

Reaching for the Horizon

The NSAC 2015 Long Range Plan

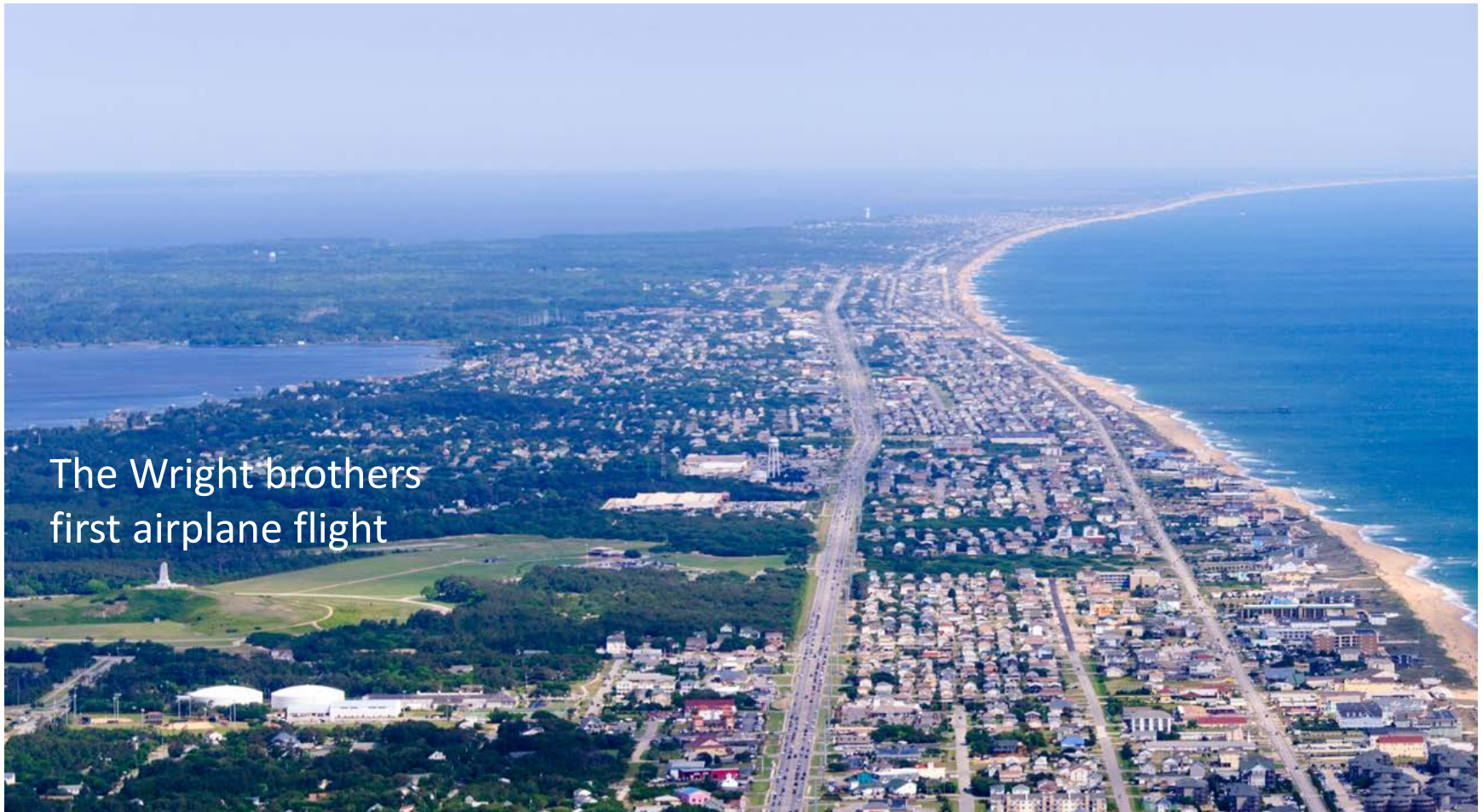
Don Geesaman

21 August

Low Energy Community Meeting

The Horizon at Kitty Hawk, NC

The location of our Long Range Plan Meeting



The Wright brothers
first airplane flight

Photo by Matt Shepherd

Charge to NSAC to Develop a New Long Range Plan

The new NSAC Long Range Plan (LRP) should articulate the scope and the scientific challenges of nuclear physics today, what progress has been made since the last LRP, and the impacts of these accomplishments both within and outside of the field. It should identify and prioritize the most compelling scientific opportunities for the U.S. program to pursue over the next decade and articulate their scientific impact. A national coordinated strategy for the use of existing and planned capabilities, both domestic and international, and the rationale for new investments should be articulated. To be most helpful, the LRP should indicate what resources and funding levels would be required (including construction of new facilities, mid-scale instrumentation, and Major Items of Equipment) to maintain a world-leadership position in nuclear physics research and what the impacts are and priorities should be if the funding available provides for constant level of effort from the FY 2015 President's Budget Request into the out-years (FY 2016-2025), with constant level of effort defined using the published OMB inflators for FY 2016 through FY 2025. A key element of the new NSAC LRP should be the Program's sustainability under the budget scenarios considered.

