A warm welcome to the Center for Frontiers in Nuclear Science

Abhay Deshpande
June 2-5, 2020
In this time of world-wide Corona-Virus crisis, I am very glad that you are doing well, attending this workshop probably means you & your loved ones are OK. Please keep it that way.

At the same time let us all show solidarity with our friends and colleagues around the world who are struggling and fighting with the virus. We wish them the best to be strong and hope they remain that way for the remainder of this pandemic.

In the meanwhile, science goes on, must go on....
Introduction to the EIC and its status

"Science: Compelling & fundamental, Realization: Timely"

Physics of EIC

Evaluation

Realization

2015

2016

2018

2019

2019 - future
EIC Status & Evolution

- CD0: December 19, 2019
- Site BNL: January 9, 2020
- BNL and JLab realize EIC as partners

- A formal EIC project is now setup at BNL
- BNL+Jlab management & scientists are working together to realize it on a fast timeline.

- CD1 anticipated March 2021
- CD2 September 2022 (final design)
- CD3 4th Quarter FY2023 (start construction)

- EIC Early Finish 4th Q FY2029
- EIC CD4 4th Q FY 2030
The EIC

The strong hadron cooling facility completes the facility

- Hadron Storage Ring
- Electron Storage Ring
- Electron Injector Synchrotron
- Possible on-energy Hadron injector ring
- Hadron injector complex
Requirements for the US electron ion collider (EIC) were defined by a community led White Paper (1212.1701.v3). The EIC with those parameters was endorsed by the Nuclear Science Advisory Committee (NSAC) in 2015/6 & by the National Academy in its evaluation of EIC science in 2018.

- **High luminosity:** $10^{33}$-$10^{34} \text{ cm}^{-2}\text{sec}^{-1}$ a factor 100-1000 times HERA (@DESY)
- **Broad range in center-of-mass energy:** 20 – 140 GeV
- **Polarized beams** e-, p, D, $^3$He… C, Be with flexible spin patterns & spin orientation
- **Wide range in hadron species:** protons…. Uranium
- **Up to two well-integrated detector(s)** into the machine lattice for max. acceptance
Summary: EIC Physics:

Understanding Mass
Current EIC detector

The EIC Users Group has just started a YELLOW REPORT writing activity that will help us move toward Technical Design Reports. *Yellow Reports to be finalized by December 2020*

New ideas and members welcome to join this effort: [EICUG.ORG](http://EICUG.ORG) or contact me.

Defining features

Click here

Time OPtimized Silicon Detector for EIC
EIC Science : Luminosity vs. Center of Mass

Currently the high-energy scenario (blue curve) is more “solid”.

Low energy (red curve) scenario is being studied now in greater detail.

The two can sit in two IRs.
Expression of Interest (EoI)

- Machine design allows for up to 2 detectors at the EIC
- Physics from EIC should start as soon as the machine is ready and starts operating

- Currently we have about 1100 EIC User Group members of which half (~600) are experimentalists (& a quarter each accelerator physicists and theorist).
- The Users group is expected to grow but how much and with what technical means, experience and interest? This will critically determine how we plan our detector strategy.

- Call for Expression of Interest (EoI), a non-binding information gathering campaign launched yesterday (June 1st). Collect information and define detector strategy accordingly.

- You are welcome to join this effort.
This workshop:

This workshop on structure of pions and kaons is timely

As the Users Group moves toward finalizing the Yellow Reports at the end of this year, they will want to know how to realize various proposed ideas of physics into actual measurements, and what luminosity, what detector design is needed….

