

EIC-Japan *Expression of Interest*

RBRC exp group meeting

December 22nd, 2020

Yuji Goto

Call for Expression of Interest

- <https://www.bnl.gov/eic/EOI.php>
- Non-binding and mainly used to guide expectations and to better understand the potential EIC experimental equipment scope and interest



- Deadline for submission: November 1st

EIC-Japan EOI

- <https://indico.bnl.gov/event/8552/contributions/>

- Institutions

- Yamagata Univ.
- RIKEN
- Kobe Univ.
- Shinshu Univ.
- Univ. of Tsukuba
- Tsukuba Univ. of Technology
- JAEA
- Nihon Univ.
- KEK
- Tokyo Metropolitan College of Industrial Technology

EIC-Japan Expression of Interest

Please indicate the name of the contact person for this submission:

(we ask for one main contact person per submission. You can as needed provide further contacts, but there should be one primary contact)

Yuji Goto, RIKEN, goto@bnl.gov

Please indicate all institutions collectively involved in this submission of interest:

(even if institutions can submit on their own, it is highly encouraged to form groups to work together within their country, their geographical region, or as a general consortium)

The EIC is a great research opportunity for Japan, and we are working to form a Japanese group. We are forming a high-energy accelerator-based experimental group in the field of both nuclear and particle physics, which holds regular study meetings and workshops.

In Japan, the Science Council of Japan (SCJ) developed a master plan for large-scale research programs in academia (Master Plan 2020) in 2019-2020. The EIC was recognized as an important international collaborative research project as a long-term research plan by the Future Planning Committee of the Committee on Nuclear Physics, and was proposed to the Master Plan. As a result, the EIC was selected as an academic major research project, although it was not selected as a priority project in the Master Plan 2020, yet.

The EIC-Japan group would like to design and construct forward detectors of the EIC detector, especially calorimeters, to lead the study of forward and the very forward physics. The forward detectors are one of the most important detectors for precisely reconstructing certain types of events of the deep inelastic scattering (DIS) process, which is the basis of all research at EIC. By measuring the forward and the most forward jets, hadrons, photons, and electrons and studying their correlations, we can precisely determine the spin and internal orbital motion of partons in the nucleon, which is still poorly understood. In particular the contribution of gluons, sea quarks and orbital angular momentum to the proton spin is still a mystery. Additionally, our understanding of the most forward events will greatly enhance the development of the QCD-based event generators. This will also greatly contribute to eliminating uncertainties in other high-energy particle experiments and cosmic ray observations.

Subsequently, in addition to the proposals in the master plan, we have expanded our activities as a Japanese group to include a group interested in building a silicon detector. The team is open for new collaborators. The following collaborators are particularly welcome: expertise in silicon sensors in general, readout electronics, signal transmission, mechanical/electrical engineering, slow control systems, etc., Eastern Asian institutes taking geographical advantage.

In this submission of the EOI from the EIC-Japan group, following institutions are involved.