The extent, benefits, impacts and opportunities of international coordination and collaborations afforded by current and planned major facilities and experiments in the U.S. and other countries, and of interagency coordination and collaboration in cross-cutting scientific opportunities identified in studies involving different scientific disciplines should be specifically addressed and articulated in the report. The scientific

No-Spoiler Alert

- I am not going to present the recommendation(s).
- The Plan will be presented at the October 15 NSAC meeting and become public.
- I am not going to quote news articles about what the recommendations might be.
- I will be happy to answer your questions except about the recommendations

Why This is Important

The Agencies Listen

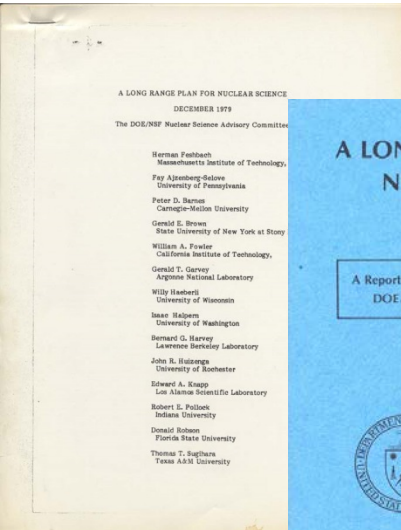
All major projects in Nuclear Physics
since 1979 have been
recommendations of a Long Range
Plan

LRP Schedule

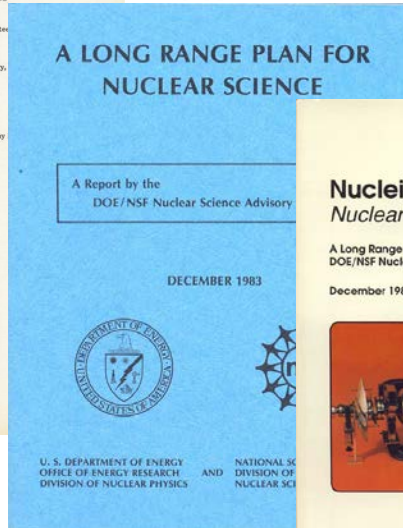
- ✓ Charge delivered at 24 April NSAC Meeting
- ✓ LRP Working Group formed in early June ~ 60 members
 - NuPECC and ANPhA observers.
- ✓ Community organization last summer
- ✓ DNP town meetings in the July/September
- ✓ Joint APS-DNP-JPS Meeting Oct 7-11, 2014 – Wednesday afternoon discussion.
- ✓ Working Group organizational meeting Nov 16, 2014 in Rockville, MD
- ✓ White papers by end of January to have greatest impact
- ✓ Cost review of EIC – Report at April 3 NSAC meeting
- ✓ Most of text of report assembled by April 10.
- ✓ Resolution meeting of Long Range Plan working group April 16-20, 2015.
- ✓ Second draft of full report by May 18
- ✓ Draft report reviewed by external wise women and men.
- LRP final report due October 2015 – NSAC Meeting and Public Presentation

