The 2nd Detector + IR at the EIC

Perspectives from the EICUG steering committee

July 30, 2023

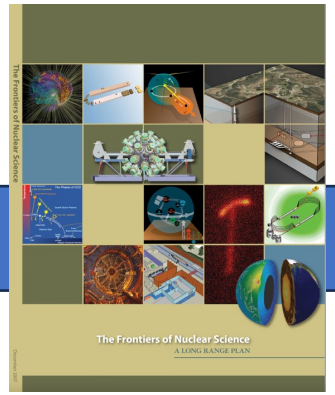
Maximizing the Scientific Output of the EIC

Early EIC designs and discussions in NSAC and NAS documents refer to ***two or more interaction regions.***

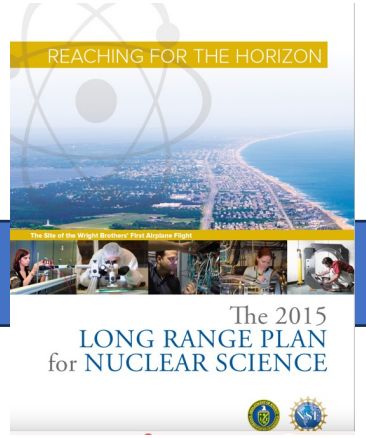
Broad support for a 2nd Detector led EIC Users Group to develop the case the Yellow Report and then a brochure *THE ELECTRON-ION COLLIDER, The Benefits of Two Detectors*

"A strong case for ***two complementary general-purpose detectors*** has been made during the panel review"

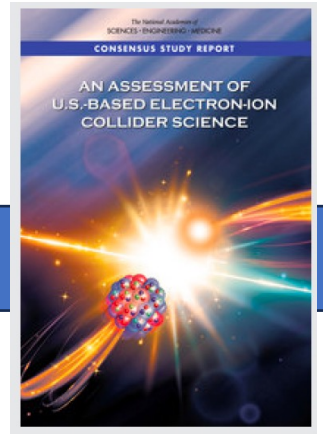
"As laid out in the section 2.1 on physics performance, ***an IR with a secondary focus can significantly broaden the physics scope and output of the EIC.***"



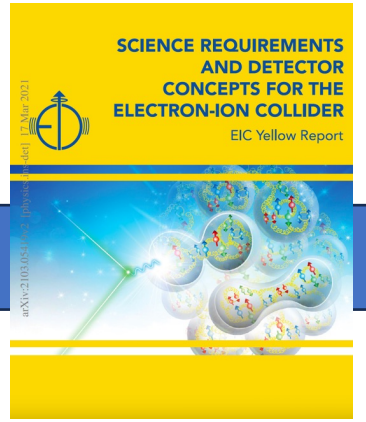
2007



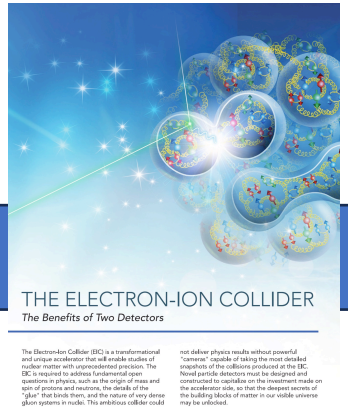
2015



2018



2020



2021

EIC Detector Proposal Advisory Panel Report

2022

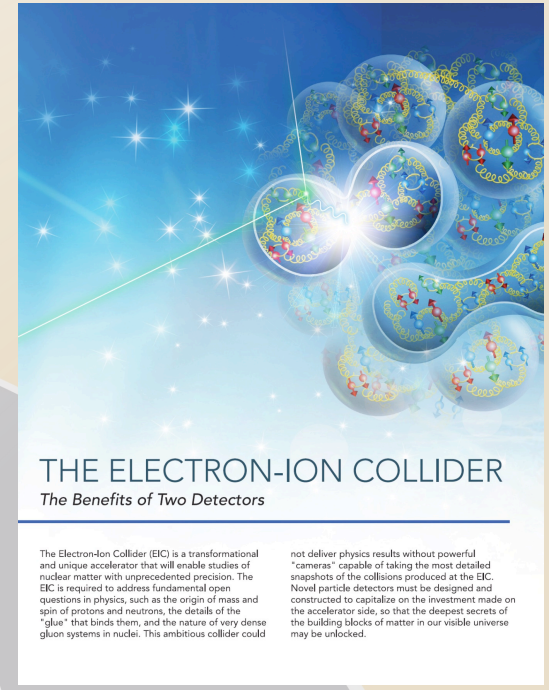
EICUG 2nd Detector/IP8 Milestones

EICUG ANNUAL MEETING SUMMER 2021

- Richard Milner and Rolf Ent lead a discussion about the role of a 2nd IR and Detector at the EIC.

