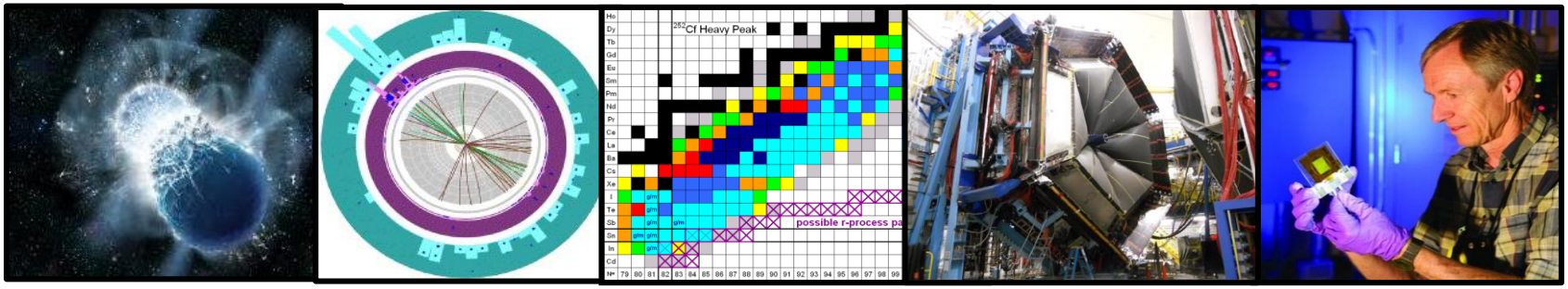
U.S. DEPARTMENT OF ENERGY | Office of Science

Perspectives From the DOE Nuclear Physics (NP) Program

NSAC Meeting

October 18, 2019

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



Big News Since the last NSAC Meeting: Confirmation of Dr. Chris Fall

From *The Scientist*—
Fall is currently the principal deputy director of the Department of Energy's (DOE) Advanced Research Projects Agency-Energy (ARPA-E), which develops new research findings into commercial products. Before joining the DOE, he worked at the Office of Naval Research (ONR) for six years, where he oversaw studies of new technology for naval systems. Prior to that, he served for three years at the White House Office of Science and Technology Policy (OSTP) during President Obama's administration. In that role, Fall was the assistant director for Defense Programs and later, the acting lead for the National Security and International Affairs Division.

Fall was a faculty member in the bioengineering and anatomy and cell biology departments at the University of Illinois at Chicago before joining the Obama administration. During his career in research, he investigated energy production in neurons and the link between cellular signaling systems and cellular energy production. He holds a PhD in neuroscience from the University of Virginia.

Dr. Chris Fall confirmed as the Office of Science Director

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**

FY2020 PR for DOE NP $624, 854M

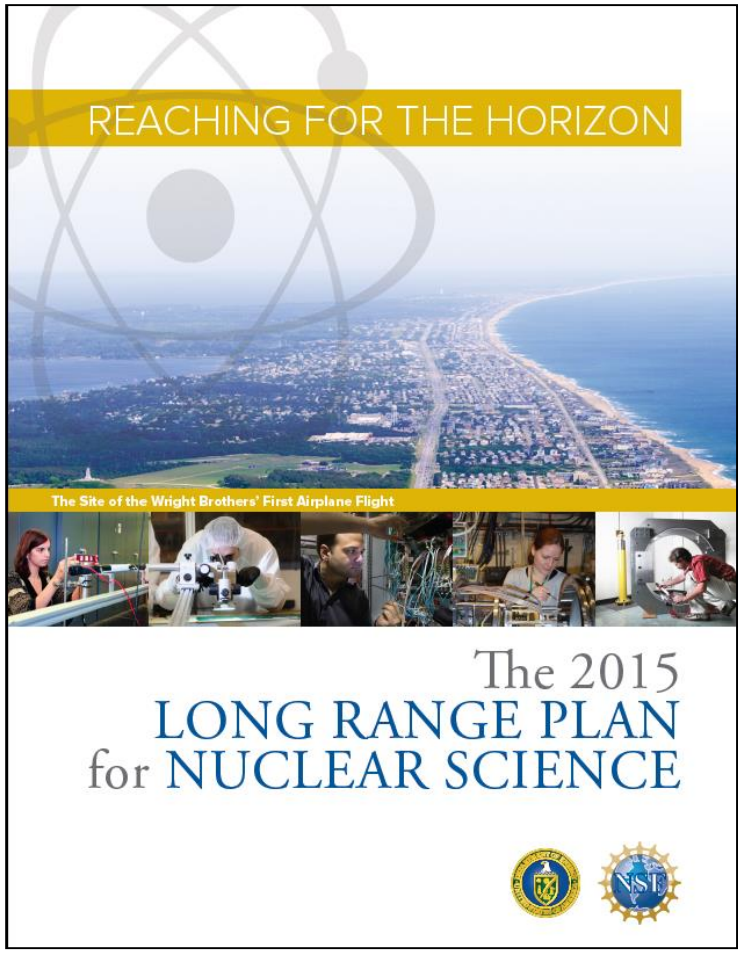
For FY2020, the House recommends $735,000,000 for NP: *Operations and Maintenance.*—Within available funds, the recommendation provides $10,000,000 for Electron Ion Collider R&D. The Department is directed to give priority to optimizing operations within Medium Energy Nuclear Physics and at the Facility for Rare Isotope Beams. Within available funds, the recommendation provides $10,200,000 for the Gamma-Ray Energy Tracking Array, $9,520,000 for the Super Pioneering High Energy Nuclear Interaction Experiment, and not less than $2,500,000 for MOLLER. Also, in accompanying table $1M in TEC funding for the EIC.

For FY2020, the Senate recommends $736,000,000 for NP: *Operations and Maintenance.*—Within available funds, the Committee recommends $45,300,000 for construction of the Facility for Rare Isotope Beams [FRIB], $1,000,000 for the Electron Ion Collider, and $30,000,000 for the U.S. Stable Isotope Production and Research Center. The Committee also recommends $28,500,000 for early operations at FRIB. […] Within major items of equipment and other project costs, the Committee recommends $1,500,000 for the Stable Isotope Production Facility; $10,200,000 for the Gamma-Ray Energy Tracking Array; $9,520,000 for sPHENIX; $5,330,000 for MOLLER; $5,000,000 for Ton-Scale Neutrino-less Double Beta Decay; $10,000,000 for the Electron Ion Collider; and $1,000,000 for the High Rigidity Spectrometer.

