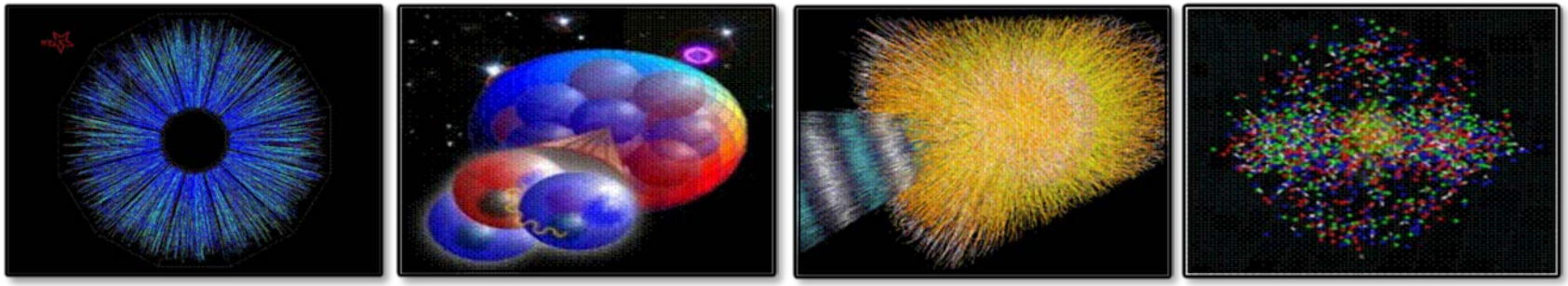
U.S. DEPARTMENT OF ENERGY | Office of Science

Perspectives from the DOE Office of Science Nuclear Physics Program

NSAC Meeting

June 30, 2014

Dr. Timothy J. Hallman
Associate Director for Nuclear Physics
DOE Office of Science



FY2015 SC Budget Status

	FY 2013 with SBIR/ STTR	FY 2014 Enacted Approp.	FY 2015 President's Request	FY15 President's Request vs. FY14 Enacted Approp.		FY 2015 House Committee Mark	FY15 House Mark vs. FY15 President's Request		FY 2015 Senate Subcomm Mark	FY15 Senate Mark vs. FY15 President's Request	
ASCR	417,778	478,093	541,000	+62,907	+13.2%	541,000	…	…	...	…	…
BES	1,596,166	1,711,929	1,806,500	+94,571	+5.5%	1,702,000	-104,500	-5.8%	...	…	…
BER	578,294	609,696	628,000	+18,304	+3.0%	540,000	-88,000	-14.0%	...	…	…
FES	385,137	504,677	416,000	-88,677	-17.6%	540,000	+124,000	+29.8%	...	…	…
HEP	748,314	796,521	744,000	-52,521	-6.6%	775,000	+31,000	+4.2%	...	…	…
NP	**519,859**	**569,138**	**593,573**	**+24,435**	**+4.3%**	**600,000**	**+6,427**	**+1.1%**	**...**	**…**	**…**
WDTS	17,486	26,500	19,500	-7,000	-26.4%	19,500	…	…	...	…	…
SLI	105,673	97,818	79,189	-18,629	-19.0%	79,500	+311	+0.4%	...	…	…
S&S	77,506	87,000	94,000	+7,000	+8.0%	94,000	…	…	...	…	…
PD	174,862	185,000	189,393	+4,393	+2.4%	180,000	-9,393	-5.0%	...	…	…
Subtotal, SC	**4,621,075**	**5,066,372**	**5,111,155**	**+44,783**	**+0.9%**	**5,071,000**	**-40,155**	**-0.8%**	**...**	**…**	**…**
Use of PY balances	...	...	...	…	…	-5,257	-5,257	…	...	…	…
Total, SC	**4,621,075**	**5,066,372**	**5,111,155**	**+44,783**	**+0.9%**	**5,065,743**	**-45,412**	**-0.9%**	**5,086,000**	**-25,155**	**-0.5%**

Outlook on FY 2015 appropriation TBD

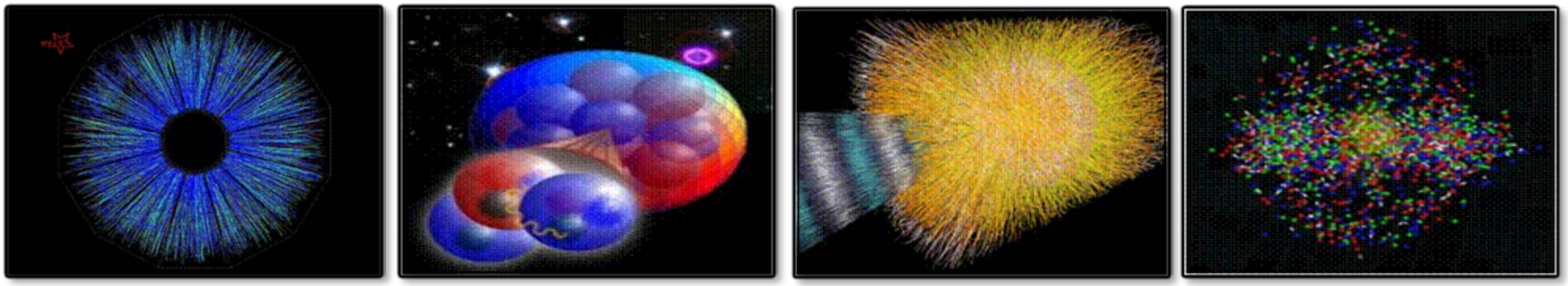
- Senate bill details unavailable
- House expected to take up EWD Appropriations Act after the July 4th recess.

Nuclear Physics

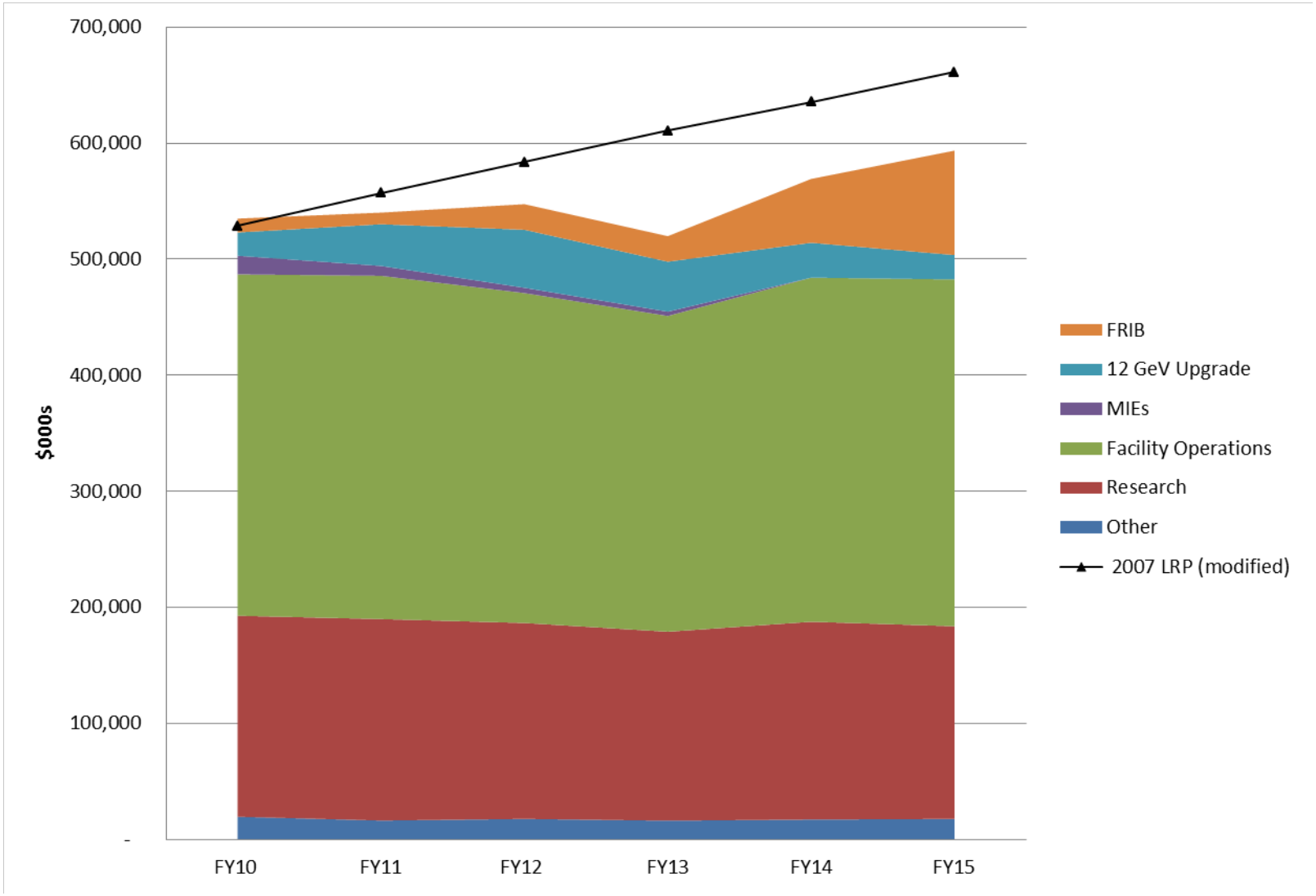
Discovering, exploring, and understanding all forms of nuclear matter

FY 2015 Budget Highlights:

- Research at RHIC capitalizes on increased luminosity and new micro-vertex detectors to probe the properties of the perfect Quark-Gluon liquid using charm and bottom quarks.
- Construction continues for the Facility for Rare Isotope Beams to study nuclear structure and nuclear astrophysics.
- The 12 GeV CEBAF Upgrade to study the quark structure of nucleons and nuclei achieves CD-4A, Accelerator Project Completion.
- ATLAS beams using the Californium Rare Isotope Breeder (CARIBU**)** advance understanding of nuclear structure and the origin of the elements in the cosmos.
- Research, development, and production of stable and radioactive isotopes is provided for science, medicine, industry, and national security.
- Research decreases relative to FY 2014.