The 2015 NSAC Long Range Plan

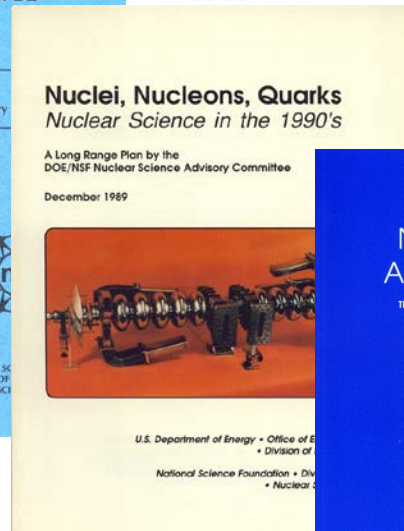
1979



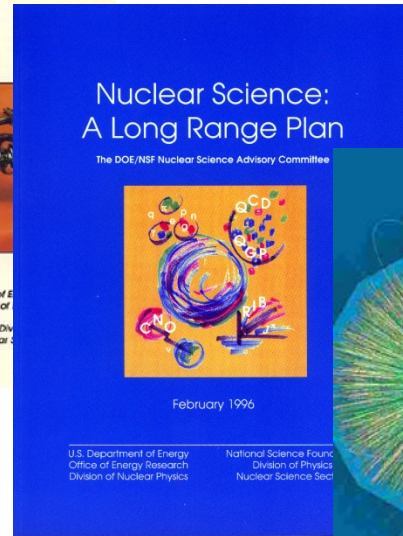
1983



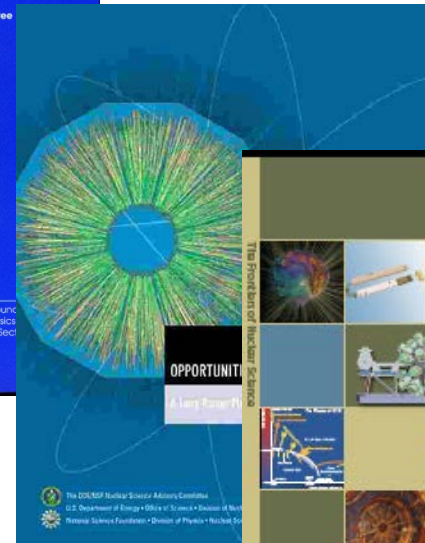
1989



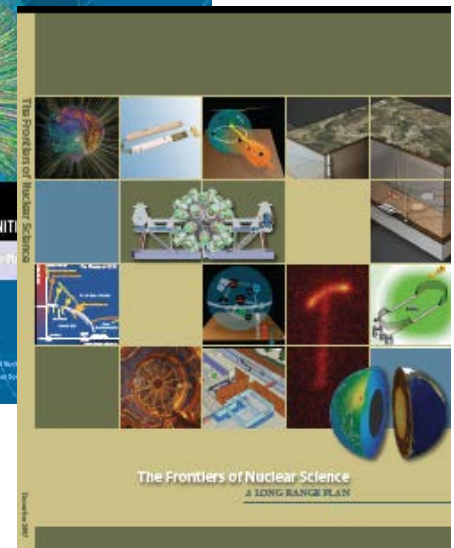
1996



2002



2007



History

1983: Increase operating and equipment funds#

Build RHIC

Following instruction to assume CEBAF led to a mixed message which had to be addressed later.

We will not make this mistake again!

1989: Complete CEBAF, Build RHIC, **Join Kaon**

1996: Pursuit of opportunities from recent investments

Build RHIC

Radioactive Beams – in-flight and ISOL

LISS and AGS hadron beams

2002: Exploit opportunities from recent investments, facility ops,
universities and theory

Build RIA

Underground Lab

CEBAF upgrade

FY07 LRP Recommendations

(after a period of little major construction)

- Complete JLAB 12 GeV
- Build FRIB
- Targeted program in fundamental symmetries
- Upgrade RHIC
- Resources for R&D for EIC
- Initiatives in theory, gamma-ray tracking and Accelerator R&D

Web locations

You can find more information on the NSAC web site:

<http://science.energy.gov/np/nsac/>

This will give you the charge, membership of the Long Range Plan working group and a link to a site at ANL with further information such as the schedule for upcoming activities.

