



U.S. DEPARTMENT OF
ENERGY

Office of
Science

DOE Perspective

2012 RHIC & AGS Annual Users' Meeting

Dr. James Sowinski

Acting Program Manager for Heavy Ion Physics

Office of Nuclear Physics

DOE Office of Science

Three years ago!

- I had the privilege of organizing this meeting

The Emergent Frontier

RHIC & AGS Annual Users' Meeting

June 1 - 5, 2009

Topical Workshops
June 1 & 2

Special Symposium on Accelerator Physics
June 3 · Berkner Hall

Plenary Sessions
June 4-5 · Berkner Hall
Featured Speaker: George Sterman

Open Forum
June 5, 1:15 PM · Berkner Hall

Register at
http://www.bnl.gov/rhic_ag/users_meeting

Organizing Committee:
Jim Sowinski, sowinski@indiana.edu
Abhay Deshpande, abhay@bnl.gov
Rene Bellwied, bellwied@physics.wayne.edu
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Conference Coordinator:
Angela Melocaton, (631) 344-5322
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BROOKHAVEN
NATIONAL LABORATORY

RHIC
AGS



The Breadth of the Horizon for Discovery in Nuclear Science

Neutron-rich Nuclei;
Structure Of Nuclei;

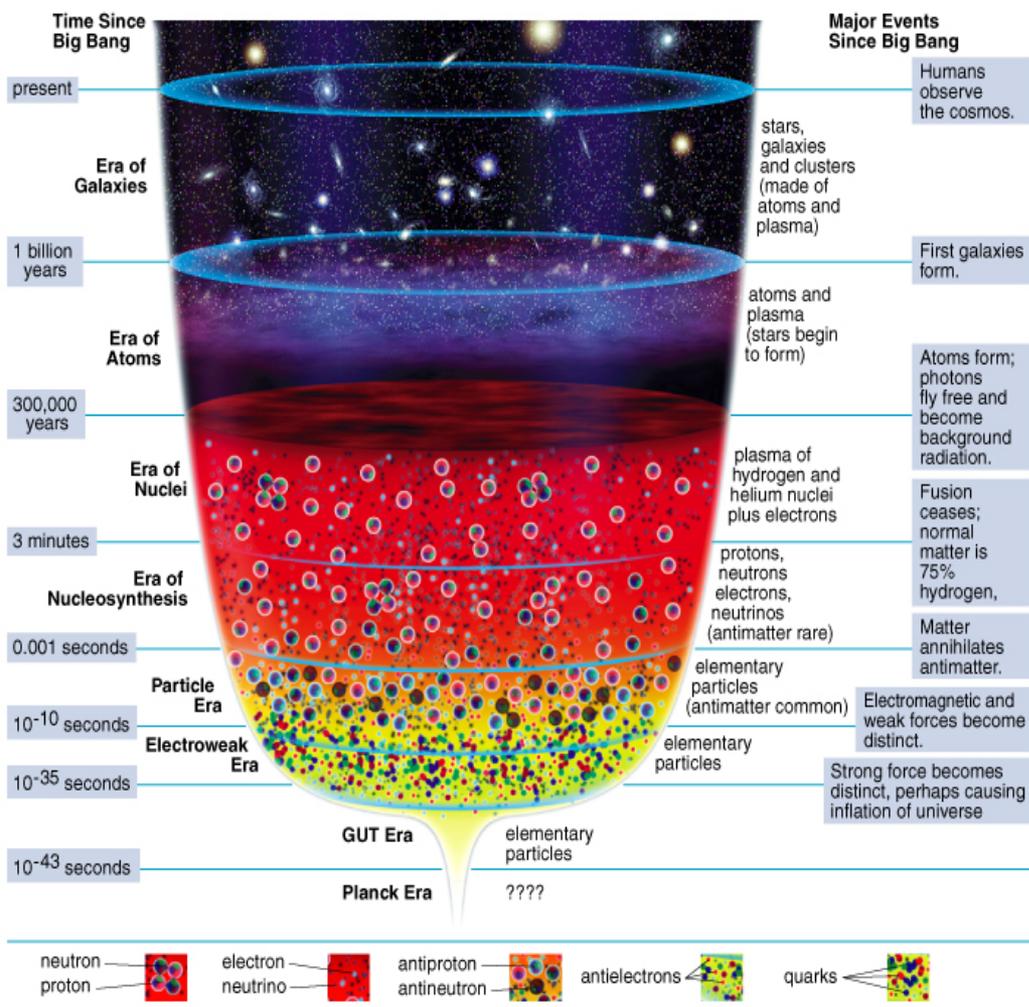
Reactions in Core
Collapse Super Novae;
Super Heavy Element 117
Heavy Nuclei Formation;
Density Effects in
Nuclei;
Neutron Skins;
Nuclear-Reactions;

**NP
Discovery
Horizon**

Anti-Helium 4;
Proton Spin
Majorana/DIRAC Neutrino;
Perfect QGP Liquid

Neutron Beta Decay;
Neutron EDM;
Parity Violation
Searches;

Evolution of the Universe



© Addison-Wesley Longman



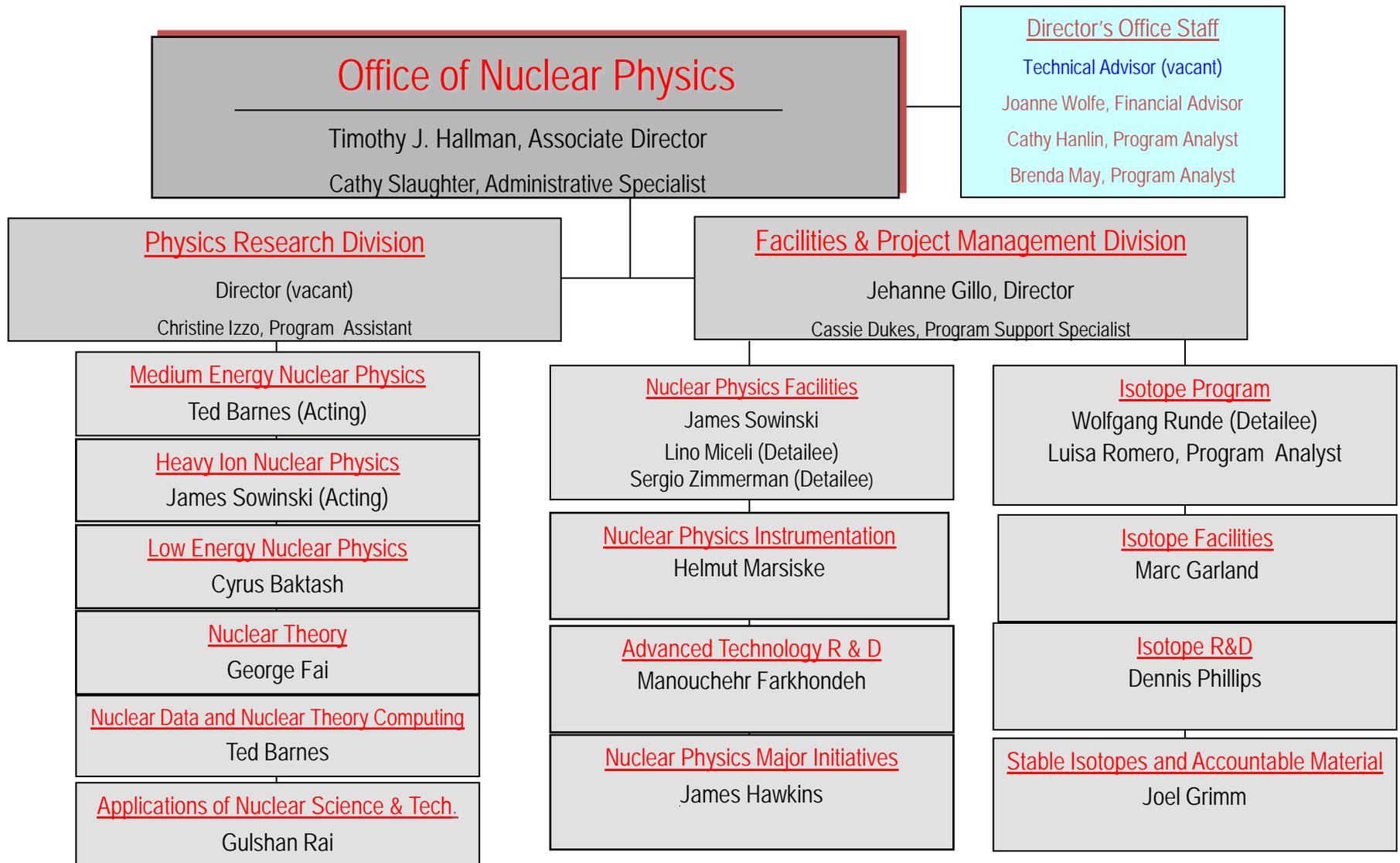
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NP has Five Subprograms