NP Budgets vs. 2007 Long Range Plan



Nuclear Physics
FY 2015 Budget Status

Nuclear Physics	FY 2013 Approp. with SBIR/ STTR	FY 2014 Enacted Approp.	FY 2015 President's Request	FY 2015 Request vs. FY 2014	FY 2015 House Mark	FY 2015 House vs. Request
Operation and maintenance						
Medium Energy	128,328	148,695	149,892	+1,197	153,842	+3,950
TJNAF Operations	78,123	94,493	96,050	+1,557	100,000	+3,950
Heavy Ions	193,229	199,693	198,966	-727	201,466	+2,500
RHIC Operations	157,021	165,072	165,072	-	167,572	+2,500
Low Energy *	78,190	75,704	75,269	-435	75,269	-
Nuclear Theory	39,057	45,142	43,096	-2,046	43,096	-
Isotope Program	18,483	19,404	19,850	+446	19,850	-
Undistributed	-	-	-	-	-23	-23
Total, Operation and maintenance	**457,287**	**488,638**	**487,073**	**-1,565**	**493,500**	**+6,427**
Construction						
14-SC-50 Facility for Rare Isotope Beams	22,000	55,000	90,000	+35,000	90,000	-
06-SC-01 12 GeV CEBAF Upgrade	40,572	25,500	16,500	-9,000	16,500	-
Total, Construction	**62,572**	**80,500**	**106,500**	**+26,000**	**106,500**	**-**
Total, Nuclear Physics	**519,859**	**569,138**	**593,573**	**+24,435**	**600,000**	**+6,427**

* Funds for FRIB in FY13 were provided under Low Energy but are moved to the FRIB Construction line in this table.

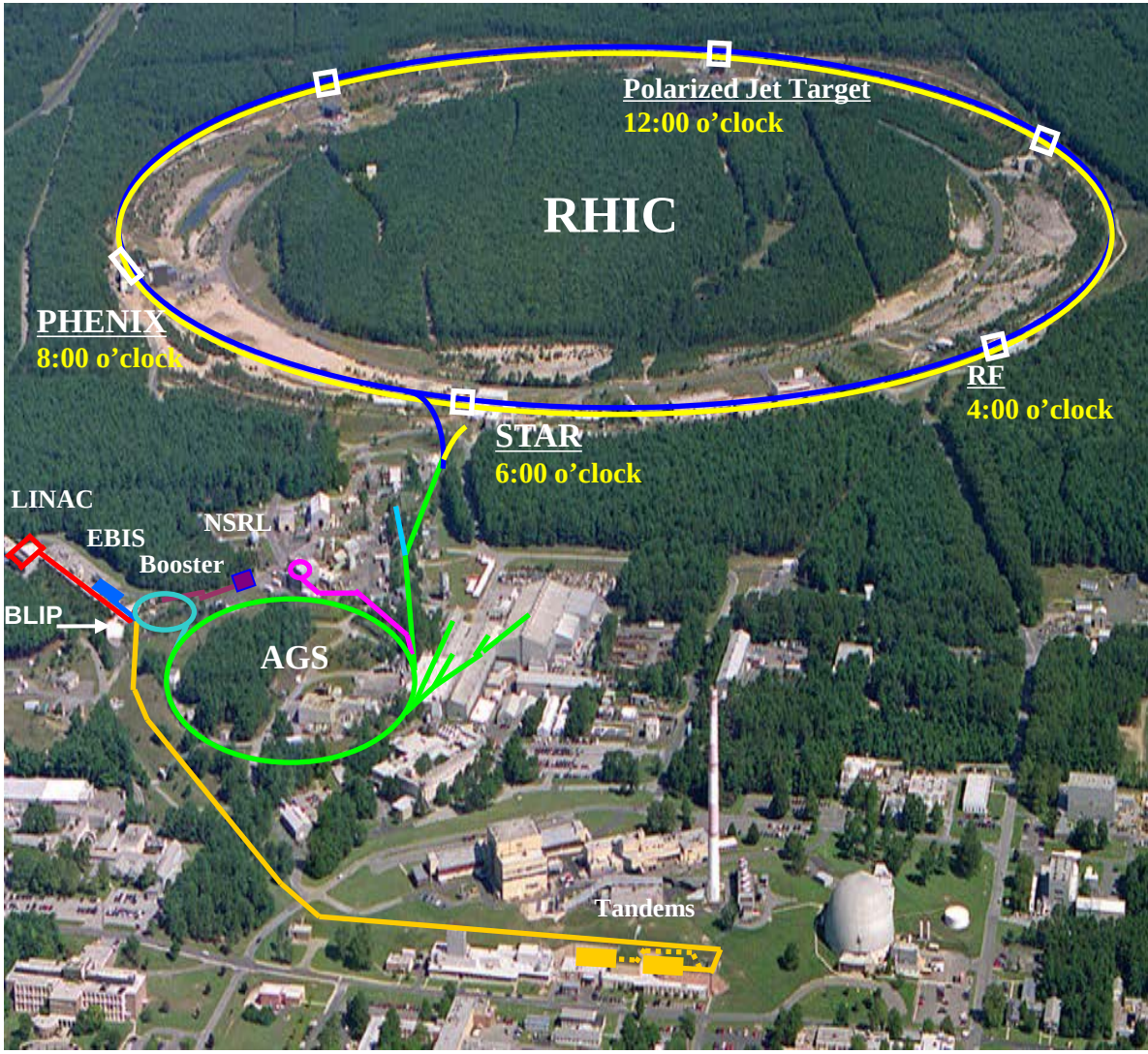
NP bottom line increase is dominated by the construction profile of FRIB

Continuing Scientific Discovery at the Relativistic Heavy Ion Collider

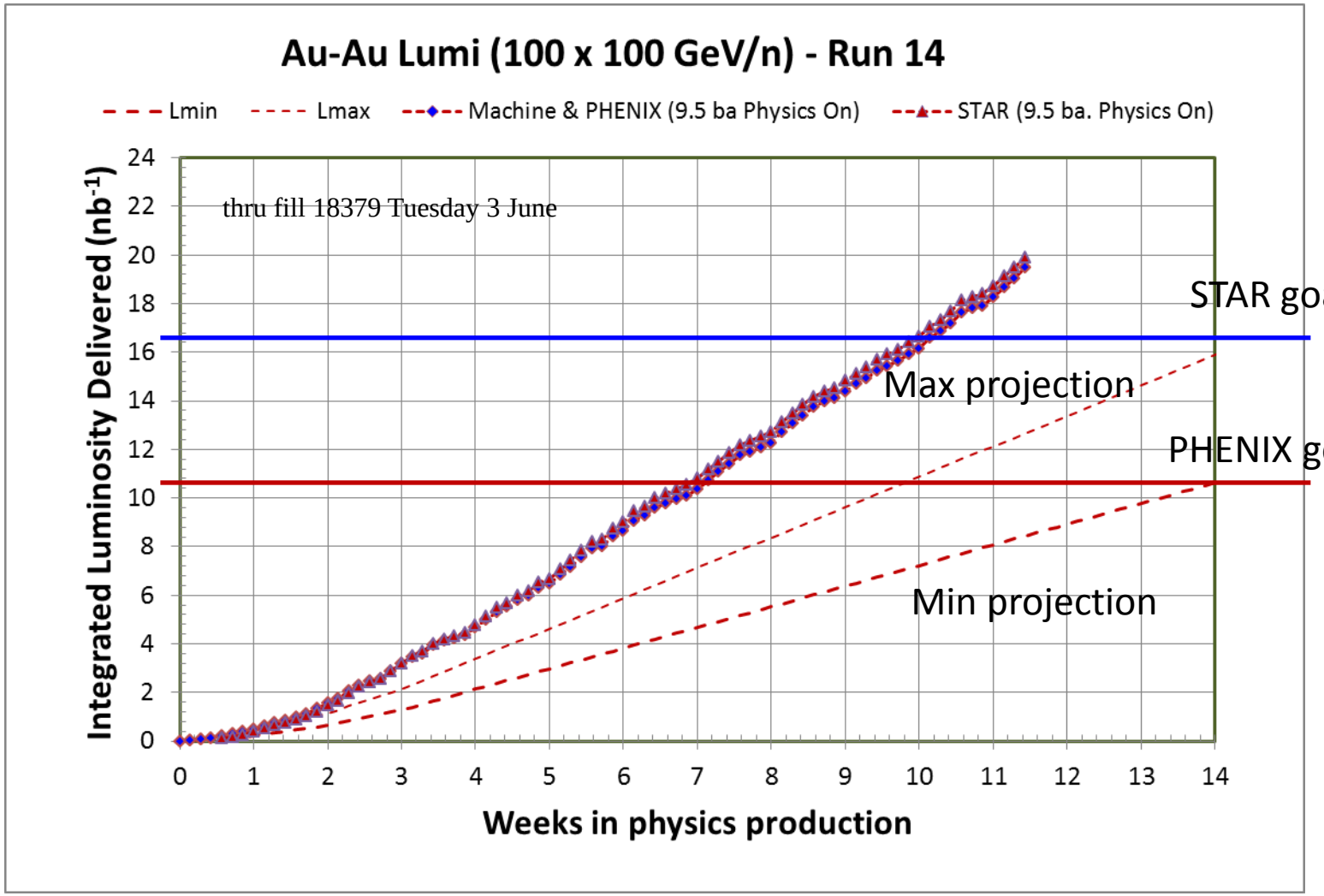
RHIC discovered a completely new state of matter—a perfect quark-gluon liquid. The RHIC science campaigns planned in the next 3-5 years will:

- determine, with precision, the properties of this perfect liquid
- search for new discoveries such as the postulated Critical Point in the phase diagram of QCD
- explore the gluon and sea quark contributions to the spin of the proton using RHIC, the only collider with polarized beams
- explore and develop intellectual connections and broader impacts to other subfields

No other facility worldwide, existing or planned, can rival RHIC in range and versatility.