Argonne Site:

<http://www.phy.anl.gov/nsac-lrp/>

This describes what we are doing and contains a link to all the input documents we have received from the community.

Resolutions: August 2014 LENP Texas Town Meeting

The town meeting culminated in the formulation of the following statement of recommendations for the LRP planning committee:

1. The study of atomic nuclei is the core of nuclear science. The frontier of this field lies in the new opportunities and intellectual challenges offered by FRIB's ability to produce intense beams of rare isotopes. This ability will lead to an unprecedented understanding of nuclei, of their role in the cosmos, and studies of fundamental interactions. The field is ideally positioned, as well, to advance applications in medicine, energy, national security, and materials science. The health of this field is required to train the talented national workforce needed to assure continuing societal benefits in these critical areas. FRIB provides an essential and unparalleled opportunity to pursue compelling science and maintain world leadership in this field.
- **We reaffirm in the strongest possible terms the scientific vision of FRIB and endorse the recommendation laid out in the 2012 National Academy Decadal Study for the timely completion of this advanced rare ion beam facility and the initiation of its full scientific program. Once completed, FRIB will be the world-leading nuclear physics facility that enables tremendous discovery potential for the physics of nuclei, nuclear astrophysics, and the study of fundamental symmetries, with the added benefit of significant applications potential in many areas of societal importance.**

Resolutions: August 2014 LENP Texas Town Meeting

Recommendation of the National Research Council Decadal Study, 2012

Finding: The Facility for Rare Isotope Beams is a major new strategic investment in nuclear science. It will have unique capabilities and offers opportunities to answer fundamental questions about the inner workings of the atomic nucleus, the formation of the elements in our universe, and the evolution of the cosmos.

Recommendation: The Department of Energy's Office of Science, in conjunction with the State of Michigan and Michigan State University, should work toward the timely completion of the Facility for Rare Isotope Beams and the initiation of its physics program.

Resolutions: August 2014 LENP Texas Town Meeting

2. In support of our science goals, we must continue forefront research to enable new discoveries, to train the next generation of scientists, and to develop new detector and accelerator technologies. Hence:

● We recommend that appropriate funds for operations and near-term upgrades of existing research capabilities at ATLAS, NSCL, university and other facilities be provided. Improvements and developments of instrumentation at existing facilities should be adequately supported. It is essential that strong support for research groups is provided.

● We recommend that enhanced support for nuclear theory be provided to address key questions in nuclear physics and astrophysics and to realize the full potential of the experimental program at FRIB. We recommend the creation of a national FRIB theory center to drive this exciting science and the computational nuclear physics initiative to take maximum advantage of high performance computing critical to this effort.

● To realize the full scientific discovery potential of FRIB and existing facilities, it is essential that major experimental systems are available. We recommend:

- the construction of the 4π GRETA in a timely manner.
- the timely construction of other new state-of-the-art instruments for FRIB, such as the High Rigidity Spectrometer and the separator for capture reactions SECAR.
- the construction of ReA12 in a timely manner.