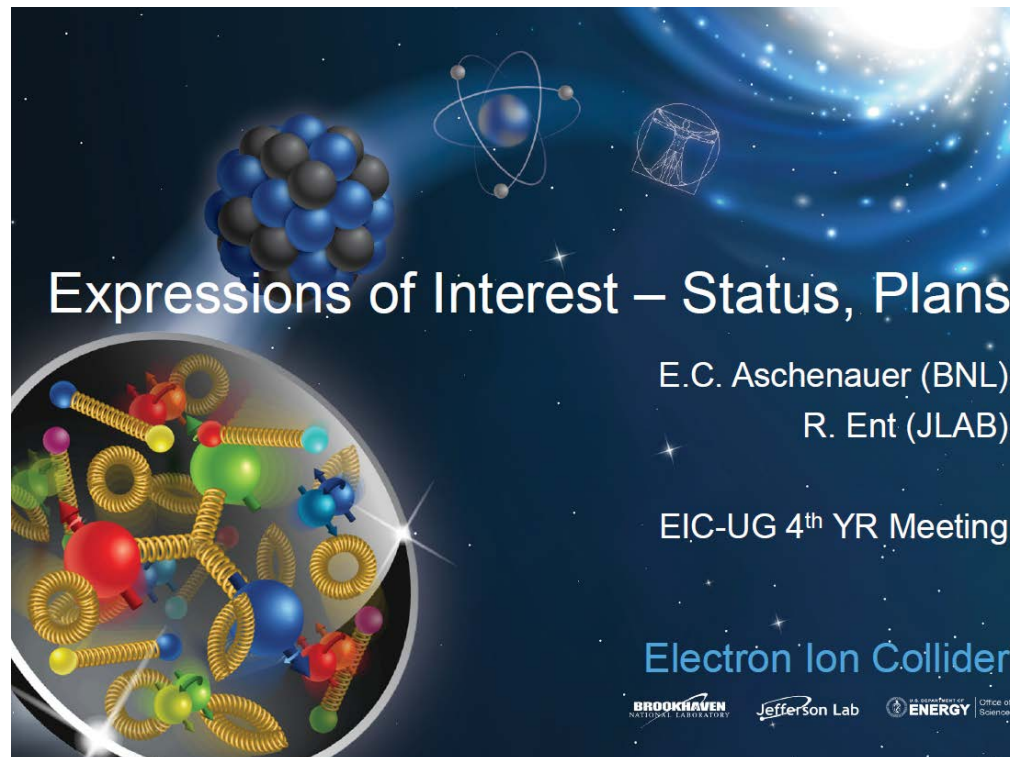
- Yamagata Univ.
- RIKEN
- Kobe Univ.

EIC-Japan EOI

- Items of interest for potential equipment cooperation
- Level of potential contributions
 - Forward hadron calorimeter
 - Although the proposal in the Master Plan is not a direct request to the Japanese Government, the construction cost of the forward hadron calorimeter is described as \$8.3M, based on the STAR FCS or Fe+Sci calorimeters mentioned above, for the construction of all the detectors in the forward hadron calorimeter.
 - Zero-degree calorimeter (EM & hadron)
 - The ZDC is also described as a construction expense in the master plan, but at this scale, the goal is to construct the facility with a view to paying for it with large scientific research funds (e.g. JSPS Kakenhi) in the future.
 - EM calorimeter: \$2.5M from ALICE-FoCal-E: W+Si
 - Hadron calorimeter: \$690K from ALICE-FoCal-H: Pb+Sci
 - Full absorption photon detector (or just preshower detector)
 - Silicon detector
 - We are developing a plan for budget request and thus making a coarse estimate of the material cost of inner silicon detector of 4PISHDEIC. The SOI detector technology is to be developed mainly conducted by the dedicated silicon detector laboratory and experts in KEK. The development is to be supported by multiple domestic institutes which reside with silicon technologies in general and experiences.

EOI – Status, Plans

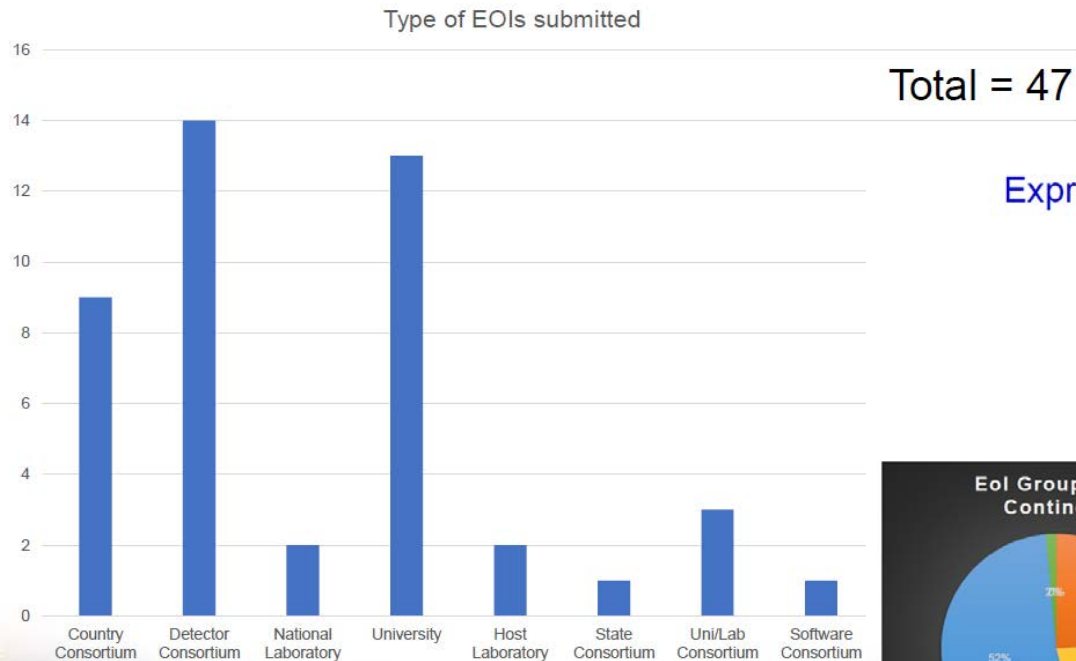
- 4th EIC Yellow Report Workshop at LBL
 - 19-22 November 2020
 - <https://indico.bnl.gov/event/9913/>