- **Medium Energy (TJNAF 12 GeV Energy Upgrade, RHIC spin)**
 - Studies the force which binds quarks and gluons in protons and neutrons
 - Searches for Parity violating processes relevant to the New Standard Model
- **Heavy Ion (RHIC and Heavy Ion Research at the LHC)**
 - Investigates the properties of new states of matter with ~ 100 higher energy density than “normal” nuclear matter
 - Studies the origin of the spin structure of the proton
- **Low Energy/Fundamental Interactions (ATLAS and FRIB)**
 - Studies nuclear structure and nuclear astrophysics
 - Investigates the properties of neutrinos, and uses cold neutrons and nuclei to test the Standard Model
- **Theory**
 - Explores all three frontiers of nuclear physics
 - Encompasses the Nuclear Data Program
- **Isotope Production and Applications**
 - Produces, prepares, and distributes isotopes for commercial applications and research
 - Research and development relevant to isotope production

DOE Office of Nuclear Physics



DOE Office of Nuclear Physics

Office of Nuclear Physics

Director's Office Staff

Technical Advisor (vacant)

Joanne Wolfe, Financial Advisor

Opportunities exist to work in our office as a detailee for a year or longer.

Searches will be conducted for permanent positions.

If interested, contact Tim or Jehanne

James Sowinski (Acting)

Low Energy Nuclear Physics

Cyrus Baktash

Nuclear Theory

George Fai

Nuclear Data and Nuclear Theory Computing

Ted Barnes

Applications of Nuclear Science & Tech.

Gulshan Rai

Nuclear Physics Instrumentation

Helmut Marsiske

Advanced Technology R & D

Manouchehr Farkhondeh

Nuclear Physics Major Initiatives

James Hawkins

Isotope Facilities

Marc Garland

Isotope R&D

Dennis Phillips

Stable Isotopes and Accountable Material

Joel Grimm

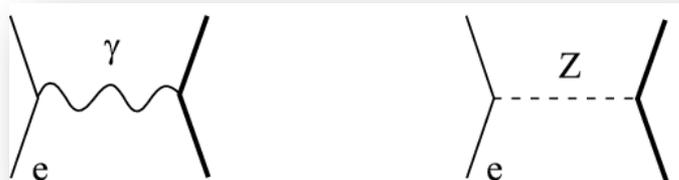


Current HI Research Program

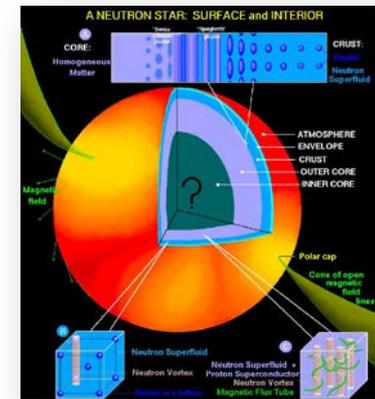
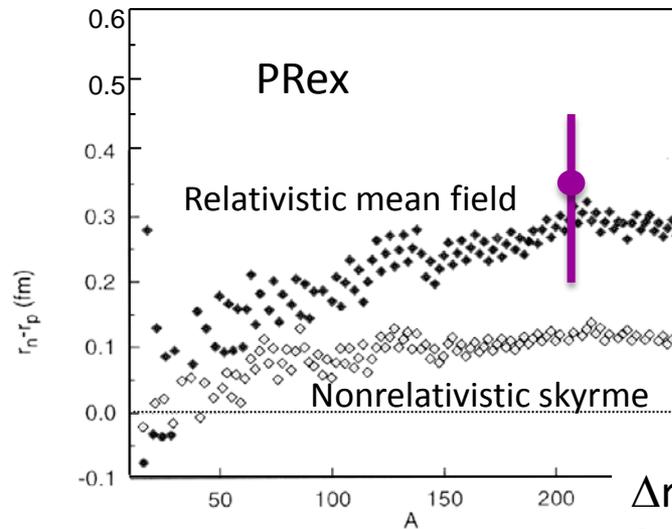
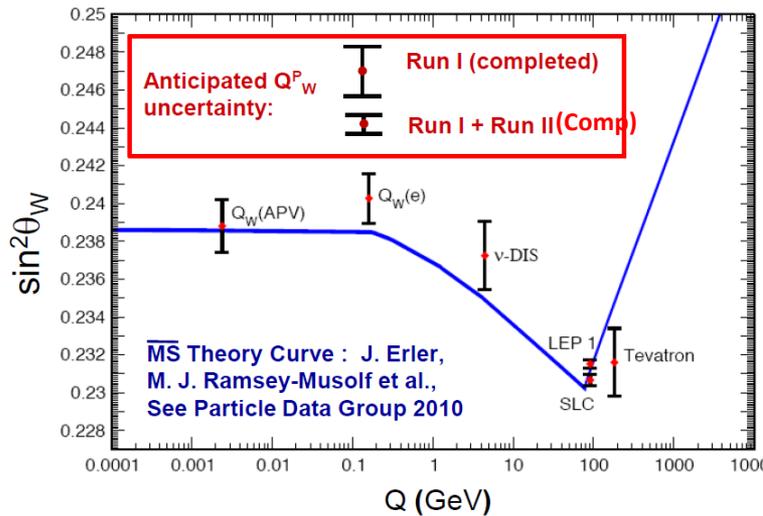
- Support ~190 PhDs and ~100 grad students
 - ~120 PhDs at Univ, ~70 at labs
 - ~65 PhDs at LHC – most also work at RHIC
 - 38 at ALICE (collab of ~1000)
 - 25 at CMS (+similar # students compared to 100 PhD+students total in CMS HI)
 - 4-5 PhDs at ATLAS (about 50 PhD+students in ATLAS HI from all countries now)

CEBAF at TJNAF

- Completed the 6 GeV program May 18, 2012
 - Qweak standard model test in parity violation
 - Measure the proton/neutron radius difference in Pb with parity violation



Qweak



Δr this large important for neutron star calc.