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.



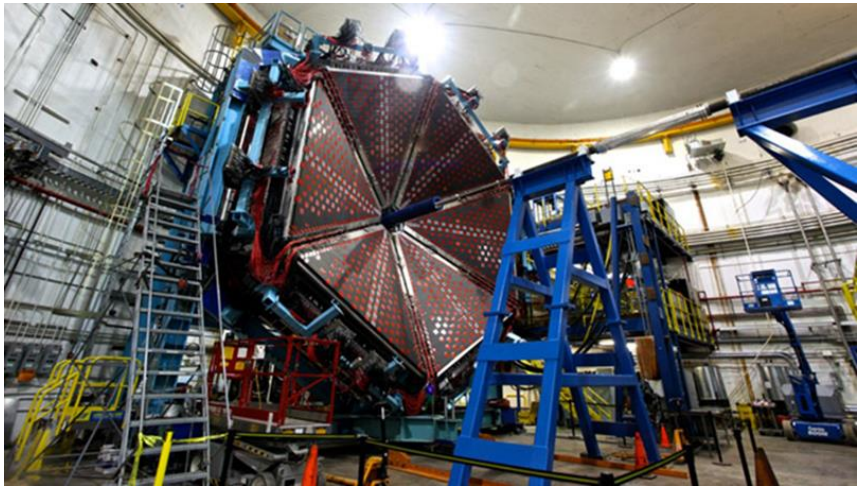
The FY 2019 appropriation continues to support progress toward the 2015 LRP Vision.

12 GeV CEBAF Science Program is in Full Swing

CEBAF operates for 32 weeks in FY19!

- Some technical challenges but those were overcome to provide the full planned running time. In FY 2018, CEBAF ops was capped at ~ 26 weeks.
- 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



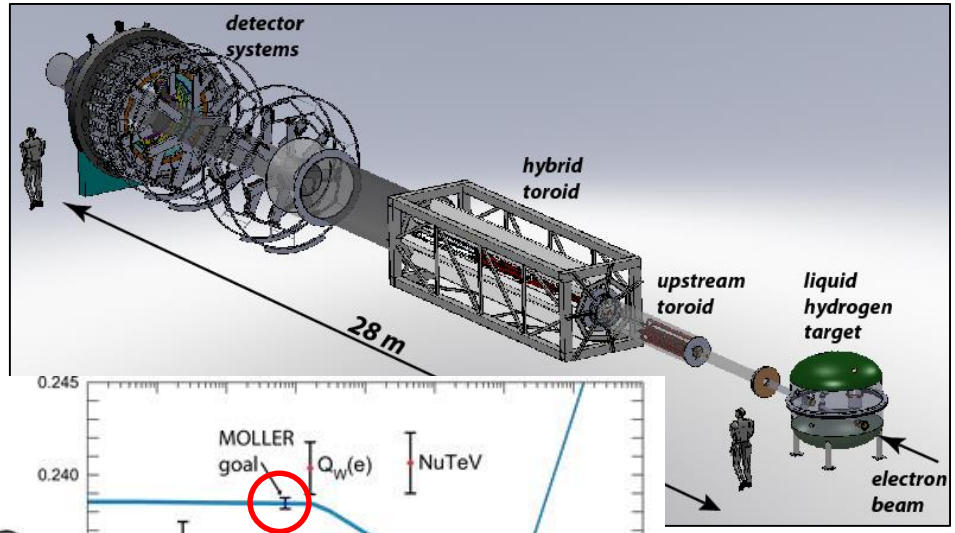
Hall B Time of Flight Detector

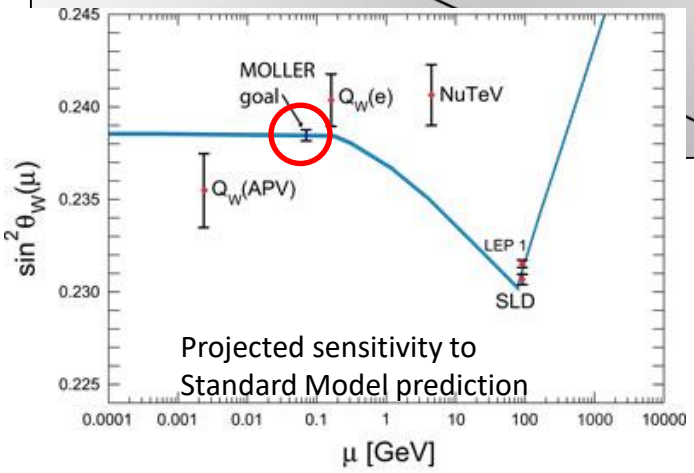
Researchers conduct experiments with the 12 GeV CEBAF Upgrade, to:

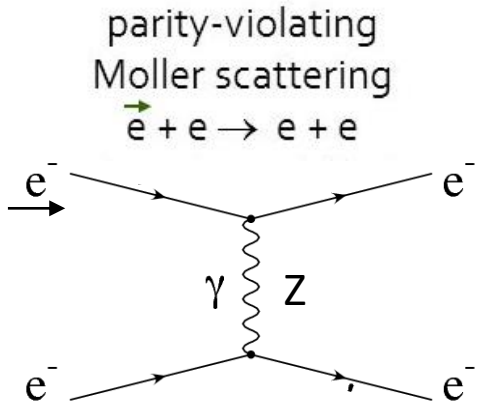
- Search for exotic new quark-anti-quark particles to advance our understanding of the strong force.
- Find evidence of new physics from sensitive searches for violations of nature's fundamental symmetries.
- Gain a microscopic understanding of the internal structure of the proton, including the origin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

MOLLER is a "Must Do" Experiment To Point the Way to New Science

The scientific world rather desperately needs additional markers due to the consistency thus far of LHC data with Standard Model Predictions. Due to the technical challenge of constructing a next generation accelerator with very high accelerating gradients, those markers will have to come from "indirect" discovery experiments like MOLLER.







