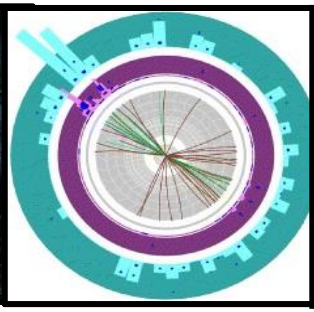
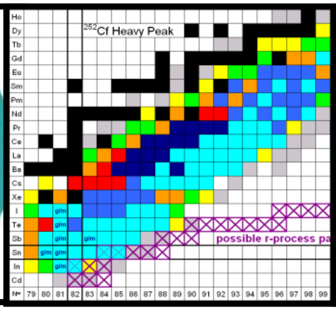
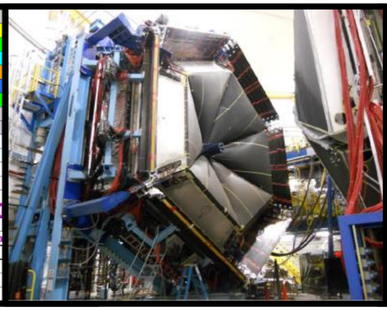
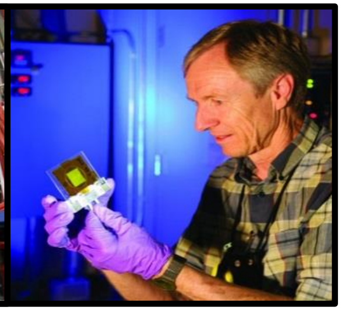
Perspectives from DOE Nuclear Physics (NP)

NSAC Meeting
November 2, 2018

Dr. T. J. Hallman
Associate Director of the Office of Science
for Nuclear Physics

Nuclear Physics FY2019 Budget Status

Nuclear Physics	FY 2018 Enacted	FY 2019 Enacted	FY 2019 Enacted vs FY 2018 Enacted
Operations and maintenance			
Medium Energy	174,953	184,190	+9,237
TJNAF Ops	*112,000*	*117,440*	*+5,440*
Heavy Ions	226,612	230,479	+3,867
RHIC Ops	*187,284*	*193,125*	*+5,841*
Low Energy	96,683	100,745	+4,062
ATLAS Ops	*21,000*	*21,630*	*+630*
FRIB Ops	*3,750*	*3,950*	
Nuclear Theory	47,852	55,327	+7,475
Isotope Program	40,700	44,259	+3,559
Undistributed	—	—	—
Total, Operations and maintenance	**586,800**	**615,000**	**+28,200**
Construction			
14-SC-50 Facility for Rare Isotope Beams	97,200	75,000	-22,200
Total, Construction	**97,200**	**75,000**	**-22,200**
Total, Nuclear Physics	**684,000**	**690,000**	**+6,000**

Senate recommends $710,000,000 for NP. Recommends $75,000,000 for FRIB and encourages early FRIB operations. Recommends $11,500,000 for SIPF MIE and $6,600,000 for GRETA MIE. Recommends optimal operations for RHIC, CEBAF, ATLAS and BLIP.

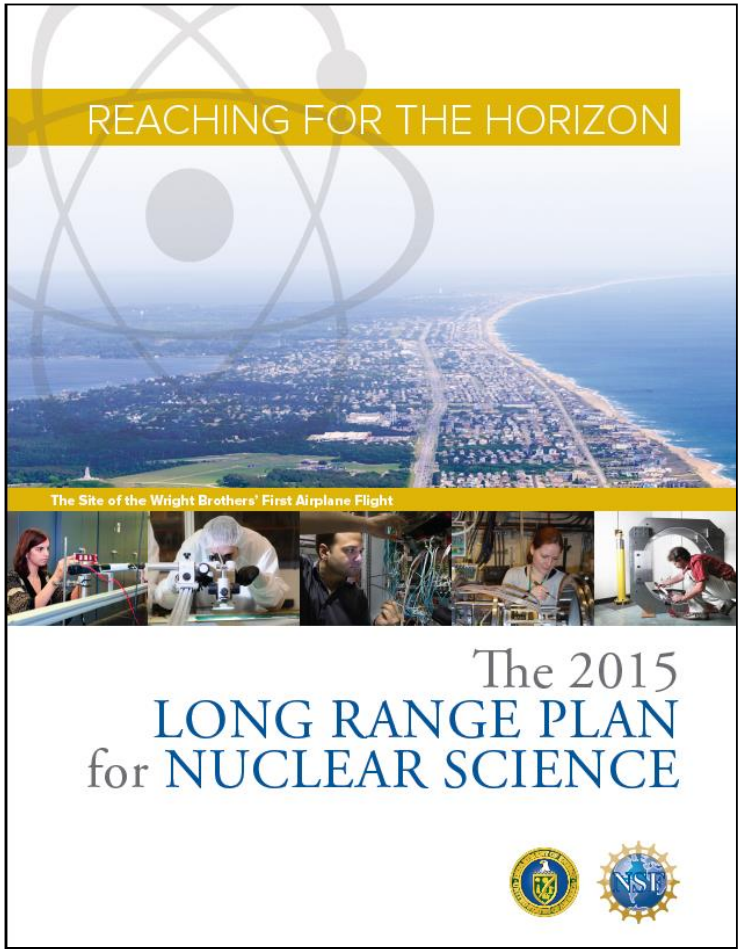
House recommends $690,000,000 for NP. Recommends $10,000,000 for SIPF MIE, $6,600,000 for GRETA MIE, and $5,660,000 for sPHENIX MIE. Encourages optimal operations of RHIC, CEBAF, ATLAS and BLIP.

Enacted Appropriation: $690,000,000 for NP. Recommends $75,000,000 for FRIB and encourages early FRIB operations. Recommends $11,500,000 for SIPF MIE, $6,600,000 for GRETA MIE, and $5,660,000 for sPHENIX MIE (within the RHIC base). Recommends optimal operations for RHIC, CEBAF, ATLAS and BLIP.

The 2015 Long Range Plan for Nuclear Science

Recommendations:

1. Capitalize on investments made to maintain U.S. leadership in nuclear science.
2. Develop and deploy a U.S.-led ton-scale neutrino-less double beta decay experiment.
3. Construct a high-energy high-luminosity polarized electron-ion collider (EIC) as the highest priority for new construction following the completion of FRIB.
4. Increase investment in small-scale and mid-scale projects and initiatives that enable forefront research at universities and laboratories.



NP is continuing to pursue the 2015 LRP Vision

General Outlook

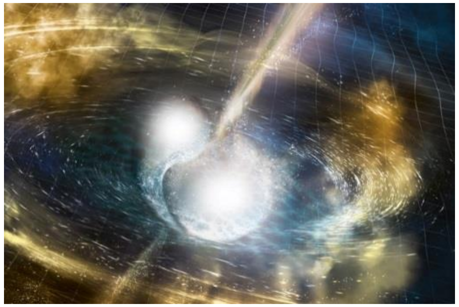
- The experience with FY18 and FY19 budgets maybe similar in the next budget cycle.
- We need to stay focused and continue to deliver important outcomes for the nation.
- Delivering exciting discoveries, important scientific knowledge, technological advances, and workforce training is what we do.
- We need to keep up the good work!

Groundbreaking New Insights

nature
International weekly journal of science

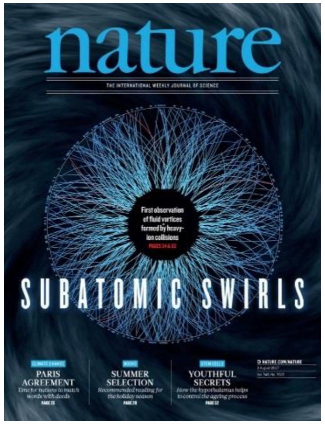
- *Precision measurement of the weak charge of the proton*, Qweak collaboration, Published: Nature 557, 207–211 (2018)
- *The pressure distribution inside the proton,* Burkert, Elouadrhiri, Girod, Published: Nature 557 (2018) no.7705, 396-399
- *A per-cent-level determination of the nucleon axial coupling for quantum chromodynamics*, Berkowitz et. al., Published: Nature 558, 91-94 (2018)
- *Ultrafast Nucleons in Asymmetric Nuclei,* M. Duer et. al., CLAS Collaboration, accepted for publication
- *A glimpse of gluons through deeply virtual compton scattering on the proton*, Dufurne et. al., Published: Nature Communications 8, 1408 (2017)

Groundbreaking Results Continued



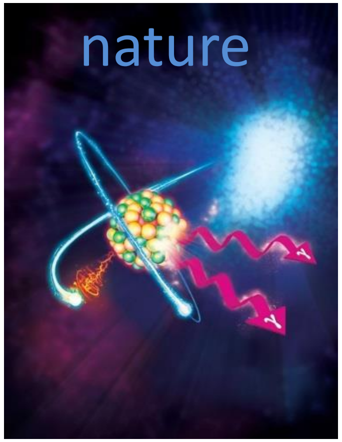
"Origin of the Heavy Elements in Binary Neutron-Star Mergers From a Gravitational-Wave Event"

Daniel Kasen[1, 2], Brian Metzger[3], Jennifer Barnes[3], Eliot Quataert[1] […]& Enrico Ramirez-Ruiz, *Nature* **volume 551**, pages 80–84 (02 November 2017)



Global hyperon polarization in nuclear collisions: evidence for the most vortical fluid

Authors: STAR Collaboration, Nature 548, 62 (2017)



Isomer depletion as experimental evidence of nuclear excitation by electron capture
Nature volume 554, pages 216–218 (08 February 2018)

C. J. Chiara[1], J. J. Carroll[2], M. P. Carpenter[3], J. P. Greene[3], D. J. Hartley[4], R. V. F. Janssens[3 n1], G. J. Lane[5], J. C. Marsh[1 n1], D. A. Matters[6], M. Polasik[7], J. Rzadkiewicz[8], D. Seweryniak[3], S. Zhu[3], S. Bottoni[3 n1], A. B. Hayes[10] […] & S. A. Karamian