CEBAF at TJNAF

- Completed the 6 GeV program May 18, 2012
 - Qweak standard model test in parity violation
 - Measure the proton/neutron radius difference in Pb with parity violation
- 12 GeV upgrade - \$310M project
 - Have entered a 16 month shutdown to install accelerator upgrades
 - 60% Complete
 - Explore
 - Strong force through exotics
 - Standard model symmetry tests
 - Structure of the nucleon

Third C-100 Cryomodule transferred to tunnel



Hall D Interior



Low Energy Nuclear Physics

▪ Nuclear Structure

Explore the limits of existence and study new phenomena

Possibility of a broadly applicable model of nuclei and how they interact

Probing neutron skins

Synthesis of superheavy elements

▪ Nuclear Astrophysics

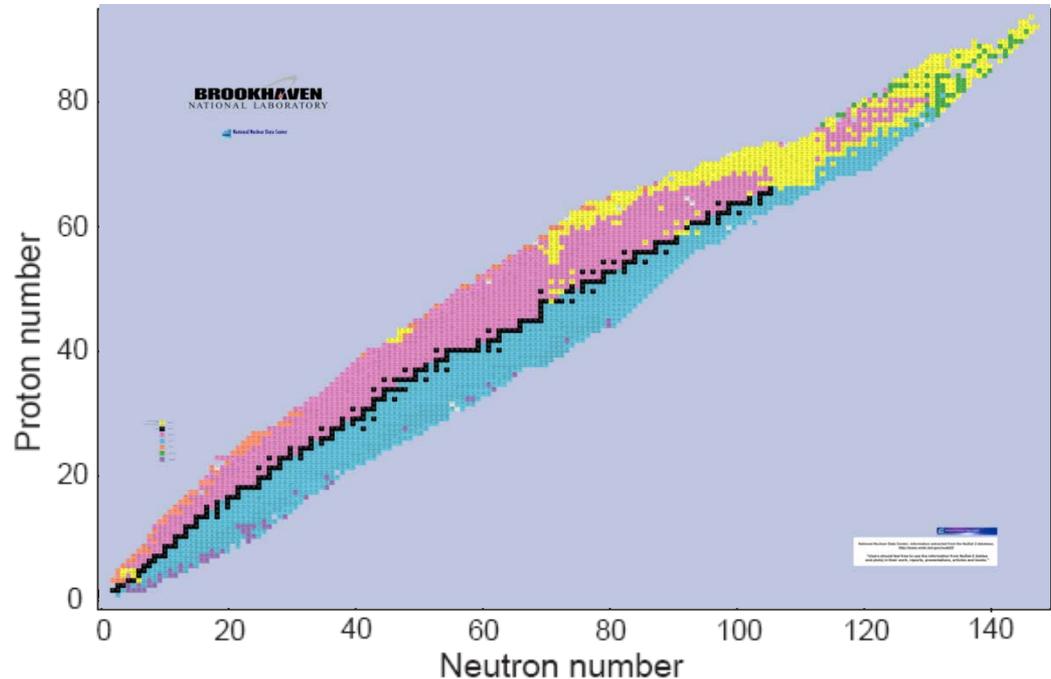
The origin of the heavy elements

Explosive nucleosynthesis

Composition of neutron star crusts

▪ Fundamental Symmetries

Tests of fundamental symmetries, Atomic EDMs, Weak Charge, Neutrino-less Double Beta Decay



Isotopes and Radioisotopes for Applications, Industry and Research

BLIP at BNL produces Isotopes for NP

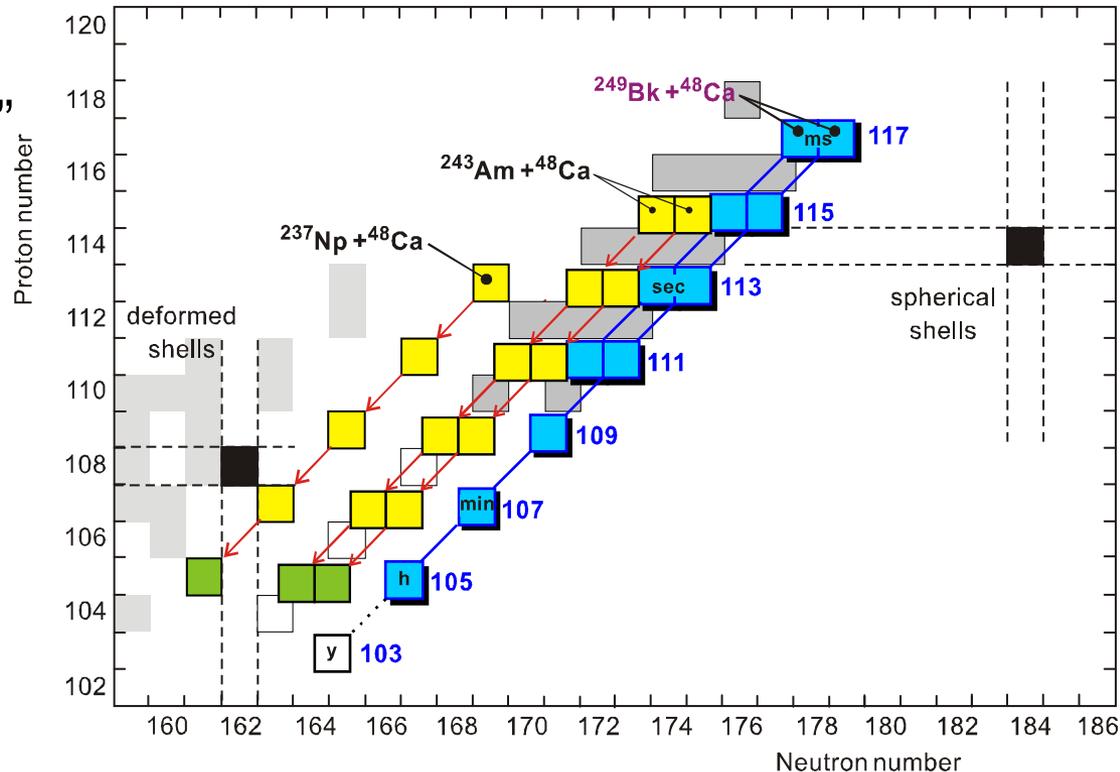
Some key isotopes and radioisotopes and the companies that use them

Strontium-82, Rubidium-82	Imaging / Diagnostic cardiology
Germanium-68, Gallium-68	Calibration / PET scan imaging
Californium-252	Oil and gas exploration and manufacturing controls
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



Discovery of Element 117

- How big can a nucleus be?
- Is there a “island of stability” of yet undiscovered long-lived heavy nuclei?
- Does relativity cause the periodic table to break down for the heaviest elements?
- 248 Berkelium target produced with HFIR and processed into a target at ORNL
- 48Ca beam at Dubna used to discover A new super heavy element (SHE) with atomic number 117



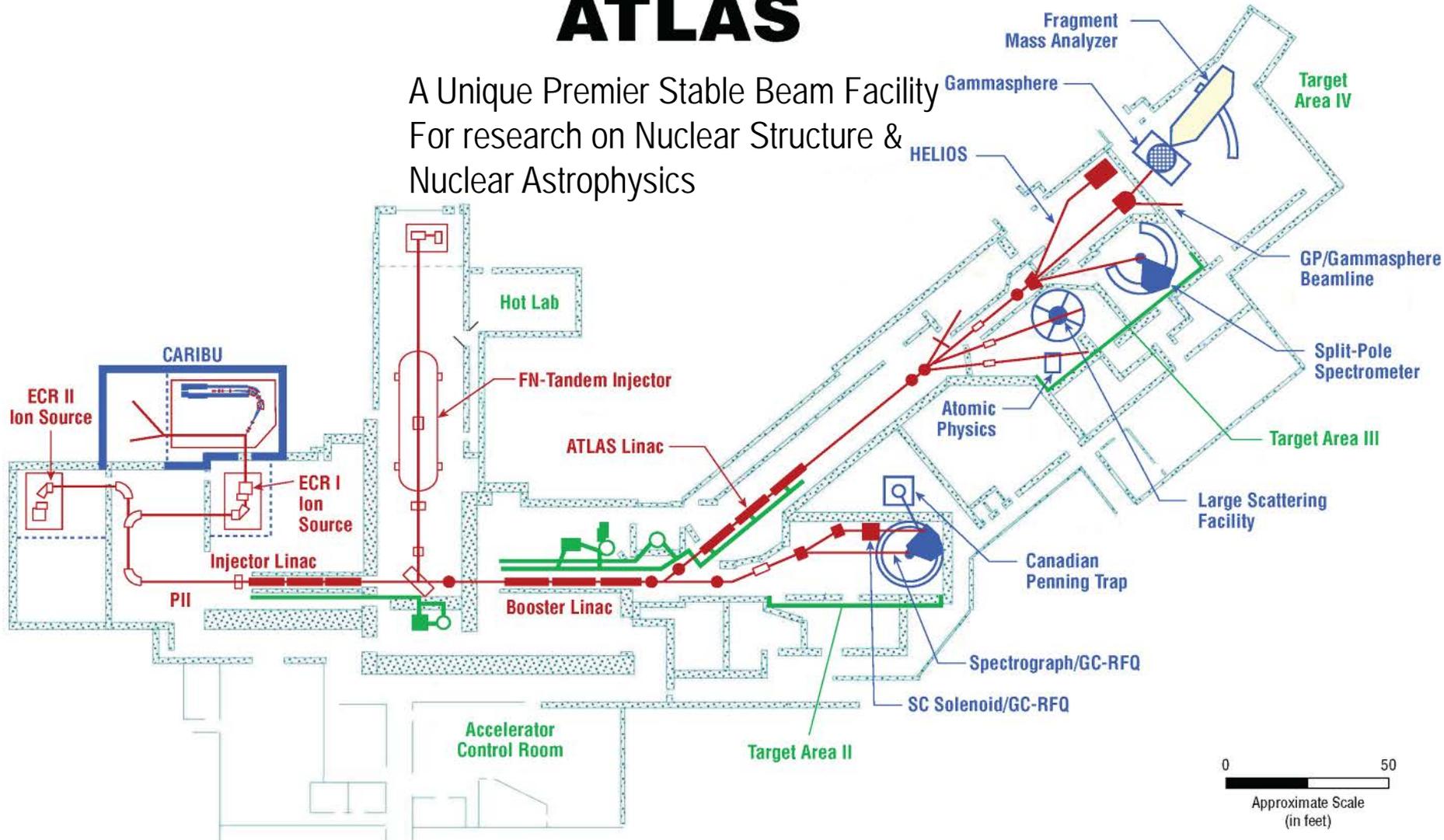
- New targets for Dubna and GSI to confirm and try for still higher atomic masses are under discussion