In MOLLER, polarized electrons are scattered of unpolarized electrons. The amount of parity violation due to interference of the two possible exchange mechanisms (γ or Z) is precisely predictable in QED. (No messy quarks or color charge, or QCD to worry about, only quantum electrodynamics). The theory is so "clean" that like the g-2 approach, If the level of parity violation is greater than expected, a new particle must be the source of the discrepancy.

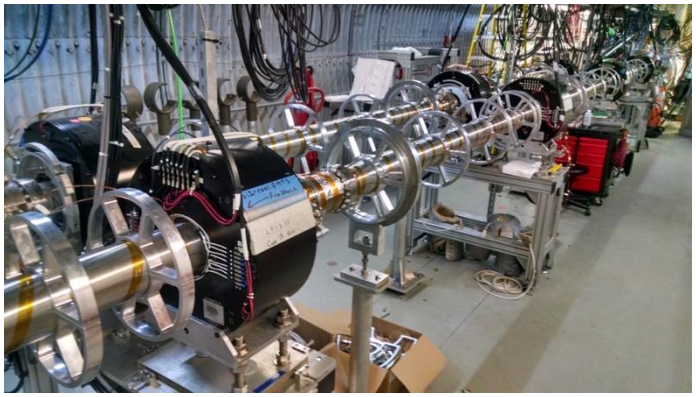
FY 2020 PR requests $0.3M start for MOLLER; House Mark ≥ $2.5M; Senate Mark $5.33M

RHIC Machine Performance Continues to Set New Records

2019 Run: 28 weeks

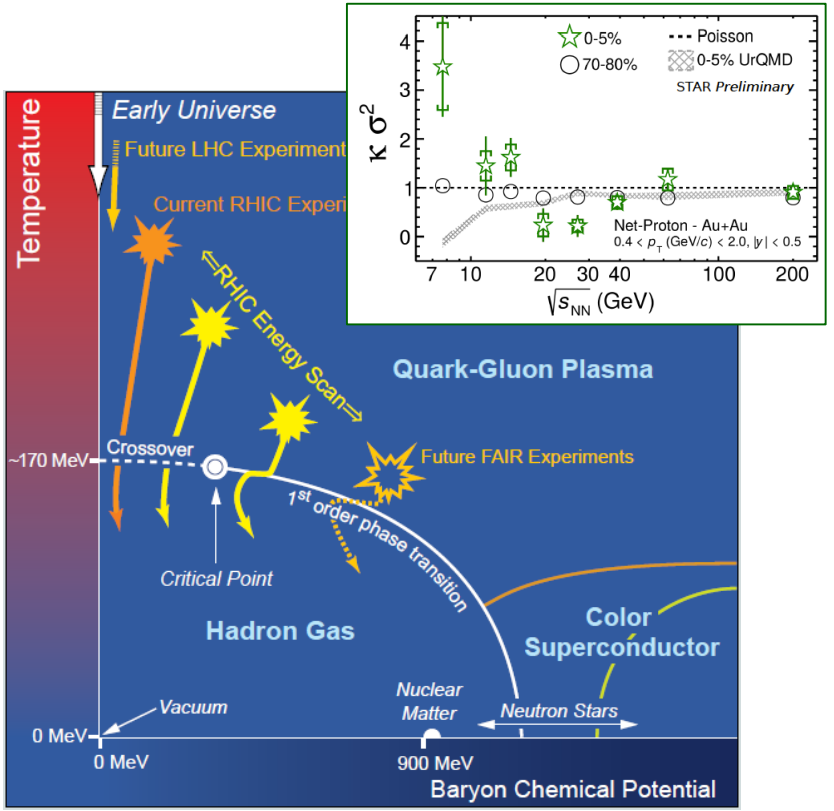
- The current focus at RHIC: search for a critical point between the phases of nuclear matter

LEReC



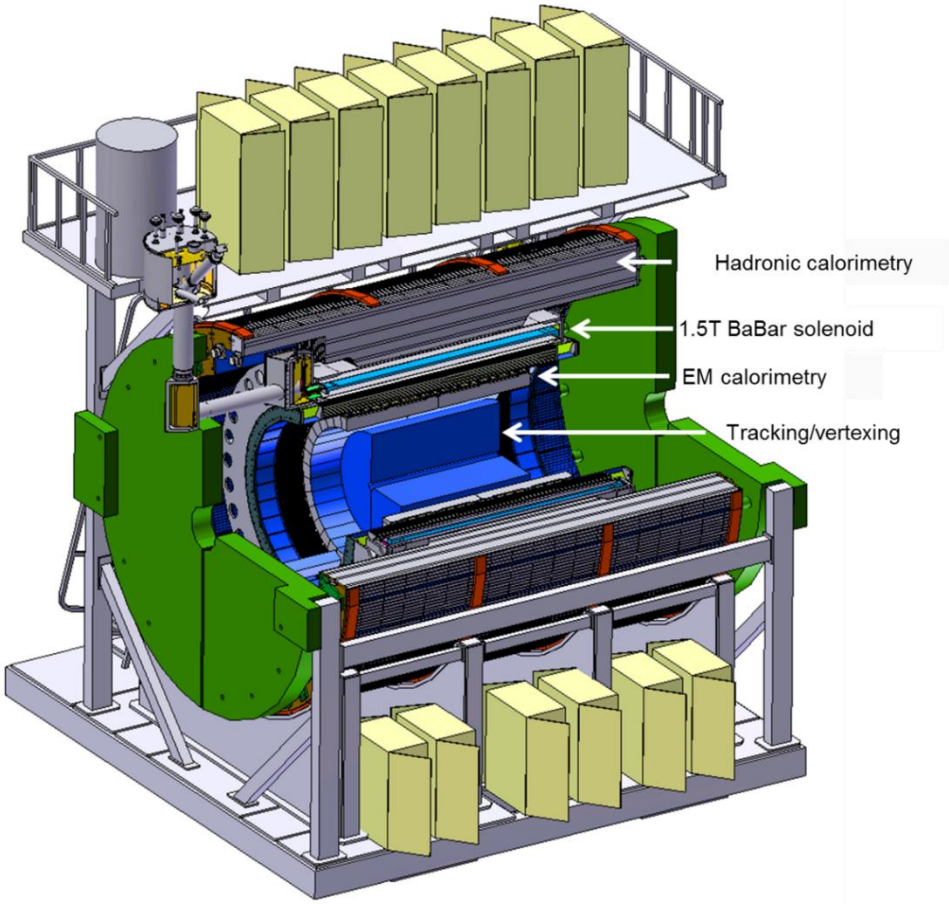
Cooling of low energy, bunched heavy ion beams (3.85–5.75 GeV/n) to increase luminosity

Project on track for 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.

