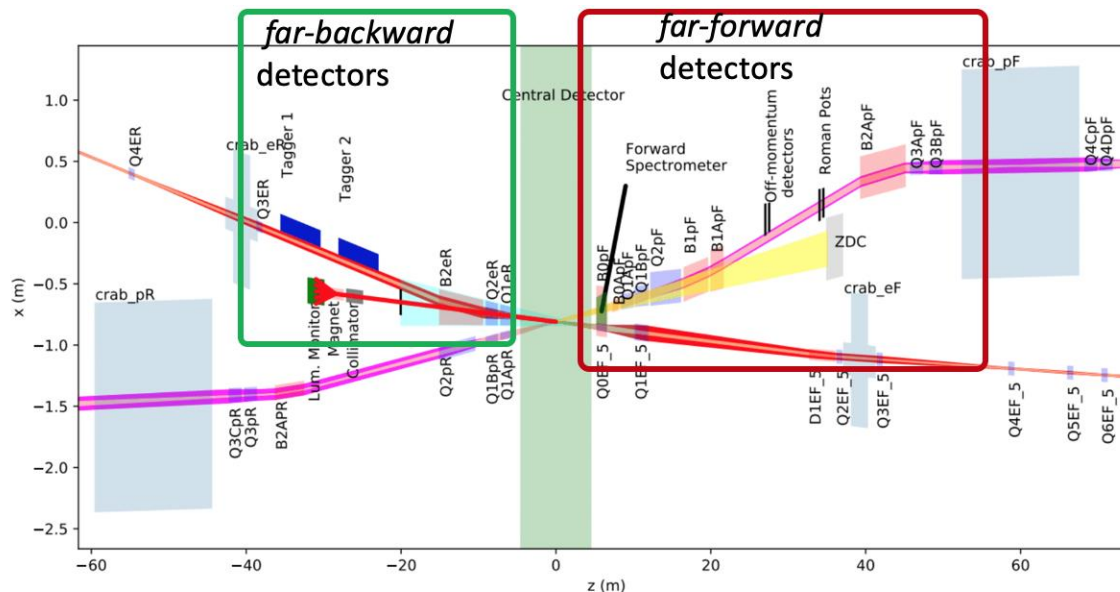
- TRD to separate electrons from high momentum hadrons?

Electron PID: W/ScFi, Pb/Sc or W/Sc shashlik

HCAL: Pb/Sc or Fe/Sc

- Alternative for improved resolution: dual readout, high-granularity

ECCE Detector – far forward/backward



Detector Technologies (from YR)

