Update on the EIC-related Generic Detector R&D Program

D. Mack (Jlab)

7/28/22

Restart of EIC-related Generic Detector R&D Program

 Jefferson Lab, in association with Brookhaven National Lab and the DOE Office of Nuclear Physics, has restarted a generic detector R&D program to address the scientific requirements for measurements at the future Electron Ion Collider.

This program will support advanced R&D on innovative, cost-effective detector concepts which reduce risk and that either the one detector in the project scope or a second detector could incorporate. (The term "generic" conveys this duality.) The program is supported through R&D funds provided to Jefferson Lab by the DOE Office of Nuclear Physics, and is open to all segments of the EIC community. It is expected to be funded at an annual level of $2M, subject to availability of funds from DOE NP.

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The above is very formal, but I treat it as my Constitution when I'm unclear on something:

- EIC-related

- Aimed at Detector 1 upgrades or Detector 2

- Reduce risk (which the program has historically very broadly interpreted: improve resolution, improve PID, improve understanding of backgrounds, reduce heat generation in tightly packed components, model physics signals better, reduce use of materials that are bad for the environment, etc etc etc)

- Innovative (why devote precious funds to the obvious?)

- cost effective (if your amazing new scintillator costs US$2,000 per cm^3, maybe don't submit a proposal)

Administrative Details

 JLab's administration of the program draws on BNL's deep experience in running an earlier version of the program from 2011 to 2021.

Discussions with Thomas Ullrich (BNL, the previous PI of the BNL-managed program) and Patrizia Rossi (JLab, member of the previous committee) and Ivan Graf (DOE) and Rolf Ent (Jlab) and Glenn Young (BNL) have been very helpful.

Modest changes in administrative philosophy:
- David Dean (Jlab, Deputy Director of Science) envisions a healthier program if committee members have 2- and 3- year terms, as opposed to the previous standing committee.

- David Mack (Jlab) will serve both as PI <u>and</u> non-voting Chair, and will submit committee recommendations to David Dean for approval.

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Again, very formal. What it means:

- I try to bug a different person each week so none of them realize I'm actually a high maintenance toddler. They may not suspect how precious their occasional advice is to me.

- It's a lot of work for me: my guess is 25% of my total effort over a year.   During the present startup, it's more like 125%.
 But I'm really excited to do this EIC service work. I love cool detectors. But in the Hall C fixed target program at 1E39 luminosity, we turn SiPMs into activated silicon junk in a few hours. With a few amazing exceptions, our Hall C detector technology is generally very conservative.

Timeline up to the Proposal Deadline

- We got a late start due to the Continuing Resolution.
- Thia Keppel and David Dean recruited me.
    (I had just stepped down from the Independent Technical Review Committee, where I could only annoy the Jlab community.
                    Now I could potentially annoy the whole planet.)

- An Administrative Plan was drafted by JLab with guidance from Ivan Graf (DOE NP).
- The Field Work Proposal was submitted.
- Proposal Guidelines from the previous BNL program – an incredible resource! - were updated.
- A JLab website was created to distribute relevant information: https://www.jlab.org/research/eic_rd_prgm .

- The call for proposals went out worldwide on June 28, 2022.

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- The call for proposals went out worldwide on June 28, 2022.

- Questions started arriving the next day to mack@jlab.org and never stopped. World-wide interest!!!
- Sometimes questions took me a few days to answer. **Next year, we'll have a FAQs page on the website, and I'll know more answers off the top of my head.**
- In the meantime, I continued recruiting a review committee beginning with Thomas Ullrich's precious list. Was aiming for 12 people.

- The deadline of course was 5pm EST on July 25, 2022.
  (I feel <u>terrible</u> about that short deadline. Seriously, during summer vacation season??!! And with random critical proposal
  writing colleagues unavailable due to COVID??!! Proponents are stressed. I'm stressed. The committee will be stressed.
  But the only other option would have been to start the program in FY23, hence the EIC community would lose the FY22 funds.
  We've got to wrap up FY22, because in just a few months the FY23 call for proposals should go out.)
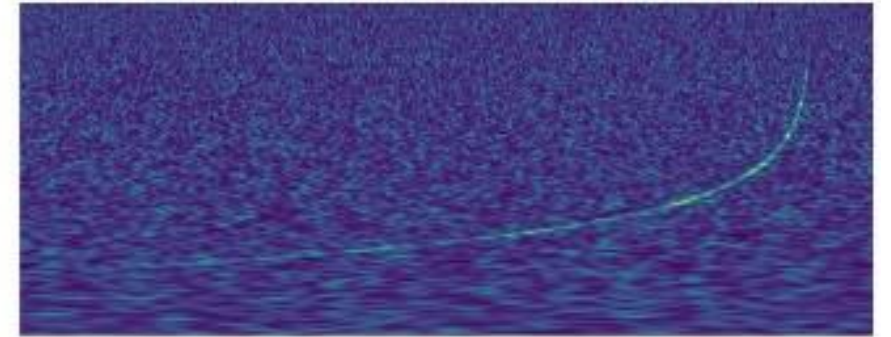
5pm, Proposal Deadline Day

We got **27** proposals. Oof! I was naively expecting at most half that, since the former program receive 20-ish proposals per year, and since some generic R&D presumably moved to Project R&D.

