

Overview of EIC Generic Detector R&D Program

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EICUG Yellow Reports - Kick-off Meeting

MIT, December 12-13, 2019



Generic EIC Detector R&D Program

- Started 2011 BNL, in association with JLab and the DOE Office of NP
- Funded by DOE through RHIC operations funds
- Program explicitly open to international participation
- Standing EIC Detector Advisory Committee consisting of internationally recognized experts in detector technology
- Typical 10-11 projects supported per FY
- 195 participants from 49 institutions (16 non-US)



Current: Marcel Demarteau** (ORNL), Carl Haber (LBNL), Peter Krizan (Ljubljana), Ian Shipsey (Oxford), Rick Van Berg (UPenn), Jerry Va'vra (SLAC), Glenn Young (BNL)

**Chair

URL: https://wiki.bnl.gov/conferences/index.php/EIC_R%25D

Meetings 2019/2020

- January 24-25, 2019
 - ▶ Review of ongoing projects
- July 11-12, 2019
 - ▶ Review of ongoing projects
 - ▶ New proposals and renewal of ongoing proposals
- September 19, 2019
 - ▶ Special Meeting with eRD14
- January 30-31 (BNL)
 - ▶ Review of ongoing projects

N.B.: Projects are labeled eRD*NN* (eRD to distinguish from CERN identifier for R&D projects)

Projects

- **Types**

- ▶ Detector hardware related R&D (one or few system)
- ▶ Software development (one topic)
- ▶ Detector related studies/simulations (one topic)
- ▶ **Consortia**
 - ◎ Work on various technologies related to major detector components
 - ◎ Tracking, PID, Calorimetry, Software/Simulations

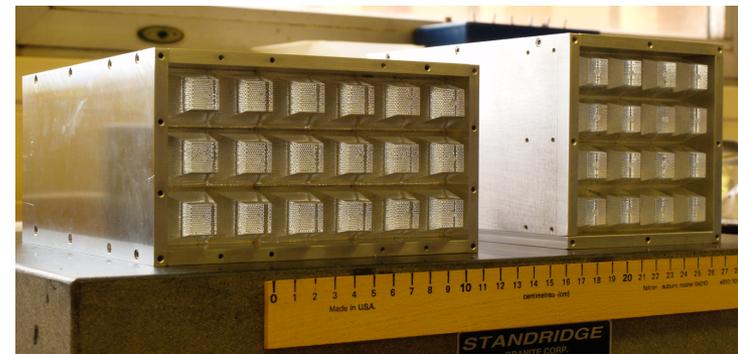
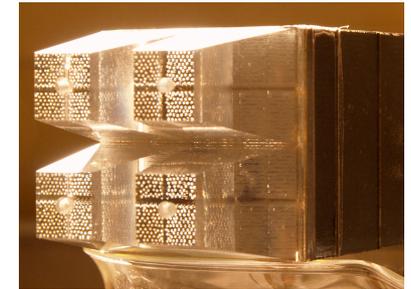
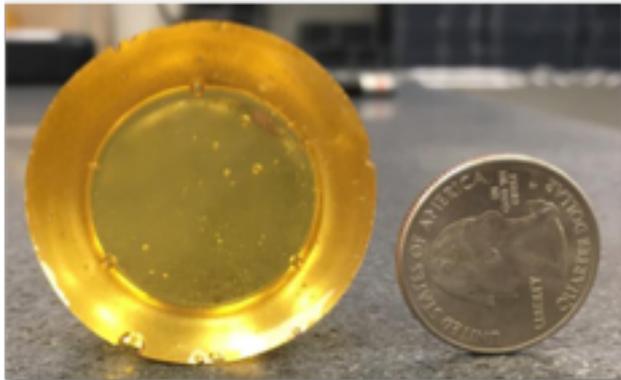
Many are active since 2011 (especially consortia), others are completed