FIONA: A Magnificent New Tool at the 88 Inch Cyclotron

Ongoing research programs

nuclear structure,

astrophysics,

heavy element studies,

technology R&D

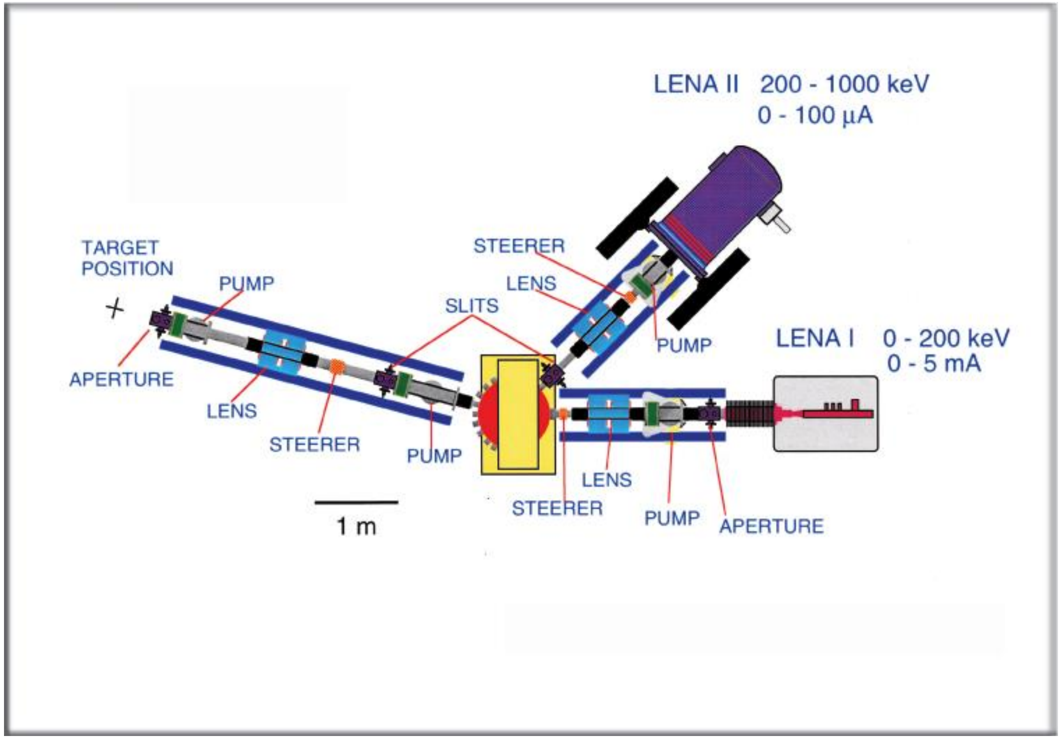
(Source Development)

A new tool to see how superheavy masses measure up to predictions. In addition to mass numbers, FIONA will study the shape and structure of heavy nuclei, help guide the search for new elements, and provide better measurements for nuclear fission and related processes in nuclear physics and nuclear chemistry research

NASA a new sponsor along with AF & DOE

Targeted Low Energy Infrastructure Investments

The LENA facility is used for directly measuring astrophysically important cross sections and resonance strengths at low bombarding energies. LENA consists of two major components, a 1 MV JN accelerator and a 200 kV accelerator. Both accelerators deliver protons or alpha-particles into the same beamline. The smaller machine provides currents of up to 1 mA on target (this is a crucial requirement for measuring very weak cross sections at low bombarding energies), while the larger accelerator is used for periodically checking the target stability (for example, by measuring well-known resonances located at higher energies).



Significant Upgrade of JN Accelerator and related infrastructure underway

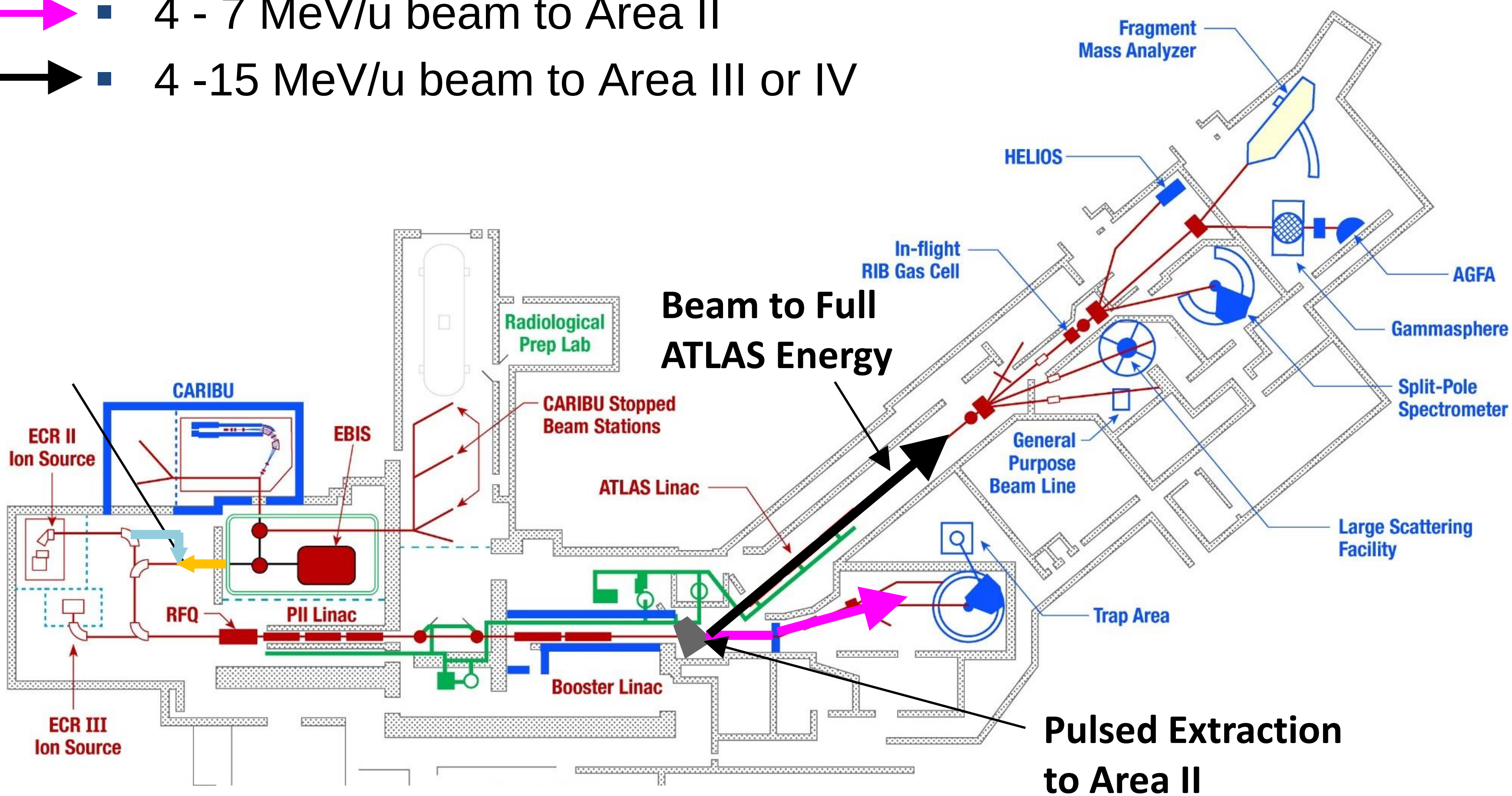
ATLAS Continues as a Premier Stable Beam Facility

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

Multi-User Upgrade AIP Planned

Scope of the Proposed Multi-User Upgrade AIP

- Injection from ECR
- Injection from CARIBU-EBIS
- 4 - 7 MeV/u beam to Area II
- 4 -15 MeV/u beam to Area III or IV



Facility for Rare Isotope Beams is > 88% Complete

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 limits of existence for nuclei
- Nuclei that have neutron skins
- Synthesis of super heavy elements

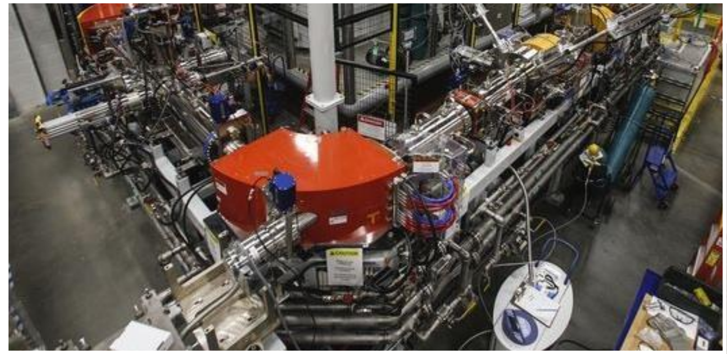
Nuclear Astrophysics

- 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 predictive model of nuclei and how they interact.

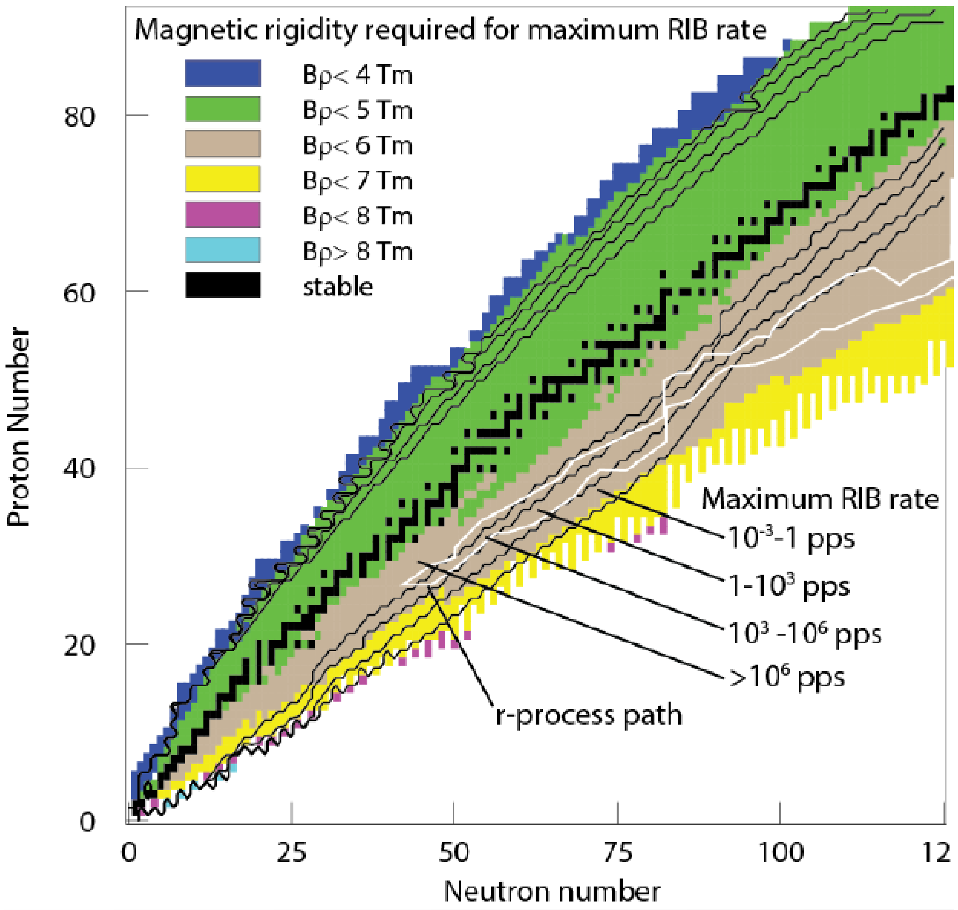


Recent Progress:

- Accelerated argon and krypton beam in first three cryomodules demonstrating that cryoplant, RF, cryomodules and controls work together
- Have installed all 14 accelerating quarter-wave cryomodules in tunnel and are preparing to accelerate beam in them early next year
- Constructing and testing remaining half-wave cryomodules at a rate of 1.5/month (18/yr), will be done with cryomodule construction in 2019.