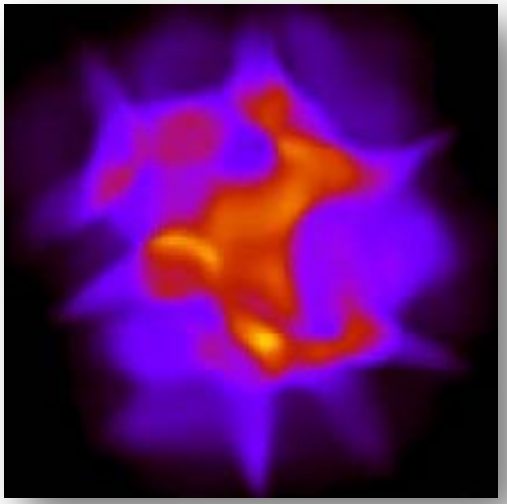


RHIC Machine Performance Continues to Amaze



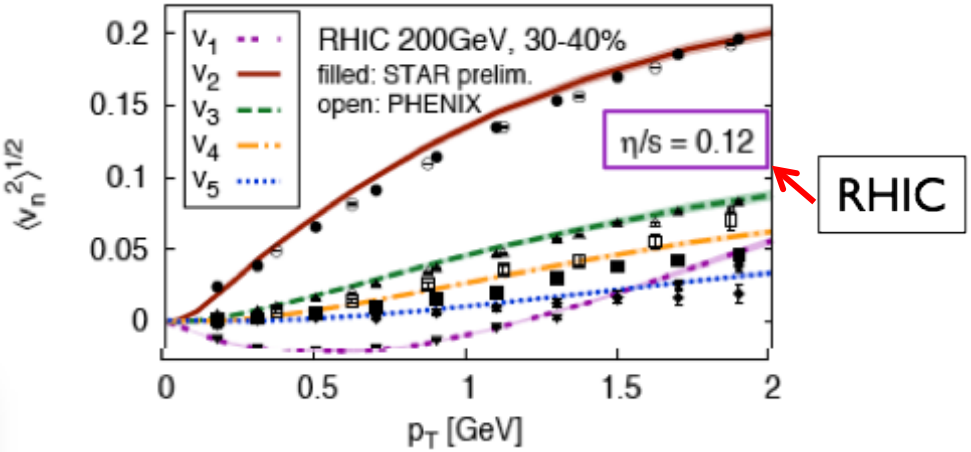
Fischer et. al. "RHIC Collider Projections (FY 2014 – FY 2018)", 4 June 2013

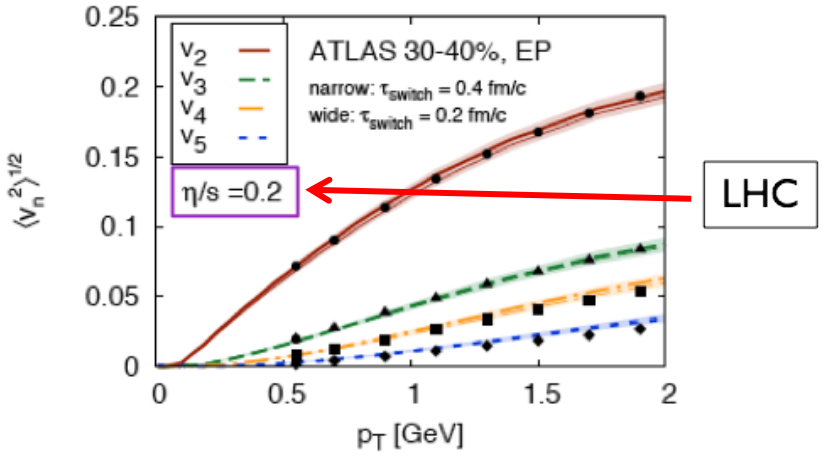
Recent RHIC Science Highlights



RHIC's "perfect" liquid is closer to perfection than LHC's: The hot soup of early-universe matter created in RHIC's heavy ion collisions found to have a lower specific shear viscosity (η/s).

Björn Schenke, winner of the 2013 IUPAP Young Scientist Prize, and world leader in modeling the early stage evolution of the dense fireball created in heavy ion collisions at RHIC



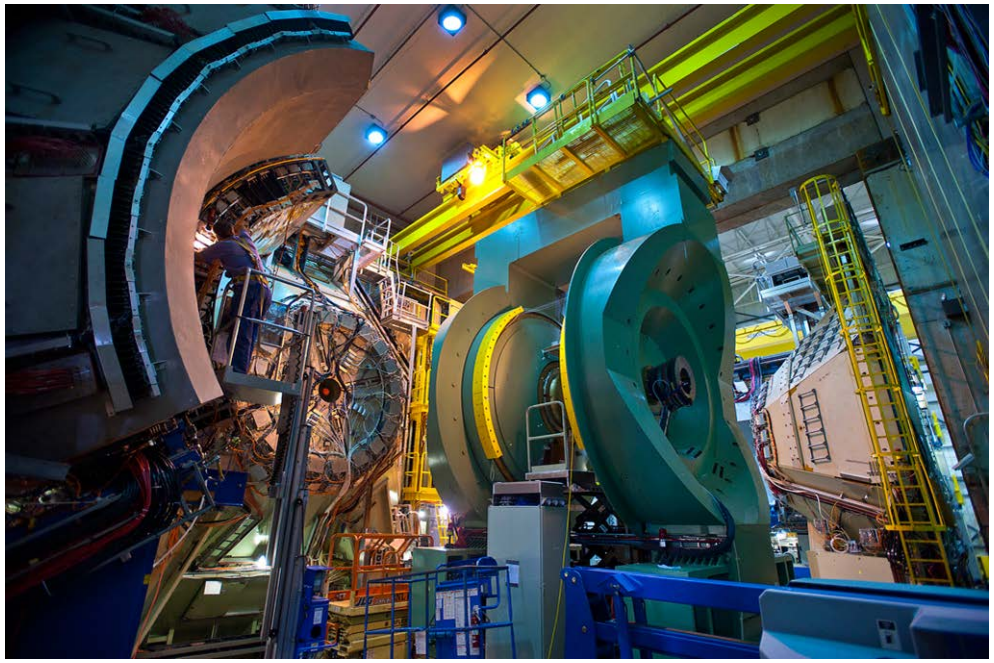


Heavy Ion – FY 2015 President's Request

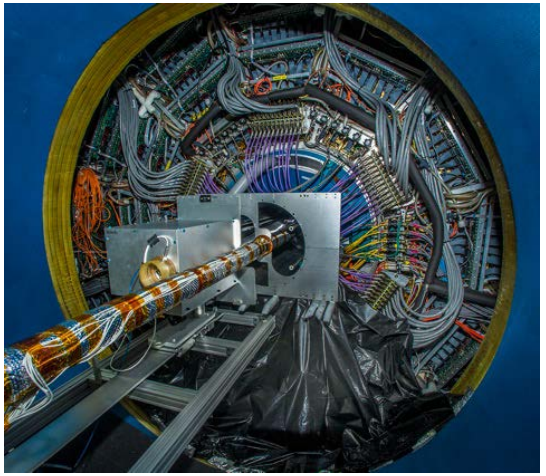
	FY 2014 Enacted	FY 2015 Request	FY15 vs. FY14
Research	34,621	33,894	-727
RHIC Operations	165,072	165,072	0
Total	**199,693**	**198,966**	**-727**

- Research decreases relative to FY 2014. Focus is on the collection and analysis of RHIC data using newly completed scientific instrumentation to better understand the initial conditions in heavy ion collisions, as well as participation in experiments at the LHC.

- RHIC Operations is maintained at the FY 2014 level which supports 2,770 beam hours (approximately 22 weeks and 68 percent utilization). Funds for experimental equipment, accelerator R&D, and materials and supplies are reduced in FY 2015 in order to optimize running levels.

