

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....





"Science: Compelling & fundamental, Realization: Timely"





NATIONAL LABORATORY

Introduction to the EIC and its status





Abhay Deshpande

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



Home # U.S. Department of Energy Selects Brookhaven National Laboratory to Host Major New Nuclear Physics Facility

WASHINGTON, D.C. - Today, the U.S. Department of Energy (DOE) announced the selection of Brookhaven National Laboratory in Upton, NY, as the site for a planned major new nuclear physics research facility.



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



The EIC design parameters



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: 10³³-10³⁴ cm⁻²sec⁻¹ a factor 100-1000 times HERA (@DESY)
- Broad range in center-of-mass energy: 20 140 GeV
- Polarized beams e-, p, D, ³He... 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:



CONSENSUS STUDY REPORT





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: <u>EICUG.ORG</u> or contact me.







Time OPtimized Silicon Detector for EIC

EIC Science : Luminosity vs. Center of Mass



Currently the highenergy 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.
- End of Eol period: End of November 2020.
- 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												
	Project Planning Phase				Project Execution Phase					Mis	sion		
19 December 2019	Preconceptual Planning		Conceptual Design		Preliminary Design		Final Design		Construction		Operations		~2030
		i CD	9-0	i CI	0-1	i CI)-2	i CD	-3	i CD-	4		
		Approve App Mission Need Prelin Baselin		prove minary le Range	App Perfor Bas	orove mance eline	Approve Start of Construction		Approve Operatio Project C	Start of ons or loseout			

CD-0	CD-1	CD-2	CD-3	CD-4	
Actions Authorized	by Critical Deci	ision Approval			
 Proceed with conceptual design using program funds Request PED funding 	• Allow expenditure of PED funds for design	 Establish baseline budget for construction Continue design Request construction funding 	• Approve expenditure of funds for construction	Allow start of operations or project closeout	

PED: Project Engineering & Design

EIC: Kinematic reach & properties



For e-N collisions at the EIC:

- ✓ **Polarized** beams: e, p, d/³He
- ✓ Variable center of mass energy
- ✓ Wide Q² range → evolution
- \checkmark Wide x range \rightarrow spanning valence to low-x physics



✓ Luminosity per nucleon same as e-p
 ✓ Variable center of mass energy
 ✓ Wide x range (evolution)
 ✓ Wide x region (reach high gluon densities)



Oceania

Oceania 1%

South America

17%

North America Asia Europe Africa South America

EIC Institutional Board

The EIC Users Group: EICUG.ORG

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



New: <u>Center for Frontiers in Nuclear Science (at Stony Brook/BNL)</u> <u>EIC²</u> at Jefferson Laboratory

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

Annual meetings: Stony Brook (2014), Berkeley (2015), ANL (2016), Trieste (2017), CAU (2018), Paris (2019), <u>FIU (2020)</u>, Warsaw (2021)

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.

January 2020	Software tutorials are given, all activities are underway					
March 19-21	First workshop at Temple University – Philadelphia					
	Goal: present progress for various groups and sub-groups, with much discussion and work time, initiate detector complementarity study based on detector technologies					
May 22-24	Second workshop at U of Pavia – Pavia, Italy					
	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 & tagging), present detector concepts and implications for physics measurements. Complete detector requirements table including segmentation needs.					
August 3-7	Status reports at EICUGM @ FIU – Miami, FL					
	Goal: Conveners/sub-conveners inform community about status and progress. Conveners identify possible issues (if any) in meeting with EICUG Steering Committee.					
September 17-19	Third workshop at CUA – Washington, DC					
	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).					
November 19-21	Fourth workshop at UCB/LBL - Berkeley, CA or Final Meeting (assembly of Yellow Report(s))					
	Goal: distribute draft YR sections before meeting					
January 2021	(optional) Final Meeting					