EIC 2ND DETECTOR AND TECHNOLOGY

SANGBAEK LEE

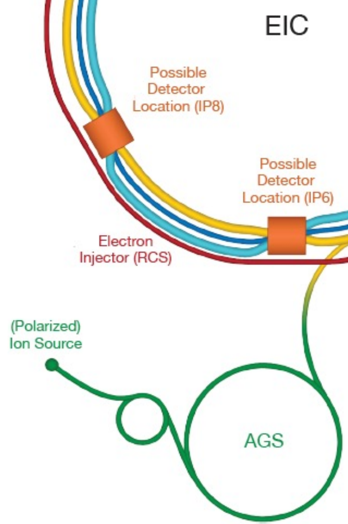
New Detectors and Technology Workshop @ RHIC/AGS Users Meeting
Wednesday August 2, 2023

EIC DETECTOR-II/ IP8 WG AT EICUG

- Charge 3 of WG
  - "***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."

- Technology aspects have been discussed in many programs
  - Regular WG Meetings
  - Detector-II/IP8 Meeting @ EICUG Meeting 2023
  - 1st International Workshop on a 2nd Detector for the EIC, 2023
  - EICUG 2nd Detector Meeting, 2022
  - Hot and Cold QCD Town Hall Meeting 2022
  - EIC Yellow Report

- Broader overview for the 2nd detector at Bill's talk at 11:30 AM, Friday, 8/4.



▲Fig 1.1, *EIC YR*

2ND DETECTOR AS A HOST FOR NEW DETECTORS

- Promoting new detector ideas for the 2nd Detector that
  1. Lead to the success of the physics programs
  2. Boost the advantages of IP8 secondary focus

- EIC-Related Generic Detector R&D
  - “This program will support advanced R&D on innovative detector concepts that either the one detector in the project scope or *a second detector* could incorporate.”, the official proposal guidelines

- Valuable design input from EICUG and EPIC on detector requirements

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EIC PHYSICS PROGRAMS

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

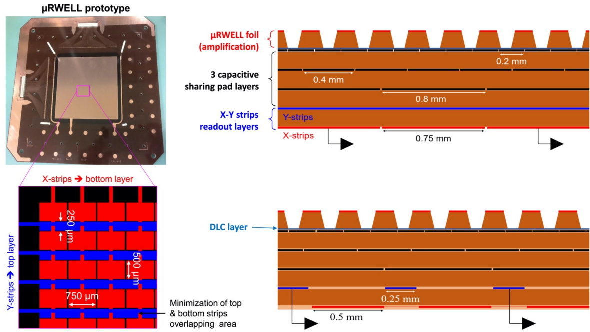
These channels are just a starting point, a way to initially focus activities within the group. Additional ideas and efforts are welcome!

◀ Renee Fatemi,
EICUG Annual meeting 2023

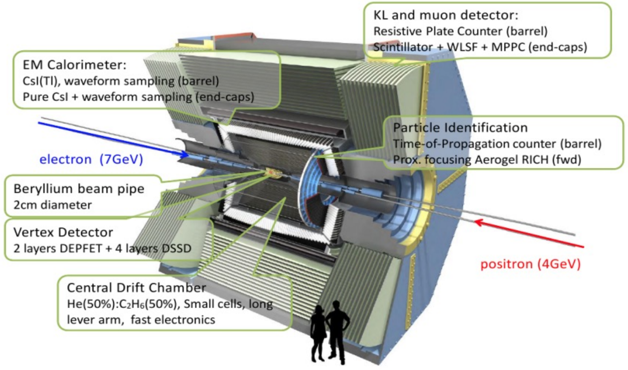
CASE STUDY) MUON DETECTION

- The benefits of μ detection include
  - VM production
  - Gluon TMDs with mesons
  - TCS and DDVCS
  - Semi-leptonic decay channels and BSM studies

- Detector examples
  - MPGDs (ex) EICGENR&D2023 16)
  - KLM-type detectors (ex) EICGENR&D2023 18)



▲Kondo Gnanvo et al., NIM A 1047 (2023) 167782



▲Belle, EPJ Web Conf. 245, 01040 (2020)

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IP8 SECONDARY FOCUS

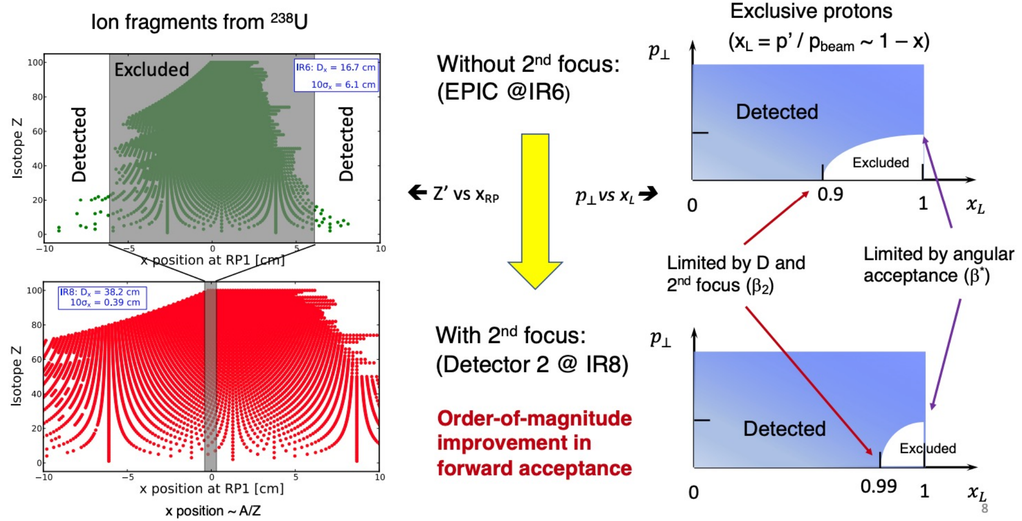
- Ion detections in the far forward region