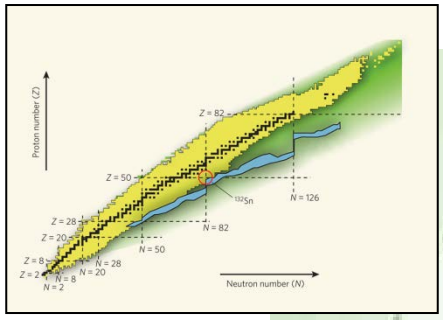


PHENIX detector at BNL's Relativistic Heavy Ion Collider (RHIC)

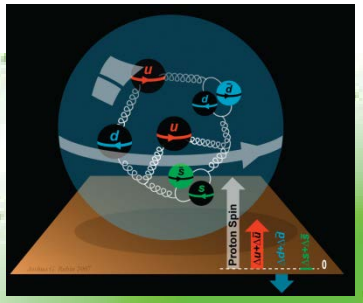


Heavy Flavor Tracker installed in STAR – ready for RHIC Run 14

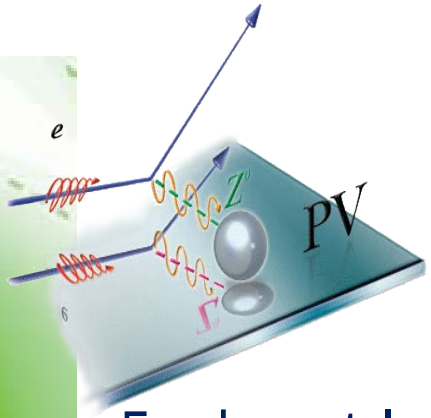
JLab: Medium Energy Nuclear Science and Its Broader Impacts



Nuclear Structure



Structure of Hadrons



Fundamental Forces & Symmetries

Medical Imaging

Quark Confinement

Accelerator S&T

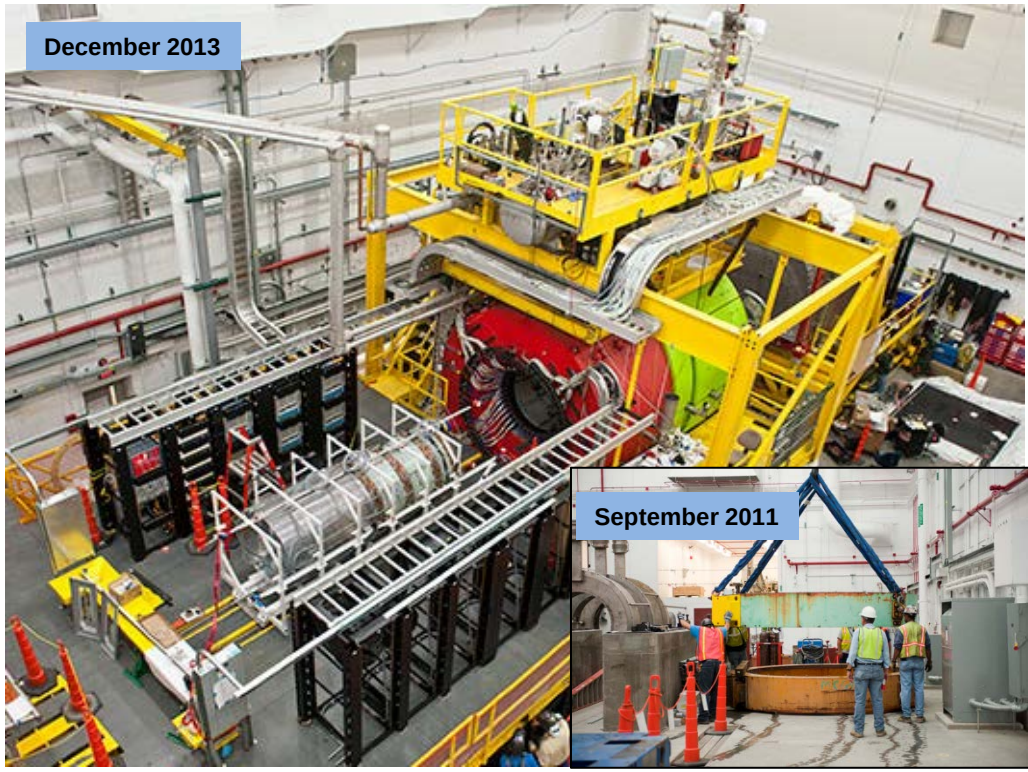
Hadrons from QGP

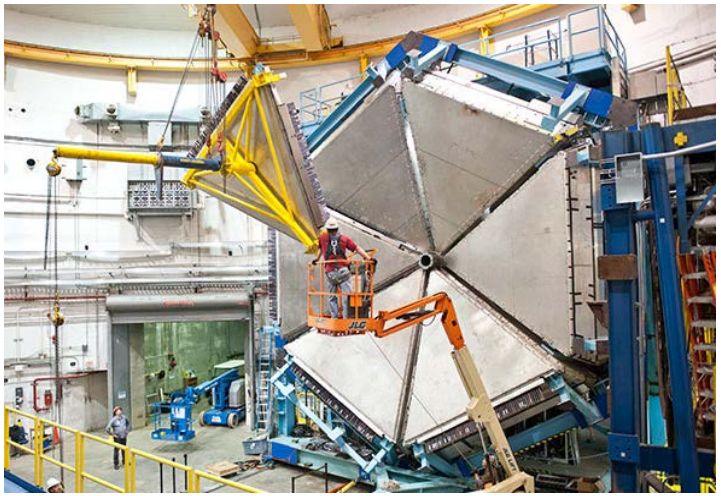
Theory and Computation

The 12 GeV CEBAF Upgrade at TJNAF is 87% Complete

With the completion of the 12 GeV CEBAF Upgrade, researchers will address:

- The search for exotic new quark anti-quark particles to advance our understanding of the strong force
- Evidence of new physics from sensitive searches for violations of nature's fundamental symmetries
- A detailed microscopic understanding of the internal structure of the proton, including the origin of its spin, and how this structure is modified when the proton is inside a nucleus





Mounting of the Forward Time-of-Flight detector arrays onto the forward carriage in Hall B

Project was re-baselined in September 2013 with a Total Project Cost of $338M and completion in September 2017

JLAB Continues to Deliver High Impact Science

LETTER

doi:10.1038/nature12964

Measurement of parity violation in electron–quark scattering

The Jefferson Lab PVDIS Collaboration*

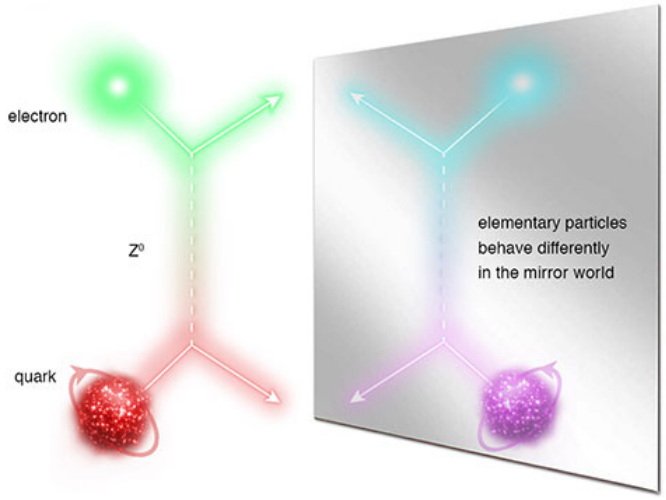
Symmetry permeates nature and is fundamental to all laws of physics. One example is parity (mirror) symmetry, which implies that flipping left and right does not change the laws of physics. Laws for electromagnetism, gravity and the subatomic strong force respect parity symmetry, but the subatomic weak force does not[1,2]. Historically, parity violation in electron scattering has been important in establishing (and now testing) the standard model of particle physics.

of the now highly successful standard model of particle physics. PVES has subsequently been used as a sensitive probe to study diverse physics, ranging from physics beyond the standard model[9,10] to the structure of both nuclei[11] and the nucleon (ref. 12 and references therein).

In so-called tree-level scattering, where the electron exchanges only a single photon or a single Z boson with the target, very simple expressions for $a_{1,3}$ in equation (2) emerge for electron DIS from deuterium:

Nature 2014

Measurement of the Parity-Violating Asymmetry in eD Deep Inelastic Scattering



Nature 506, 67–70 (06 February 2014)

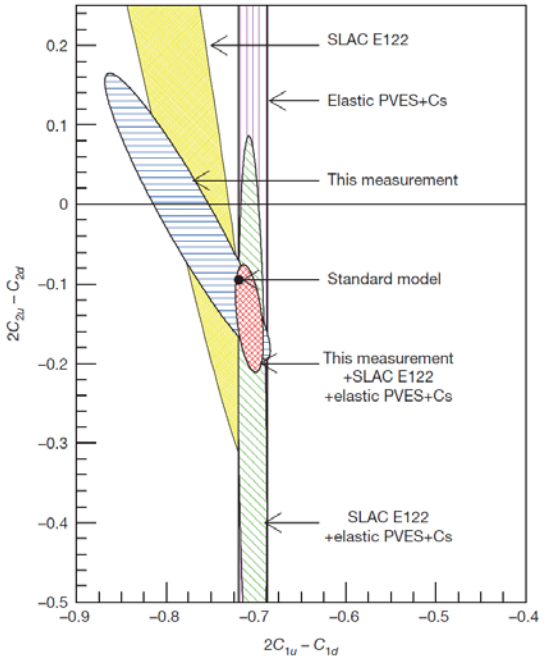
The Jefferson Lab PVDIS Collaboration

See also News & Views, *Nature* 506, 43–44 (06 February 2014)

Longitudinally Polarized Electron Scattering from Unpolarized Deuterium

$$A_{LR} = A_{PV} = \frac{\sigma_{\uparrow} - \sigma_{\downarrow}}{\sigma_{\uparrow} + \sigma_{\downarrow}} \sim \frac{A_{weak}}{A_{\gamma}} \sim \frac{G_F Q^2}{4\pi\alpha} \left(\alpha\,[2C_{1u} - C_{1d}] + \beta\,[2C_{2u} - C_{2d}]\right)$$

- The present result leads to a determination of the effective electron-quark weak coupling combination $2C_{2u} - C_{2d}$ that is five times more precise than previously determined.
- It is the first experiment to isolate, when combined with previous experiments like Qweak, a non-zero C_{2q} (at 95% confidence level).
- This coupling describes how much of the mirror-symmetry breaking in the electron-quark interaction originates from the quarks' spin preference in the weak interaction. The result provides a mass exclusion limit on the electron and quark compositeness and contact interactions of ~5 TeV.