SPRING 2022

- EICUG-SC expanded and codified the arguments, producing a glossy brochure that was distributed to same international funding agencies that received copies of the yellow report, as well as with the DPAP committee.



- DPAP Report:

  "A strong case for ***two complementary general-purpose detectors*** has been made during the panel review"

  "…requires a ***well-chosen balance between optimization as general-purpose detector versus partial specialization*** and the ability to cross check the other detector for a broad range of measurements. The design of a second detector should be chosen with these criteria in mind."

  "The time required for its design and construction may offer ***opportunities for benefiting from technological progress***."

  "As laid out in the section 2.1 on physics performance, ***an IR with a secondary focus can significantly broaden the physics scope and output of the EIC***."

EICUG 2nd Detector/IP8 Milestones

EICUG ANNUAL MEETING 2022

- The steering committee interpreted the support from the users group discussions and from the DPAP report as a mandate to continue the detector2/IP8 effort.
- Formed a working group from volunteers
- Added physics and detector conveners in spring of 2023

December 2022

- CNFS Workshop focusing on cross checks of key measurements & potential discoveries and new opportunities enabled by unique features of a 2nd detector such as the 2nd focus in IR8.

May 2022

- 1st International Workshop on Detector II focused on identifying areas of opportunities for detector components and initial areas of physics focus.

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Anselm Vossen (Duke/JLAB)

Thomas Ulrich (BNL/Yale)

Pawel Nadel-Turonski (CFNS/SBU)

Simonetta Liuti (UVA)

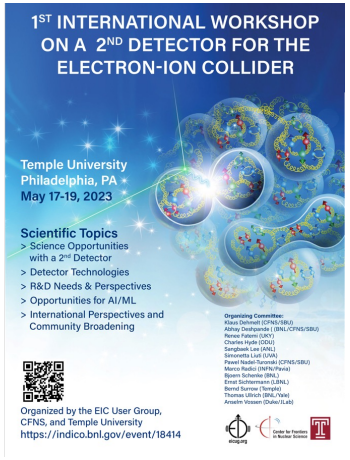
Detector WG

- Klaus Dehmelt (CFNS/SBU)
- Ernst Sichtermann (LBNL)

Physics WG

- Charles Hyde (ODU)
- Bjoern Schenke (BNL)

Unique opportunities for Det II @ IP8



A. **MAGNETIC FIELD** - Solenoid field up to 3T, allowing for high resolution momentum reconstruction for charged particles.

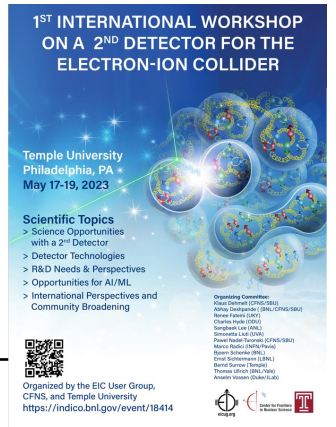
B. **EXTENDED COVERAGE** for precision electromagnetic calorimetry - important for DVCS on nuclei

C. **MUONS** – enhanced muon ID in backward and barrel region.

D. **BACKWARD HADRONIC CALO** - Low-x physics, reconstruction of current jets in the approach to saturation

E. **SECONDARY FOCUS** - tagging for nearly all ion fragments and extended acceptance for low pT/ low x protons. Enables detection of short-lived rare isotopes.

Golden Channels Strawman



CHANNEL	PHYSICS	DETECTOR II OPPORTUNITY
Diffractive dijet	Wigner Distribution	detection of forward scattered proton/nucleus + detection of low p_T particles
DVCS on nuclei	Nuclear GPDs	High resolution photon + detection of forward scattered proton/nucleus
Baryon/Charge Stopping	Origin of Baryon # in QCD	PID and detection for low p_T pi/K/p
F_2 at low x and Q^2	Probes transition from partonic to color dipole regime	Maximize Q^2 tagger down to 0.1 GeV and integrate into IR.
Coherent VM Production	Nuclear shadowing and saturation	High resolution tracking for precision t reconstruction

These channels are just a starting point, a way to initially focus activities within the group. Additional ideas and efforts are welcome!