	PYs	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	DOE Total	MSU	TOTAL
FUNDING PROFILE	**318,000**	**100,000**	**97,200**	**75,000**	**40,000**	**5,300**	**635,500**	**94,500**	**730,000**

The Need For a High Rigidity Spectrometer (HRS) at FRIB



The magnetic rigidity for achieving the maximum rare isotope beam intensity is greater than 4 Tesla-meters for almost all species produced at FRIB and ranges up to 8 Tesla-meters for the most neutron rich rare isotopes of interest for research on nucleo-synthesis

By design, the day-1 physics program will make use of existing NSCL infrastructure. The S800 and Sweeper Spectrometers currently available at NSCL have magnetic rigidity (bending power) limits of 4 Tesla-Meters

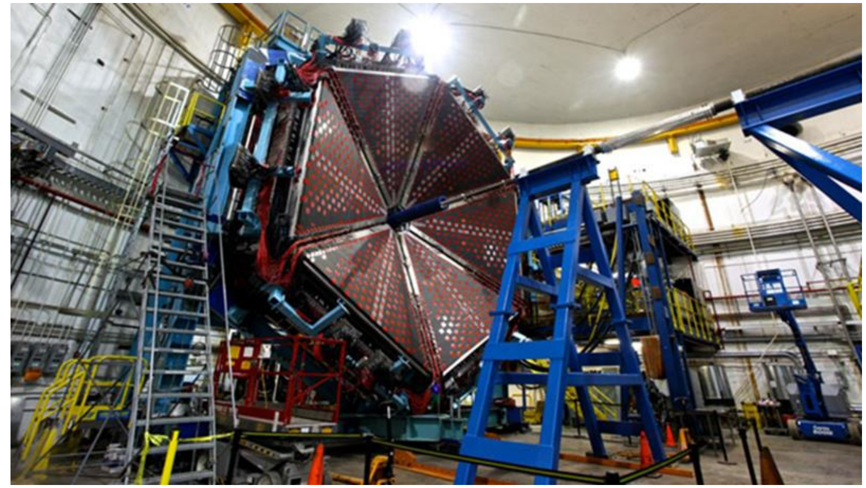
The regions most interesting for research on heavy element production in the cosmos (the nuclei with maximum neutrons) needs almost 8 T-m. Current NSCL instrumentation limit is 4 T-m so, upgraded capability is required GRETA Already in Progress

12 GeV CEBAF Science Program is Underway

CEBAF operates for 32 weeks inFY19

- Recent technical challenges in 17/18 have limited reliability and machine availability. CEBAF ops capped at ~ 26 weeks in FY18.
- Larger investments in maintenance and investments to improve reliability. A larger portion of operations towards cryomodule refurbishment to maintain energy of beam.
- Simultaneous 4-Hall operations.

Hall D Solenoidal Spectrometer



Hall B Time of Flight Detector

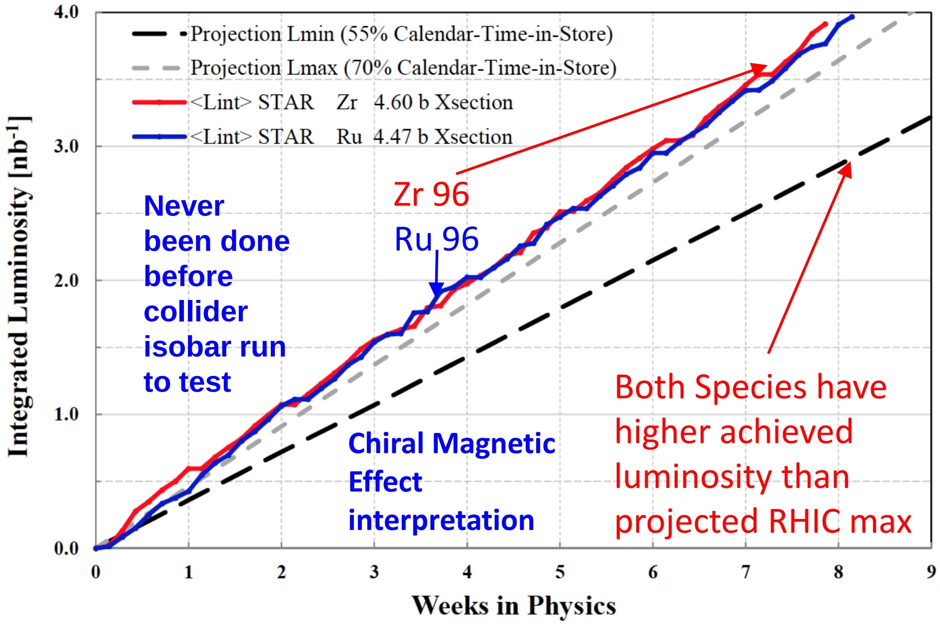
Researchers conduct experiments with the 12 GeV CEBAF Upgrade, to:

- Search for exotic new quark-anti-quark particles to advance our understanding of the strong force.
- Find evidence of new physics from sensitive searches for violations of nature's fundamental symmetries.
- Gain a 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.

At RHIC, Implementing New Capability for New Discoveries Continues

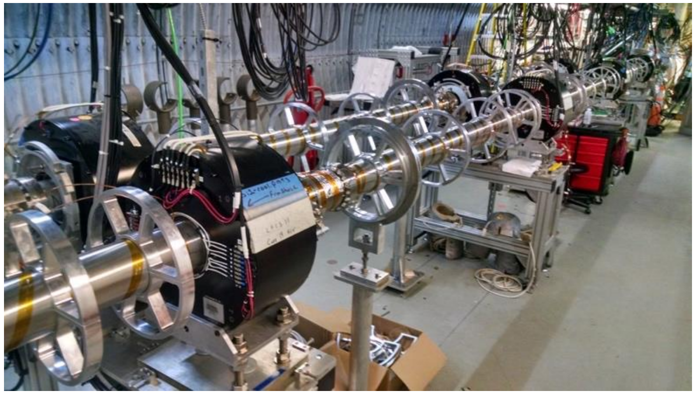
2018 Run

Understanding the origin of charge separation wrt the reaction plane



2019 Run

- The next focus at RHIC: a search for a critical point between the phases of nuclear matter begins in FY2019. A critical factor is electron cooling:



Cooling of low energy, bunched heavy ion beams (3.85–5.75 GeV/n) to increase luminosity

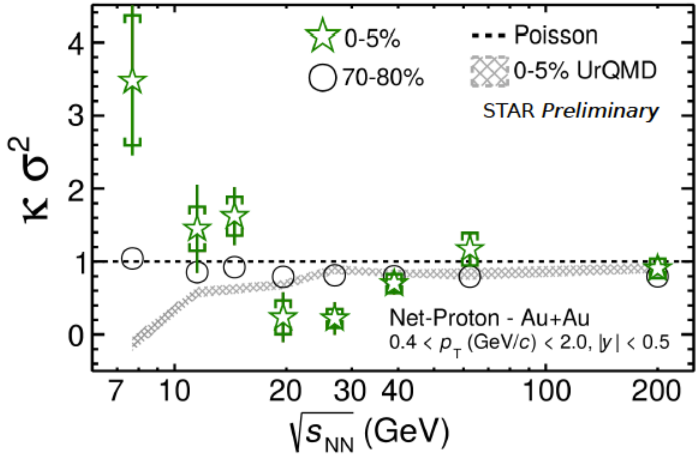
Project on track for completion in 2018 and use in low-energy RHIC runs

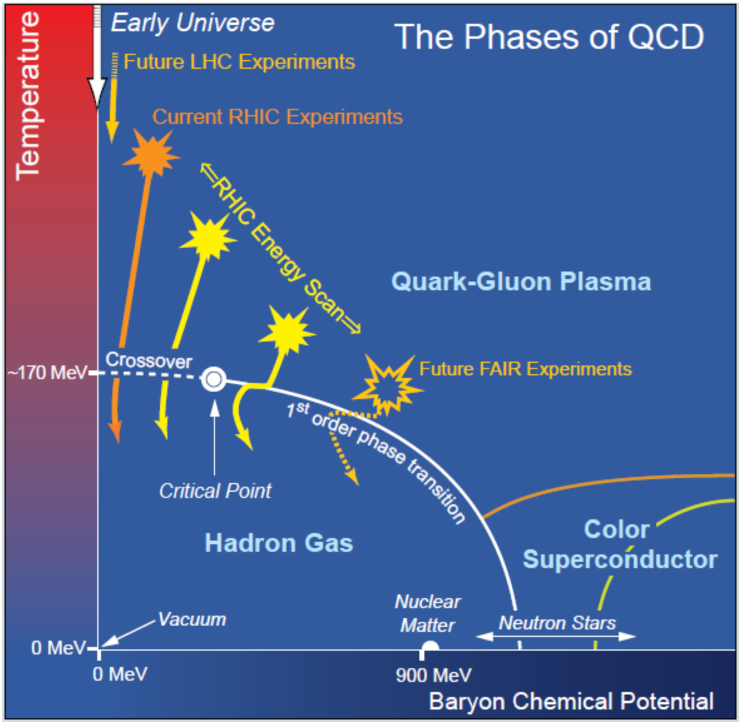
- Consistently high facility availability (~85%)
- No other facility worldwide, existing or planned, rivals RHIC in science reach and versatility as a heavy ion collider. It is the only polarized proton collider in the world.

For Beam Energy Scan II (BESII) Statistics One of the Challenges

One striking fact is that the liquid-vapor curve can end. Beyond this "Critical Point" the sharp distinction between liquid and vapor is lost. The location of the Critical Point and of the phase boundaries represent two of the most fundamental characteristics for any substance.

