U.S.-Based Electron Ion Collider Science Assessment
an ongoing study by the National Academies

Ernst Sichtermann (Lawrence Berkeley National Laboratory)
The short version

“Until the report is publicly released…” its contents are confidential.
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The content, findings, recommendations etc. are thus for another day.
The short version and an outline for the next 18 slides

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The remainder of this talk is based only on *publicly available* materials:

- Path to the NAS EIC Science Assessment (abbreviated version)

- NAS studies, process and stages
  
  EIC Science Assessment specifics

- Closing comments
How are the sea quarks and gluons, and their spins, distributed in space and momentum inside the nucleus?

Where does the saturation of gluon densities set in?

How does the nuclear environment affect the distribution of quarks and gluons and their interactions in nuclei?
Nuclear Physics enabled by EIC beam energy, intensity, polarization, and species, detector capabilities, theory
The EIC White Paper - Two Facility Options

Nuclear Physics enabled by EIC beam energy, intensity, polarization, and species, detector capabilities, theory
The 2015 Long Range Plan for Nuclear Science

NSAC and APS DNP partnered to tap the full intellectual capital of the U.S. nuclear science community in identifying exciting, compelling, science opportunities.

Recommendations:

• The progress achieved under the guidance of the 2007 Long Range Plan has reinforced U.S. world leadership in nuclear science. **The highest priority in this 2015 Plan is to capitalize on the investments made.**

• The observation of neutrinoless double beta decay in nuclei would...have profound implications. **We recommend the timely development and deployment of a U.S.-led ton-scale neutrinoless double beta decay experiment.**

• Gluons...generate nearly all of the visible mass in the universe. Despite their importance, fundamental questions remain.... These can only be answered with a powerful new electron ion collider (EIC). **We recommend a high-energy high-luminosity polarized EIC as the highest priority for new facility construction following the completion of FRIB.**

• **We recommend increasing investment in small-scale and mid-scale projects and initiatives that enable forefront research at universities and laboratories.**

NP is implementing these recommendations which are supported in the President’s FY 2017 request.
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Next Formal Step on the EIC Science Case

THE NATIONAL ACADEMIES OF SCIENCES, ENGINEERING, AND MEDICINE
Division on Engineering and Physical Science
Board on Physics and Astronomy
U.S.-Based Electron Ion Collider Science Assessment

Summary
The National Academies of Sciences, Engineering, and Medicine (“National Academies”) will form a committee to carry out a thorough, independent assessment of the scientific justification for a U.S. domestic electron ion collider facility. In preparing its report, the committee will address the role that such a facility would play in the future of nuclear science, considering the field broadly, but placing emphasis on its potential scientific impact on quantum chromodynamics. The need for such an accelerator will be addressed in the context of international efforts in this area. Support for the 18-month project in the amount of $540,000 is requested from the Department of Energy.

Mail reviews received; proposal approved for funding in PAMS; PR package in PAMS being processed.

Progress is also being made on a second Joint NAS study on Space Radiation Effects Testing
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“U.S.-Based Electron Ion Collider Science Assessment” is now getting underway. The Chair will be Gordon Baym. The rest of the committee, including a co-chair, will be appointed in the next couple of weeks. The first meeting is being planned for January, 2017.
The National Academy of Sciences was established in 1863 by an Act of Congress, signed by President Lincoln, as a private, nongovernmental institution to advise the nation on issues related to science and technology. Members are elected by their peers for outstanding contributions to research. Dr. Marcia McNutt is president.

The National Academy of Engineering was established in 1964 under the charter of the National Academy of Sciences to bring the practices of engineering to advising the nation. Members are elected by their peers for extraordinary contributions to engineering. Dr. C. D. Mote, Jr., is president.

The National Academy of Medicine (formerly the Institute of Medicine) was established in 1970 under the charter of the National Academy of Sciences to advise the nation on medical and health issues. Members are elected by their peers for distinguished contributions to medicine and health. Dr. Victor J. Dzau is president.

The three Academies work together as the National Academies of Sciences, Engineering, and Medicine to provide independent, objective analysis and advice to the nation and conduct other activities to solve complex problems and inform public policy decisions. The National Academies also encourage education and research, recognize outstanding contributions to knowledge, and increase public understanding in matters of science, engineering, and medicine.
HOW THE PUBLIC CAN FOLLOW AND PROVIDE INPUT TO STUDIES

The Current Projects System was established with a link from the National Academies homepage, www.national-academies.org, to make it easy for members of the general public with interest in the subject to follow the progress of a study and submit comments. The system offers separate views by subject and by project title.