Resolutions: August 2014 LENP Texas Town Meeting

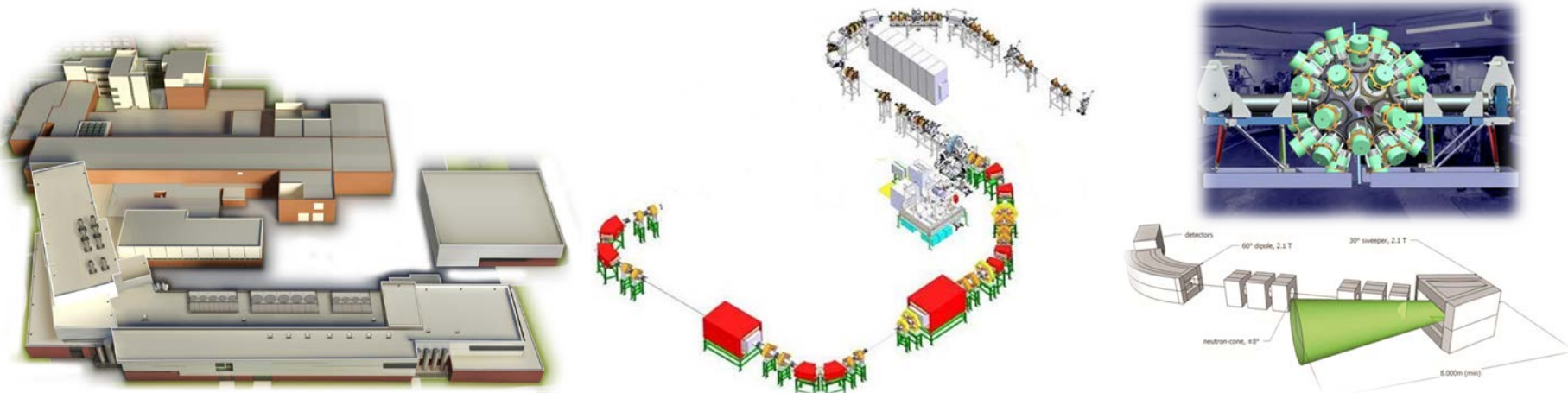
- 3. We endorse the recommendation of the 2014 Computational Nuclear Physics Meeting: “Capitalizing on the pre-exascale systems of 2017 and beyond requires significant new investments in people, advanced software, and complementary capacity computing directed toward nuclear theory.”**

- 4. Education and innovation are key components of any vision of the future of the field of nuclear science. We therefore fully endorse the recommendations of the Education and Innovation Town Meeting.**

Nuclear Astrophysics Resolution 1

1. FRIB's unprecedented intense beams of fast, stopped, and reaccelerated rare isotopes offer game changing opportunities for nuclear astrophysics, in particular in the areas of explosive nucleosynthesis and neutron stars.

- We strongly support the timely completion of the Facility for Rare Isotope Beams (FRIB) and the implementation of the full science program as the highest priority for the nuclear astrophysics community.
- To operate a broad nuclear astrophysics program we strongly recommend the development and implementation of critical equipment such as SECAR, GRETA, and the HRS for nuclear astrophysics measurements.



Nuclear Astrophysics Resolution 2

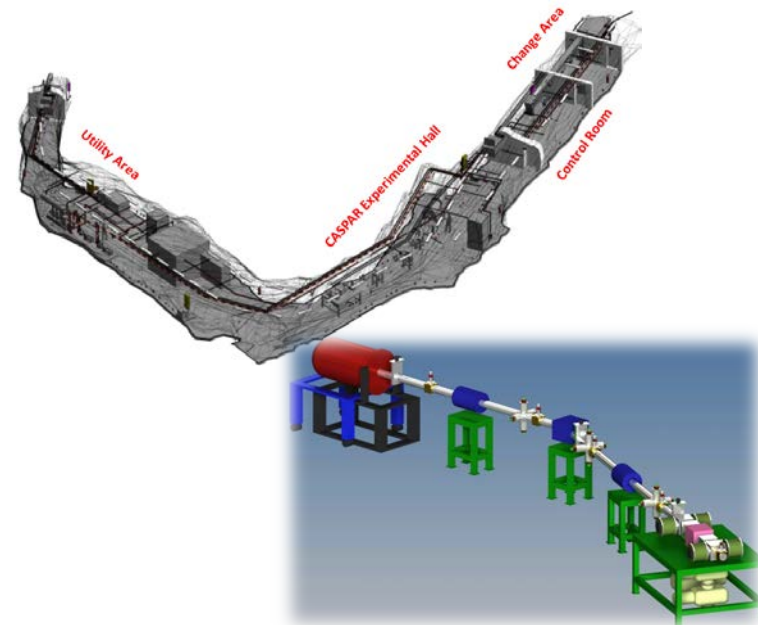
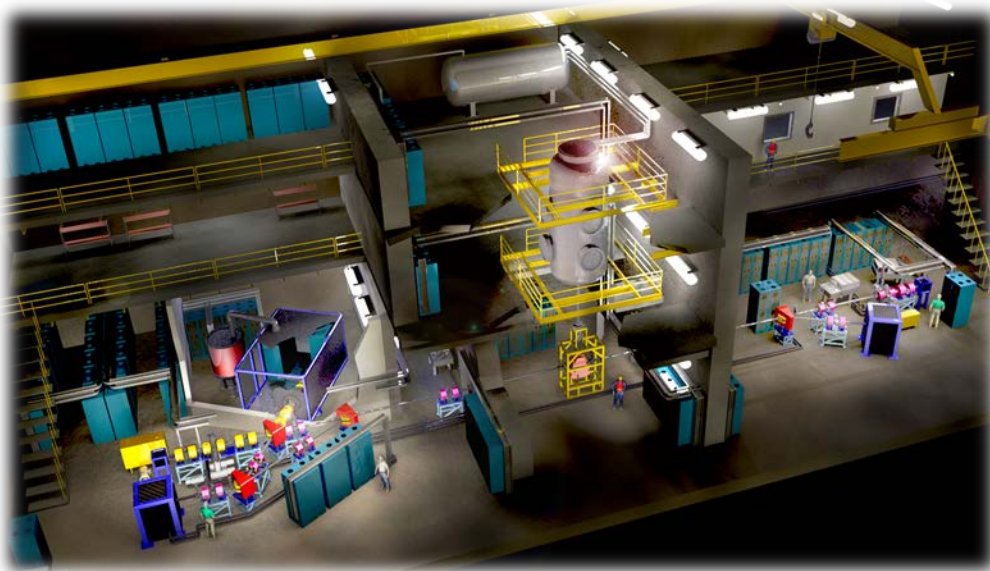
2. To address the compelling questions in nuclear astrophysics and to operate an effective and competitive nuclear astrophysics program a broad range of nuclear probes, techniques, and theory is essential. This requires appropriate utilization of the available nuclear physics facilities, in particular university-based laboratories, and strong theory support.