Experimentally verifying the location of fundamental QCD "landmarks" is central to a quantitative understanding of the nuclear matter phase diagram.





A primary signature of the Critical Point will be non-Poissonian scaled kurtosis (net baryon number fluctuations)

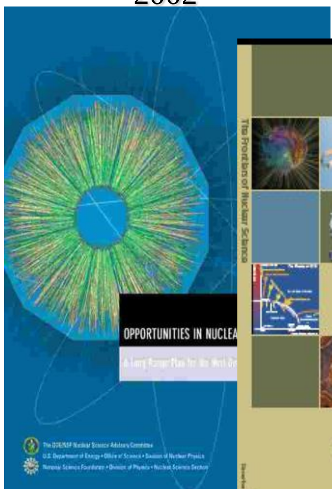
For BES II, a 2 year campaign (~ 48 weeks) is planned

Results from the first survey run appear tantalizing, but the statistics do not allow a conclusion. Fluctuations consistent with Poissonian behavior fall along the line at unity

The Science Case for An Electron-Ion Collider

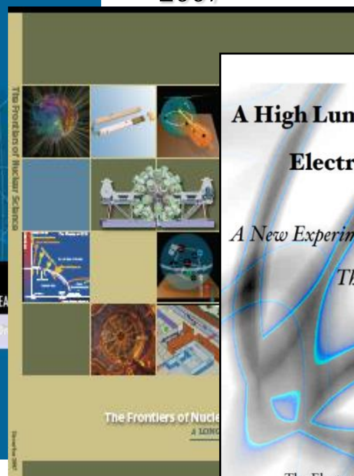
A strong community emphasis on the urgent need for a machine to illuminate the dynamical basis of hadron structure in terms of the fundamental quark and gluon fields has been a persistent message for almost two decades

2002



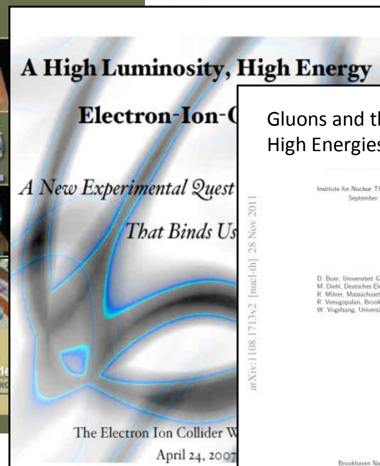
"…essential accelerator and detector R&D [for EIC] should be given very high priority in the short term."

2007



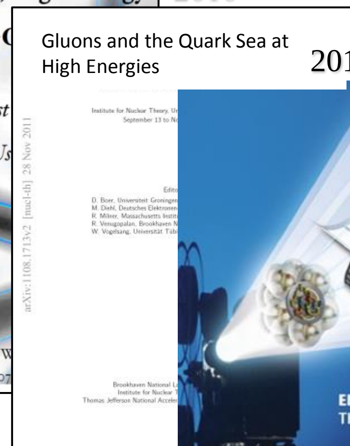
"We recommend the allocation of resources …to lay the foundation for a polarized Electron-Ion Collider…"

2009



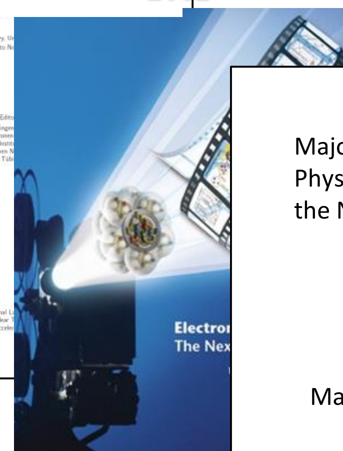
"..a new dedicated facility will be essential for answering some of the most central questions."

2010

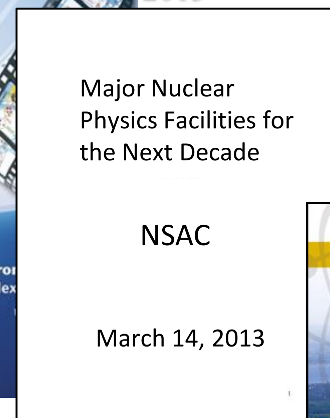


"The quantitative study of matter in this new regime [where abundant gluons dominate] requires a new experimental facility: an Electron Ion Collider.."

2012



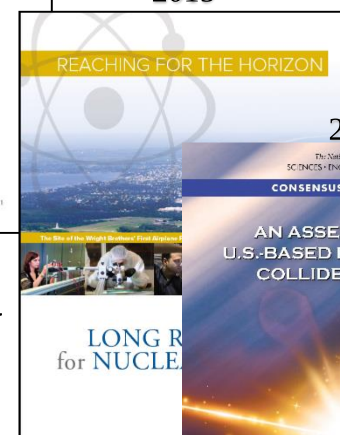
2013



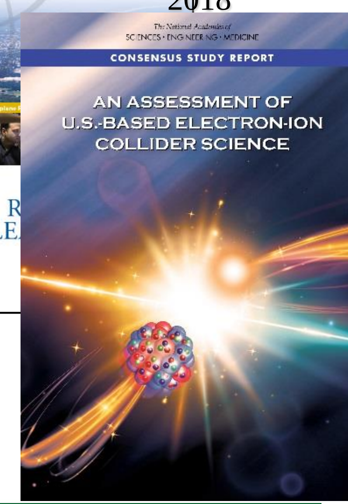
Electron-Ion Collider..*absolutely central* to the nuclear science program of the next decade.

"a high-energy high-luminosity polarized EIC [is] the highest priority for new facility construction following the completion of FRIB."

2015



2018



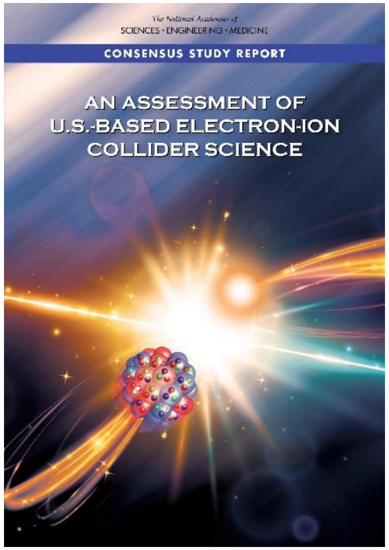
NAS Assessment of a U.S. Based Electron-Ion Collider

Finding 1: An EIC can uniquely address three profound questions about nucleons—neutrons and protons—and how they are assembled to form the nuclei of atoms:

How does the mass of the nucleon arise?

How does the spin of the nucleon arise?

What are the emergent properties of dense systems of gluons?



Consideration of the accelerator requirements to answer these questions leads to the second finding.

Finding 2: These three high-priority science questions can be answered by an EIC with highly polarized beams of electrons and ions, with sufficiently high luminosity and sufficient, and variable, center-of-mass energy.

As a result of the comprehensive survey the committee made of existing and planned accelerator facilities in both nuclear and particle physics around the world, it finds that

Finding 3: An EIC would be a unique facility in the world and would maintain U.S. leadership in nuclear physics.

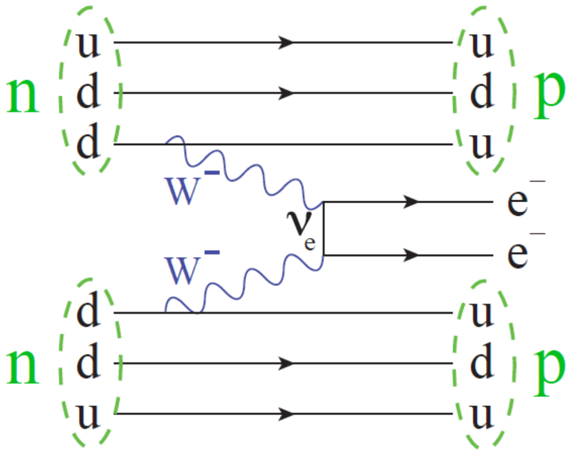
An EIC would be the only high-energy collider planned for construction in the United States. Its high design luminosity and highly polarized beams would push the frontiers of accelerator science and technology. For these reasons, the committee finds that

Finding 4: An EIC would maintain U.S. leadership in the accelerator science and technology of colliders and help to maintain scientific leadership more broadly.

The Campaign to Finally Determine the Fundamental Nature of the Neutrino

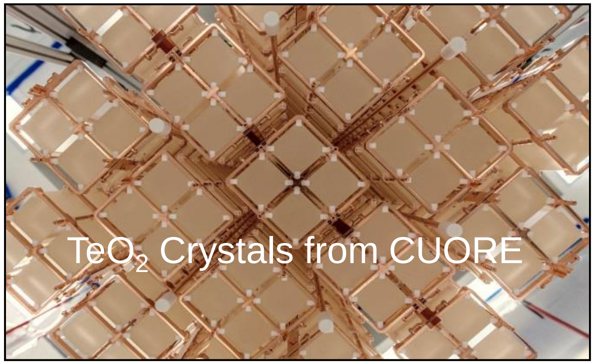
How can it be determined whether the neutrino is a Majorana Particle?

Search for Neutrino-less Double Beta Decay ($0\nu\beta\beta$): in a selected nucleus, two neutrons decay into two protons and two electrons, with no neutrinos being emitted.



It can only happen if the two neutrinos from the two W^- particles annihilate internally because the neutrino is its own anti-particle

Scientists have been eagerly working to demonstrate the necessary sensitivity



TeO_2 from CUORE and CUOREcino

1.5×10^{25} years, 90% CL

Ge^{76} from Majorana Demonstrator

1.9×10^{25} years, 90% CL

Ge^{76} from GERDA

8.0×10^{25} years, 90% CL

Xe^{136} from EXO-200

1.8×10^{25} years, 90% CL

Xe^{136} from Kamland-Zen

1.1×10^{26} years, 90% CL

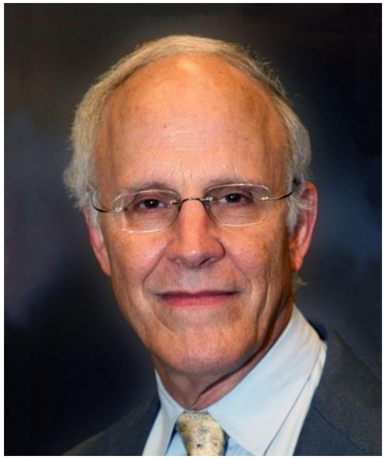
The Campaign to Determine the Fundamental Nature of the Neutrino

RECOMMENDATION II, 2015 Long Range Plan

The excess of matter over antimatter in the universe is one of the most compelling mysteries in all of science. The observation of neutrinoless double beta decay in nuclei would immediately demonstrate that neutrinos are their own antiparticles and would have profound implications for our understanding of the matter-antimatter mystery.