I want to believe this much interest, and so many good ideas, has to be a good thing. But geez:
It took 2 days just skim the proposals and put basic information into a spreadsheet.
To keep review committee workload down, the committee size will have to increase to ~16.

5pm, Proposal Deadline Day

This LIGO "log(power) vs time" spectrum of a chirp is a fair representation of the "proposal submission intensity vs time".

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Fun Facts About the Proposals

- 27 proposals

- 369 pages

- $4.3M in requests   (roughly a factor of 3.6 more than disbursable funds after Jlab overhead charges, committee expenses(?), etc)

Proposals: The Whole Elephant

EICGENR&D Proposal Number	Title	PI(s)	Institution(s) (abbreviated and only includes PI's at this time)	# of pages	Budget Request $US
1	CSGlass for hadron calorimetry at the EIC	T. Horn	Catholic University of America, Washington, DC, USA	8	97,240
2	A proposal for MPGD-based transition radiation detector/tracker	Y. Furletova, J. Velkovska	Jlab, and Vanderbilt U., USA	12	174,999
3	Precise Timing with a Micro Pattern Gaseous Detector	K. Dehmelt	Stony Brook U., USA	15	94,694
4	BeAGLE, a tool to refine IR and detector requirements for the EIC	M.D. Baker	MDBPADS LLC, Miller Place, NY	10	105,400
5	Continued Development and Evaluation of a Low-Power High-Density High Timing Precision Readout ASIC for AC-LGADs (HPSoC)	B. Schumm, L. Macchiarulo,	UCSC, and Nalu Scientific LLC	17	150,000
6	A new radiation tolerant low power Phase-Locked Loop IP block in a 65 nm technology for precision clocking in the EIC frontend electronics	D. Neyret, W. van Noije	IRFU, CEA Saclay, France, and Instituto de Física da U. de São Paulo (USP), São Paulo, Brasil	11	54,000
7	Refined Methods for Transfer Matrix Reconstruction Using Beamline Silicon Detectors for Exclusive Processes at the EIC	A. Jentsch, B. M. Murray	BNL, Upton, NY, USA, and U. of Kansas, Lawrence, KS, USA	5	127,000
8	TOMATO (end-TO-end siMulation fAst deTectOrs): An end-to-end simulation framework for fast detectors at the EIC	D. Tapia Takaki	The University of Kansas Center for Research, Inc., Lawrence, KS, USA	9	46,423
9	Z-Tagging Mini DIRC	C. E. Hyde	Old Dominion University, Norfolk, VA, USA	13	114,000
10	Implementation of a gain layer in Monolithic Active Pixel Sensor (MAPS) for high resolution timing application	P. Schwemling	CEA IRFU Saclay, France	7	355,000
11	Development of a Generic, Low-power and Multi-channel Frontend Readout ASIC for Precision Timing Measurements at EIC	Z. Ye, A. Apresyan	U. of Illinois at Chicago, Chicago, IL, USA, and Fermilab	10	210,000
12	Development of a Novel Readout Concept for an EIC DIRC	G. Kalicy (the submitter)	Catholic University of America, Washington, DC, USA	9	95,000
13	Simulations of the physics impact of a solenoid-based compensation scheme for the field of the main detector solenoid in IR8	Pawel Nadel-Turonski, Wenliang Li, and V. Morozov	Department of Physics, Stony Brook U., Stony Brook, NY, USA, and ORNL, Oak Ridge, TN, USA	18	128,000
14	Tracking and PID with a GridPIX Detector	P. Garg	Department of Physics and Astronomy, Stony Brook University, USA	17	74,555
15	Particle identification and tracking in real time using Machine Learning on FPGA	S. Furletov, D. Romanov	Jlab, Newport News, VA, USA	7	101,044
16	Development of High Precision and Eco-friendly MRPC TOF Detector for EIC	Zhihong Ye, and Zhenyu Ye	Department of Physics, Tsinghua U., Beijing, China, and Department of Physics, U. of Illinois at Chicago, Chicago, IL, USA	18	118,000
17	Machine Learning for Detection of Low-Energy Photons in the EIC ZDC	L. Wood	PNNL	10	226,000
18	Superconducting Nanowire Detectors for the EIC	W. Armstrong	ANL	26	138,000
19	EIC KLM R&D Proposal	A. Vossen	Duke U., Durham, North Carolina, USA	24	245,100
20	High Quantum Efficiency III-nitrides photocathodes and hybrid photon detectors for EIC	L. Cultrera	BNL, Upton, NY, USA	20	275,000
21	Exclusive and Semi-inclusive reactions in the muonic channel, and development of muon detectors in the far forward region	M. Boer	Virginia Tech, Blacksburg, VA, USA	10	75,000
22	Injection Molding of Large Plastic Scintillator Tiles at Optical Quality	O. Hartbrich	ORNL, Oak Ridge, USA	10	128,000
23	Development of Thin Gap MPGDs for EIC Trackers	K. Gnanvo	Jlab	12	161,354.50
24	Simplified LGAD structure with fine pixelation	G. Giacomini	BNL, Upton, NY, USA	14	215,000
25	Imaging Calorimetry for the Electron-Ion Collider	M. Zurek, and Z. Papandreou	ANL, and U. Regina, Regina, Saskatchewan, Canada	20	97,000
26	Silicon Tracking and Vertexing Consortium	N. Apadula (the submitter)	LBNL, USA	18	574,200
27	Combined design of a projective tracker and PID system for the EIC Detector-1 with the assistance of Artificial Intelligence	C. Fanelli	College of William and Mary, VA, USA	19	110,000
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If you think you submitted a proposal and you don't see it here, we need to have a (well documented) conversation.