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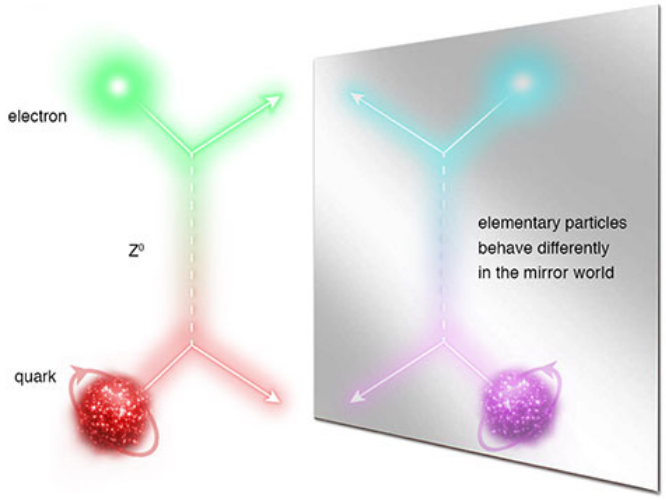

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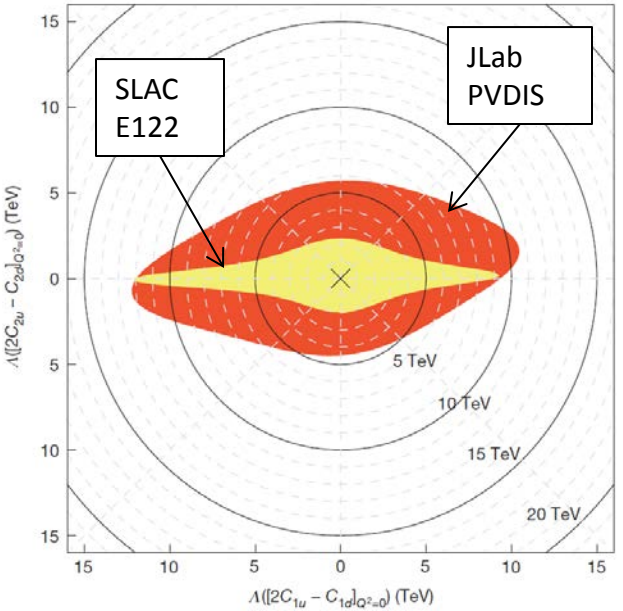


Medium Energy – FY 2015 President's Request

	FY 2014 Enacted	FY 2015 Request	FY15 vs. FY14
Research	36,864	36,007	-857
TJNAF Operations	94,493	96,050	+1,557
SBIR/STTR/Other	17,338	17,835	+497
Total	**148,695**	**149,892**	**+1,197**

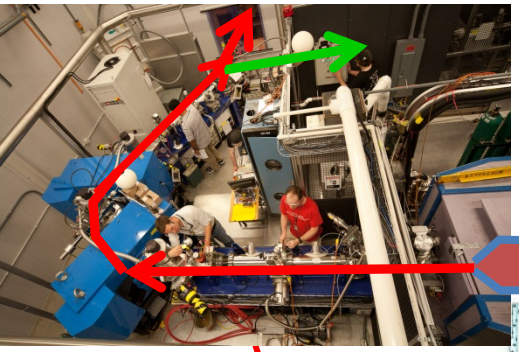
- Research decreases relative to FY 2014. Focus is on the highest priority research preparations for the 12 GeV program and RHIC polarized proton run data.

- Supports 45 operations staff FTEs transitioning from the 12 GeV Upgrade project back to the base operations budget as the 12 GeV CEBAF Upgrade project ramps down. The needed funding has been partially offset by redirecting funds from other activities such as equipment, AIP and GPP projects.

- Support is provided for NP's required contribution to the SBIR/STTR programs.

CEBAF - Thomas Jefferson National Accelerator Facility (JLab)

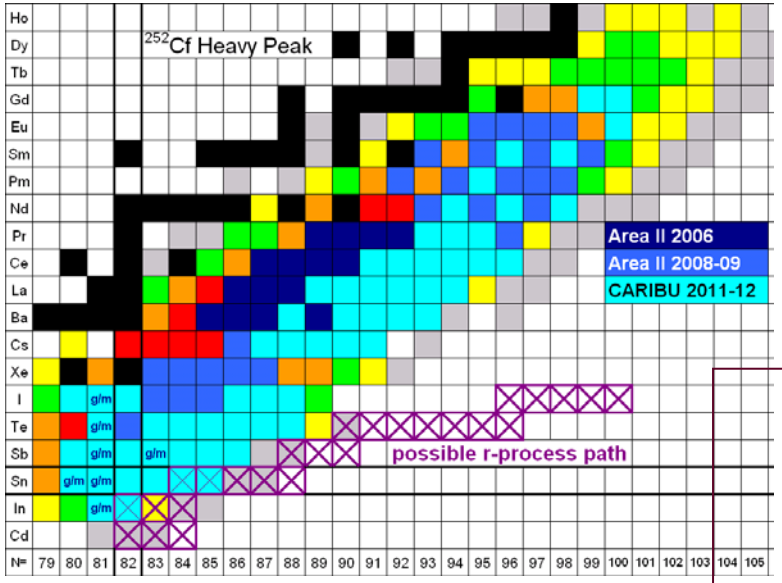
ATLAS at ANL Uniquely Provides Low Energy SC Research Opportunities



ATLAS

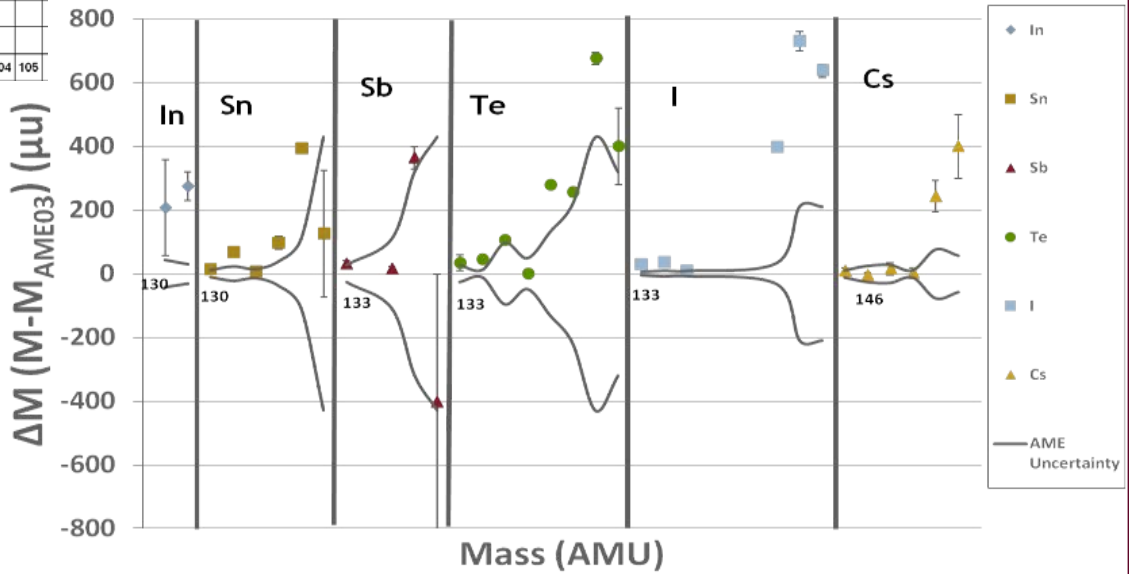
ATLAS is a unique premier Stable Beam Facility for research on Nuclear Structure & Nuclear Astrophysics

First Physics With CARIBU



Neutron-rich isotopes are found to be systematically less bound than predicted

Mass measurements with the CPT at CARIBU



Facility for Rare Isotope Beams

FRIB will increase the number of isotopes with known properties from ~2,000 observed over the last century to ~5,000 and will provide world-leading capabilities for research on:

Nuclear Structure

- The ultimate limits of existence for nuclei
- Nuclei which have neutron skins
- The synthesis of super heavy elements

Nuclear Astrophysics

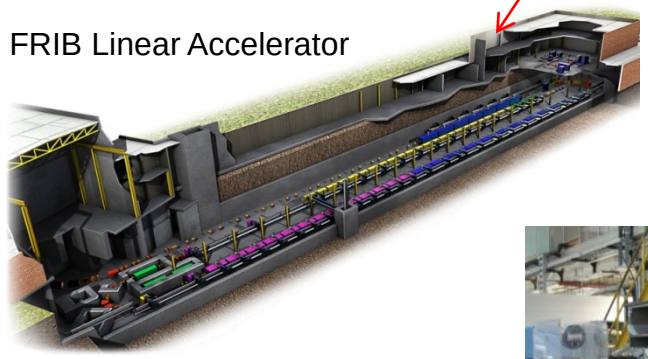
- The origin of the heavy elements and explosive nucleo-synthesis
- Composition of neutron star crusts

Fundamental Symmetries

- Tests of fundamental symmetries, Atomic EDMs, Weak Charge

This research will provide the basis for a model of nuclei and how they interact.