We recommend the timely development and deployment of a U.S.-led ton-scale neutrinoless double beta decay experiment.

A ton-scale instrument designed to search for this as-yet unseen nuclear decay will provide the most powerful test of the particle-antiparticle nature of neutrinos ever performed. With recent experimental breakthroughs pioneered by U.S. physicists and the availability of deep underground laboratories, we are poised to make a major discovery.



David Gross: Nobel Laureate — "I have complete confidence that a ton-scale measurement of neutrino-less double beta decay will be done—because its has to. We will never know the complete nature of the neutrino otherwise."

The demonstrators have delivered; further scientific progress awaits a ton scale experiment. This is a global race in which the United States is currently a leader

Early FY 2018 NP QIS/QC Awards

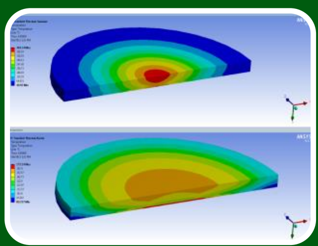
Lead Insititution	PI	Title	Description
University of Washington	Martin Savage	Nuclear Physics Pre-Pilot Program in Quantum Computing	to support pre-pilot research activities that will begin to bring Quantum Computing (QC) and Quantum Information Science (QIS) expertise into the nuclear theory community, including starting to address scientific applications of importance for nuclear physics research. This pre-pilot proposal will organize the nuclear theory community at the national level in order to address Grand Challenge problems in nuclear physics through the use of QC and QIS.
MIT	Joseph Formaggio	Investigating Natural Radioactivity in Superconducting Qubits	to measure the impact of background radioactivity on qubit coherence times. MIT will be responsible for simulation of radiation transport models and development of calibration sources to be deployed in various qubit measurements. MIT will also coordinate this effort with Prof. William Oliver (MIT and Lincoln Labs). PNNL will be responsible for radioassay of materials using their calibrated measurement stations.
ANL	Ian Cloet	Quantum Simulators for Nuclear Physics: Theory	to support a postdoctoral fellow to work on the proposal for Quantum Simulations for Nuclear Physics. This pilot effort will begin to develop the expertise and knowledge that builds toward a QCD simulations on Quantum Computers and Analog Quantum Simulators.
ANL	Valentine Novosad	Superconducting Quantum Detectors for Nuclear Physics and QIS	to work on the proposal for Superconducting Quantum Detectors for Nuclear Physics and QIS.
LLNL	Stephan Frederich	Thorium 229mTh	to study of the feasibility of suppressing the internal conversion transition of 229mTh by implanting it in high band gap materials such as MgF_2

FY 2018 Awards Made Through Annual Solicitation

DOE Isotope Program Mission

Produce and/or distribute radioactive and stable isotopes that are in short supply; includes by-products, surplus materials and related isotope services

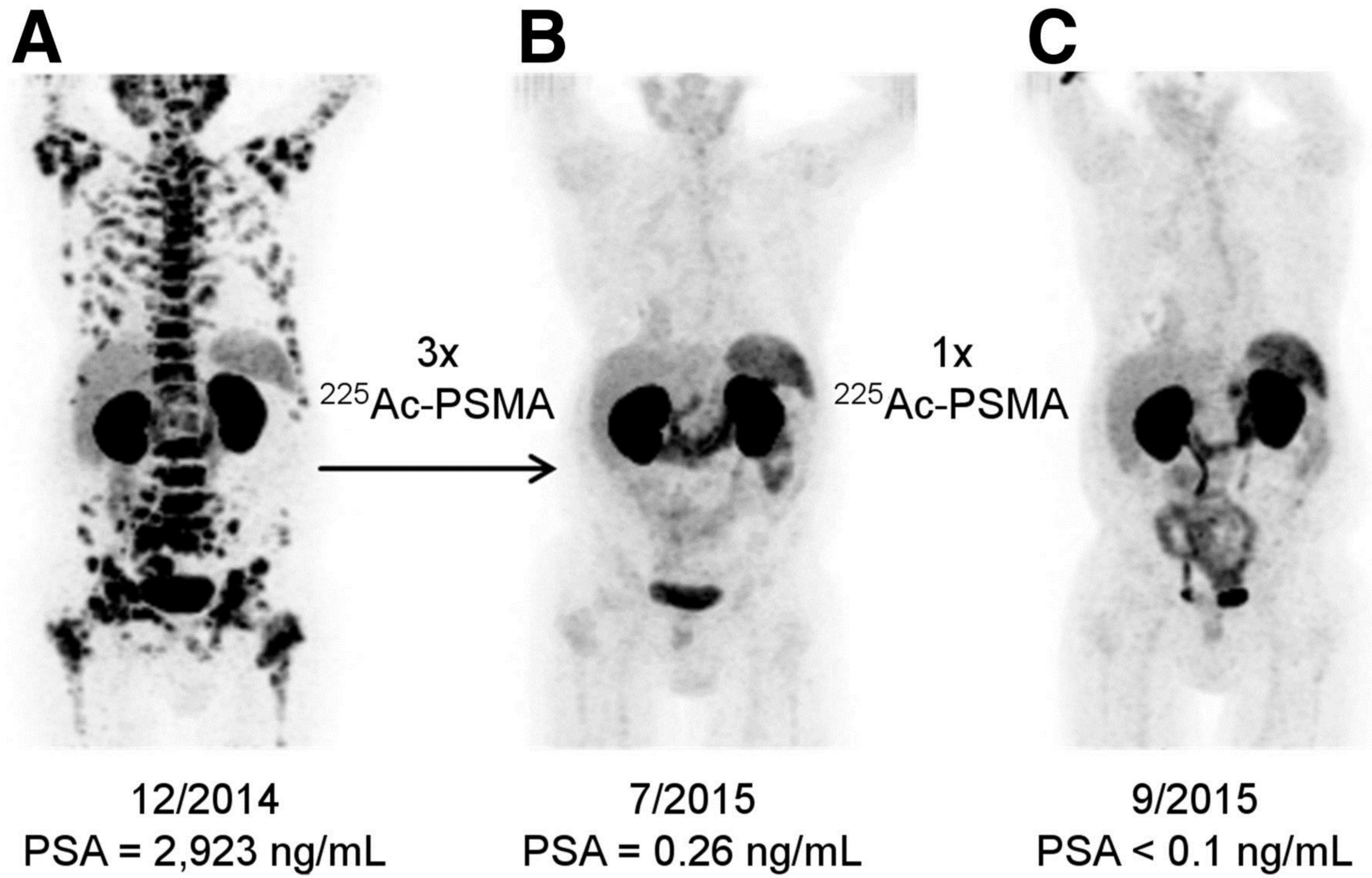
Maintain the infrastructure required to produce and supply priority isotope products and related service



Conduct R&D on new and improved isotope production and processing techniques which can make available priority isotopes for research and application. Develop workforce.

OMB moved Isotope Program from Office of Nuclear Energy to NP in FY 2009 Passback

Support for Isotope Research/Mission Readiness is Enabling the Saving of Lives



Ga-68 PET/CT scans of a different patient with metastatic prostate cancer. Image **A** shows pre-therapeutic tumor spread. Image **B** was taken 2 months after the third cycle of treatment with the α-emitting isotope Ac-225 attached to a tumor seeking drug. Image **C** was taken 2 months after one additional treatment dose. Clemens Kratochwil et al. J Nucl Med 2016;57:1941-1944

A Remarkable Journey of Discovery With a Big Payoff 100 Years On

The previous slide documents a remarkable demonstration of how fundamental science discoveries spanning more than 100 years have converged to benefit society today:

Invention of scintillation detectors	Sir William Crookes 1903)
Invention of Photomultiplier	Curran 1944
Invention of NaI scintillation detectors	Hofstadter 1948
Clinical Use of Ga68	Anger and Gottschalk 1963
Invention of Pet Imaging	Hoffmann & Phelps 1976
Proton Irradiation of Thorium to produce Ac225	DOE IP, BNL, LANL, ORNL 2013

This is a simple example of why we need to always “do new stuff” scientifically –because aside from leaning things, we benefit greatly on important practical things in the long run.

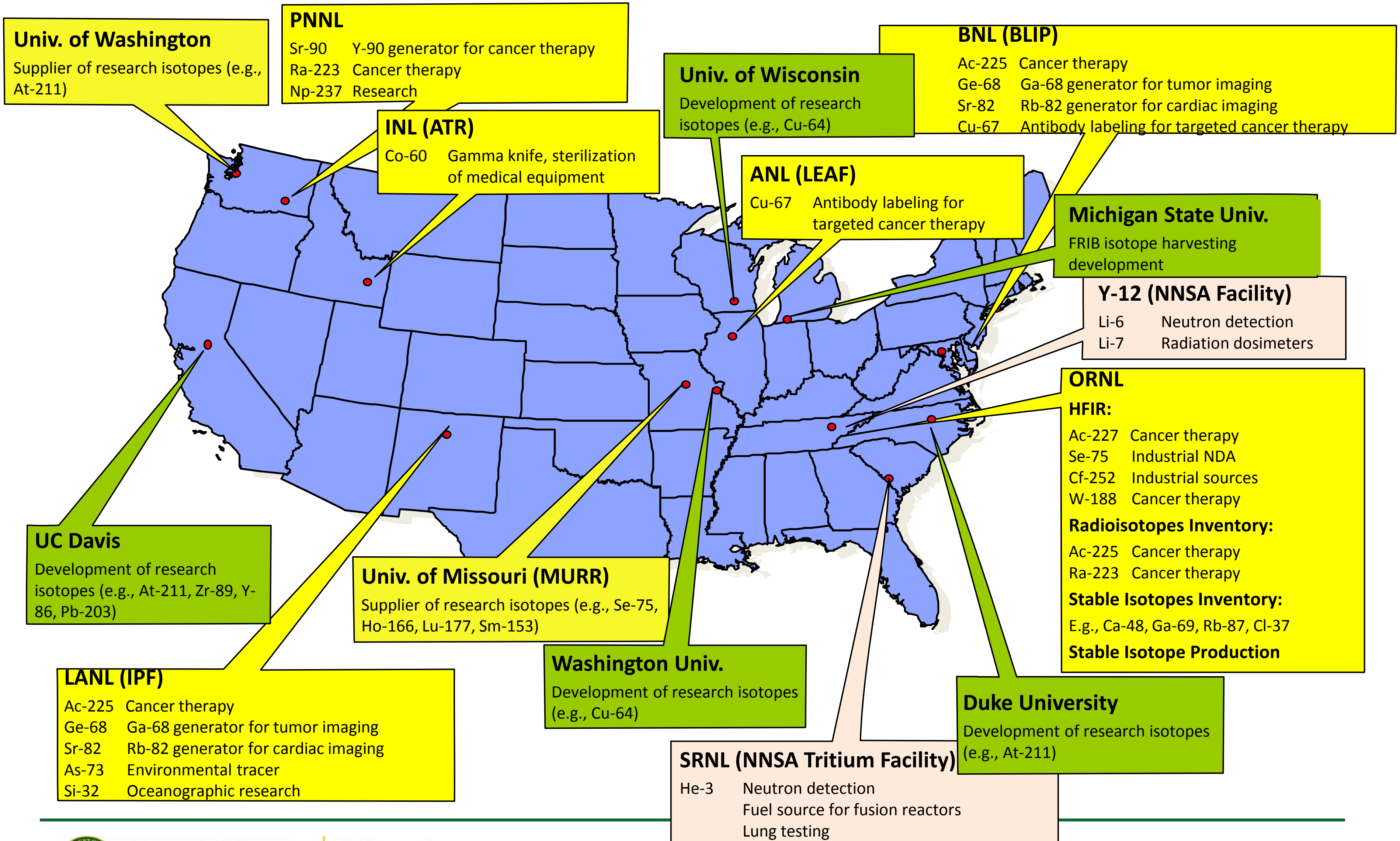
Stable Isotope Production Facility (SIPF)