- We recommend to appropriately support operations and planned upgrades at **ATLAS, NSCL, and university-based laboratories** as well as the utilization of these and other facilities for enabling measurements with the broad range of beams required to achieve the science goals in nuclear astrophysics. It is essential that strong support for research groups is provided.
- We recommend **strengthening support for nuclear theory** and the founding of an **FRIB theory center** that addresses the needs of a broader nuclear astrophysics community. In addition we recommend focused multi-institutional research collaborations in theory and simulation to take advantage of new opportunities created by increased computing capabilities and large data science.

Nuclear Astrophysics Resolution 3

3. High intensity underground accelerator measurements have emerged as a critical tool for directly studying reactions in stellar burning that govern stellar evolution and provide the seeds for explosive nucleosynthesis.

- We recommend the construction and operation of a high intensity underground accelerator facility for the study of stable beam reactions near quiescent stellar burning conditions.**



Nuclear Astrophysics Resolution 4

4. Interdisciplinary centers are important for advances in nuclear astrophysics as they overcome field boundaries between nuclear physics and astronomy, and bring together the diverse experiment, theory, and observation communities that comprise the field of nuclear astrophysics.

Data compilation, dissemination, and distribution is an essential component for such interdisciplinary efforts.

- We recommend the continued support for the operation of the Joint Institute for Nuclear Astrophysics as Physics Frontiers Center and other field bridging initiatives.
- We recommend continued robust support of the operation of data centers and other data compilation efforts of importance for nuclear astrophysics.

Nuclear Astrophysics Resolution 5

5. Education and innovation are key components of any vision of the future of the field of nuclear science.

- **We fully endorse the recommendations of the Education and Innovation White Paper.**

Joint Resolutions: LENP and NAP Town Meetings

The Low Energy Nuclear Physics and Nuclear Astrophysics town meetings culminated in the formulation of the following joint statement of recommendations for the LRP planning committee:

Science and society rely on our understanding of the atomic nucleus. Its relevance spans the dimensions of distance from 10^{-15} m (proton's radius) to 12 km (neutron star radius) and timescales from fractions of a second after the Big Bang to today; i.e., 13.8 billion years later. As reaffirmed by the 2012 National Academies of Sciences' decadal study "*Nuclear Physics: Exploring the Heart of Matter*," the path to understanding the nucleus requires the completion of the Facility for Rare Isotope Beams (FRIB) and its effective operation. Unprecedented access to a vast new terrain of nuclei will result in scientific breakthroughs and major advances in our understanding of nuclei and their role in the cosmos, and will open new avenues in cross-discipline contributions in basic sciences, national security, and other societal applications.