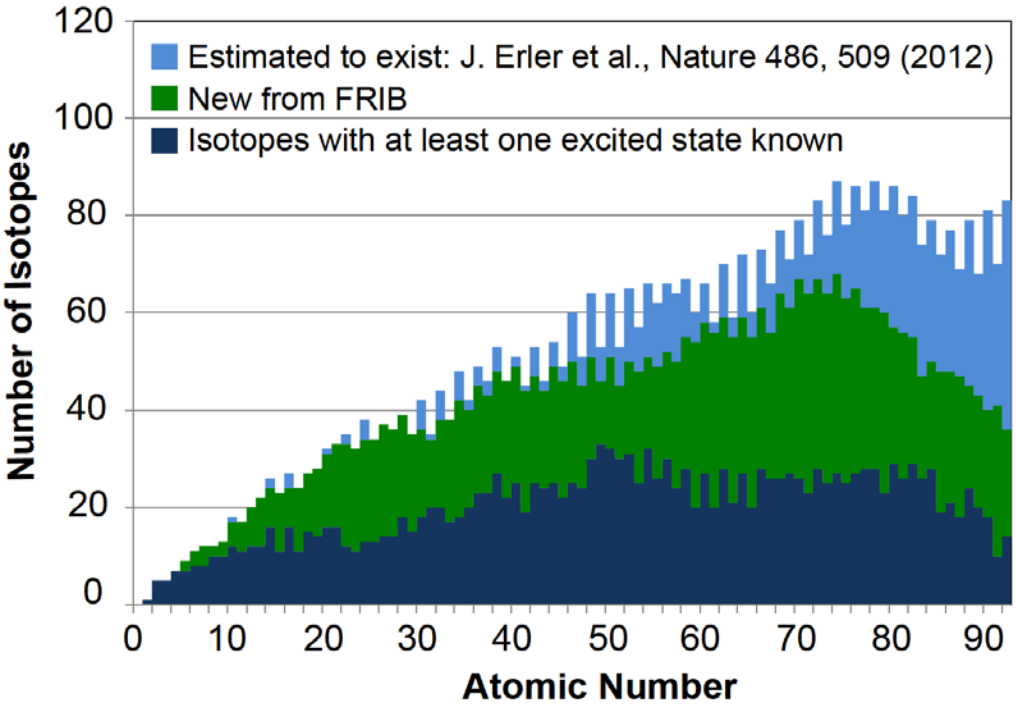
FRIB Linear Accelerator

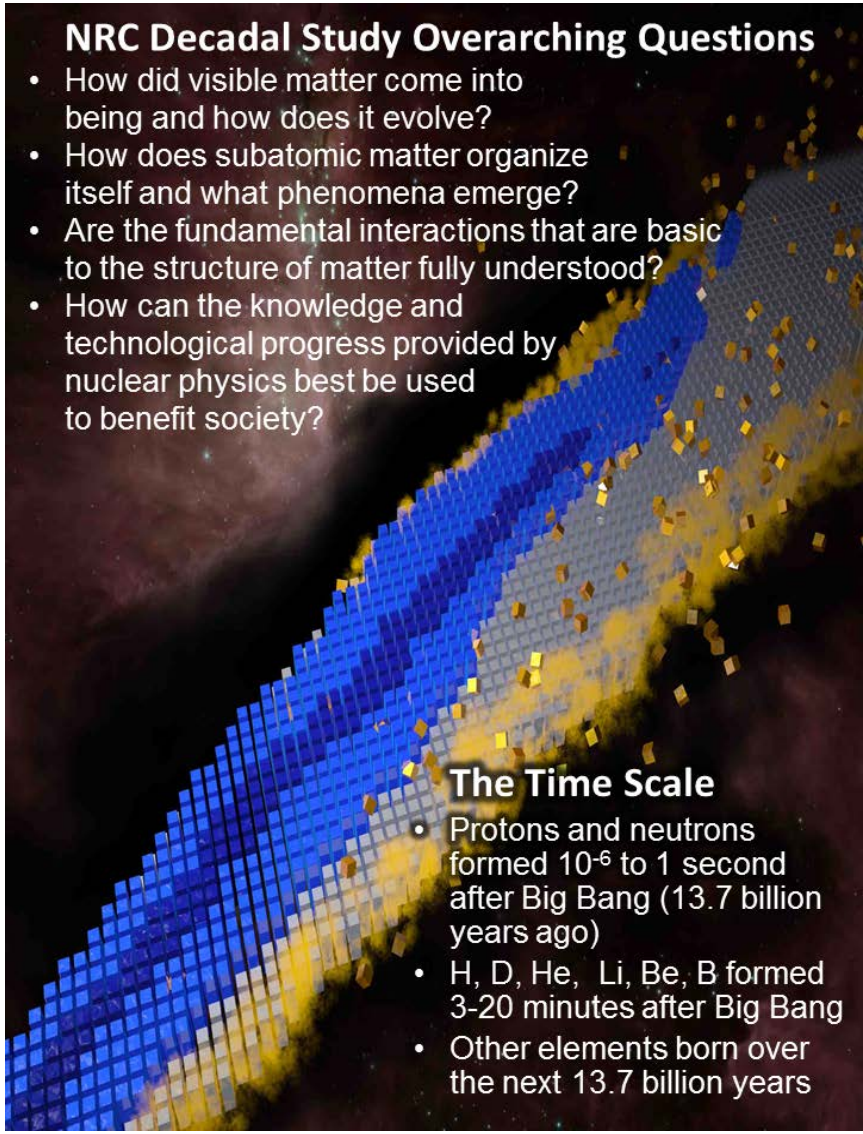


The coils of this high temperature superconducting (HTS) quadrupole exceeded the required currents at elevated temperatures, indicating additional operating current margin and more stability.

FRIB: 21st Century Science Questions

- FRIB physics is at the core of nuclear science: "To understand, predict, and use"
- FRIB provides access to a vast unexplored terrain in the chart of nuclides





Facility for Rare Isotope Beams

Ground breaking ceremony with participation by DOE officials and Senate and House representatives was held on March 17, 2014.

TPC $000s	PYs	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	TOTAL
FRIB	51,000	22,000	55,000	90,000	100,000	100,000	97,200	75,000	40,000	5,300	635,500

Successful review to assess readiness for CD-3b held June 24-26, 2014

Preparations for NP Stewarded Neutrino-less Double Beta Decay Experiments

R&D on one of several approaches by U.S. scientists is ongoing at Lead, South Dakota

Recent progress on the Majorana Demonstrator 4800 feet below ground at the Sanford Underground Research Facility (SURF)

With techniques that use nuclear isotopes inside cryostats, often made of ultra-clean materials, scientists are “tooling up” to study whether neutrinos are their own anti-particle.

NSAC has been charged to identify the criteria for a next generation double beta decay experiment.

Inspection of copper being electroformed at the Temporary Clean Room in SURF

Low Energy – FY 2015 President's Request

	FY 2014 Enacted	FY 2015 Request	FY15 vs. FY14
Research	49,180	48,450	-730
ATLAS Operations	17,246	17,541	+295
HRIBF Disposition and Other Operations	9,278	9,278	0
Total	**75,704**	**75,269**	**-435**

- Research decreases relative to FY 2014. Focus is on nuclear structure and nuclear astrophysics research at ATLAS, preparation for FRIB, commissioning of the Majorana Demonstrator, the neutron program at the FNPB, completion of fabrication of CUORE, and support for the GRETINA detector and KATRIN experiment.

- Operations at the ATLAS national user facility are optimized at 5,900 hours of research beam time (95% of optimal operations).

- Funding is maintained for operations of the 88-Inch Cyclotron at LBNL, which is funded jointly with the USAF and the NRO, and for continued equipment disposition at HRIBF.

Cryomodule components at ATLAS (ANL)

Nuclear Theory

Maintaining adequate support for a robust nuclear theory effort is essential to the productivity and vitality of nuclear science

The essential role of a strong nuclear theory effort goes without saying:

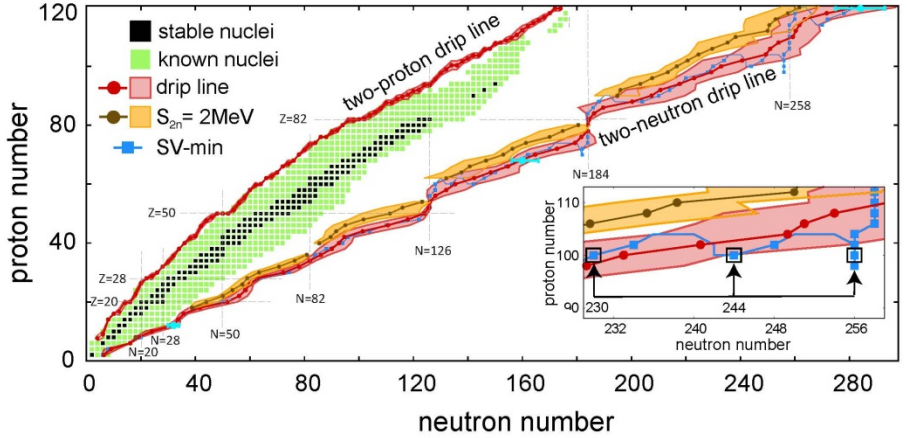
- Poses scientific questions that lead to the construction of facilities
- Helps make the case for, and guide the design of new facilities, their research programs and their strategic operations plan
- Provides a framework for understanding measurements made at facilities
- Topical Collaborations (fixed-term, multi-institution collaborations established to investigate a specific topic) appear to have been very successful and, resource permitting, the model will be continued

Nuclear Theory – FY 2015 President's Request

	FY 2014 Enacted	FY 2015 Request	FY15 vs. FY14
Research	36,115	33,719	-2,396
SciDAC	2,000	2,000	0
Nuclear Data	7,027	7,377	+350
Total	**45,142**	**43,096**	**-2,046**

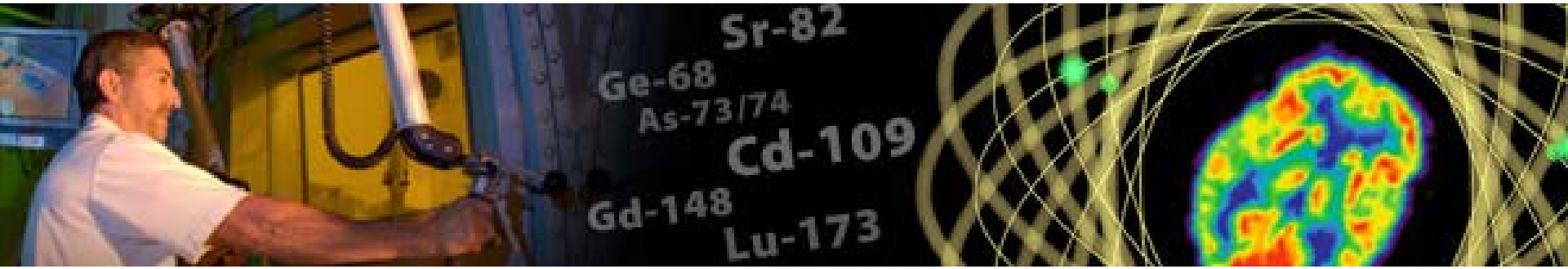
- Research decreases relative to FY 2014. Focus is on the highest priority nuclear theory efforts at universities and laboratories and NP's contribution to LQCD computing.
- Funding is provided for the fourth year of the five-year SciDAC-3 projects first funded in FY 2012.
- Funding for the Nuclear Data program maintains staff and enhances this important national and international resource.