- The upcoming FY 2020 Request will be the last year of support for the SIPF MIE, which directly supports the DOE Isotope Program mission, upgrading domestic capability that has been lacking since 1998.
  - Renewed enrichment capability will benefit nuclear and physical sciences, industrial manufacturing, homeland security, and medicine.
  - Nurtures U.S. expertise in centrifuge technology and isotope enrichment that could be useful for a variety of peaceful-use activities.
  - Addresses U.S. demands for high priority isotopes needed for suite of activities: neutrinoless double beta decay, dark matter experiments, target material for Mo-99 production.
  - Help mitigate U.S. foreign dependence on stable isotope enrichment.

SIPF responds to Nuclear Science Advisory Committee – Isotopes (NSACI):

- 2009 Recommendation: "Construct and operate an electromagnetic isotope separator facility for stable and long-lived radioactive isotopes."
- 2015 Long Range Plan: "We recommend completion and the establishment of effective, full intensity operations of the stable isotope separation capability at ORNL."

DOE Isotope Program Production and/or Development Sites -2018



FRIB Isotope Harvesting

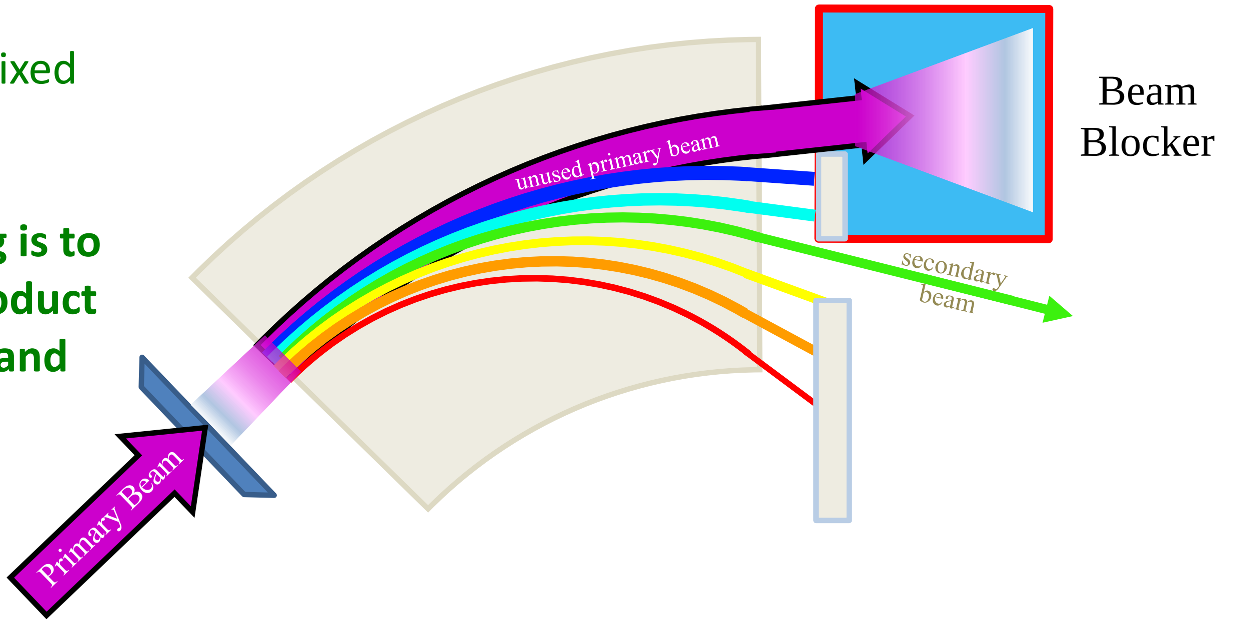
FRIB will create Ci-quantities of useful radioisotopes as byproducts of normal operations.

They will mostly be present as ions, or as dissolved gases in beam-dump cooling water.

The radionuclides will be all mixed together.

The goal of isotope harvesting is to collect and purify FRIB's byproduct radionuclides for use in basic and applied research.

- FRIB linac provides a "primary beam"
  - e.g. $^{48}Ca^{20+}$ 240 MeV/u ~33 pμA (2 x10^{14} particles per second)
- Primary beam hits a thin target (e.g. Be) and fragments
  - Reaction produces almost any nucleus with mass <50 and Z<Ti
    - » Probabilities for conversion are ~10^{-3} for masses near $A = A_0$, ~10^{-6} for other masses
    - » 90% of the primary beam does not react!
- Fragments are still moving, and a "secondary beam" is purified based on charge-to-mass
    - » Unreacted primary beam is directed to a "beam blocker" where many more nuclear reactions occur.

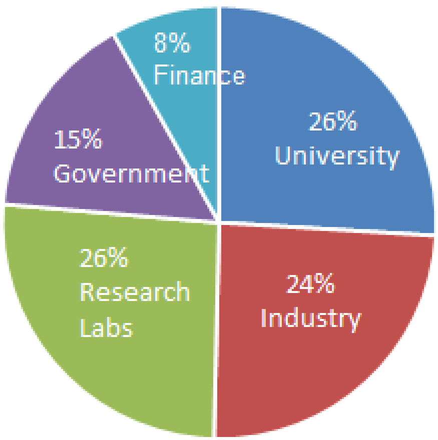


How An NP Trained Workforce Benefits the Nation

Where Do the Entrants into Industry Go?

Data scientist at a company that develops software for predictive maintenance of machines
Chemist at a European large home fragrance company
Research Scientist at a mining technology company
Sr. technical staff at an international internet-of-things company
Sr. Chemist at a mining company
Sr. Research Scientist at a Fotune-100 conglomerate
Founder of a cloud company and Founder/General Partner of a venture capital firm
Sr. Scientist at an international optics company
Head of bioinformatics at a molecular therapy company
Director of Radiological Product Development of a global healthcare technology company
Scientist at a global image sensor company
Vice President of Engineering of a software application development company
Chief Researcher at an international industrial research lab
Director of Innovation at a popular data science platform company
Scientific Translator and Editor
Senior Manager at a EU-listed company that provides microstructuring equipment for the semiconductor industry.
Software engineer at an international computer game company, specializing in physics simulations for games.
Technical Lead of a NYSE-listed company that provides high-speed data movement interconnects
Accelerator and materials technical lead at the radiation effects laboratory of a major Fortune-50 aerospace company.
Owner of a private technology/consulting company

Case Study of an
NP supported Experiment



SC WDTS Research Opportunities

Science Undergraduate Laboratory Internships (SULI)	January 10, 2019 at 5:00 PM ET.
Community College Internships (CCI)	January 10, 2019 at 5:00 PM ET
Visiting Faculty Program (VFP)	January 10, 2019 at 5:00 PM ET
Office of Science Graduate Student Research Program (SCGSR)	November 15, 2018 at 5:00PM ET
Albert Einstein Distinguished Educator Fellowship	November 15, 2018 at 8:00PM ET

FY2018 University Early Career Awards

PI Name (Last, First)	Selectee Institution Name	City, State	Title
Briceno, Raul	Old Dominion University,	Norfolk, VA	Multi-hadron systems via Lattice QCD
Jones, Benjamin	The University of Texas at Arlington,	Arlington, TX	Single Molecule Fluorescence Imaging for a Background-Free Neutrinoless Double Beta Decay Search
Meisel, Zach	Ohio University,	Athens, OH	Constraining Neutron Star Structure with Indirect Nuclear Reaction Studies
Singh, Jaideep	Michigan State University,	East Lansing, MI	Towards a Next Generation Search for Time-Reversal Violation Using Optically Addressable Nuclei in Cryogenic Solids
Noronha-Hostler, Jacquelyn	Rutgers, The State University of New Jersey,	Piscataway, NJ	Dynamical Aspects of the Quark Gluon Plasma
Vossen, Anselm G.	Duke University,	Durham, NC	Novel Experimental Probes of QCD in SIDIS and e+e- Annihilation
De Viveiros Souza Filho, Luiz	The Pennsylvania State University,	University Park, PA	Project 8 at Penn State: Developing the Ultimate Neutrino Mass Experiment

FY2018 Laboratory Early Career Awards

PI Name (Last, First)	Selectee Institution Name	City, State	Title
Valente-Feliciano, Anne Marie	TJNAF	Newport News, VA	Nex Gen SRF with optimized performance via energetic condensation thin film technology
Gandolfi, Stefano	LANL	Los Alamos, NM	Weak interactions in Nuclei and Nuclear Matter
Da Silva, Cesar	LANL	Los Alamos, NM	Gluon saturation in the deep small Bjorken-x region using the LHCb eperiment