I hope discussions here will help that discussion and influence the decision… because we need just such input for influencing the EIC science.
### Critical Decision Process

#### PROJECT ACQUISITION PROCESS AND CRITICAL DECISIONS

<table>
<thead>
<tr>
<th>Project Planning Phase</th>
<th>Project Execution Phase</th>
<th>Mission Operations</th>
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<tr>
<td>Preconceptual Planning</td>
<td>Conceptual Design</td>
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<tr>
<td>CD-0</td>
<td>CD-1</td>
<td>Operations</td>
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<tr>
<td>Approve Mission Need</td>
<td>Approve Preliminary Baseline Range</td>
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<td>Approve Performance Baseline</td>
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<td>Approve Start of Construction</td>
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<td>Approve Start of Operations or Project Closeout</td>
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#### Actions Authorized by Critical Decision Approval

<table>
<thead>
<tr>
<th>CD-0</th>
<th>CD-1</th>
<th>CD-2</th>
<th>CD-3</th>
<th>CD-4</th>
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<tbody>
<tr>
<td>• Proceed with conceptual design using program funds</td>
<td>• Allow expenditure of PED funds for design</td>
<td>• Establish baseline budget for construction</td>
<td>• Approve expenditure of funds for construction</td>
<td>• Allow start of operations or project closeout</td>
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<td>• Request PED funding</td>
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<td>• Continue design</td>
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PED: Project Engineering & Design

19 December 2019

~2030
EIC: Kinematic reach & properties

For e-N collisions at the EIC:
- Polarized beams: e, p, d/3He
- Variable center of mass energy
- Wide $Q^2$ range $\rightarrow$ evolution
- Wide x range $\rightarrow$ spanning valence to low-x physics

For e-A collisions at the EIC:
- Wide range in nuclei
- Luminosity per nucleon same as e-p
- Variable center of mass energy
- Wide x range (evolution)
- Wide x region (reach high gluon densities)
The EIC Users Group: EICUG.ORG

Formally established in 2016
~1075+ Ph.D. Members from 31 countries, 224 institutions
New members welcome

EICUG Structures in place and active:
EIC UG Steering Committee, Institutional Board, Speaker’s Committee, Election & Nominations Committee
Task forces on:
-- Beam polarimetry, Luminosity measurement
-- Background studies, IR Design

Year long workshops: Yellow Reports for detector design


New:
Center for Frontiers in Nuclear Science (at Stony Brook/BNL)
EIC² at Jefferson Laboratory
EICUG Led Yellow Report Preparation Activity

Intended to prepare a pre-Conceptual Design for an EIC detector by early 2021.

By 2023 (CD3) most of the technical and engineering design of the detector.

The Yellow Report Web Page for more details.

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<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
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<tbody>
<tr>
<td>January 2020</td>
<td>Software tutorials are given, all activities are underway</td>
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<td>March 19-21</td>
<td>First workshop at Temple University – Philadelphia</td>
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<td>Goal: present progress for various groups and sub-groups, with much discussion and work time, initiate detector complementarity study based on detector technologies</td>
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<td>May 22-24</td>
<td>Second workshop at U of Pavia – Pavia, Italy</td>
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<td>Goal: present initial physics measurements and detector requirements following five chosen processes/tools (inclusive measurements, semi-inclusive measurements, jets and heavy quarks, exclusive measurements, diffractive measurements &amp; tagging), present detector concepts and implications for physics measurements. Complete detector requirements table including segmentation needs.</td>
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<td>August 3-7</td>
<td>Status reports at EICUGM @ FIU – Miami, FL</td>
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<td>Goal: Conveners/sub-conveners inform community about status and progress. Conveners identify possible issues (if any) in meeting with EICUG Steering Committee.</td>
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<td>September 17-19</td>
<td>Third workshop at CUA – Washington, DC</td>
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<td>Goal: present mature studies of detector requirements from physics processes, balance detector concepts versus impact on physics measurements. Discuss possible systematics reduction among complementary detector choices. Complete final “to-do” list for YR(s).</td>
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<td>November 19-21</td>
<td>Fourth workshop at UCB/LBL – Berkeley, CA or Final Meeting (assembly of Yellow Report(s))</td>
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<td>Goal: distribute draft YR sections before meeting</td>
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<td>January 2021</td>
<td>(optional) Final Meeting</td>
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