- <https://indico.bnl.gov/event/8552/contributions/>
 - Total 47 LOIs

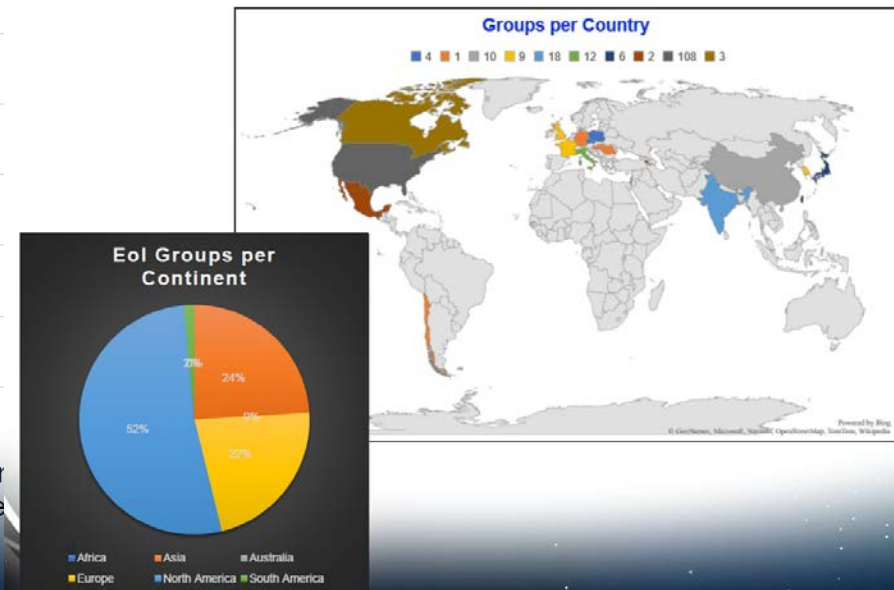
EOI – Status, Plans

Expressions of Interest – Distribution



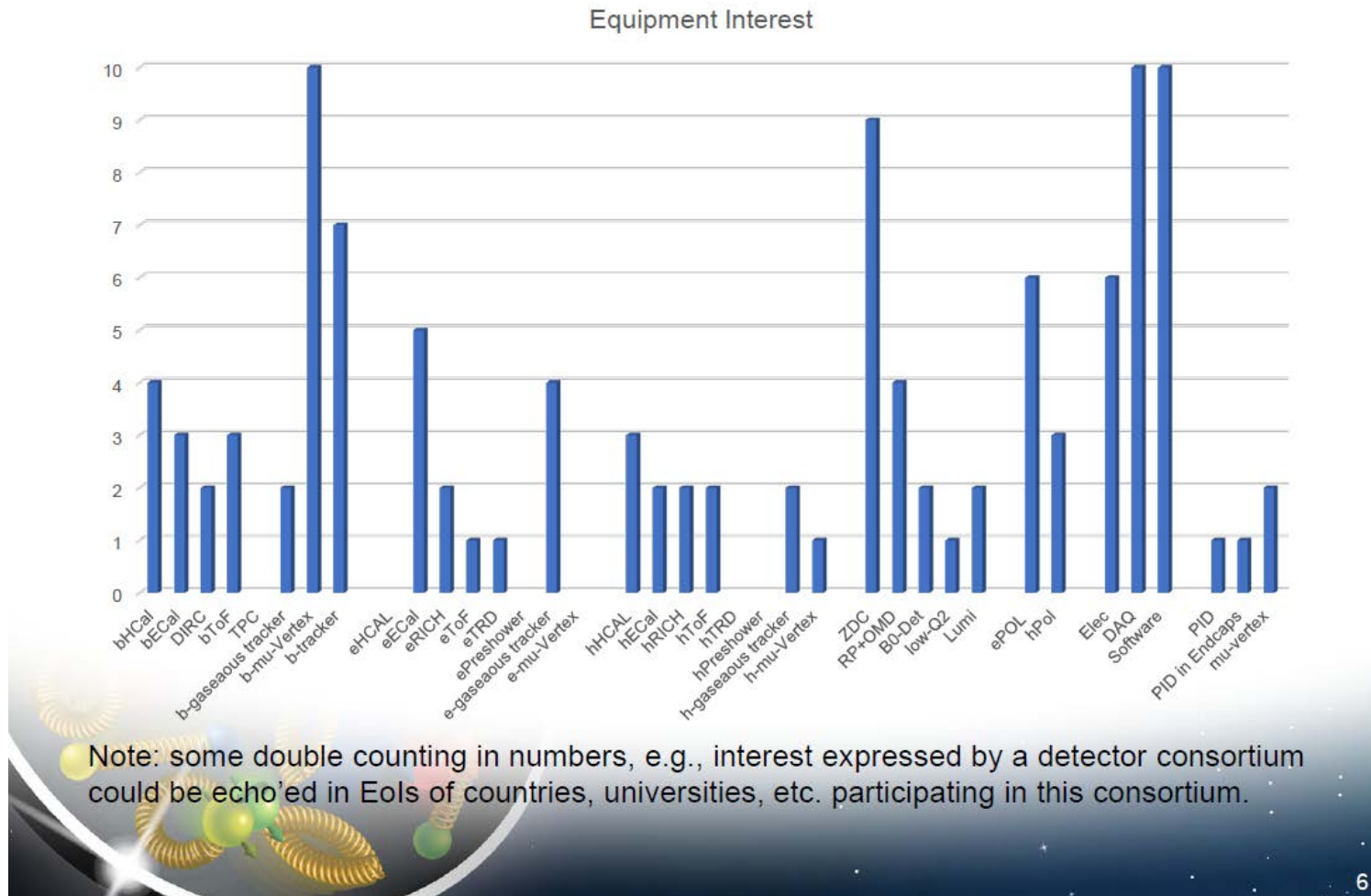
Note: some arbitrariness in categorization, like two national labs (and one) came in together with universities, and one national lab came in as detector consortium.

Expressions of Interest – Geographically



EOI – Status, Plans

Expressions of Interest – Equipment Interest



Silicon Barrel

- **LGAD**

- EOI: Fast timing silicon detectors for EIC detectors (Rice/BNL/ANL/LANL/MIT/ORNL)
- EOI for the ECCE Consortium (MIT/Rice/ORNL)
- EOI on Silicon Detectors at EIC (UIC/NCKU)

- **MAPS**

- EOI for Si Consortium (LBNL/UK/BNL/China/ORNL)
- EOI for UC Consortium (LBNL/UCB/LANL)
- EOI for the ECCE Consortium (LANL/ORNL/BNL)
- EOI of the INFN Community
- EOI for Indian Consortium
- EOI for Korean Institutions
- EOI Czech Republic

- **SOI**

- EOI for ANL (ANL/KEK/RIKEN)
- EIC-Japan EOI

ZDC

- **LHC-ZDC**
 - EOI for high resolution ZDC (Kansas/UIUC)
 - EOI for the ECCE Consortium (UIUC/MIT/ORNL)
- **ALICE-FoCal**
 - EOI for high resolution ZDC (ORNL/LBNL/ODU/RIKEN)
 - EOI for LBNL and UCB
 - EOI for Korean Institutions
 - EIC-Japan EOI
- **RHIC-ZDC**
 - EOI for BNL
 - EOI for China
 - EOI Czech Republic