Within Available Funds in FY2020 OMB Request, the sPHENIX Upgrade is Continued



- mapping the character of the hadronic matter under extreme conditions by varying the temperature of the medium, the virtuality of the probe, and the length scale within the medium.
- understanding the parton–medium interactions by studying heavy-flavor jets.
- probing the effect of the quark–gluon plasma on the Upsilon states by comparing the p-p (proton-proton), p-A (proton-nucleus), and A-A (nucleus-nucleus) collisions.

August 16, 2018: CD-1 and CD-3a for long lead procurements

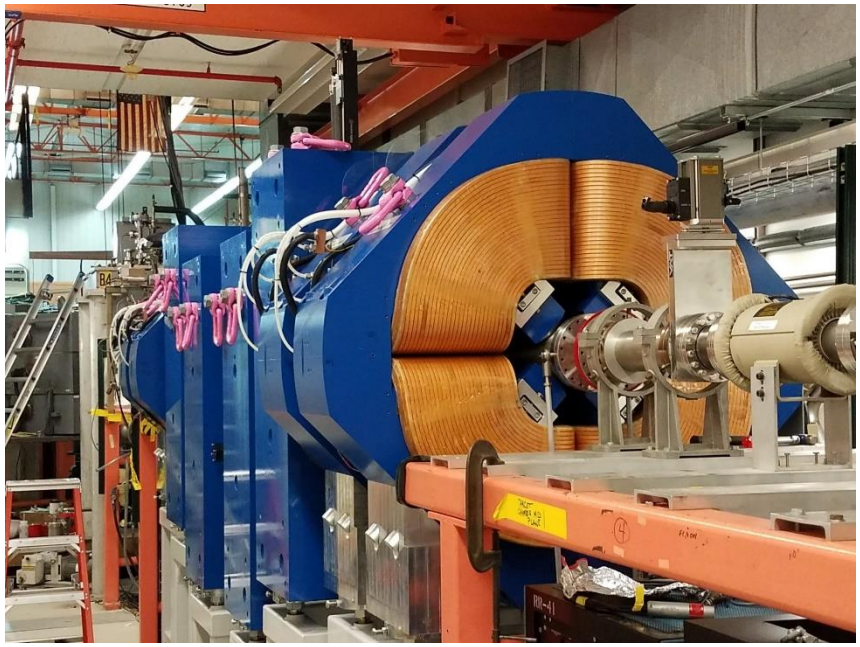
$3M Proposed from within the RHIC base for FY 2020 Request

FY 2020 House and Senate Marks: $9.52M

implemented from within RHIC base by limiting operations to one detector and periodically not operating facility.

Progress at ATLAS

In the six months of operation during 2019, RAISOR delivered seven RIB – 6 for physics measurements, and 1 developmental beam. RAISOR is operating as anticipated, and able to satisfy a wide range of experiments. RAISOR has already expanded the reach of the in-flight program to higher mass regions and elements farther from stability. The continued development and optimization of this system will enable exciting physics for years.



The RAISOR magnets installed at ATLAS

First Observation of the ^{108}Xe-^{104}Te-^{100}Sn Super-Allowed α-Decay Chain

An island of α emitters with Z>50 and N>50 just above ^{100}Sn offers a unique opportunity to study α decay near the N=Z line. In self-conjugate nuclei, protons and neutrons occupy the same orbitals, and it has been proposed that this could result in an enhanced α pre-formation factor leading to relatively faster decay lifetimes compared to the ^{208}Pb region. The previously unmeasured ^{108}Xe-^{104}Te-^{100}Sn α-decay chain consist of candidates for super-allowed α emitters. In a simplified picture, these nuclei can be viewed as a ^{100}Sn core coupled to 1, or 2 α particles, which are kept inside the nucleus by the Coulomb barrier.

Facility for Rare Isotope Beams > 91% Complete and Targeted Commissioning Continues