Argonne Tandem Linac Accelerator System Layout

ATLAS

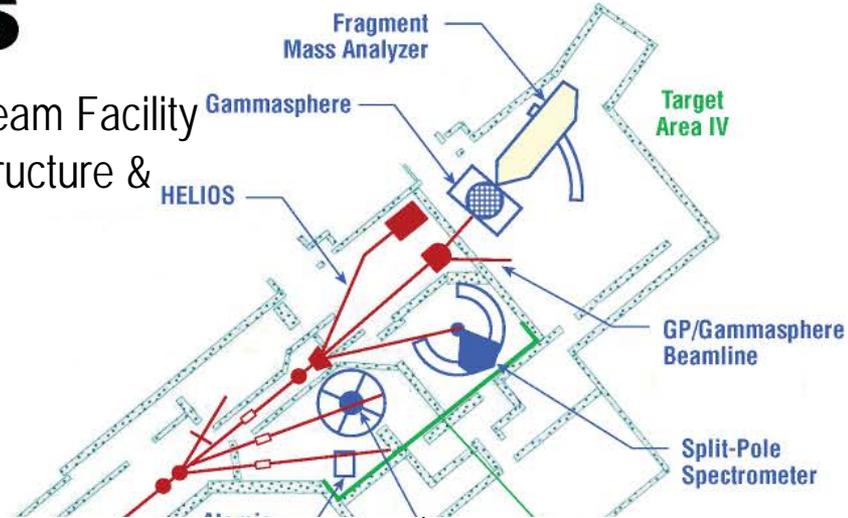
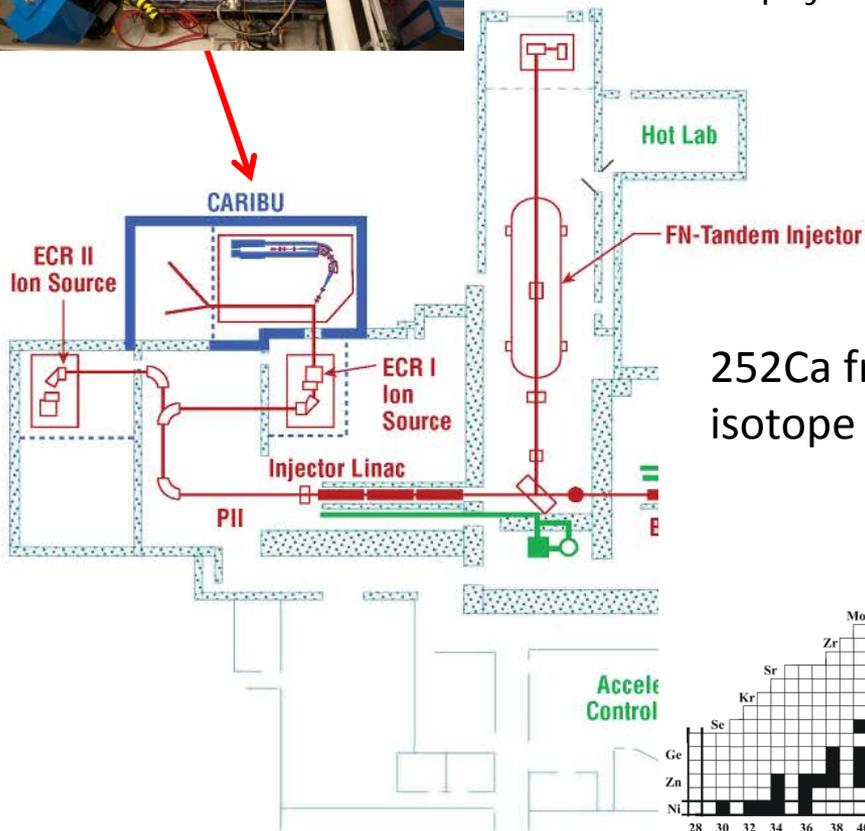
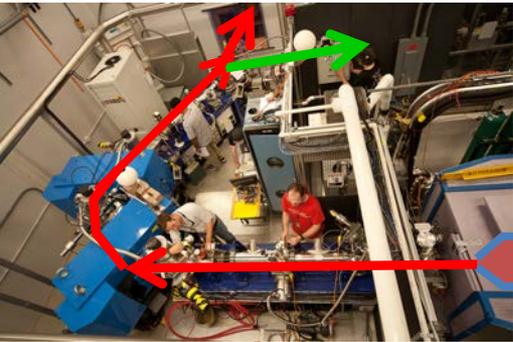
A Unique Premier Stable Beam Facility
For research on Nuclear Structure &
Nuclear Astrophysics



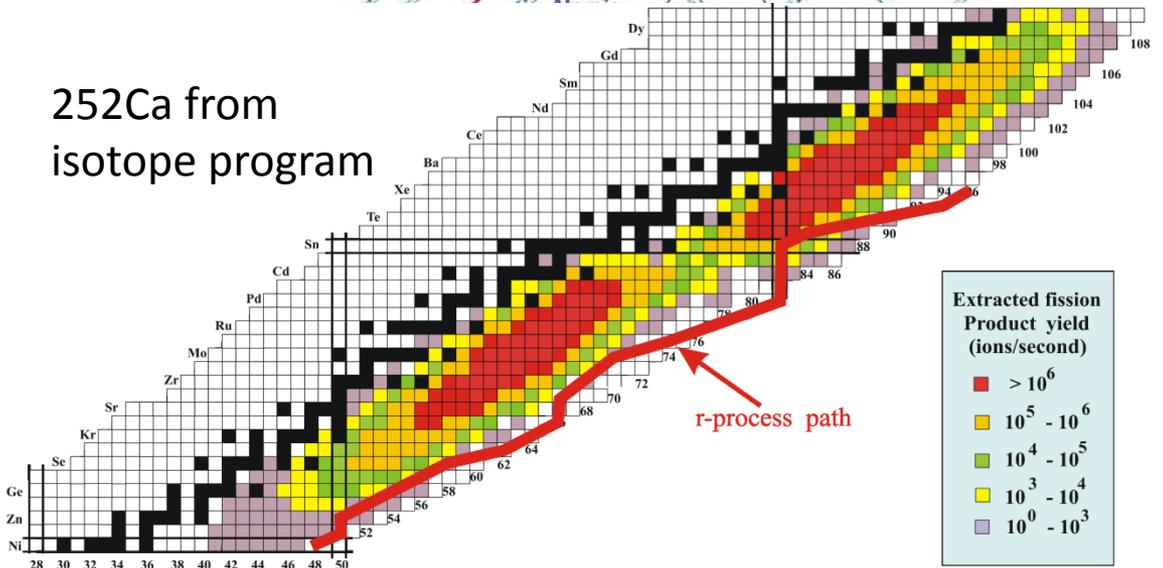
Argonne Tandem Linac Accelerator System Layout

