

EIC Project

- Status
- Roadmap
- Physics Overview

Rolf Ent

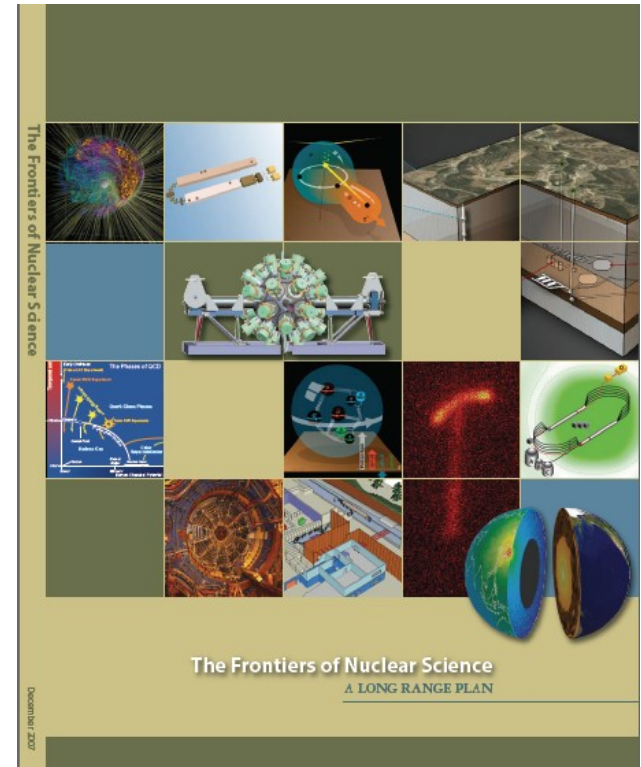
e-p Exclusive Workshop at Rutgers University

March 14-15, 2010

EIC Project - Status

NSAC 2007 Long-Range Plan:

"An **Electron-Ion Collider (EIC)** with **polarized** beams has been **embraced** by the **U.S. nuclear science community** as embodying the vision for **reaching the next QCD frontier**. EIC would provide unique capabilities for the study of QCD well beyond those available at existing facilities worldwide and complementary to those planned for the next generation of accelerators in Europe and Asia."



- MEIC/ELIC = a 3-11 GeV on 20-60 GeV ep/eA collider
 - fully-polarized, longitudinal and transverse
 - luminosity: about 10^{34} e-nucleons $\text{cm}^{-2} \text{s}^{-1}$
 - Almost all parameters "defendable"
 - upgradable to higher energies (250 GeV protons)

(M)EIC@JLab: Basic Considerations

- Optimize for nucleon/nuclear structure in QCD
 - access to sea quarks/gluons ($x > 0.01$ or so)
 - deep exclusive scattering at $Q^2 > 10$
 - any QCD machine needs range in Q^2
 - $s = 1000$ or so to reach decade in Q^2
 - high luminosity, 10^{34} or so essential
 - lower, more symmetric energies for resolution & PID
- **Not** driven by gluon saturation (small- x physics) ...
 - ... *avoid fundamental conflict of "classical" EIC*
- "Sweet spot" for
 - electron energies from 3 to 5 GeV (minimize synchrotron)
 - proton energies ranging from 20 to 60 GeV
 - but larger range of s accessible ($E_e = 11$ GeV, $E_p = 12$ GeV)
- **Decrease R&D needs**, while maintaining **high luminosities**
 - Potential future upgrade to high-energy collider,
but no compromising of nucleon structure capabilities

Current Ideas for a Collider

Design Goals for Colliders Under Consideration World-wide

| | Energies | s | luminosity |
|----------------------|------------------------|-----------------|--------------------------------------|
| MEIC@JLab | Up to 11 x 60 | 240-2650 | Close to 10^{34} |
| Future ELIC@JLab | Up to 11(22?) x 250 | 11000 (22000?) | Close to 10^{35} |
| Staged MeRHIC@BNL | Up to 4 x 250 | 800-4000 | Close to 10^{33} |
| eRHIC@BNL | Up to 20(?) x 250 | 20000 | Few x 10^{33} |
| ENC@GSI | Up to 3 x 15 | 180 | Few x 10^{32} |
| LHeC@CERN | Up to 70 x 7000 | 1960000 | 10^{33} |

Present focus of interest (in the US) are the (M)EIC and Staged MeRHIC versions, with s up to 2650 and 4000, resp.

Both laboratories are working together to get advice on the best steps towards a US Electron-Ion Collider.

Sam Aronson and Christoph Lehmann/Hugh Montgomery have named an international EIC Advisory Committee:

Joachim Bartels

Allen Caldwell

Albert De Roeck

Walter Henning (chair)

David Hertzog

Xiangdong Ji

Robert Klanner

Alfred Mueller

Katsunobu Oide

Naohito Saito

Uli Wienands

1st meeting Feb. 16, 2009 at SURA headquarters, D.C.

2nd meeting Nov. 2&3, 2009 at Jefferson Lab

3rd meeting around September???, 2010 At BNL???

Concrete design for EIC@Jlab requested by this meeting

Internal reviewed cost estimate requested by this meeting

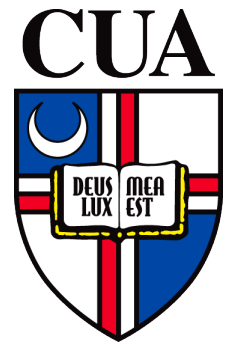
EIC Project - Roadmap

| Year | CEBAF Upgrade | Electron-Ion Collider |
|------------|---|---|
| 1994 | 1 st CEBAF at Higher Energies Workshop | |
| 1996 (LRP) | Energy Upgrade an Initiative | |
| ~2000 | Energy choice settled, "Golden Experiments" | 1 st workshops on US Electron-Ion Collider |
| 2002 (LRP) | JLab 12-GeV Upgrade 4 th recommendation | Electron-Ion Collider an Initiative |
| 2007 (LRP) | JLab 12-GeV Upgrade highest recommendation | Electron-Ion Collider "half-recommendation" |
| 2010 | | EIC "Golden Experiments"??? |
| 2013 (LRP) | JLab 12-GeV & FRIB construction highest recommendation? | EIC a formal (numbered) recommendation? |
| 2015 | JLab 12-GeV construction complete | EIC Mission Need, formal R&D ongoing? |
| 2025? | | EIC construction complete? |

Electron-Ion Collider - Roadmap



- EIC (eRHIC/ELIC) webpage: <http://web.mit.edu/eicc/>
- Last meeting: January 10-12, 2010 @ Stony Brook
- Next meeting: July 29-31, 2010 @ Catholic University, DC



- Long program at the Institute for Nuclear Theory, Seattle, this Fall:
centered around spin, small-x, imaging, electroweak
- Weekly meetings at both BNL and JLab
- Wiki pages at <http://eic.jlab.org/> & <https://wiki.bnl.gov/eic/index.php/Luminosity>

EIC Project - Science

General EIC @ INT Science Focus Areas:

- Origin of Nucleon Spin
- Strong Color Fields
- Imaging
- EW physics

Or, my own personal Elevator-Talk EIC science goals:

Map the spin and 3D quark-gluon structure of protons

(show the nucleon structure picture of the day...)

Discover the role of gluons in atomic nuclei

(without gluons there are no protons, no neutrons, no atomic nuclei)

Understand the creation of the quark-gluon matter around us

(how *does* $E = Mc^2$ work to create pions and nucleons?)

(add electroweak...)