- ***The highest priority in low-energy nuclear physics and nuclear astrophysics is the timely completion of the Facility for Rare Isotope Beams and the initiation of its full science program.***

Joint Resolutions: LENP and NAP Town Meetings

In support of our science goals we must continue forefront research, exploit existing facilities, develop new capabilities and equipment, and enable major advances in nuclear theory.

- ***We recommend appropriate support for operations and planned upgrades at ATLAS, NSCL, and university-based laboratories, as well as for the utilization of these and other facilities, for continued scientific leadership. Strong support for research groups is essential.***
- ***We recommend enhanced support for theory in low-energy nuclear science and nuclear astrophysics, which is critical to realize the full scientific promise of our fields.***
- ***We recommend targeted major instrumentation and accelerator investments to realize the discovery potential of our fields.***

Joint Resolutions: LENP and NAP Town Meetings

Realizing the scientific potential of Low Energy Nuclear Physics and Nuclear Astrophysics demands large-scale computations in nuclear theory that exploit the US leadership in high-performance computing.

- ***We endorse the recommendation of the 2014 Computational Nuclear Physics Meeting:
“Capitalizing on the pre-exascale systems of 2017 and beyond requires significant new investments in people, advanced software, and complementary capacity computing directed toward nuclear theory.”***

Joint Resolutions: LENP and NAP Town Meetings

Education, outreach, and innovation are key components of any vision of the future of the field of nuclear science. Our fields play a leading role in education and training of the nation's nuclear science workforce. Our fields are ideally positioned, as well, to advance applications in medicine, energy, national security, and materials science. The health of this field is required to train the talented national workforce needed to assure continuing societal benefits in these critical areas. Continuation of this role is a major goal of our fields.

We endorse the recommendations of DNP Education and Innovation Town Meeting.

EIC Cost review

Since the cost of an EIC was a significant issue for the plan, there was a cost review chaired by Ed Temple.

Excerpt from Summary:

Of the uncertainties that remain, the subcommittee considers the dominant ones to be technical. Given these technical uncertainties, based on the plans presented by both teams, the subcommittee concluded that an EIC could be built for about \$1.5B in FY15\$. We note that critical information on the performance of the eRHIC energy recovery linac (ERL) and the coherent electron cooling (CeC) approaches is planned to become available in 2016. Such information could go a long way toward reducing the greatest technical uncertainties for the eRHIC concept. The total on-project cost for both approaches may potentially be reduced as technical risk is retired, by off-project funds especially for the detectors from international sources, by redirection of operating funds at the host laboratory or by reducing the design requirements.

Recommendations from the Town Meetings

Run JLAB12
Run RHIC RHI
Run RHIC Spin
and run at other existing facilities
Run ATLAS and NSCL
Participation in LHC

Build and run FRIB

Build EIC

Lead NLDBD

INCREASE Instrumentation and MIE

Increase theory and theory computing

Increase experimental research
particular push in Astro, FS&N

These flow into possible Working Group recommendations

Requests

FRIB Ops \$80M/year

EIC \$1000-1500M

NLDBD \$ 250M

Midscale and MIE

JLAB \$75M

LE \$116M

RHI \$31M

ASTRO \$25M

OTHER FS&N \$116M

Subtotal \$363M

Computing \$10

Research \$30/year

Not
Priority
Ordered!