R&D Project	Topic	Status
eRD1	EIC Calorimeter Development	active
eRD2	A Compact Magnetic Field Cloaking Device	completed
eRD3	Design and assembly of fast and lightweight forward tracking prototype systems	completed (merged with eRD6)
eRD6	Tracking and PID detector R&D towards an EIC detector	active
eRD10	(Sub) 10 Picosecond Timing Detectors at the EIC	completed (merged into eRD14)
eRD11	RICH detector for the EIC'S forward region particle identification - Simulations	completed (merged into eRD14)
eRD12	Polarimeter, Luminosity Monitor and Low Q2-Tagger for Electron Beam	completed
eRD14	An integrated program for particle identification (PID)	active

R&D Project	Topic	Status
eRD15	R&D for a Compton Electron Detector	completed
eRD16	Forward/Backward Tracking at EIC using MAPS Detectors	active
eRD17	BeAGLE: A Tool to Refine Detector Requirements for eA Collisions in the Nuclear Shadowing/Saturation Regime	active
eRD18	Precision Central Silicon Tracking & Vertexing	active
eRD19	Detailed Simulations of Machine Background Sources and the Impact to Detector Operations	completed (see eRD21)
eRD20	Developing Simulation and Analysis Tools for the EIC	active
eRD21	EIC Background Studies and the Impact on the IR and Detector design	active
eRD22	GEM based Transition Radiation Tracker R&D for EIC	active
eRD23	Streaming Readout for EIC Detectors	active
eRD24	Silicon Detectors with high Position and Timing Resolution as Roman Pots at EIC	active

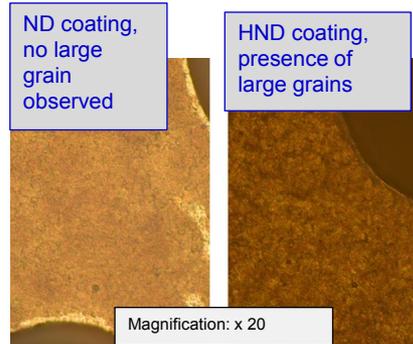
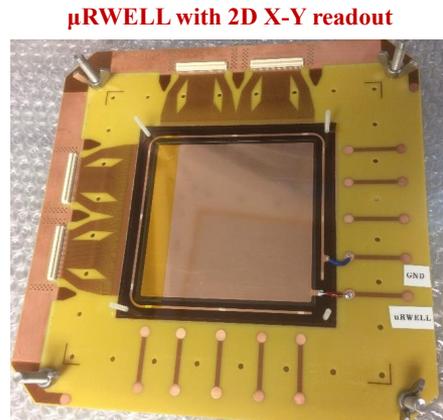
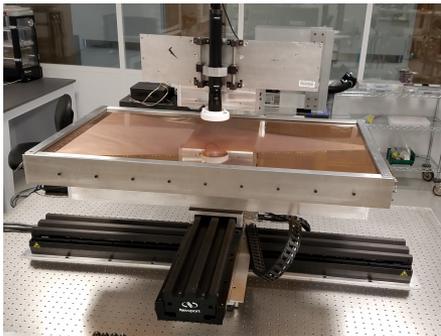
Examples (I)

- eRD1 (Calorimetry)
 - ▶ Scintillating fibers embedded in W-powder composite absorber, a.k.a W-SciFi
 - ▶ Shashlik Calorimeters
 - ▶ Lead Tungstate (PbWO_4) crystals
 - ▶ Scintillating Glasses
 - ▶ Hadron Calorimetry (beginning)
 - ▶ SiPM testing