Reports of the National Academies are available from the National Academies Press, 500 Fifth Street, NW, Washington, DC 20001
1-800-624-6242 • www.nap.edu.

OUR STUDY PROCESS

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Institute of Medicine
National Research Council

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The National Academies - Studies

Stage 1: Defining the Study

Stage 2: Committee Selection and Approval
   An appropriate range of expertise for the task
   A balance of perspectives
   Screened for conflicts of interest

Stage 3: Committee Meetings, Information Gathering, Deliberations, and Drafting the Report

Stage 4: Report Review

Release to the sponsor and (shortly thereafter) to the public

http://www.nationalacademies.org
Project Scope / Statement of Task:

The committee will assess the scientific justification for a U.S. domestic electron ion collider facility, taking into account current international plans and existing domestic facility infrastructure.

In preparing its report, the committee will address the role that such a facility could play in the future of nuclear physics, considering the field broadly, but placing emphasis on its potential scientific impact on quantum chromodynamics.
Study - U.S.-Based Electron Ion Collider Science Assessment

Project Scope / Statement of Task (continued):

In particular, the committee will address the following questions:

- What is the merit and significance of the science that could be addressed by an electron ion collider facility and what is its importance in the overall context of research in nuclear physics and the physical sciences in general?

- What are the capabilities of other facilities, existing and planned, domestic and abroad, to address the science opportunities afforded by an electron-ion collider? What unique scientific role could be played by a domestic electron ion collider facility that is complementary to existing and planned facilities at home and elsewhere?

- What are the benefits to U.S. leadership in nuclear physics if a domestic electron ion collider were constructed?

- What are the benefits to other fields of science and to society of establishing such a facility in the United States?
Committee - U.S.-Based Electron Ion Collider Science Assessment

Co-Chairs:

Dr. Ani Aprahamian, professor of experimental nuclear physics at the University of Notre Dame
Dr. Gordon A. Baym (NAS), professor emeritus at the University of Illinois at Champaign-Urbana

Members:

Dr. Christine Aidala, associate professor of physics at the University of Michigan
Dr. Peter Braun-Munzinger, scientific director of the ExtreMe Matter Institute (EMMI) at GSI
Dr. Haiyan Gao, professor of physics and Vice Chancellor for academic affairs at Duke University
Dr. Kawtar Hafidi, associate chief scientist for Laboratory Directed R&D at Argonne National Laboratory
Dr. Wick C. Haxton (NAS), professor of physics at the University of California, Berkeley
Dr. John Jowett, senior accelerator physicist at CERN.
Dr. Larry McLerran, Director of the Institute for Nuclear Theory at the University of Washington
Dr. Lia Merminga, Associate Laboratory Director, Accelerator Directorate, SLAC
Dr. Zein-Eddine Meziani, professor of physics at Temple University
Dr. Richard G. Milner, professor of physics at MIT and director of MIT’s LNS
Dr. Thomas Schaefer, professor of physics at North Carolina State University
Dr. Ernst Sichtermann, senior scientist at Lawrence Berkeley National Laboratory
Dr. Michael Turner (NAS), Bruce V. Rauner Distinguished Service Professor at the University of Chicago and director of the Physics Frontier Center and the Kavli Institute for Cosmological Physics
NAS Study Process:

“Study committees gather information from many sources in public meetings but they carry out their deliberations in private in order to avoid political, special interest, and sponsor influence”

U.S.-Based EIC Science Assessment:

Publications and reports, e.g. the EIC White-Paper, 2015 LRP, and many others

Presentations and discussions,

Four in-person committee meetings and two committee teleconferences
Committee Meetings - U.S.-Based EIC Science Assessment

February 1, 2017 - Washington, DC

9:00 Welcome and meeting overview
   Ani Aprahamian and Gordon Baym, co-chairs
9:15 National Academies basics
   Andrea Peterson, BPA program officer
9:30 Bias and conflict
   David Lang, Study Director
10:30 Discussion: statement of task
11:30 European perspectives on an EIC facility
   Peter Braun-Munzinger, GSI, committee member
13:00 The 2015 NSAC Long Range Plan
   Donald Geesaman, Argonne National Laboratory
13:45 EIC R&D Community Review Summary
   Kevin Jones, Oak Ridge National Laboratory
14:30 Discussion with Congressional Staff
   Adam Rosenberg, House S&T Comm., Energy Subcomm.
15:00 Discussion with NSF Physics
   Denise Caldwell, NSF PHY
15:30 RHIC Cold QCD Plan for 2017 to 2023
   Christine Aidala, U. of Michigan, committee member
16:15 Electron-Ion Collider: The next QCD frontier
   Richard Milner, MIT, committee member