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

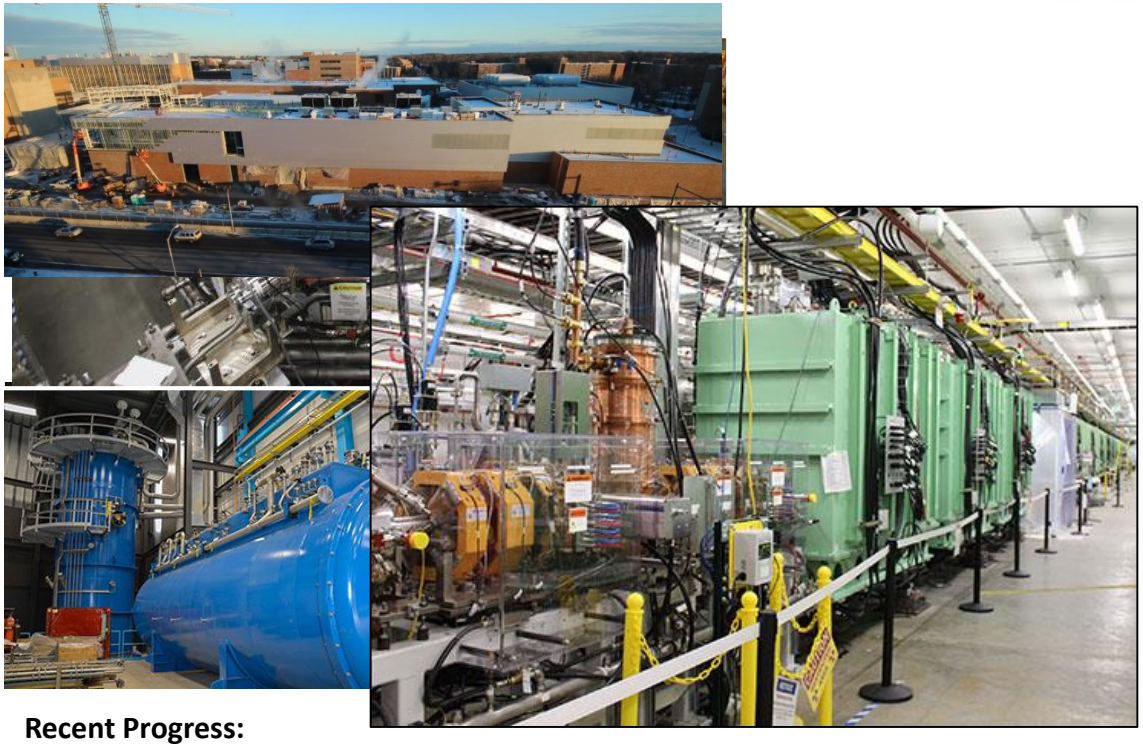
Nuclear Astrophysics

- 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.



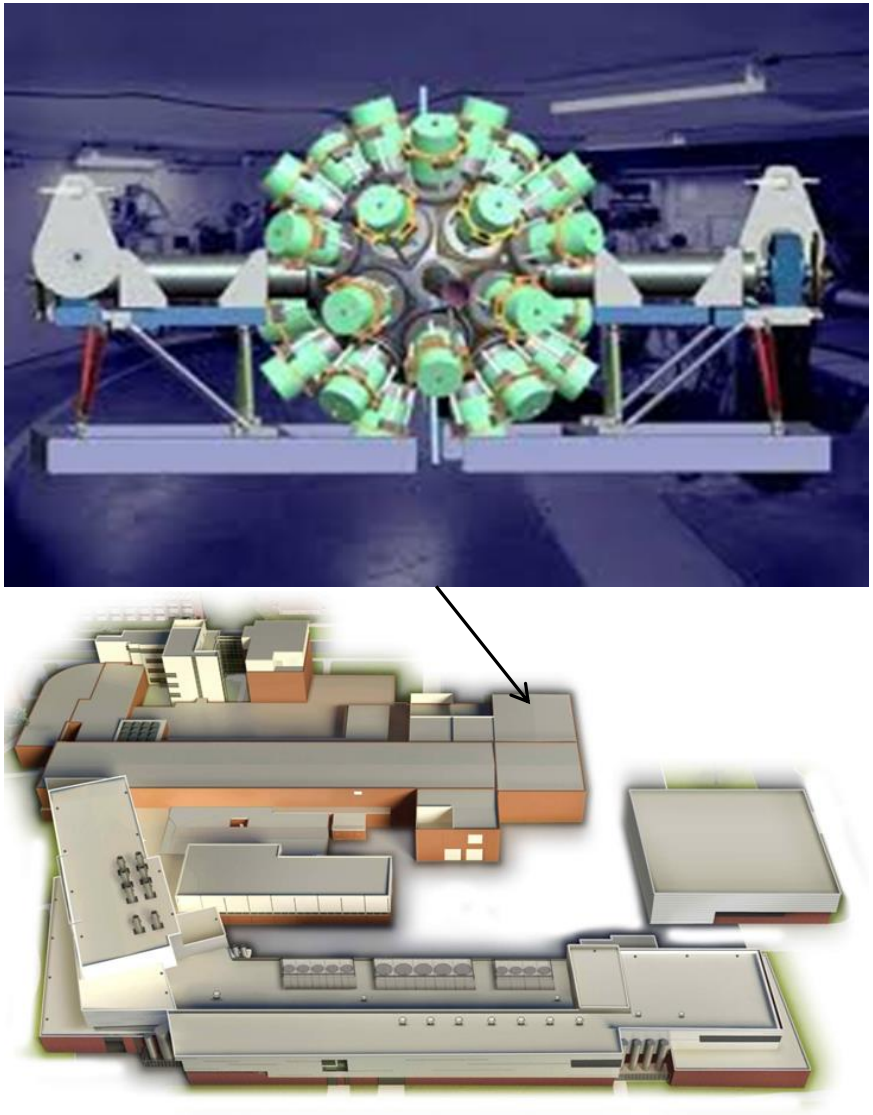
Recent Progress:

- 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.