New GPU-based LQCD processor at TJNAF



How many different nuclei exist?
NP researchers theorize the number to be ~7,000

Isotope Program Mission



The mission of the DOE Isotope Program is threefold

- Produce and/or distribute radioactive and stable isotopes that are in short supply, associated byproducts, surplus materials and related isotope services.
- Maintain the infrastructure required to produce and supply isotope products and related services.
- Conduct R&D on new and improved isotope production and processing techniques which can make available new isotopes for research and applications.

Produce isotopes that are in short supply only –
the Isotope Program does not compete with industry

More than 150 customers in FY 2013

More than 460 shipments in FY 2013

The NP Isotope Program Continues to Provide Isotopes and Radioisotopes in Short Supply

Some key isotopes and radioisotopes and the companies that use them

Strontium-82, Rubidium-82	Imaging / Diagnostic cardiology
Germanium-68, Gallium-68	Calibration / PET scan imaging
Californium-252	Oil and gas exploration and manufacturingcontrols
Selenium-75	Radiography / Quality control
Actinium-225, Yttrium-90, Rhenium 188	Cancer / Infectious disease treatment
Nickel-63	Explosives detection at airports
Gadolinium-160, Neodymium-160	Tracers and contrast agents for biological agents
Iron-57, Barium-135	Standard sources for mass spectroscopy
Sulfur-34	Environmental monitoring
Rubidium-87	Atomic frequency / GPS applications
Lithium-6, Helium-3	Detection of Special Nuclear Materials
Samarium-154	Solar energy /transportation applications

Bracco Diagnostics Inc.

Spectrum Technique

It Also Serves a Very Important Role in Coordination and Communication: The 2nd Workshop on Isotope Federal Supply and Demand (Sept 19-20, 2013)

70 attendees
23 different federal institutions
Over 200 isotopes identified

- Armed Research Institute
- Defense Logistics Agency
- Defense Threat Reduction Agency
- Department of Agriculture
- DOE/National Isotope Development Center
- DOE/National Nuclear Security Administration
- DOE/New Brunswick Laboratory
- DOE/Office of Fossil Energy-Oil and Natural Gas
- DOE/Office of Intelligence
- DOE/Office of Nuclear Energy
- DOE/Office of Science
- Department of Homeland Security
- Department of State
- Department of Transportation
- Federal Bureau of Investigation
- Food and Drug Administration
- National Aeronautics and Space Administration
- National Institutes of Health
- National Institute of Standards and Technology
- National Science Foundation
- National Security Staff
- Office of Science & Technology Policy
- Office of the Director of National Intelligence

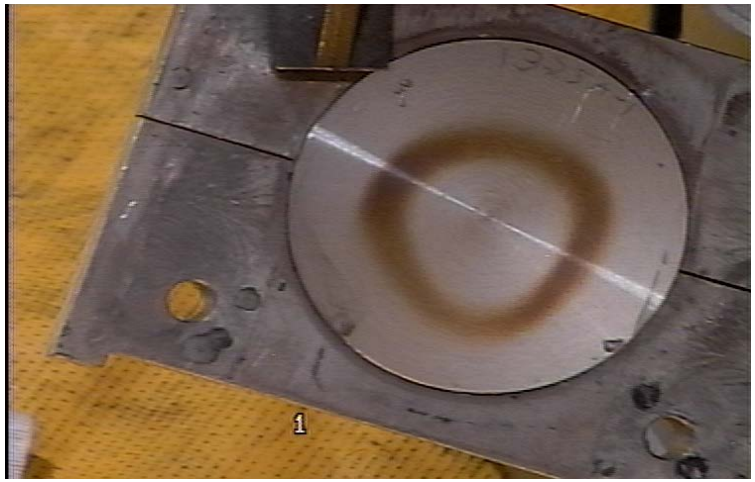
One Year Ago

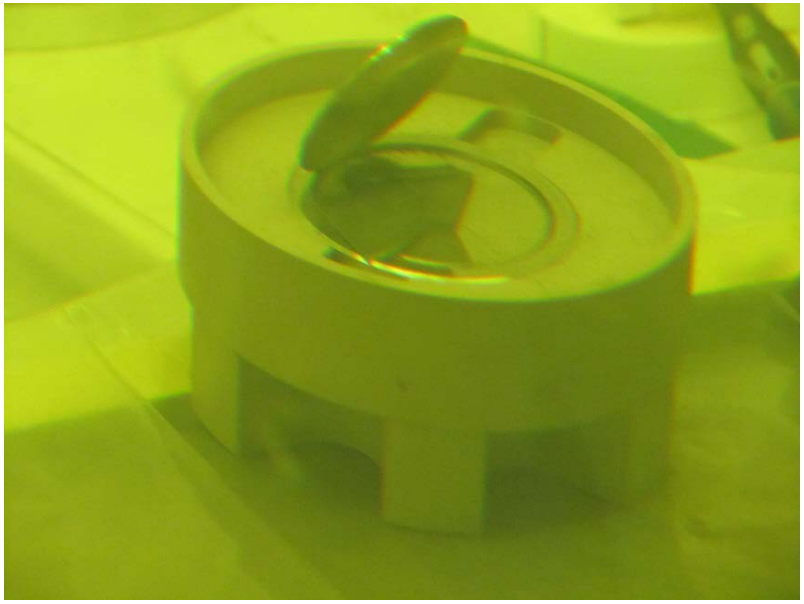
R&D Creates New Production Method for Actinium-225

- A new isotope project at LANL shows promise for rapidly producing major quantities of a new cancer-treatment agent, actinium-225.
- Using proton beams, LANL and BNL could match current annual worldwide production of the isotope in just a few days.
- A collaboration among LANL, BNL, and ORNL is developing a plan for full-scale production and stable supply of Ac-225.
- Ac-225 emits alpha radiation. Alpha particles are energetic enough to destroy cancer cells but are unlikely to move beyond a tightly controlled target region and destroy healthy cells. Alpha particles are stopped in their tracks by a layer of skin—or even an inch or two of air.

Where are we today?
Thorium Target Irradiations for Ac-225 (Cancer Therapy)

Rear window of 10g Th target prototype after irradiation





Open target in a hot cell showing Th "pie-slices" Target cut in "pie-slices" to facilitate DOT Type A shipping

- Two targets fabricated with 10g Thorium
  - First target irradiated in November 2013 for short duration to test thermal parameters
  - Second target irradiated in January 2014 for >50 mCi Ac-225 production
- Material has been sent to ORNL for processing.
- Product will be sent to Memorial Sloan-Kettering for evaluation for future Phase 1 Clinical Trial.

Isotope Program – FY 2015 President's Request

	FY 2014 Enacted	FY 2015 Request	FY15 vs. FY14
Research	4,562	4,562	0
Operations	14,842	15,288	+446
Total	**19,404**	**19,850**	**+446**

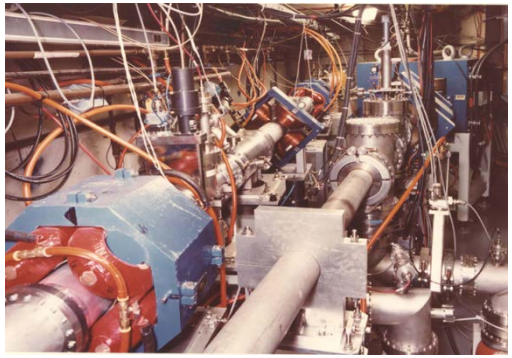
- Research is flat with FY 2014. Focus continues support for important core laboratory research activities to enhance the development and production techniques for critical isotopes, and competitive R&D awards to universities and laboratories.

- Funding maintains mission readiness at constant effort for safe and reliable operations of IPF, BLIP and Hot Cell facilities at LANL,ORNL and BNL.