New Cohort of SCGSR Awardees

First Name	Middle Name	Last Name	Current Graduate Institution	Primary Graduate Thesis Advisor	Graduate Thesis Title	Host DOE Laboratory	Collaborating DOE Laboratory Scientist	Research Proposal Title
Andrew	Michael	Lopez	University of Tennessee, Knoxville / Physics & Astronomy / Physics (12/2019 - Semester: 97.00)	Yuri Efremenko / University of Tennessee, Knoxville	Cosmogenic Backgrounds to Neutrino-less Double-Beta Decay in the MAJORANA DEMONSTRATOR	Los Alamos National Laboratory (LANL)	Steven Elliott / Physics Division Group P-23 / Fellow NM / 505-665-0068 / elliotts@lanl.gov	Next Generation Depth Requirement and Cosmogenic Background Study for neutrinoless double-beta decay Experiments
Glenn		Randall	Arizona State University / Physics / Nuclear Physics (5/2020 - Semester: 85.00)	Ricardo Alarcon / Arizona State	The Effect of Fierz Interference on Measurements of the Axial-Vector to Vector Coupling Ratio in the Nab Experiment	Oak Ridge National Laboratory (ORNL)	Leah Broussard / Physics Division / Wigner Fellow TN / 865-574-4497 / broussardlj@ornl.gov	Precision Detector Calibration and Linearity for the Nab Experiment at the SNS
Sahara Jesmin		Mohammed Prem Nazeer	Hampton University / Physics / Physics (8/2020 - Semester: 72.00)	Michael Kohl / Hampton University /	A neutral particle search with DarkLight Phase 1C	Thomas Jefferson National Accelerator Facility (TJNAF)	Stephen Benson / Accelerator Division, CASA /	Construction and commissioning of GEM Detectors for the DarkLight Phase 1C Experiment
Adam		Zec	University of Virginia / Physics / Physics (5/2021 - Semester: 81.00)	Kent Paschke / University of Virginia	Precision Measurements of Nuclear Structure with the PREX-II and CREX Experiments	Thomas Jefferson National Accelerator Facility (TJNAF)	Dave Gaskell / Halls A and C / Staff Scientist III VA / 757-269-6092 / gaskelld@jlab.org	Compton Polarimetry for the PREX-II and CREX Experiments
Kyle	David	Bednar	Kent State University Main Campus / Physics / Theoretical Nuclear Physics (5/2019 - Semester: 187.00)	Peter Tandy / Kent State University	QCD Modeling of the Partonic Structure of Hadrons	Argonne National Laboratory (ANL)	Ian Cloet / Physics / Physicist IL / +1-630-252-4093 / icloet@anl.gov	QCD Effects in Nucleon Tomography
Joshua	Douglas	Martin	University of New Mexico Main Campus / Physics and Astronomy / Physics (8/2020 - Semester: 50.00)	Huaiyu Duan / University of New Mexico	Neutrino Oscillations Near Compact Objects	Los Alamos National Laboratory (LANL)	Joseph Carlson / T-2 / Group Leader NM / 505-667-6245 / carlson@lanl.gov	A Two Dimensional Model of Neutrino Oscillations Near A Compact Object

Expectations for Professional Behavior

The Office of Science is exploring the development of an official statement regarding expectations for how individuals it interacts with should conduct themselves.

In the interim, The Office of Nuclear Physics embraces the Code of Conduct adopted by the American Physical Society, and it will remind attendees at meetings it convenes, including review panels, site visits, etc., that it expects a standard for professional behavior that is consistent with the APS declaration.

The APS Code of Conduct

It is the policy of the American Physical Society (APS) that all participants, including attendees, vendors, APS staff, volunteers, and all other stakeholders at APS meetings will conduct themselves in a professional manner that is welcoming to all participants and free from any form of discrimination, harassment, or retaliation. Participants will treat each other with respect and consideration to create a collegial, inclusive, and professional environment at APS Meetings. Creating a supportive environment to enable scientific discourse at APS meetings is the responsibility of all participants.

Participants will avoid any inappropriate actions or statements based on individual characteristics such as age, race, ethnicity, sexual orientation, gender identity, gender expression, marital status, nationality, political affiliation, ability status, educational background, or any other characteristic protected by law. Disruptive or harassing behavior of any kind will not be tolerated. Harassment includes but is not limited to inappropriate or intimidating behavior and language, unwelcome jokes or comments, unwanted touching or attention, offensive images, photography without permission, and stalking.

Other DOE NP News Items

- In NP Physics Division, Inter-Agency FOA for nuclear data and one for QIS for 2019
- Three charges at the upcoming NSAC Meeting: COV, Mo99, QIS.
- NSAC subpanel on Mo99 is already looking to tool up under Susan Seestrom (Chair).
- Report rom Quadrennial review of lab Low Energy Research will be out soon
- Discussions beginning with AF and NASA about FY2019 funding for 88 inch cyclotron.
- Progress on several MIE's the field has identified as priorities is continuing
- Ted Barnes has retired (T Hallman for ND and George Fai for Computing/SciDAC)
- Chris Gould has returned home (Paul Sorensen covering for the moment)
- sPHENIX project is continuing within the RHIC base
- DOE will partner in LEGEND-200; R&D for other efforts (e.g. nEXO) being worked
- Continued support planned for continued data taking with current UCNTau setup and
- nEDM project is continuing.
- Workshop for Applied Nuclear Data Activities (WANDA) will be held at George Washington University on 22-24 January, 2019.

General Outlook

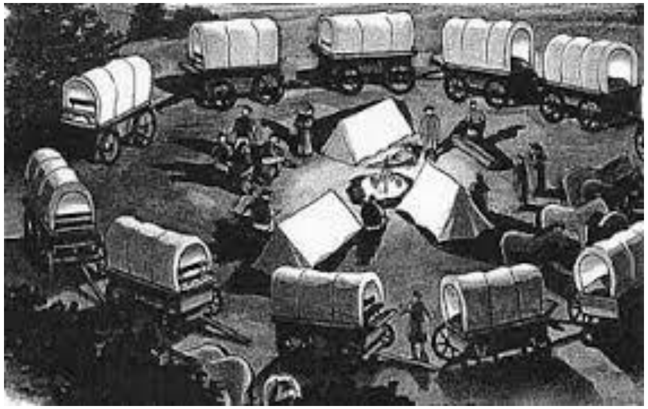
- The experience with FY18 and FY19 budgets maybe similar in the next budget cycle.
- We need to stay focused and continue to deliver important outcomes for the nation.
- Delivering exciting discoveries, important scientific knowledge, technological advances, and workforce training is what we do.
- We need to keep up the good work!

A Long Tradition of Partnership and Stewardship

There has been a long tradition in Nuclear Science of effective partnership between the community and the agencies in charting compelling scientific visions for the future of nuclear science.

Key factors:

1) Informed scientific knowledge as the basis for recommendations and next steps
2) Mutual respect among scientific sub-disciplines
3) Commitment to the greater good of nuclear science as a discipline
4) Meticulously level playing field leading to respect for process and outcomes
5) Deep appreciation for the wisdom of Ben Franklin



Additional Information

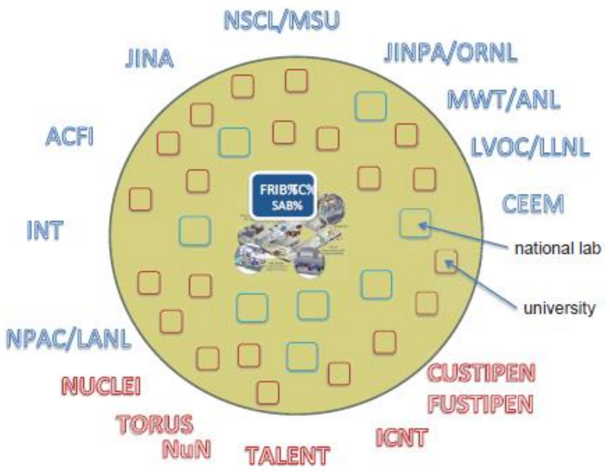
Nuclear Theory

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

A strong Nuclear Theory effort:

- Poses scientific questions and presents new ideas that potentially lead to discoveries and 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 and interprets the results.

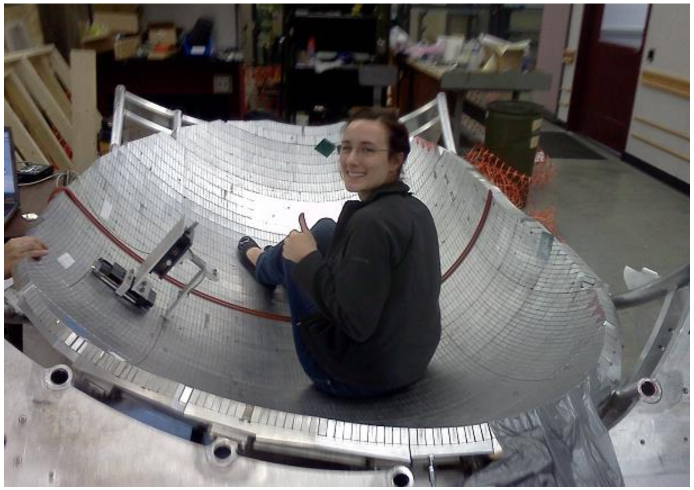
- In FY20, 4 fixed-term, multi-institution Theory Topical Collaborations are continued to investigate specific topics
- The FRIB Theory Alliance is continued
- LQCD computing is restored
- Funding maintains support for SciDAC-4 projects that received 5-year awards starting in FY17



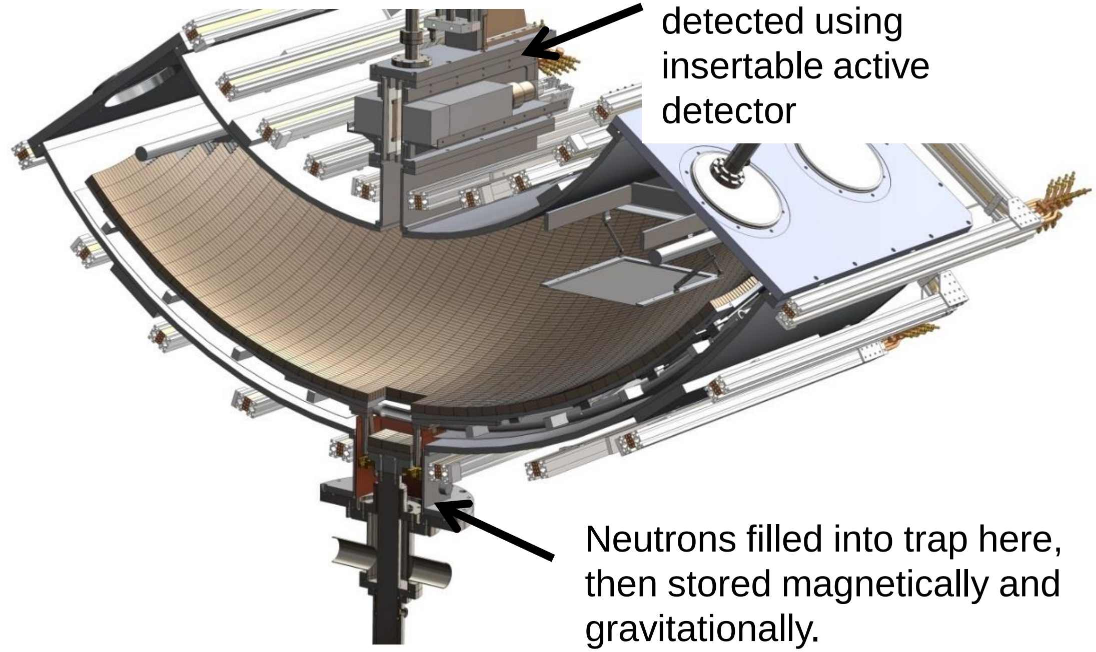
FRIB Theory Alliance

An Important "Other Low Energy" Advance from UCNtau

The UCNτ experiment testbed is operational and acquiring data to study systematic effects.