ATLAS

A Unique Premier Stable Beam Facility
For research on Nuclear Structure &
Nuclear Astrophysics



252Ca from
isotope program

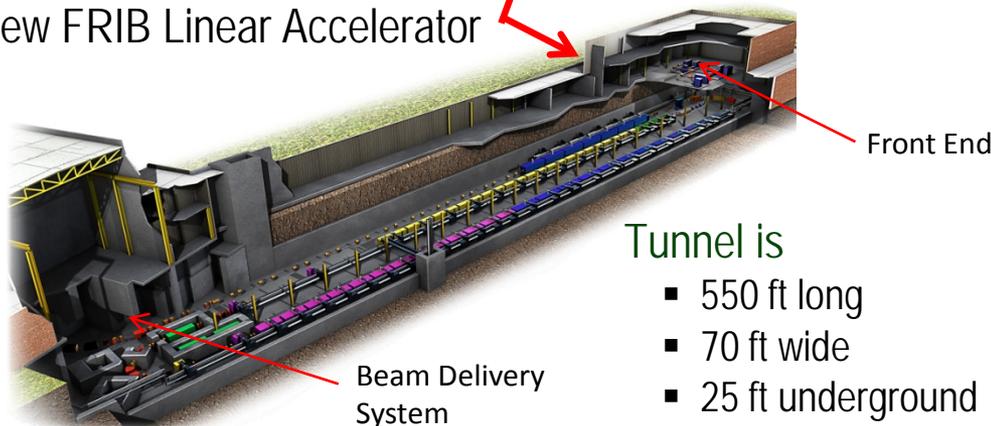


Research Focus of the Facility for Rare Isotope Beams

Existing National Superconducting Cyclotron Laboratory



New FRIB Linear Accelerator



Tunnel is

- 550 ft long
- 70 ft wide
- 25 ft underground

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

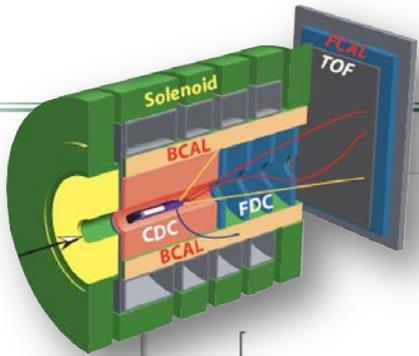
Fundamental Symmetries

- Tests of fundamental symmetries, Atomic EDMs, Weak Charge

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

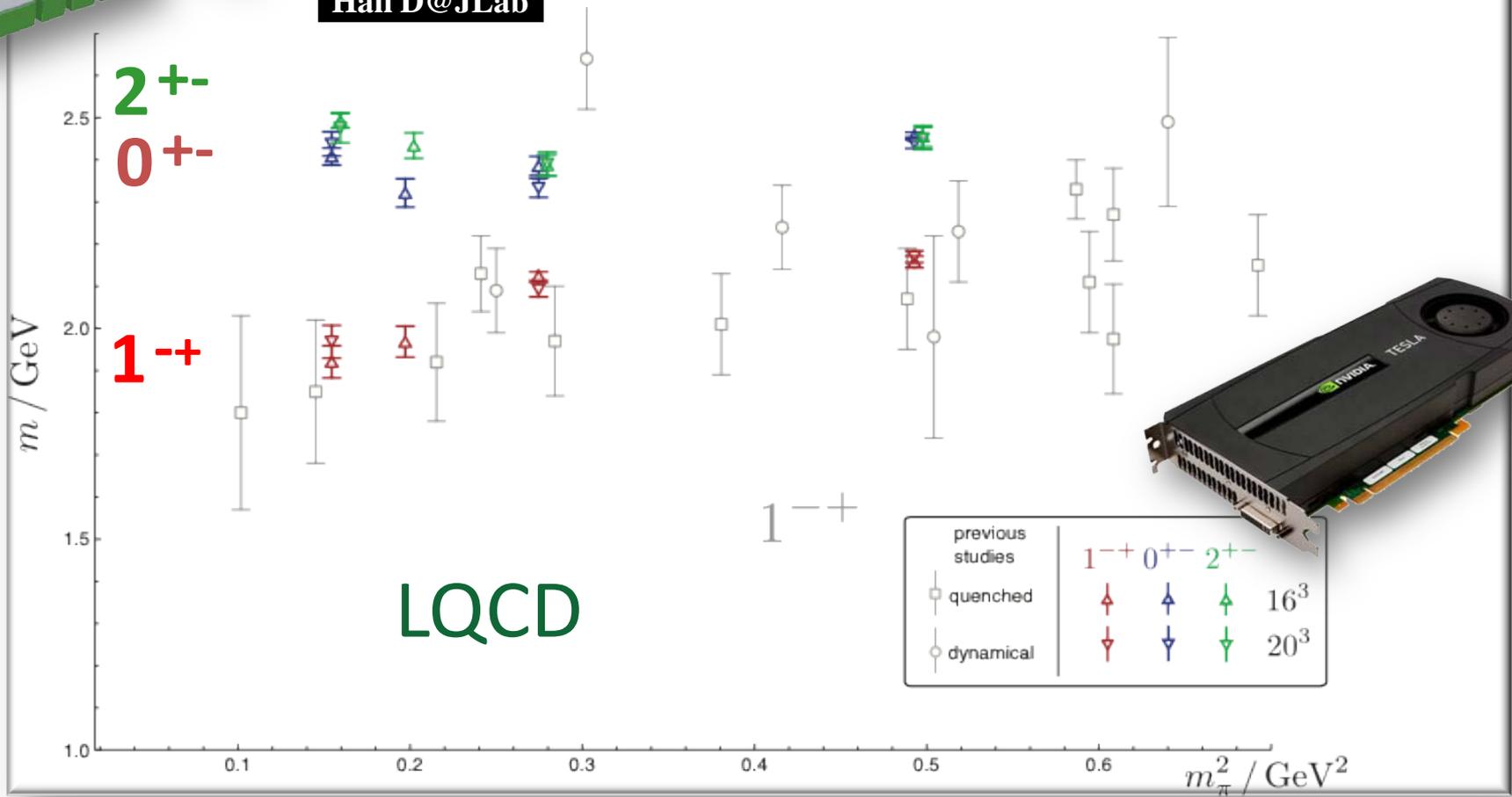


Nuclear Theory – Spans the entire NP program



Isovector Meson Spectrum

States with Exotic Quantum Numbers



Dudek et al.