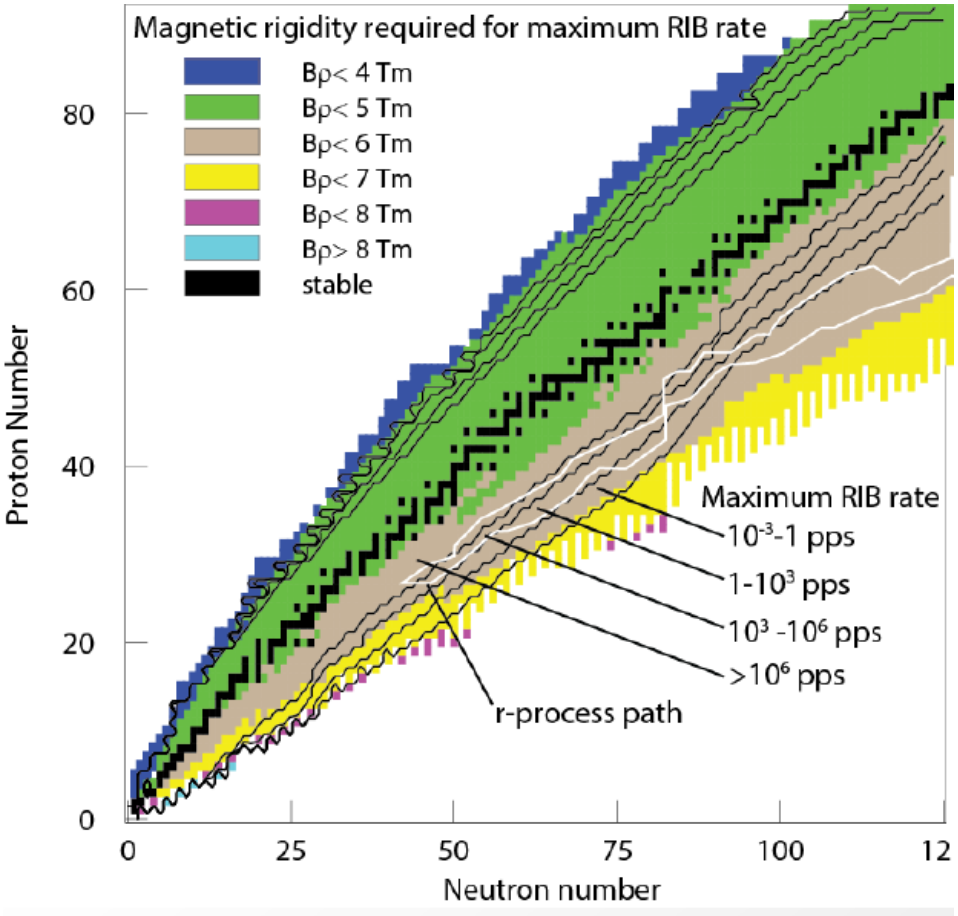
	PYs	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	DOE Total	MSU	TOTAL
FUNDING PROFILE	318,000	100,000	97,200	75,000	40,000	5,300	635,500	94,500	730,000

Fabrication of the Gamma-Ray Energy Tracking Array (GRETA) for FRIB Continues

- Next major OPA review on readiness for CD-2/3 (Approve Performance Baseline and Start of Construction): April 23-25, 2020
- Project ~20% complete based on preliminary project plans.
- Project progressing on track and within costs. Three detectors (out of 18 total) are in various stages of fabrication and all appear on track. Electronic, computing, and mechanical systems are also all progressing well and on track.
- $2.5M included in the FY2020 Request; $10.2M indicated in both the House and Senate Marks
- Est. Total Project Cost: $52M-$65M



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



- CD-0 (Approve Mission Need) received 11/01/2018 with a cost range of $80M to $90M and projected CD-4 (Approve Project Completion) in FY 2026.
- Project being awarded small amount of dollars in FY2019 ($240,000) to support requirements for CD-1 (Approve Alternative Selection and Cost Range).
- Requested FY 2020 funding to initiate the project.
- Anticipating next step is OPA review for CD-1.
- TEC Funding of $1.0M Requested in FY2020; Not referenced in House language; $1.0M identified in the Senate Mark Language.

Supporting the FRIB Theory-Experiment Tango

FRIB-Theory Alliance

- is now a broad-based organization in the low-energy theory community (~180 members). Current annual funding is $720k (this is the third year of the award, up for renewal in 2020). Director: Jorge Piekarewicz, Managing Director: Filomena Nunes.

Bridge positions:

- Two at Washington University at St. Louis in 2018, Saori Pastore (many-body methods and weak interactions) and Maria Piarulli (nuclear forces and many-body methods).
- Offer accepted at North Carolina State: Sebastian Konig (applications of EFT to nuclei and few-body physics)
- A call is out for partner institutions for the next bridge position.

Fellow program:

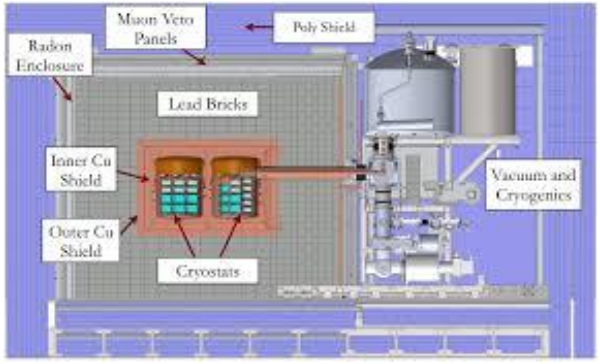
- Currently 3 FRIB Theory Fellows (1 MSU, 1 ARGONNE, 1 LANL); plan to advertise mid-August for an additional 2

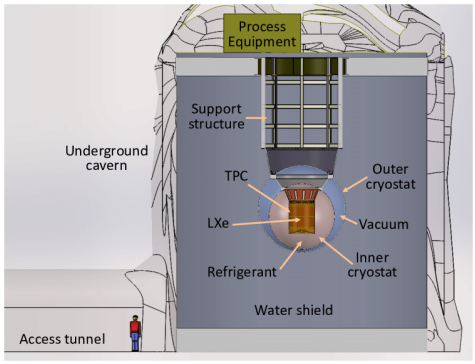
Recent activities:

- Summer school on machine learning
- Topical program on EDMs
- TALENT course on nuclear reaction experiments

Current Status of Ton-Scale 0νββ

- Within DOE, Office of Science, NP is the steward of neutrinoless double beta decay and the ton-scale experiment
- Critical Decision – 0, Mission Need, approved in November 2018
- TEC construction start for a ton-scale 0νββ experiment requested in the FY2020 President's Budget Request. TEC Funding of $1.44M Requested. R&D funding is continuing
- Met on the margins of IUPAP WG9 Meeting in London (8/2019) to discuss possible international collaboration
- Processes for technology down-select and site selection for a 1 ton experiment are under discussion:
  - Three front runner candidate experiments, LEGEND-1000 (Ge-76), CUPID (Mo-100), nEXO (Xe-136).
  - Three current candidate site locations: Gran Sasso (Italy), SNOLAB (Canada) and SURF (U.S)





Ton-scale 0νββ not referenced in the House Mark
$5.0M identified for ton-scale 0νββ in the Senate Mark Language