Acceptance of the Far-Forward detectors At low x_B, the physical t_{min} for DVCS in ^{4}He cannot be reached by the detectors, therefore detector acceptances directly define the minimal t which can be experimentally accessed, which

◀ p. 363, EIC YR

- IP8 secondary focus improves the detector acceptance for ion detection

EIC far-forward acceptance with and without a 2nd focus



◀ Pawel Nadel-Turonski,
EICUG Annual meeting 2023

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EIC-RELATED GENERIC DETECTOR R&D PROGRAM

- Committee chair: Dave Mack (JLab)
  - Annual proposal opportunity at https://www.jlab.org/research/eic_rd_prgm
  - 15 approved proposals out of 27 received proposals for the FY22 cycle
  - 20 proposal received for FY23 by July 14 2023
  - See Dave’s slides for his talk at the EICUG meeting, 2023 https://indico.cern.ch/event/1238718/contributions/5485994/attachments/2692366/4672363/EICGENRandD_30July2023v3.pdf

- Support for the 2nd detector is one of the main objectives of the EIC-related generic R&D program.

- The program also helps to identify the detector expertise within the community

EIC-RELATED GENERIC DETECTOR R&D PROGRAM

EICGENRandD 2022 ID Number	Title	PI(s)	PI Institution(s)
12	Development of a Novel Readout Concept for an EIC DIRC	G. Kalicy (submitter)	CUA, USA
14	Tracking and PID with a GridPIX Detector	P. Garg	Stony Brook U., USA
16	Development of High Precision and Eco-friendly MRPC TOF Detector for EIC	Zhihong Ye, and Zhenyu Ye	Tsinghua U., China, and U. of Illinois at Chicago, USA
18	Superconducting Nanowire Detectors for the EIC	W. Armstrong	ANL, USA
19	EIC KLM R&D Proposal	A. Vossen	Duke U., USA
23	Development of Thin Gap MPGDs for EIC Trackers	K. Gnanvo	Jlab, USA

Related talks at Detector-II Workshop, May 2023

Talk	Location	Speaker	Time
hpDIRC	SERC 116, Temple University	Grzegorz Kalicy	13:00 - 13:20
Gridpix miniTPC	SERC 116, Temple University	Thomas Hemmick	13:00 - 13:20
AC-LGAD ToF	SERC 116, Temple University	Zhenyu Ye	13:40 - 14:00
Nanowire	SERC 116, Temple University	Whitney Armstrong	14:20 - 14:40
Research and development for an EIC 2nd detector KLM	SERC 116, Temple University	Simon Schneider	16:00 - 16:05
uRWELL PICOSEC	SERC 116, Temple University	Kondo Gnanvo	13:20 - 13:40

- The WG has invited the detector experts to discuss the technology concepts.
- For the full technology inventory, see Thomas Ullrich’s slides: https://indico.bnl.gov/event/18414/contributions/76157/attachments/47563/80668/EIC_Technology_Inventory_Temple.pdf

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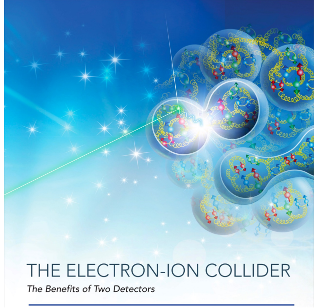
CONCLUSION



- EIC Detector 2 is a perfect place where the new detectors can benefit the EIC physics programs. I have curated some examples from the past meetings, but there are many more not discussed here.

- EIC Generic R&D has played important role.

- The WG always welcomes more input on the detector requirements! In particular, the input from RHIC/AGS users and the *New detectors and Technology* enthusiasts is extremely valuable! Please contact us at eic-det2-conveners-l@lists.bnl.gov or one of the conveners ▶

- Stay tuned for our upcoming events!

Sangbaek Lee (ANL)
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)

EXAMPLE OF EFFORTS TO IDENTIFY THE DETECTOR EXPERTISE OUTSIDE THE COMMUNITY

- Ex)

Magnet

Source: CERN/WP8, Snowmass, ECFA

Examples of magnets for future experiments that represent the engineering and R&D challenges:

Accelerator	Detector	B [T]	R[m]	L[m]	I [kA]	E [GJ]	comment
LHC	CMS	4	3	13	20	2.7	scaling up
LHC	ATLAS solenoid	2	1.2	5.3	7.8	0.04	scaling up
FCC-ee [Ch8-1]	CLD	2	3.7	7.4	20-30	0.5	scaling up
	IDEA	2	2.1	6	20	0.2	ultra light
CLIC [Ch8-2]	CLIC-detector	4	3.5	7.8	20	2.5	scaling up
FCC-hh [Ch8-3]	main solenoid	4	5	19	30	12.5	new scaling up
	forward solenoid	4	2.6	3.4	30	0.4	scaling up
IAXO [Ch8-4]	8 coil toroid	2.5	8x0.6	22	10	0.7	new toroid
MadMax [Ch8-5]	dipole	9	1.3	6.9	25	0.6	large volume

CERN: Magnet R&D (WP 8) on advanced powering, 4-T facility, instrumentation

Reality check: anything but low X/X_0 coils is probably beyond a 2nd EIC detector's timeframe - expect no miracles.

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◀ Thomas Ullrich,
Detector-II Workshop, May 2023