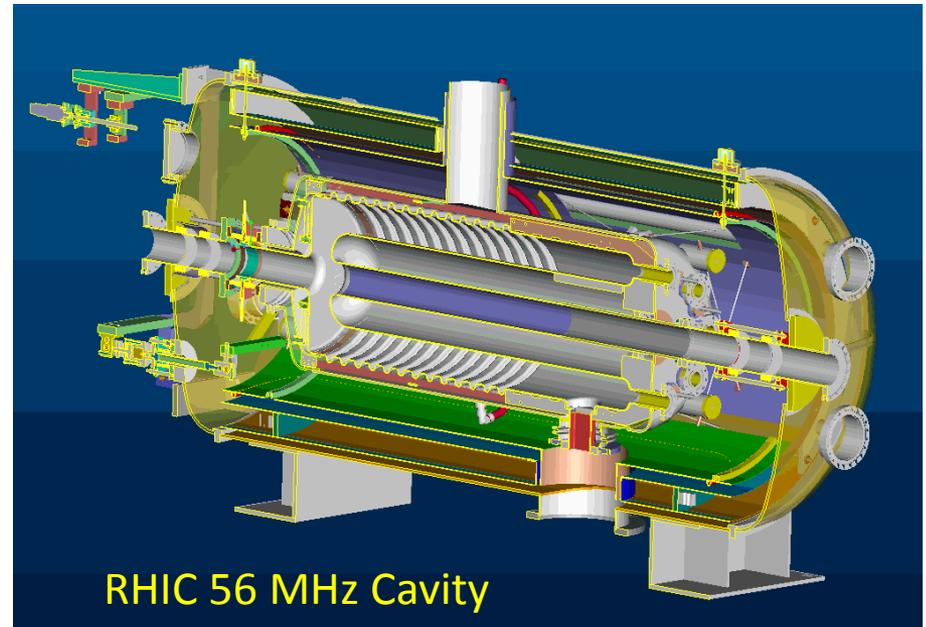


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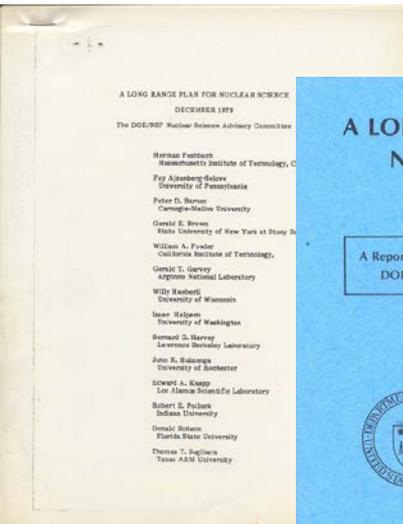
Accelerator R&D for Next Generation Facilities

- Superconducting RF has long history in NP program
 - ATLAS – first ion beams in 1978
 - CEBAF – CW electrons 1994
- Central to upgrades
 - 56 MHz cavity for RHIC
 - ATLAS Energy and intens.
 - CEBAF 12 GeV
 - EIC
- Education
 - CASE – BNL + SBU
 - CASA – TJNAF + ODU and other Univ.

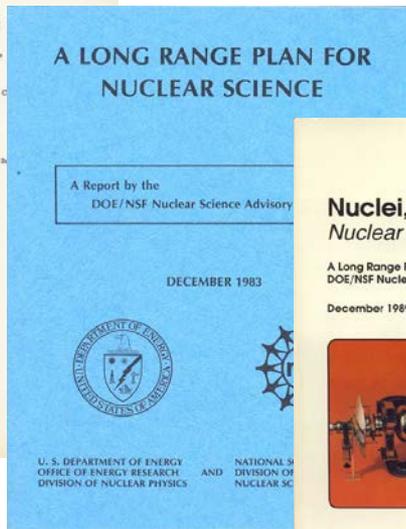


Setting Science Priorities – NSAC Long Range Plans

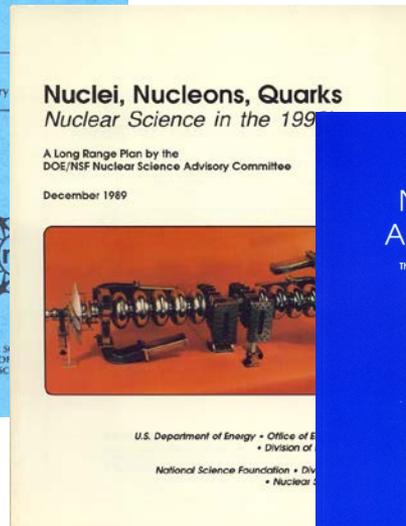
1979



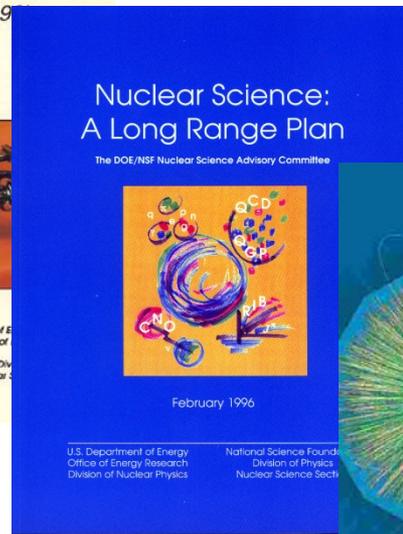
1983



1989



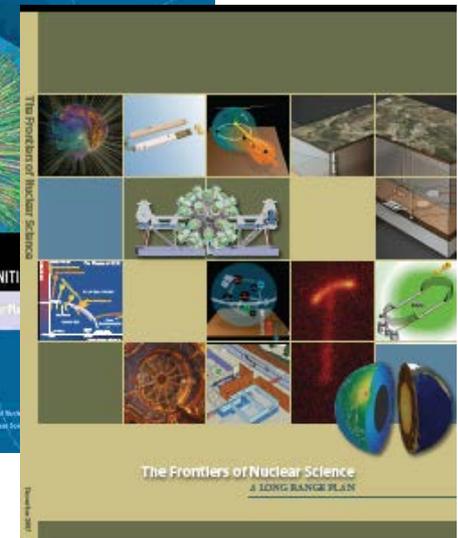
1996



2002



2007



The Long Range Plans have:

- Identified the scientific opportunities
- Recommended scientific priorities

The plans have been informed by a number of sources including important National Academy Studies

The record of important accomplishments and successes 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



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Major Recommendations of the 2007 NSAC Long Range Plan

- We recommend completion of the 12 GeV CEBAF Upgrade at Jefferson Lab. The Upgrade will enable new insights into the structure of the nucleon, the transition between the hadronic and quark/gluon descriptions of nuclei, and the nature of confinement.
Construction underway
- We recommend construction of the Facility for Rare Isotope Beams (FRIB), a world-leading facility for the study of nuclear structure, reactions, and astrophysics. Experiments with the new isotopes produced at FRIB will lead to a comprehensive description of nuclei, elucidate the origin of the elements in the cosmos, provide an understanding of matter in the crust of neutron stars, and establish the scientific foundation for innovative applications of nuclear science to society.
Project received CD-1 on August 31, 2010
- We recommend a targeted program of experiments to investigate neutrino properties and fundamental symmetries. These experiments aim to discover the nature of the neutrino, yet-unseen violations of time-reversal symmetry, and other key ingredients of the New Standard Model of fundamental interactions. Construction of a Deep Underground Science and Engineering Laboratory is vital to U.S. leadership in core aspects of this initiative.
Projects underway (KATRIN, CUORE, Majorana Demonstrator, FNPB, neutron EDM)
- The experiments at the Relativistic Heavy Ion Collider have discovered a new state of matter at extreme temperature and density—a quark-gluon plasma that exhibits unexpected, almost perfect liquid dynamical behavior. We recommend implementation of the RHIC II luminosity upgrade, together with detector improvements, to determine the properties of this new state of matter.
RHIC luminosity upgrade largely achieved and detector upgrades in progress

Office of Nuclear Physics FY 2013 Congressional Request

The FY 2013 request for Nuclear Physics optimizes, within available resources, scientific productivity by a balance of investments in research, facility operations, new tools, and capabilities.

- It continues support for the two highest priorities in the 2007 Long Range Plan for Nuclear Science:
 - 12 GeV CEBAF Upgrade
 - Funding for the 12 GeV CEBAF Upgrade project (TEC and OPC) ramps down \$6.9M according to the original baseline plan; it does not restore the FY 2012 reduction of \$16M.
 - Facility for Rare Isotope Beams (FRIB)
 - Funding for FRIB is flat with the FY 2012 enacted level.
- The FY 2013 budget is a decrease of \$20.4M, or 3.7%, relative to the enacted FY 2012 appropriation.
 - Funding for research across the program decreases by \$9.9M, or 5.8%, relative to FY 2012.
 - NP national user facilities are operated for an estimated 5,360 hours of beam time for research, 38% of optimal utilization for the operating facilities, and a decrease of about 6,800 hours compared with the beam hours planned for FY 2012.
 - Reduction in hours is a result of reduced RHIC and ATLAS operations, and a planned shutdown period at CEBAF associated with the construction of the 12 GeV CEBAF Upgrade.
 - At RHIC, FY 2013-FY 2014 running will be combined into a single back-to-back run bridging the two fiscal years.
 - HRIBF D&D activities are supported.
 - Funding is provided for the STAR Heavy Flavor Tracker MIE per the project baseline.