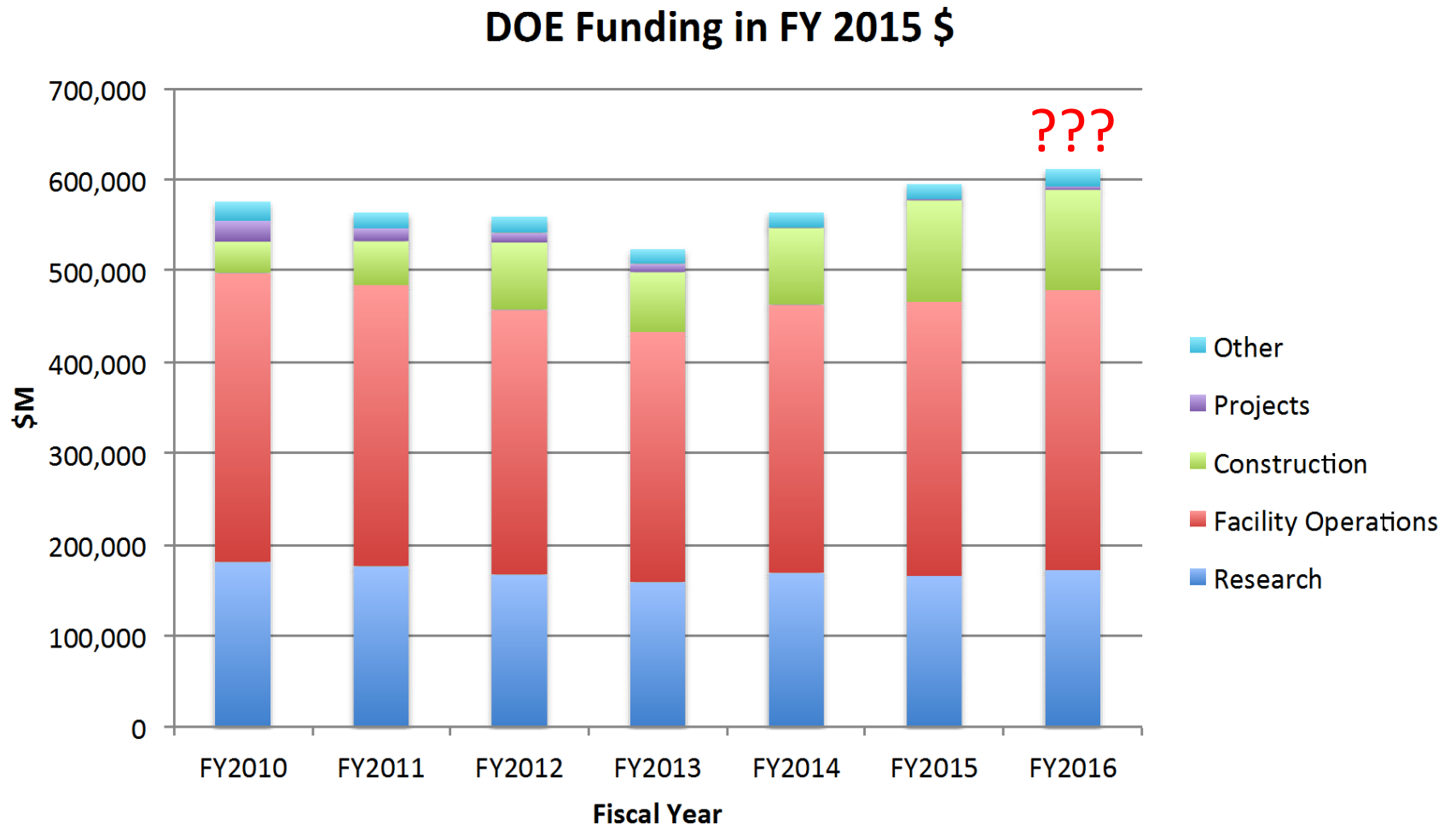
Budget Constraints are Real!

We were asked what resources and funding levels would be required to maintain a world leadership position in nuclear physics research

and

what the impacts are and priorities should be if funding available provides for a constant level of effort...

Budget History



General Thoughts

- How do we make it clear that we understand we cannot get everything.
- Many small recommendations only make sense if they are to shut something down. Otherwise how do you evaluate relative priorities?
- We have to trust the agencies have the wisdom to deal with scarce resources across areas of the field.

Summary

- The community worked very effectively preparing for the Long Range Plan

Thank you!

- The LRP working group respectfully grappled with a number of serious issues.
- I believe we are creating a plan that will allow us to reach new horizons.
- When you see it in October, I hope you will agree.