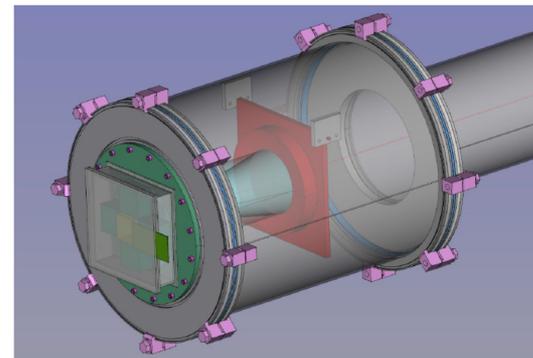
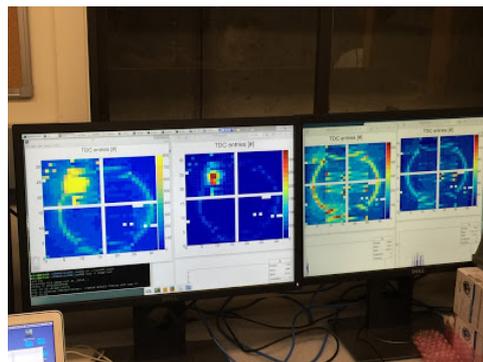
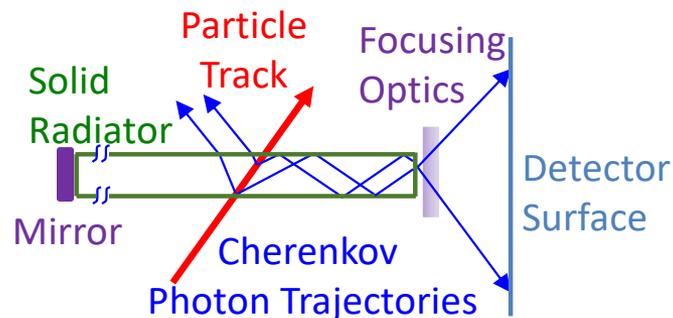
Examples (II)

- eRD6 (Tracking)
 - ▶ GEMs & multi-layer GEMs & GEM + MMG
 - ▶ Low-mass GEM tracker
 - ▶ Resistive micro-well detector (μ RWELL) detector (new)
 - ▶ Micro-TPC
 - ▶ Cherenkov-TPC
 - ▶ Gaseous single-photon detection with MPGDs for high-p RICH - new photocathode based on NanoDiamond (ND) particles coupled to MMG
 - ▶ TPC Readout Chambers



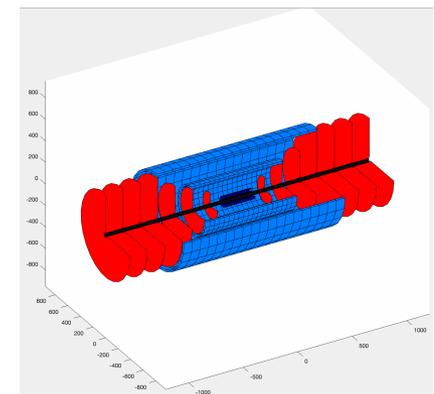
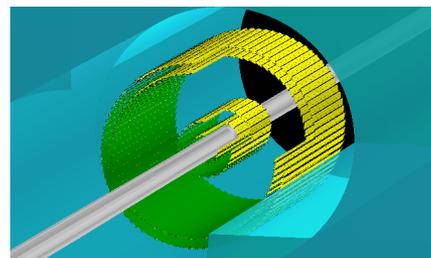
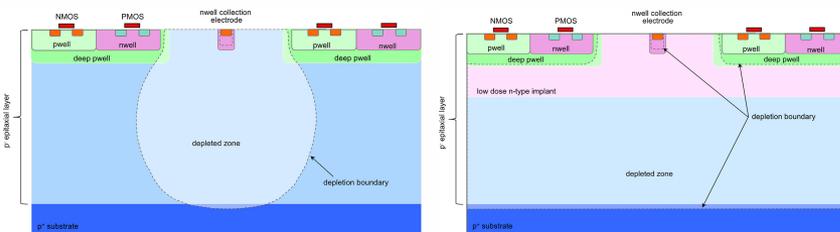
Examples (III)

- eRD14 (PID)
 - ▶ DIRC (Detection of Internally Reflected Cherenkov light) for barrel region
 - ▶ mRHIC: Compact aerogel RICH covering up to 10 GeV/c ($\pi/K/p$)
 - ▶ dRICH: RICH with two radiators (gas + aerogel) to cover the full momentum range: more than 3 s.d. separation for $\pi/K/p$ over 3-50 GeV/c in forward region (up to 15 GeV for e/π)
 - ▶ Photosensors
 - ▶ High field tests