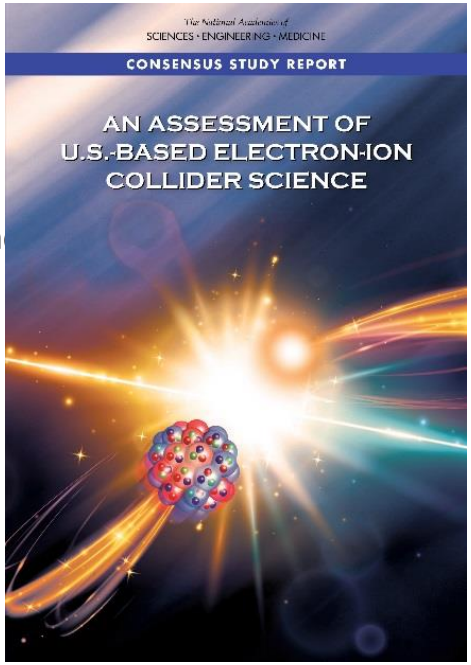
NAS Assessment of a U.S. Based Electron-Ion Collider

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?



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, an 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.

Current Status and Path forward for the EIC

The “wickets” are substantially aligned for a major step forward on the EIC

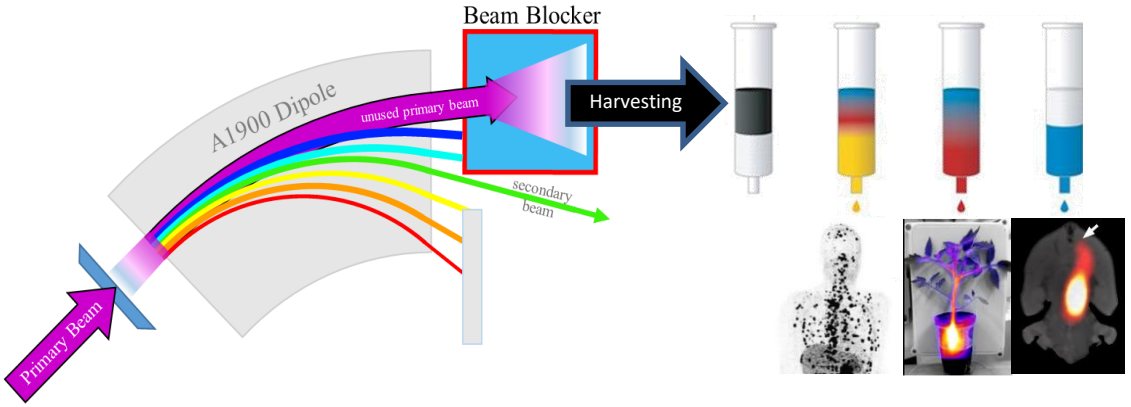
- A Mission Need Statement for an EIC has been approved by DOE
- An Independent Cost Review (ICR) Exercise mandated by DOE rules for projects of the projected scope of the EIC has been completed
- DOE is moving forward towards a request for CD-0 (approve “Mission Need”)
- DOE convened a panel to assess options for siting between two proposed concepts.
- The Deputy Secretary is the Acquisition Executive for this level of DOE Investment
- The FY 2020 President’s Request includes $ 1.5 million OPC. The FY 2020 House Mark identifies $ 10 million OPC and $ 1 million TEC.
  Senate Mark identifies $ 10 million OPC and $ 1 million TEC.

FRIB Isotope Harvesting

- NSCL-scale beam dump for R&D efforts:
  - Beam dump water purification system is tested and ready for routine use.
  - R&D irradiations and processing have successfully extracted ^{47}Ca and ^{76}Kr, parent radionuclides for nuclear medicine generators.
- FRIB beam dump design supports harvesting of isotopes
- Conceptual design complete:
  - Beam dump water and gas processing system
  - Radiochemistry processing hot-cells and infrastructure
- Proposal submitted to DOE-NP
- Isotope program:
  - 3-year design, construction, commissioning period

Towards realization of the 2015 NSAC recommendation:

Infrastructure for isotope harvesting at FRIB – During routine operation for its nuclear physics mission, FRIB will produce a broad variety of isotopes that could be harvested synergistically without interference to the primary user.



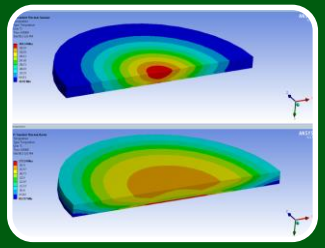
Purifying radionuclides using chemistry instead of magnets

$2M planned in FY2020
Completion Goal: Q4FY22

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.

Senate Mark identifies $30,000,000 for the U.S. Stable Isotope Production and Research Center (SIPRC), and $1,500,000 for the Stable Isotope Production Facility (SIPF)

Potential Areas of Collaboration Between NIH and NP

- Accelerator expertise

  NP technical staff have advanced accelerator expertise developed to optimize operation of NP national user facilities and develop next-generation NP facilities that may be relevant for medical accelerators

- Advanced detectors for imaging

  NP researchers have significant expertise in hyper-polarized gas techniques, detecting the interaction of particles and radiation in matter, including new detection techniques, miniaturization of detectors/electronics, and low counting/background applications

- Expertise in image reconstruction

  NP researchers have mathematical and computational backgrounds that lend themselves to solving complex image reconstruction challenges

- Expertise in storage/mining of big data

  NP supported research regularly requires manipulation and mining of large complex data sets, much of it accomplished remotely over the internet

- Expertise in pattern recognition via AI/ML

  NP researchers “fish” patterns out of highly complex environments using AI/ML

- Expertise in systems optimization via AI/ML

  NP Technical staff have growing experience in applying AI/ML to optimize operation of complex accelerator systems in real time

Early 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 MgF2

FY 2018 Awards Made Through Annual Solicitation

Quantum Information Science

- EOP and Legislative Priority
  - National Quantum Initiative Act Public Law 115-368
- Cuts across all SC research programs, including DOE Isotope Program
- Cuts across several other DOE programs
  - OE and NNSA
- QIS funded in FY 2018 ($62M) and FY 2019 ($123M)
- FY 2020 proposal would focus on establishment of at least one DOE quantum center, budget request - $168.5M