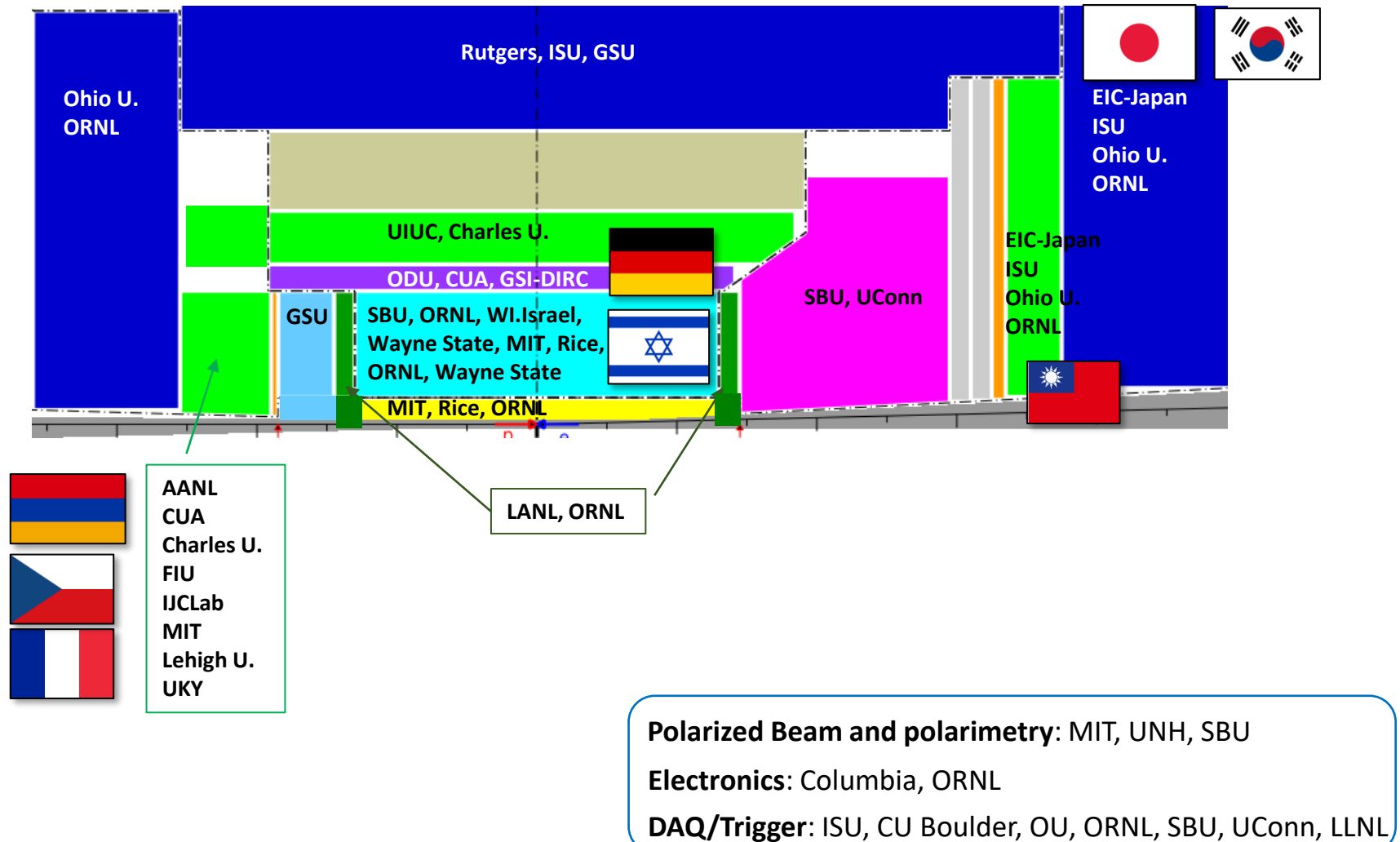
FAR BACKWARD DETECTORS

- low-Q2 tagger
 - Lumi-detector
- Lepton polarimetry
hadron polarimetry

FAR FORWARD DETECTORS

- ZDC – **Si/W & PWO (SciGlass)**
 - Roman Pots – **Silicon sensors, AC-LGADs**
 - Off-momentum det. – **Silicon sensors**
 - B0-trackers – **MAPS & timing layers**
- Lepton polarimetry
hadron polarimetry