2013 Congressional Appropriations Committee Markups

The challenges in the NP budget have been recognized

- (Senate) The Committee is concerned about the lack of strategic direction for nuclear physics and the inability of the program to adapt to a changing budget environment. The Committee believes that the budget request puts at risk all major research and facility operations activities without significantly advancing nuclear physics goals. For example, **the budget request reduces the operating times of two major facilities—a 50 percent reduction in operating time for the Relativistic Heavy Ion Collider at Brookhaven National Laboratory** and a 15 percent reduction at the Argonne Tandem Linac Accelerator System at Argonne National Laboratory. At the same time, the budget request does not provide sufficient funds to advance the new Facility for Rare Isotope Beams at Michigan State University, and the current construction project to upgrade the Continuous Electron Beam Accelerator Facility at the Thomas Jefferson National Laboratory is at risk of falling behind schedule.
- (Senate) The Committee directs the Office of Science to charge the **Nuclear Physics Advisory Committee to submit a report by December 1, 2012** to the Office of Science and the Committee that proposes research and development activities for nuclear physics under a flat budget scenario over the next 5 fiscal years. The report should specifically identify priorities for facility construction and facility decommissioning to meet those priorities.
- (House) The Committee notes that funding requirements for construction and operation of all operating and currently-planned facilities in the Nuclear Physics program are likely to be in excess of available budgets in future years. **The Committee therefore supports the Nuclear Science Advisory Committee's review of these facilities** and encourages an expedited process that can inform the prioritization and hard decisions that will likely be necessary next year.



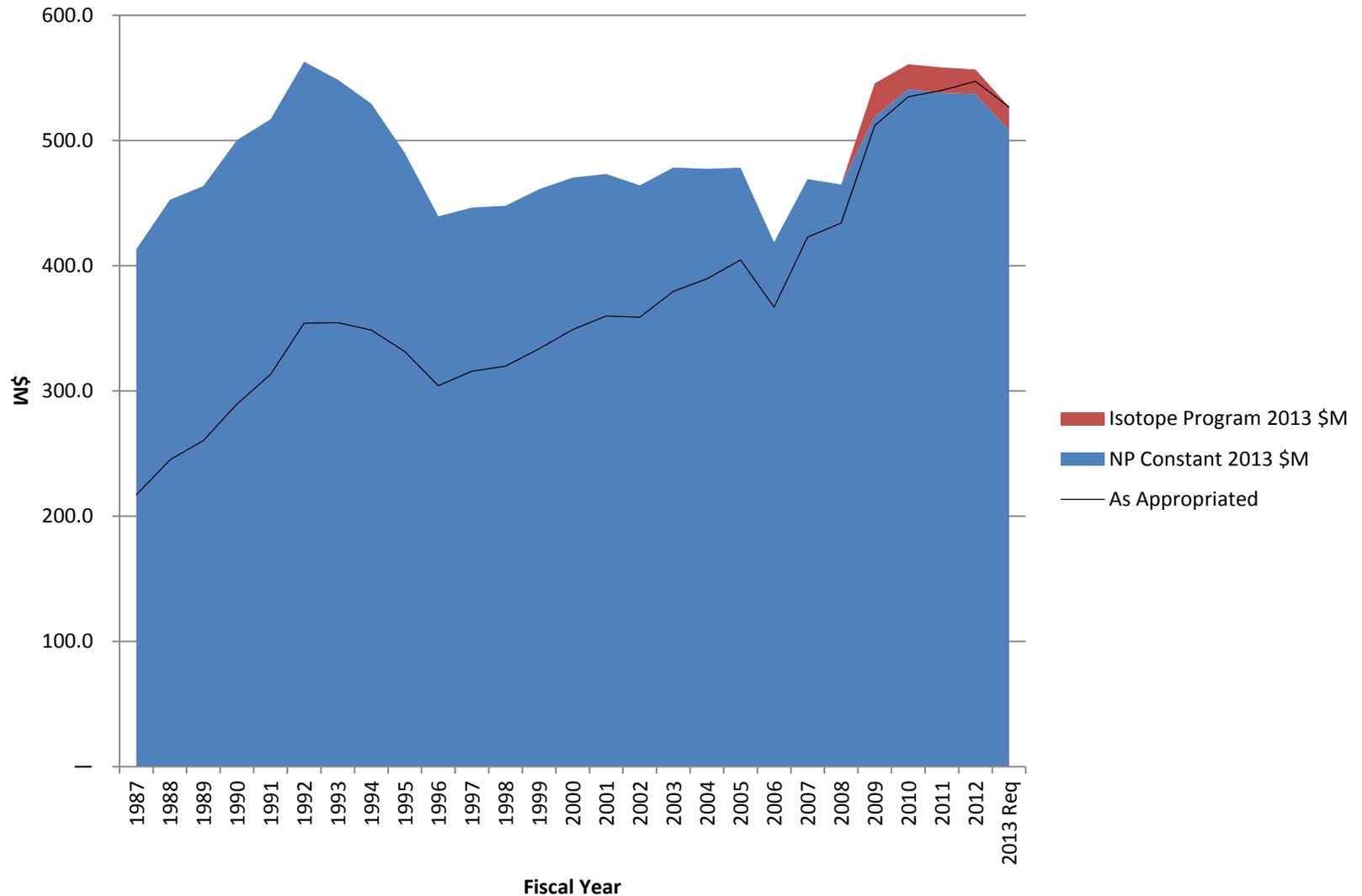
Congressional Markup – Not an appropriation!

	FY 2012		FY 2013							
	Current Approp.	President's Request	President's Request vs. FY 2012 Appropriation	House Mark	House Mark vs. President's Request		Senate Mark	Senate Mark vs. President's Request		
SCIENCE										
ASCR.....	440,868	455,593	+14,725	+3.3%	442,000	-13,593	-3.0%	455,593	—	—
BES.....	1,688,093	1,799,592	+111,499	+6.6%	1,657,146	-142,446	-7.9%	1,712,091	-87,501	-4.9%
BER.....	609,557	625,347	+15,790	+2.6%	542,000	-83,347	-13.3%	625,347	—	—
FES...	400,996	398,324	-2,672	-0.7%	474,617	+76,293	+19.2%	398,324	—	—
HEP.....	790,860	776,521	-14,339	-1.8%	776,521	—	—	781,521	+5,000	+0.6%
NP.....	547,387	526,938	-20,449	-3.7%	547,938	+21,000	+4.0%	539,938	+13,000	+2.5%
WDTS.....	18,500	14,500	-4,000	-21.6%	14,500	—	—	14,500	—	—
SLI.....	111,800	117,790	+5,990	+5.4%	112,313	-5,477	-4.6%	117,790	—	—
S&S...	80,573	84,000	+3,427	+4.3%	82,000	-2,000	-2.4%	83,000	-1,000	-1.2%
PD.....	185,000	202,551	+17,551	+9.5%	185,000	-17,551	-8.7%	190,000	-12,551	-6.2%
SBIR/STTR (SC).....	—	—	—	—	—	—	—	—	—	—
Subtotal, Science...	4,873,634	5,001,156	+127,522	+2.6%	4,834,035	-167,121	-3.3%	4,918,104	-83,052	-1.7%
SBIR/STTR (DOE)...	—	—	—	—	—	—	—	—	—	—
Subtotal, Science...	4,873,634	5,001,156	+127,522	+2.6%	4,834,035	-167,121	-3.3%	4,918,104	-83,052	-1.7%
Rescission...	—	—	—	—	-23,500	-23,500	—	—	—	—
Use of PY Bal.....	—	-9,104	-9,104	-6,355	-9,104	—	—	-9,104	—	—
Total, Science Approp.....	4,873,634	4,992,052	+118,418	+2.4%	4,801,431	-190,621	-3.8%	4,909,000	-83,052	-1.7%