DOE NP FY 2019 Funding for QIS: $6.8M Peer Review in Progress for Proposals in Response to FY 2019 FOA

Machine Learning / Artificial Intelligence

- Executive Office of the President (EOP) Priority
  - Major U.S. Government initiative is in planning stage
- Cuts across SC programs
  - ASCR, BES, BER, FES, and HEP
- Cuts across many DOE programs
  - OE, EE, FE, NE, NNSA
- Cuts across multiple U.S. Government Agencies, including NIH, DoD, and VA
- FY 2020 SC request - $71M
  - patterned after the Exascale Computing Project

FY2019 SC NP ECA Awards

PI Name	Institution	Proposal Title
Broussard, Leah	Oak Ridge National Laboratory (ORNL	Systematics of Precision Neutron Physics Experiments
Palczewski, Ari	Thomas Jefferson National Accelerator Facility (TJNAF),	Developing the surface engineering basis for next-generation SRF accelerators
Saldanha, Richard	Pacific Northwest National Laboratory (PNNL)	Enhancing the Discovery Potential of the nEXO Neutrinoless Double Beta Decay Experiment
Constantinou, Martha	Temple University	EIC physics from Lattice QCD
Davoudi, Zohreh	University of Maryland	Analog and Digital Quantum Simulations of Strongly Interacting Theories for Applications in Nuclear Physics
Foucart, Francois	University of New Hampshire	Nuclear Astrophysics through simulations of neutron star mergers using Monte-Carlo neutrino radiation transport
Hen, Or	Massachusetts Institute of Technology	Study of Short-Range Correlations in Nuclei Using Electro-induced Nucleon-knockout Reactions at High Momentum-Transfer
Zhang, Jiehang	New York University, New York, NY	Exploring Quantum Many-body Physics with a Trapped Ion Quantum Information Processor

Comments and Items of Interest

- Peer review for FY2019 QIS FOA underway. FY 2020 FOA is planned. The NSAC subpanel report on QIS/QC will be presented today at the NSAC meeting, October 18, 2019. There have been some notional discussions of a “Town-Meeting” to get the NP community organized to respond to potential opportunities.

- Peer review for FY2019 Inter-Agency Nuclear Data FOA underway’ FY2020 FOA is possible

- SC is coordinating with its communities to “organize interest” in the Fed related to making Machine Learning and Artificial Intelligence a priority initiative. On a related note, JLAB will be organizing a community wide workshop on this topic.

- NP is also attempting to ensure NP involvement in the micro-electronics priority initiative.

- Four new program managers have joined NP: Paul Sorensen for Fundamental Symmetries; Sharon Stephenson for Nuclear Structure and Nuclear Astrophysics’ Arne Freyberger for Isotope Accelerator Facilities; Jon Neuhoff for Isotope Reactor Facilities

Comments and Items of Interest

- Despite a great deal of “movement” at a number of levels, things in DOE NP are generally progressing
- Although the recommended bottom lines for DOE NP add very significant resources, the language in the marks leads to constraints which will impact the core program.
- The “word on the street” is that the two houses of Congress are striving to pass the Energy & Water Bill early. What will ultimately happen is anyone’s guess and it includes all possibilities from early passage of a bill to a government shutdown and everything in-between.
- Isotope initiatives continue to be a very high priority generally.
- The Office of Science continues to intensify focus and emphasis on D&I
- The first ever “Distinguished Scientist” awards, a new recognition by SC, have been publicly announced. In the first-ever cohort, Barbara Jacak is an award recipient from the nuclear science community.
- Next DOE NP COV will be convened December 9-11, 2019. Filomena Nunes, Chair.

The SC microsite on Diversity, Equity & Inclusion now posted on the SC website.

The direct link is:

https://science.energy.gov/sc-2/research-and-conduct-policies/diversity-equity-and-inclusion/

"The DOE Office of Science (SC) is fully committed to fostering safe, diverse, equitable, and inclusive work, research, and funding environments that value mutual respect and personal integrity. Effective stewardship and promotion of diverse and inclusive workplaces that value and celebrate a diversity of people, ideas, cultures, and educational backgrounds is foundational to delivering on the SC mission. The scientific community engaged in SC-sponsored activities is expected to be respectful, ethical, and professional.

The DOE SC does not tolerate discrimination or harassment of any kind, including sexual or non-sexual harassment, bullying, intimidation, violence, threats of violence, retaliation, or other disruptive behavior in the federal workplace, including DOE field site offices, or at national laboratories, scientific user facilities, academic institutions, other institutions that we fund, or other locations where activities that we support are carried out…"

Harassment

Harassment of any kind, including sexual and non-sexual harassment, bullying, intimidation, violence, threats of violence, retaliation, or other disruptive behavior is not tolerated in the federal workplace, including Department of Energy (DOE) site offices, or at DOE national laboratories, scientific user facilities, academic institutions, other institutions receiving Office of Science funding, or at locations where activities are funded by the DOE Office of Science.

Harassment includes any unwelcome conduct or reprisal (verbal, written, or physical) that is based on an individual's race, color, sex (including pregnancy, gender identity, and sexual orientation), religion, national origin, age, disability (physical or mental), genetic information, or participation in protected equal employment opportunity (EEO) activities including reporting allegations of harassment or providing information related to harassment allegations.

Harassing behaviors include any unwelcome conduct that: (1) has the purpose or effect of unreasonably interfering with an employee's work performance; (2) creates an intimidating, hostile, or offensive work environment; or (3) affects an employee's employment opportunities or compensation.

Sexual harassment is any unwelcome behavior of a sexual nature including, but not limited to, unwelcome sexual advances, requests for sexual favors (i.e., sexual coercion, including quid pro quo), physical conduct of a sexual nature, or other similar behavior. Sexual harassment also includes verbal and nonverbal behaviors that convey hostility, objectification, exclusion, or second-class status about members of a particular gender (e.g., gender harassment) (NAS 2018). Sexual harassment, like non-sexual harassment, is not always obvious and often subtle.

General Outlook

- The experience with FY18 and FY19 budgets has required readiness for big swings in the budget. FY2020 may be similar.

- 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