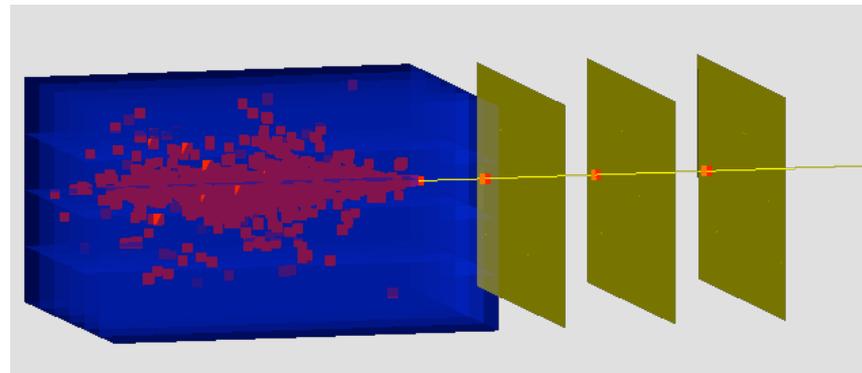
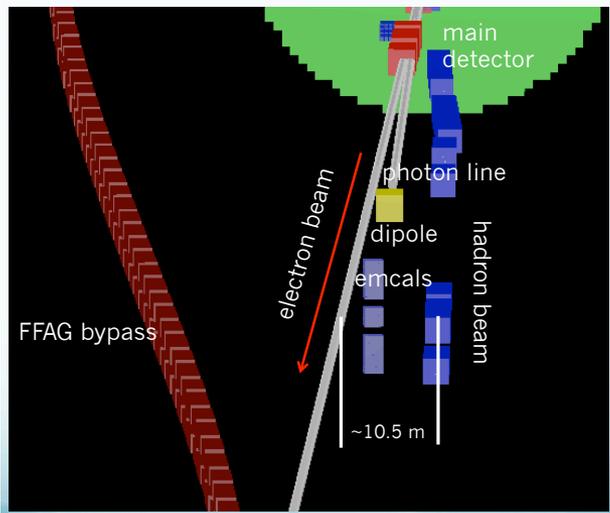
Examples (IV)

- eRD16 & eRD18 (Si Detectors & Simulations)
 - ▶ Simulations to optimize geometry (pixel size, # of layers, radii, # of disks, ...) for forward/backward and barrel - design based on depleted MAPS
 - ▶ Si/Maps as main tracker (new studies)
 - ▶ Sensor development
 - Selected technology: TowerJazz 180 nm modified process
 - Fully depleted with small collection electrode



Examples (V)

- eRD12 (completed 2016)
 - ▶ Electron polarimeter
 - ▶ Luminosity monitor
 - ▶ Low Q^2 -tagger ($Q^2 < 0.1 \text{ GeV}^2$)
 - ▶ Roman pot study (now also eRD24)
 - ▶ Requirements, Locations, Simulations, Technologies



Other eRD Efforts Relevant for Today

- eRD20: Software/simulation consortia
 - ▶ see talk by Markus
- eRD17: BEaGLE - eA generator
- eRD21: Background studies
 - ▶ see also talk by Alexander/Yulia

Where to Find Information?

- Many projects have a good publication record (see [Reference document](#) on Indico page of this meeting).
- All projects do a good job describing the status in their [Progress Reports](https://wiki.bnl.gov/conferences/index.php/EIC-Detector-Proposals) (<https://wiki.bnl.gov/conferences/index.php/EIC-Detector-Proposals>).
- ▶ [Note: Consortia completed some of their R&D. One needs to go back in time to look those up.](#)
- For a quick overview see the [Presentations](#) of the various projects (<https://wiki.bnl.gov/conferences/index.php/Meetings>).
- Each project has a [Contact Person](#) that are listed together with the progress reports (see above).
- Ask me (thomas.ullrich@bnl.gov)