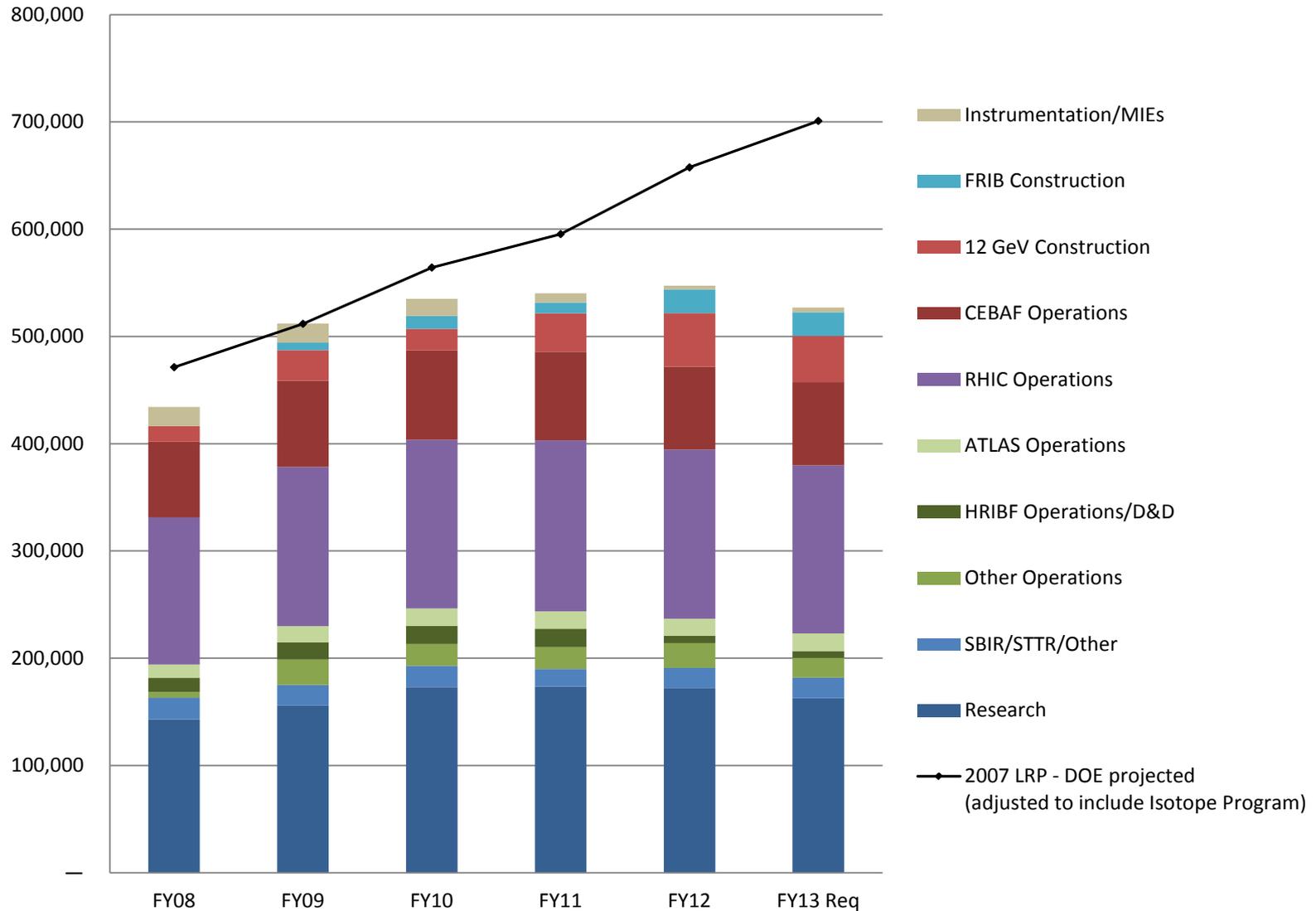
Nuclear Physics Funding History

FY 1987 – FY 2013 (in constant FY13 \$)



Nuclear Physics Funding Distribution

FY 2008 – FY 2013 (actual \$)



From the DOE-NSF Charge to NSAC

DOE and NSF are making significant progress toward achieving the vision of the 2007 Long Range Plan for Nuclear Science. However, DOE and NSF now seek your advice to continue the vision in the Plan so that the recommendations can move forward in light of projected constrained budgets.

We seek advice from NSAC on implementing the priorities and recommendations of the 2007 Long Range Plan in light of projected budgetary constraints and for guidance on developing a plan to implement the highest priority science in the context of likely available funding and world-wide capabilities. We request that NSAC examine the existing research capabilities and scientific efforts, assess their role and potential for scientific advancements, and advise the two agencies regarding the time and resources needed to achieve the planned programs. Your report should describe how to optimize ...

Based on the priorities and opportunities identified and recommended in the 2007 Long Range Plan, the report should discuss what scientific opportunities will be addressed, and what existing and future facilities and instrumentation capabilities would be needed by the Federal nuclear science program to mount a productive, forefront program for each of the funding scenarios.

NSAC SubCommittee

- Members have been appointed and the committee has received their charge from NSAC
- First meeting was held May 15, 2012
- The Division of Nuclear Physics has been notifying the community about the activities of the subcommittee.
- A web site has been set up for public information at <http://cyclotron.tamu.edu/nsac-subcommittee-2012/>
- Report requested by January (December in congressional language)



Message to the DNP from NSAC Subcommittee Chair, Bob Tribble

To members of the DNP:

The first meeting of a new NSAC subcommittee was held on May 15, 2012. The subcommittee has been charged to provide advice on implementing the priorities and recommendations of the 2007 NSAC Long Range Plan in light of projected budgetary constraints and for guidance on developing a plan to implement the highest priority science in the context of likely available funding and world-wide capabilities. The subcommittee used its first meeting to hear presentations from DOE and NSF representatives and to begin setting the agenda for the next meeting, which will mostly focus on presentations from the four major areas of science that were covered in the 2007 Long Range Plan. Also some significant time in the first meeting was devoted to the issue of community input to the process.

While the subcommittee is not carrying out a new LRP, it recognizes that the impact of the present effort will be significant for the field. We welcome input from individual members of the community and have a link on the subcommittee website

<http://cyclotron.tamu.edu/nsac-subcommittee-2012>

for DNP members to post comments to the subcommittee.

Message to the DNP from NSAC Subcommittee Chair, Bob Tribble

For those interested in using this mechanism, comments will need to be submitted with your name and email address so that they can be approved by a moderator before they are posted. For those of you who are involved in a program at a major US user facility, it may be more appropriate to work through your User Group to provide input to the subcommittee. Other groups may want to 'self organize' in order to have their collective voice heard.

Since this is not a new LRP exercise, extended White Papers detailing all of the potential avenues of research will likely not be very useful to the subcommittee. More concise summaries putting the importance of the science in clear language would be particularly valuable. In addition, the DNP Executive Committee has agreed to set aside time at the fall DNP meeting in Newport Beach (likely in conjunction with the Town Meeting) for community input to the process. More information on the Fall Meeting plans will be forthcoming.

Bob Tribble
NSAC Subcommittee Chair

Concluding Perspective

- While the “climate” is said to be difficult in Washington it is more like the “weather”. It can and has changed rapidly.
- Our office will work with the community to mitigate impacts and ensure continuation of the highest priority nuclear science research.
- Here at RHIC
 - The 2012 run has been spectacular.
 - Results and upgrades presented at this meeting are exciting.
 - Continue to do the best physics you can. Make sure the public hears about it. Develop and bring forward your best ideas for the future. This is your best ammunition.
 - I look forward to seeing the latest results at Quark Matter in Washington!