Next Steps

Develop concrete physics projections for selected channels

- Identify people for each channel
- Leverage ePIC software & simulation structure
- Start with magnetic field - study effect of field + tracking choices on tracks in backward region
- Explore complementarity with ePIC technologies – mRICH, SciGlass etc.

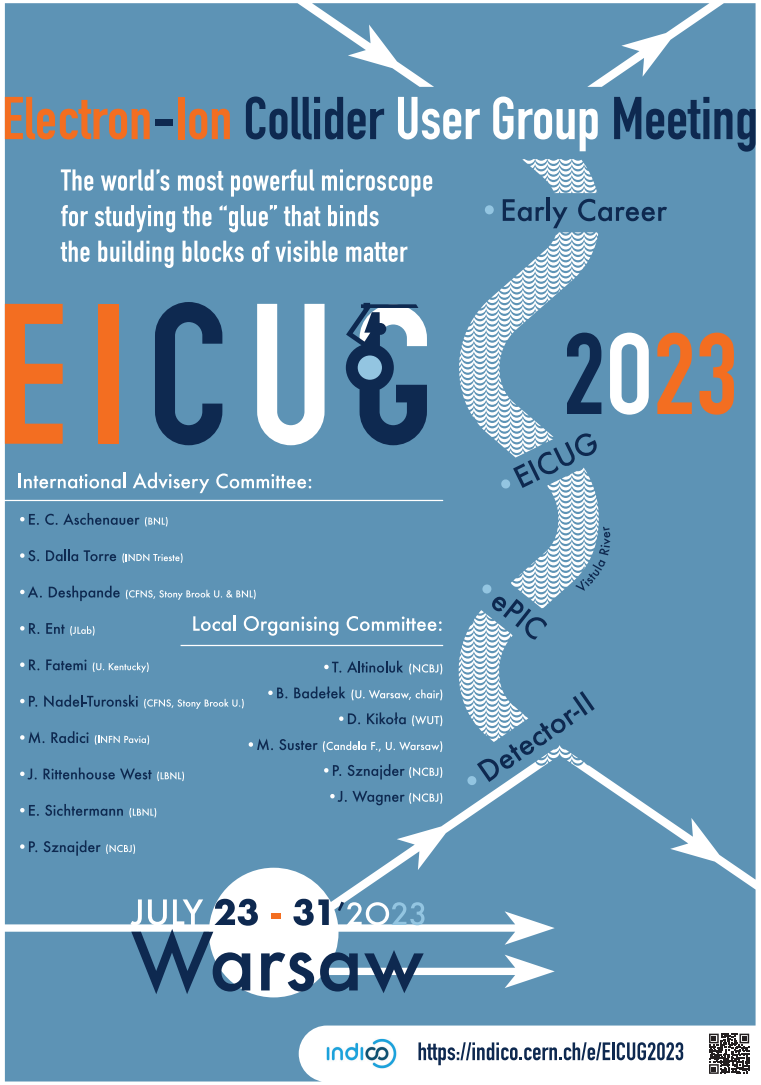
Recruit new institutions

- Goal is to engage institutions that are interested in EIC, but on an extended timeline, after the day 1 commissioning of ePIC.
- Informally contact colleagues we know to gauge interest and possible involvement. Explore possibility of remote workshop on DetII/IP8.
- Maintain close communication with project so as to avoid mixed or confusing messages to potential international partner.

Keep an ear to the ground

- Stay engaged in the entire EIC process - the next few years will be critical!
- Stay focused and flexible.

- Thank you for joining us for the detector II component of the EICUG Annual Meeting.
- **Thank you** to our LOC for accommodating us!
- Please help us bring new ideas to the table and sign-up to work on your favorite high priority channel for a 2nd detector.
- This is another opportunity to help shape the future physics scope at the EIC.



Backup

Charge for Detector II/IP8 Working Group

1. Engage the broader community, ***including theorists, accelerator physicists and ePIC experimentalists***, to fully develop projections for the portfolio of measurements that are complementary to the ePIC physics program, including those that capitalize on the implementation of the secondary focus.

2. Work with the EICUG Steering Committee and Project to ***recruit new institutions*** and establish a diverse and vibrant 2nd Detector working group.

3. Utilize the extended design period for Detector 2 to identify groups that will focus on ***R&D for emerging technologies*** that could provide another aspect of complementarity to ePIC.

4. Facilitate the development of a ***unified concept*** for a general-purpose detector at IR8. In particular, the 2nd detector should be complementary to the project detector at IR6 and may capitalize on the possibility of a secondary focus at IR8.