Hadron Calorimeter (Forward)

- **STAR-FCS (Fe-Sci/SiPM)**
 - EOI for UC Consortium (UCLA)
 - EOI for BNL Public Final
 - EOI for Korean Institutions
 - EIC-Japan EOI
- **sPHENIX Barrel (Fe-Sci/SiPM)**
 - EOI for BNL Public Final
 - EOI for Georgia State University
- **sPHENIX Forward**
 - EOI for the ECCE Consortium (ISU/BNL)
- **Fe-Sci**
 - EOIL for Jefferson Lab
- **Dual-Readout**
 - EOI for Korean Institutions
- **CMS**
 - EOI Laboratories of CNRS-IN2P3

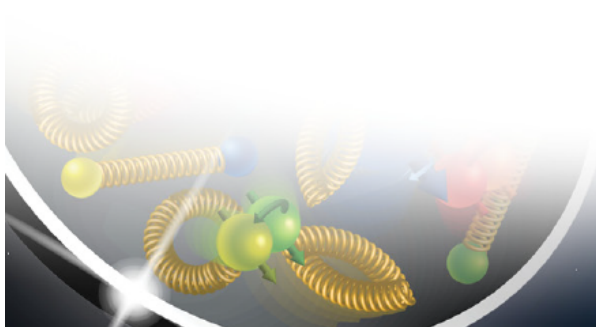
EOI – Status, Plans

Expressions of Interest – In-Kind Equipment (reuse)

Possible equipment for use of EIC detector:

- sPHENIX/BABAR magnet (with some modifications)
- Accompanying sPHENIX Hadronic Calorimetry
- Perhaps also some sPHENIX EM Calorimetry
- STAR HCal Calorimetry (FeSc 520 towers)
- E864 lead-scintillating fiber HCal 754 towers, 10cm x10cmx117cm
- TPC
- Few-100 PbWO₄ crystals (2.05 x 2.05 x 20 cm³)
- JLab + BNL ~10k Pb-Glass blocks (3.8 x 3.8 x 45 cm³)
- BNL Pb-Glass blocks (5.8 x 5.8 x 60 cm³)
- Ex-BABAR DIRC bars

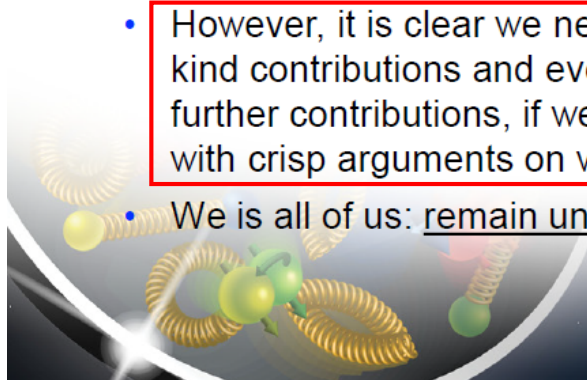
Examples only!