Technology interests – central detector

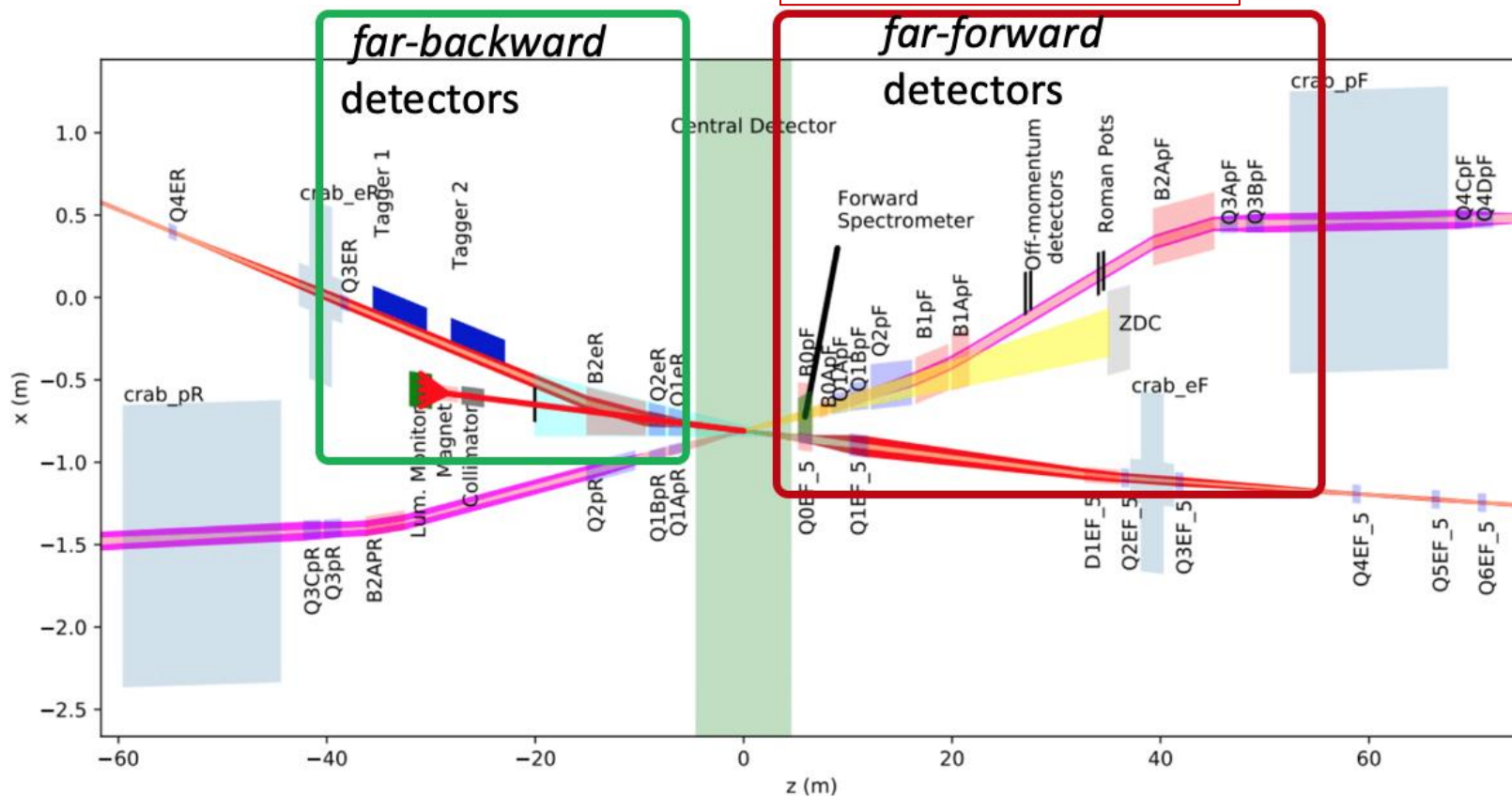


Technology interests - FF/FB Detector



Glasgow U., ODU

BGU/Israel, MIT, ORNL, UIUC,
IJCLab-Orsay, EIC-Japan, TAU/Israel,
UVA, GWU, MIT-BATES, HUIJ/Israel



ECCE IB Meetings Schedule

❑ Will take every two weeks – the next four meetings are:

❑ Monday April 26

❑ Monday May 10

❑ Monday May 24

❑ Monday June 7

❑ Suggested meeting times – rotating to accommodate time zones

Date	EDT	UK	Europe	Japan
April 26	4pm	9pm	10pm	5am
May 10	5am	10am	11am	6pm
May 24	8am	1pm	2pm	9pm
June 7	4pm	9pm	10pm	5am
...				

ECCE 2nd IB Meeting Agenda

- ☐ Updates since last IB meeting
- ☐ The Teams will present their initial plans to accomplish the goals associated with the timeline and how they will organize themselves
- ☐ Next steps: important discussion about the timeline and open tasks and opportunities

08:00	→ 08:30	ECCE News and Status
08:30	→ 08:45	Discussion
08:45	→ 09:00	Editorial Team
08:45		Editorial Team Report Speakers: Peter Steinberg (BNL) , Richard Milner (MIT) , Tom Cormier (ORNL)
09:00	→ 09:15	Diversity, Equity and Inclusion
09:00		DE&I Report Speakers: Elena Long (University of New Hampshire) , Marie BOER, simonetta liuti (universoty of virginia)
09:15	→ 09:45	Physics Benchmark Team
09:15		Physics Benchmark Team Report ¶ Speakers: Carlos Munoz Camacho (IJCLab-Orsay (France)) , Rosi Reed (Lehigh University)
	09:30	Discussion
09:45	→ 10:00	Computing Team
09:45		Computing Team Report Speaker: Cristiano Fanelli (MIT)
10:00	→ 10:30	Detector Team
10:00		Detector Team Report Speakers: Douglas Higinbotham (Jefferson Lab) , Kenneth Read (Oak Ridge National Laboratory)
	10:15	Discussion
10:30	→ 11:00	Further Discussion

You can make ECCE happen!

- ❑ ECCE offers a great start to realizing the EIC Science Program.
- ❑ Ongoing activities are the first steps in designing ECCE and evaluating its ability to address the EIC science mission
- ❑ Nothing is set in stone – your participation defines ECCE
 - We need your input and creativity
 - This is a once in a lifetime opportunity

Enjoy the workshop!

Mailing lists: <https://lists.bnl.gov/mailman/listinfo>

ecce-eic-public-l : ECCE consortium public announcements

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ecce-eic-dei-l : Diversity, Equity and Inclusion Team discussions and announcements

ecce-eic-det-l : Detector Team discussions and announcements

ecce-eic-phys-l : Physics Benchmark Team discussions and announcements

ecce-eic-prop-l : Proposal Team discussions and announcements

<https://www.ecce-eic.org/>