Isotope Production Facility at LANL

TA-48 hot cells at LANL

Brookhaven Linac Isotope Producer beam line



Hot cells used to purify highly radioactive materials for medical use

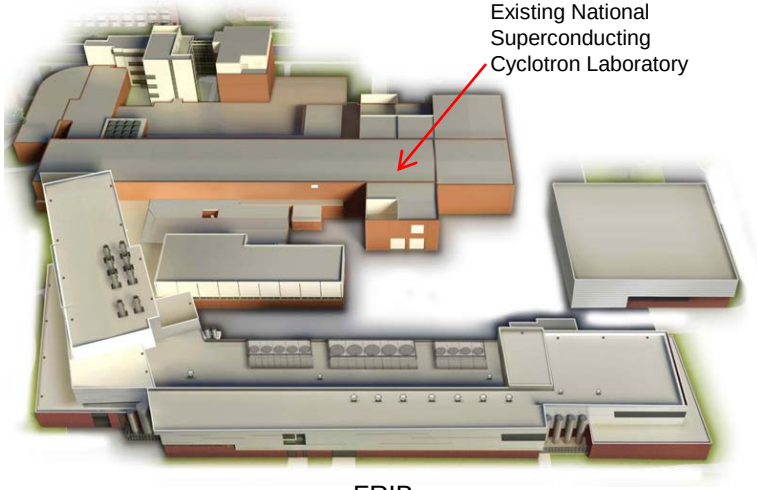
Construction – FY 2015 President's Request

	FY 2014 Enacted	FY 2015 Request	FY15 vs. FY14
12 GeV CEBAF Upgrade	25,500	16,500	-9,000
Facility for Rare Isotope Beams	55,000	90,000	+35,000
Total	**80,500**	**106,500**	**+26,000**

- Funding supports the re-baselined profile for the 12 GeV CEBAF Upgrade at TJNAF, approved in September 2013.

- Funding supports the baselined profile for the Facility for Rare Isotope Beams (FRIB) at MSU, approved in August 2013.

12 GeV Upgrade Accelerator



FRIB

TPC $000s	PYs	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	TOTAL
12 GeV	230,928	43,072	30,000	21,000	12,000	1,000	–	–	–	–	338,000
FRIB	51,000	22,000	55,000	90,000	100,000	100,000	97,200	75,000	40,000	5,300	635,500

Nuclear Science Advisory Committee

- Ongoing NSAC Charges
  - To provide guidance on an effective strategy for implementing a possible second generation U.S. experiment on neutrino-less double beta decay (NLDBD) capable of reaching the sensitivity necessary to determine whether the nature of the neutrino is Majorana or Dirac.
  - To form a Subcommittee to assess the effectiveness of the National Nuclear Security Administration-Global Threat Reduction Initiative's Domestic Molybdenum-99 (Mo99) Program, in accordance with direction given to the DOE in the National Defense Authorization Act for FY 2013.
  - To form a subpanel to examine potential gaps in training and workforce critical to the NP/SC mission
  - To form a new subpanel to conduct a new study of the opportunities and priorities for isotope research and production resulting in a long range strategic plan for the Department of Energy (DOE) Isotope Program
  - To conduct a new Long Range Plan exercise to study the opportunities and priorities for United States nuclear physics research and recommend a long range plan that will provide a framework for coordinated advancement of the Nation's nuclear science research programs over the next decade.

Neutrinoless Double Beta Decay NSAC Charge

Scientific Importance

It is the assessment of this Subcommittee that the pursuit of neutrinoless double beta decay addresses urgent scientific questions of the highest importance, and that sufficiently sensitive second generation experiments would have excellent prospects for a major discovery. Furthermore, we recommend that DOE and NSF support this subject at a level appropriate to ensure a leadership position for the US in this next phase of discovery-caliber research.

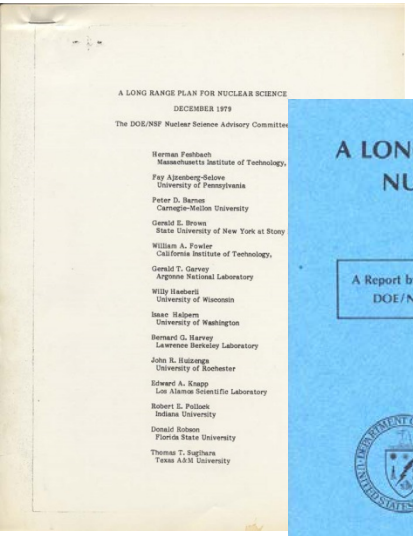
Status of Ongoing and Planned Experiments

The Subcommittee recommends that the "current generation" experiments continue to be supported and that the collaborations continue to work to resolve remaining R&D issues in preparation for consideration of a future "second generation" experiment. New techniques that offer promise for dramatic reductions in background levels should also be supported.

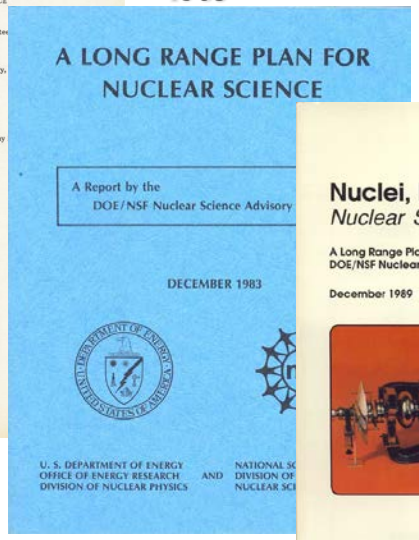
4. Each of the current approaches has technical advantages and each has significant remaining challenges to demonstrate sensitivity at a level suitable for covering the inverted neutrino mass hierarchy region. Based on the information provided to us, we judge that in a period of 2-3 years there will be much more information available from the results of these experiments. At that point one could assess the future prospects with much higher reliability than today.

Defining the Science – Long Range Plans

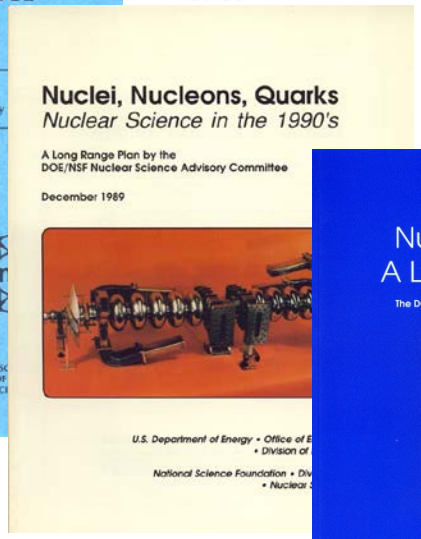
1979



1983

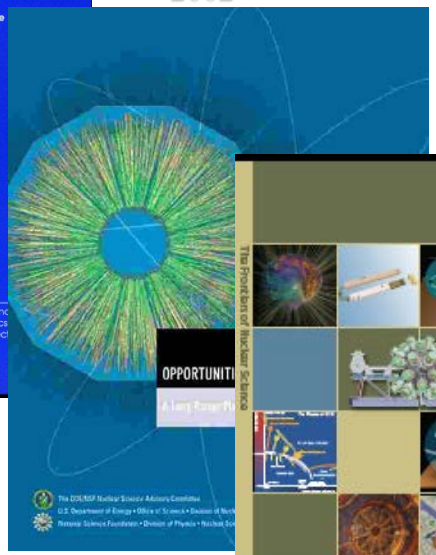


1989

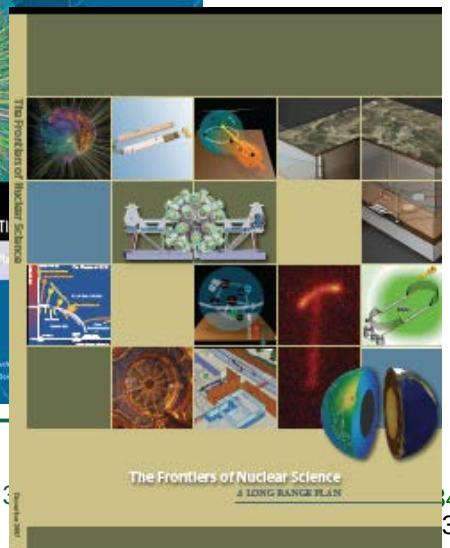


1996

2002



2007



The Long Range Plans have:

- Identified the scientific opportunities
- Recommended scientific priorities

Effectively defining the field of Nuclear Physics for the Nation

Last LRP in 2007

Nation's leadership role today is largely a result of:

- The responsible/visionary **strategic planning** embodied in the NSAC Long Range Plans
- Federal government's decision to utilize the guidance and provide the needed resources

NP News and Events

- Competitive Reviews for proposals received up to May 1, 2014 have been scheduled
- Successful OPA review of the 12 GeV CEBAF Upgrade on April 8-10, 2014
- FRIB Groundbreaking March 17, 2014
- FY2016 Budget formulation in progress
- Elizabeth Bartosz will begin as Nuclear Physics Instrumentation Program Manager
- Gulshan Rai appointed as Medium Energy Program Manager
- Ted Barnes working with community on strategic visions for Nuclear Data and Nuclear Theory Computing
- Coordination on Accelerator R&D with HEP and BES continuing
- Some strategic restructuring of “day-to-day” operation of the Isotope Program; Marc Garland work directly with NIDC Management
- SC Director nomination awaiting confirmation
- SC transitioning rapidly to Portfolio Analysis and Management System
- Review of the National Nuclear Data Program will take place July 16-17, 2014
- Science Review or Moeller and SPHENIX planned in the next 2-3 months

Outlook

- **The future of nuclear science in the United States continues to be rich with science opportunities.**
- **Long term, an electron-ion collider may be the optimum path towards new opportunities in QCD research.**
- **The United States continues to provide resources for and to expect:**
  - U.S. world leadership in discovery science illuminating the properties of nuclear matter in all of its manifestations.
  - Tools necessary for scientific and technical advances which will lead to new knowledge, new competencies, and groundbreaking innovation and applications.
  - Strategic investments in tools and research to provide the U.S. with premier research capabilities in the world.

Nuclear Science will continue to be an important part of the U.S. science investment strategy to create new knowledge and technology innovation supporting U.S. security and competitiveness