Committee Building ~~Almost Done~~ In Progress
Need ~~12~~ 16 Brilliant People "at" the Review in ~1 month (no pressure, Dave)

Name	Institution
FY22 committee:	
Clara Matteuzzi	INFN (retired)
Fabrice Retiere	TRIUMF
Daniel Pitzl	DESY
Jin Huang	BNL
Justin Stevens	W&M
Stefan Ritt	PSI
Klaus Dehmelt	Stony Brook
Oleg Eyser	BNL
Jerry Va'vra	SLAC (retired)
Glenn Young	BNL
Starting in FY23:	
Marina Artuso	Syracuse

Thomas Ullrich (BNL) and Patrizia Rossi (Jlab) will be ex-officio members.

Ed Kinney (U. Colorado, Chair of the EIC Detector Advisory Committee) has been invited to attend the review.

Glenn and Jerry served on the previous version of this committee.

Glenn is also on the EICDAC.

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I had a pretty good idea of the required skillsets from the previous version of the program:

tracking (solid state)
tracking (gaseous)
PID (RICH/DIRC)
PID (TOF)
Calorimetry
Misc detectors
New scintillators
Machine-detector interface
Photo-transducers
DAQ (digitizers and readout)
Simulation
Analysis
Polarimetry
DAQ (software)

But now I have data (ie, an Avogadro's number of proposals) and can target more precisely.

Summary

That's the update.

Lots of work to do in the next month(s).

Things I'm thankful for that I didn't already mention:

- All the additional committee member nominations I got from the EIC community. (Thanks, Yordanka Ilieva for that suggestion.)

- Total strangers who say "yes!" and agree to be on the committee when I ask, because they think the work will be interesting and are ready to take on more service work.

- People who email me, or stop by my office for 20 minutes, and say, "Of course, you already know this, …." yet increase my total knowledge about the EIC generic R&D project by 10%. It's the startup of this program, and my ignorance is vast. Please tell me your thoughts.

Hopes for FY23 Proposal Round

Less of this:

More of this:

backups

Rolf's Slide on the Previous Generic R&D Program

EIC Generic Detector R&D Program – R&D Supported

Project	Topic
eRD1	EIC Calorimeter Development
eRD2	A Compact Magnetic Field Cloaking Device
eRD3	Design and assembly of fast and lightweight forward tracking prototype systems
eRD6	Tracking and PID detector R&D towards an EIC detector
eRD10	(Sub) 10 Picosecond Timing Detectors at the EIC
eRD11	RICH detector for the EIC'S forward region particle identification - Simulations
eRD12	Polarimeter, Luminosity Monitor and Low Q2-Tagger for Electron Beam
eRD14	An integrated program for particle identification (PID)
eRD15	R&D for a Compton Electron Detector
eRD16	Forward/Backward Tracking at EIC using MAPS Detectors
eRD17	BeAGLE: A Tool to Refine Detector Requirements for eA Collisions in the Nuclear Shadowing/Saturation Regime

Project	Topic
eRD18	Precision Central Silicon Tracking & Vertexing
eRD19	Detailed Simulations of Machine Background Sources and the Impact to Detector Operations
eRD20	Developing Simulation and Analysis Tools for the EIC
eRD21	EIC Background Studies and the Impact on the IR and Detector design
eRD22	GEM based Transition Radiation Tracker R&D
eRD23	Streaming Readout for EIC Detectors
eRD24	Silicon Detectors with high Position and Timing Resolution as Roman Pots at EIC
eRD25	Si-Tracking
eRD26	Pulsed Laser System for Compton Polarimetry
eRD27	High Resolution ZDC
eRD28	Superconducting Nanowire Detectors
eRD29	Precision Timing Silicon Detectors for for combined PID and Tracking System

Tracking **PID** **Calorimetry** **Software/Simulations** **Other**

Jefferson Lab
Thomas Jefferson National Accelerator Facility