EOI – Status, Plans

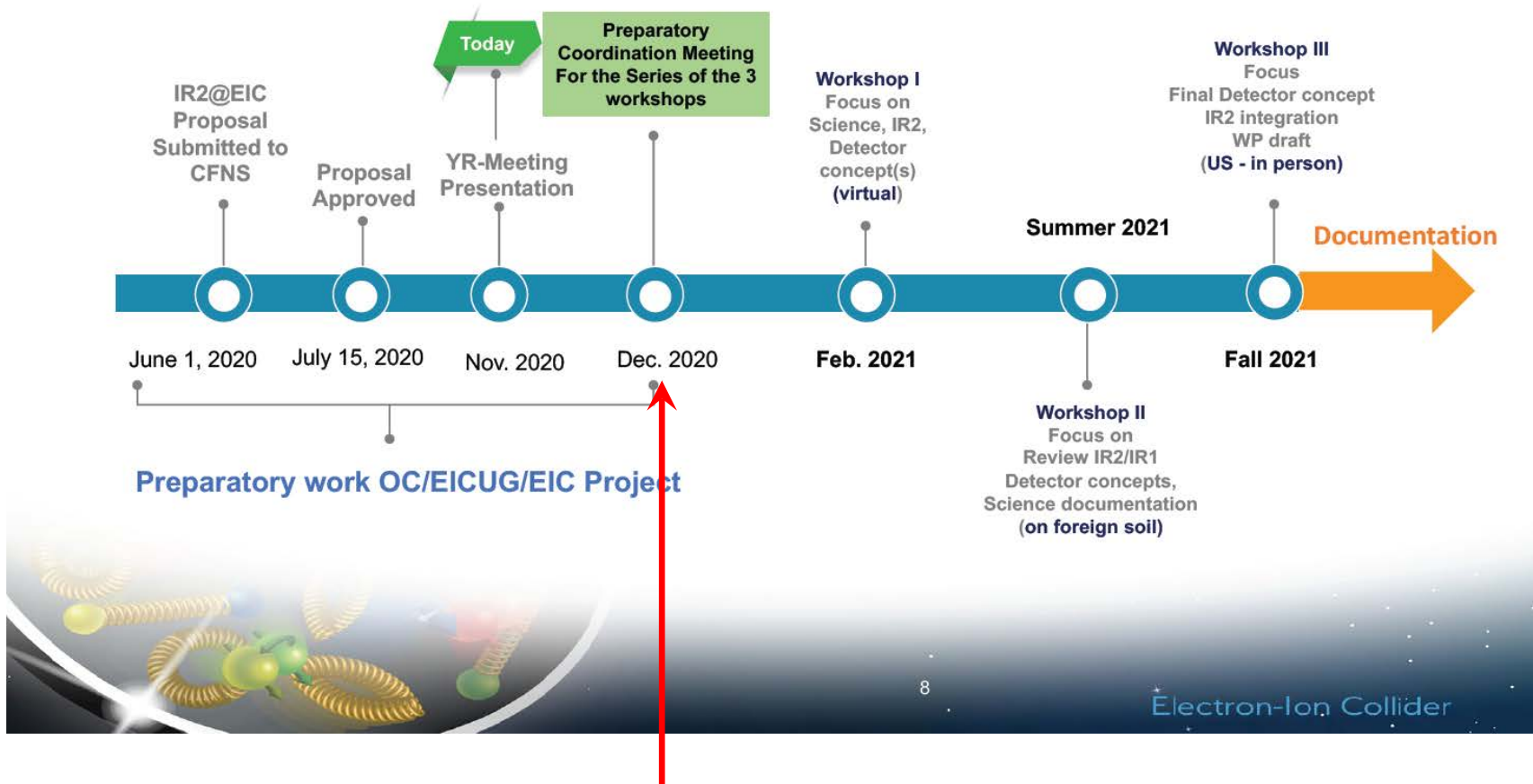
Expressions of Interest – Final Perspective

- There is clearly large interest in EIC science and experimental equipment
 - Both domestically among universities and national labs
 - And international, with many countries represented (Canada, China, Czech, France, India, Italy, Japan, Korea, Poland, UK and institutional Eols of Chile, Hungary, Mexico, Rumania, and group Eols with Armenia, Israel, Saudi Arabia and Taiwan as members)
- At this stage of early-project development, with EIC science still a decade away, impressively many are committed to work on EIC.
- In-kind contributions, from EIC project point of view, clearly suffice to maintain low-risk for a general-purpose EIC detector that is assumed to be 70% project-funded and 30% contributions (in-kind and labor).
 - EIC Project Risk Registry #120: “Failure to Secure in-Kind Detector Components and Labor” – risk assignment “Very Low”.
- The EIC train clearly left the station!
- However, it is clear we need to remain vigilant and follow up to secure in-kind contributions and even argue, based on our strong EIC science, for further contributions, if we want to be able to secure a second detector, with crisp arguments on why.
- We are all of us: remain unified and (internationally) argue our EIC case.



Workshop Series on IR2 & Detector EIC

IR2@EIC Series of Workshops - Timeline



- <https://indico.bnl.gov/event/9794/>