February 2, 2017

9:00 Discussion with DOE Nuclear Physics
   Tim Hallman, DOE NP
10:00 Continued discussion with DOE
11:00 Discussion with DOE Office of Science
   Steve Binkley, DOE Office of Science
11:30 Continued discussion with DOE
13:00 Discussion: Next Steps
   Statement of Task
   Report Outline
   Information gathering
   Future meetings, work plan and schedule
14:00 Adjourn

http://www.nationalacademies.org/cp/
# Committee Meetings - U.S.-Based EIC Science Assessment

## April 19, 2017 - Irvine, CA

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Presenter</th>
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<tbody>
<tr>
<td>9:00</td>
<td>Welcome</td>
<td>Gordon Baym, co-chair</td>
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<td>9:10</td>
<td>General Discussion and review of previous meeting</td>
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<td>10:00</td>
<td>Physics of gluon saturation</td>
<td>Jean-Paul Blaizot, IPhT CEA-Saclay</td>
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<td>11:00</td>
<td>Heavy Ion Physics at CERN</td>
<td>Peter Braun-Munzinger, GSI, committee member</td>
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<td>12:45</td>
<td>Deep-inelastic scattering</td>
<td>Amanda Cooper-Sarkar, Oxford University</td>
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<td>13:30</td>
<td>Theoretical Perspectives on EIC Science</td>
<td>Xiandong Ji, U. of Maryland/Shanghai Jiao Tong U.</td>
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<td>14:30</td>
<td>JLab 5-year physics agenda</td>
<td>Zein-Eddine Meziani, Temple U., committee member</td>
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<td>15:15</td>
<td>Science potential of a U.S.-based EIC</td>
<td>Abhay Deshpande, Stony Brook University</td>
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<td>16:00</td>
<td>Discussion</td>
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## April 20, 2017

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<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>9:00</td>
<td>Discussion: Preliminary conclusions and recommendations</td>
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<td>Report outline</td>
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<td>Writing responsibilities</td>
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<td></td>
<td>Further information gathering</td>
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<tr>
<td>11:00</td>
<td>Discussion, continued</td>
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<td>13:00</td>
<td>Discussion: Future meetings</td>
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<td>Assignments</td>
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<td></td>
<td>Schedule</td>
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<tr>
<td>14:00</td>
<td>Adjourn</td>
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Committee Meetings - U.S.-Based EIC Science Assessment

September 11, 2017 - Woods Hole, MA

8:30 Welcome Gordon Baym, co-chair
8:45 Review of chapters 1 and 2
10:30 Dipole cross-section measurements and the physics of gluon saturation Al Mueller, Columbia U.
11:15 EIC accelerator technology development Lia Merminga, SLAC, committee member
13:00 EIC computing challenges and opportunities Ernst Sichtermann, LBNL, committee member
13:45 Open discussion of EIC physics: energies, crucial experiments, etc.
15:00 Review of chapters 3, 4, and 5
17:00 Initial discussion of findings and recommendations

September 12, 2017

8:30 Discussion of findings and recommendations; work on drafts
11:00 Work on drafts, continued
13:00 Discussion: Future meetings
Further assignments
Schedule
14:00 Adjourn

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Committee Meetings - U.S.-Based EIC Science Assessment

**November 27, 2017 - Washington, DC**

- 9:00 Brief introduction by co-chairs (Ani Aprahamian and Gordon Baym, co-chairs)
- 9:15 Discussion of findings and recommendations
- 10:30 High level discussion: does the draft reflect our findings and recommendations?
- 13:00 Review of chapters 1 and 2
- 14:45 Review of chapters 3 and 4
- 16:15 Review of chapters 4 and 5

**November 28, 2017**

- 9:00 Further discussion of findings and recommendations
- 11:00 Discussion: Further assignments
- 13:00 Wrap up / continued discussion of next steps
- 14:00 Adjourn

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Closing Comments - U.S.-Based EIC Science Assessment

“Until the report is publicly released…” its contents are confidential.

This said, I hope to have given you a flavor of the process and the study status from publicly available resources.

With deep gratitude to:

Many colleagues who developed the case for the EIC over many years,
The DOE, sponsor of this study,
Speakers and participants in our open meeting sessions,
Reviewers for their thoughtful comments,
NAS staff, in particular James Lancaster, David Lang, Christopher Jones, Henry Ko, Andrea Peterson, and Linda Walker,
Committee co-chairs and fellow members.

Thank You and Stay Tuned!