Cubic meter trap stores tens of thousands of neutrons per fill, allowing rapid study of small effects.



Key features of experiment:

1) Magnetic bottle has storage time much greater than free neutron lifetime, rapid phase space mixing
2) Rapid internal neutron detection scheme counts surviving neutrons with constant efficiency
3) No absolute counting efficiencies needed: only relative neutron counting

A Breakthrough Neutron Lifetime Experiment

Measurement of the neutron lifetime using a magneto-gravitational trap and in situ detection

R. W. Pattie Jr.[1], et al.

Science 11 May 2018:
Vol. 360, Issue 6389, pp. 627-632

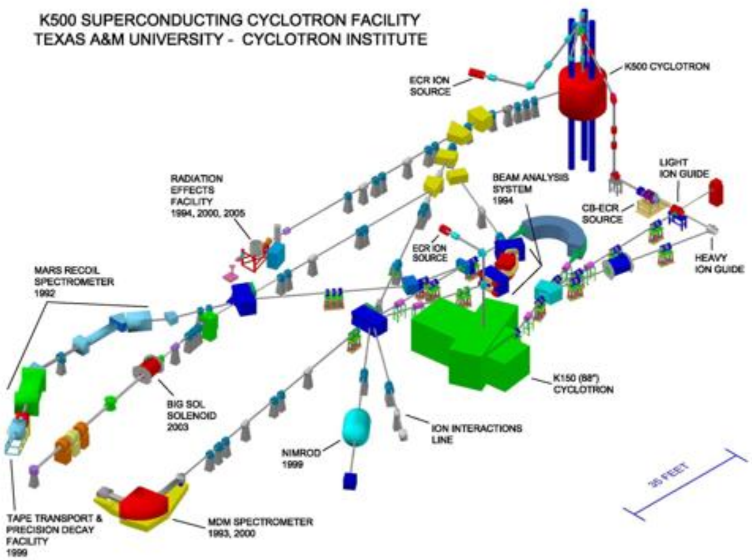
Abstract

The precise value of the mean neutron lifetime, τ_n, plays an important role in nuclear and particle physics and cosmology. It is used to predict the ratio of protons to helium atoms in the primordial universe and to search for physics beyond the Standard Model of particle physics. We eliminated loss mechanisms present in previous trap experiments by levitating polarized ultracold neutrons above the surface of an asymmetric storage trap using a repulsive magnetic field gradient so that the stored neutrons do not interact with material trap walls. As a result of this approach and the use of an in situ neutron detector, the lifetime reported here [877.7 ± 0.7 (stat) +0.4/–0.2 (sys) seconds] does not require corrections larger than the quoted uncertainties.

Two NP Centers of Excellence at TUNL and Texas A&M

1967 - 2017 50 YEARS OF BEAM exploring the nuclear frontier

CYCLOTRON INSTITUTE
TEXAS A&M UNIVERSITY

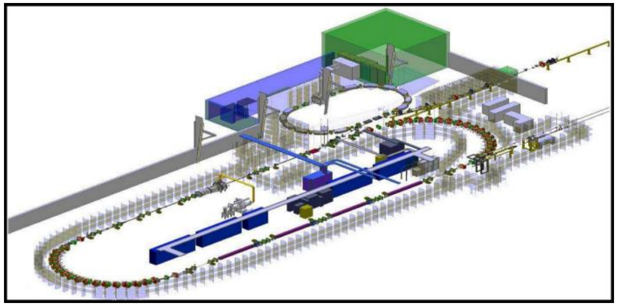


The Texas A&M University Cyclotron Institute jointly supported by DOE and the State of Texas focuses on conducting basic research, educating students in accelerator-based science and technology, and providing technical capabilities for a wide variety of applications in space science, materials science, analytical procedures and nuclear medicine.

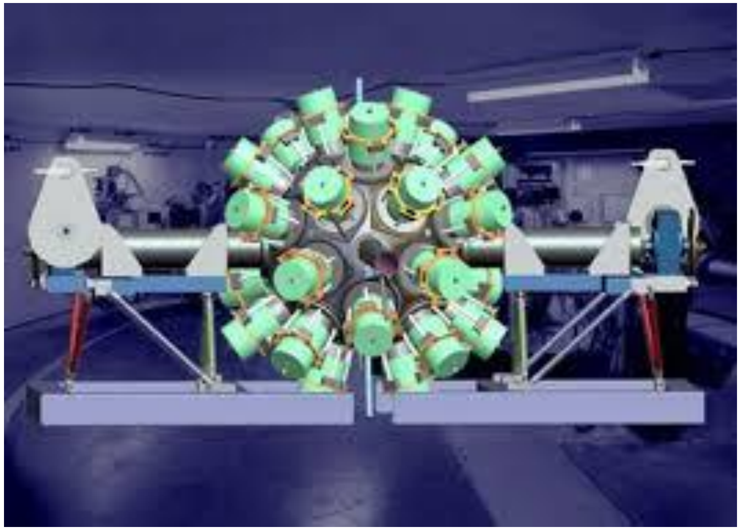
The 88 inch cyclotron also plays a crucial role in space radiation effects chip testing for the Air Force

TUNL TRIANGLE UNIVERSITIES NUCLEAR LABORATORY
Durham, North Carolina
A US Department of Energy Center of Excellence in Nuclear Physics

The Triangle Universities Nuclear Laboratory (TUNL) is Center of Excellence that focuses on low-energy nuclear physics research. TUNL is a consortium Duke University, North Carolina State University, and the University of North Carolina at Chapel Hill comprising about 30 faculty members, 20 postdocs and research scientists, and 50 graduate students.



FRIB Instrumentation/Theory Effort Are Underway



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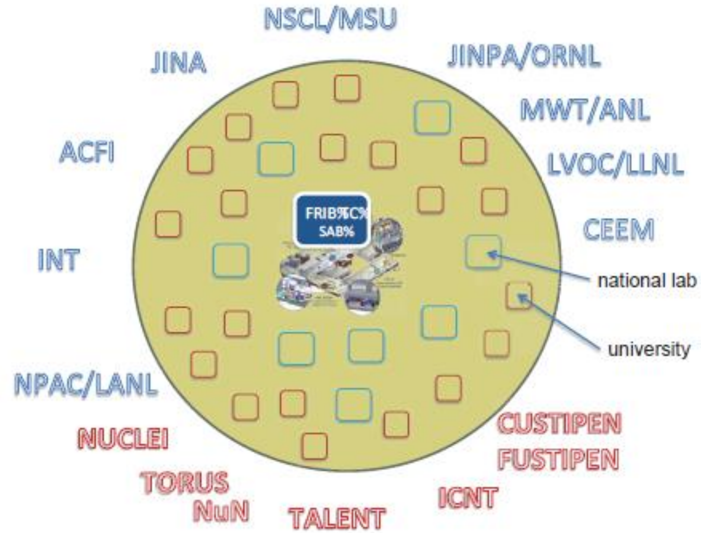
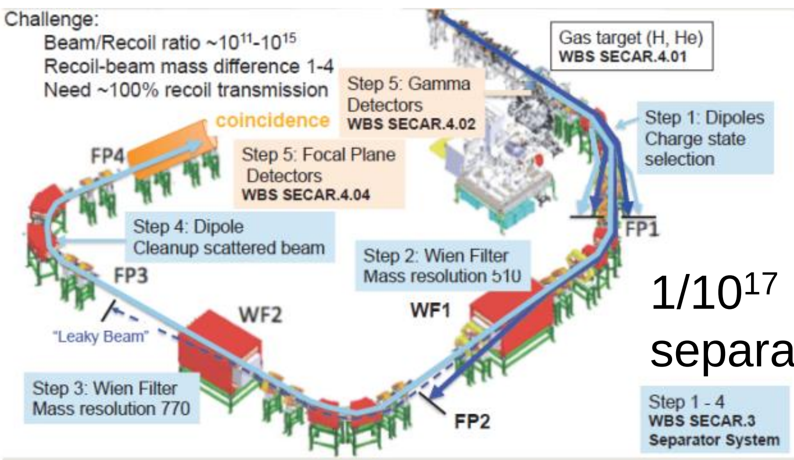
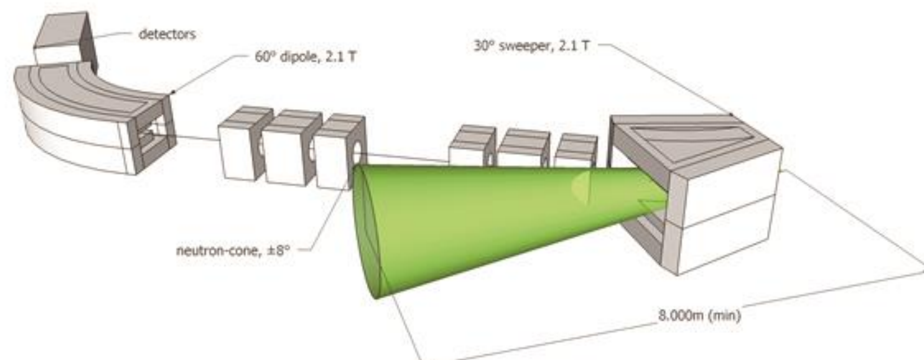


FRIB Theory Alliance



$1/10^{17}$ separation

SECAR Complete FY20/21



Pre-Conceptual High Rigidity Spectrometer (HRS)