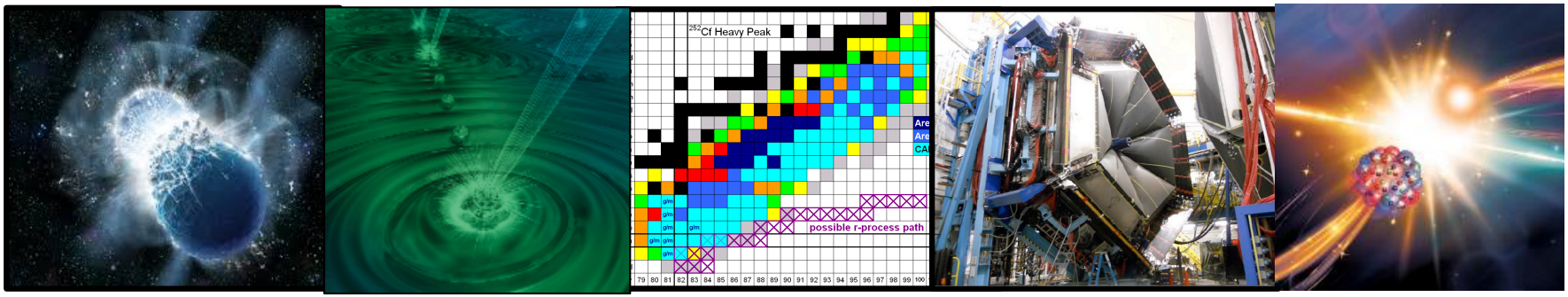
U.S. DEPARTMENT OF ENERGY | Office of Science

Perspectives from DOE Nuclear Physics (NP)

JLAB User Meeting
June 22, 2020

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



Interesting Times

A lot has happened in the last little while !

- FY 2020 Appropriation — December 2019
- EIC CD0 — December 2019
- EIC Site Selection — January 2020
- FY 2021 President's Request — February 2020
- COVID 19 Decampment — March 2020
- SC Reorganization — April 12, 2020

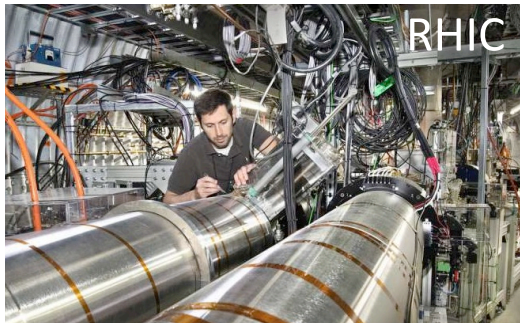
Nuclear Physics "As Appropriated" FY2020 Budget Status

Nuclear Physics	FY 2019 Enacted	FY2020 Enacted
Operations and maintenance		
Medium Energy	184,994	189,089
TJNAF Ops	*118,440*	*123,610*
Heavy Ions	227,625	232,362
RHIC Ops	*191,771*	*195,151*
Low Energy	101,896	127,037
ATLAS Ops	*22,746*	*22,839*
FRIB Ops	*3,950*	*28,500*
Nuclear Theory	56,226	52,012
Isotope Program	44,259	49,500
EIC OPC Funding	-	10,000
Total, Operations and maintenance	**615,000**	**660,000**
Construction		
14-SC-50 Facility for Rare Isotope Beams	75,000	40,000
21-SC-52, Electron Ion Collider	-	1,000
20-SC-51, U.S. Stable Isotope Production and Research Center	-	12,000
Total, Construction	**75,000**	**53,000**
Total, Nuclear Physics	**690,000**	**713,000**

Enacted Appropriation: $713,000,000 for NP. Directs $28,500,000 for FRIB operations. Also directs optimal funding for operations, major items of equipment, and other project costs. $1,000,000 provided for the first year of EIC TEC funds, $12,000,000 for the first year of US SIPRC TEC funds, and $40,000,000 for FRIB Construction funds.

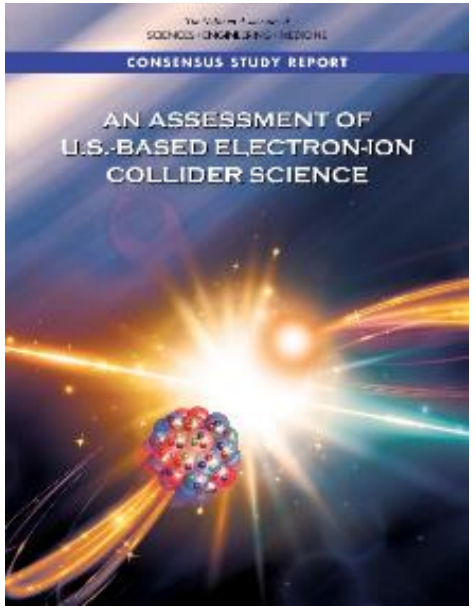
IP and NP Budgets will be completely separate in the FY 2022 Request

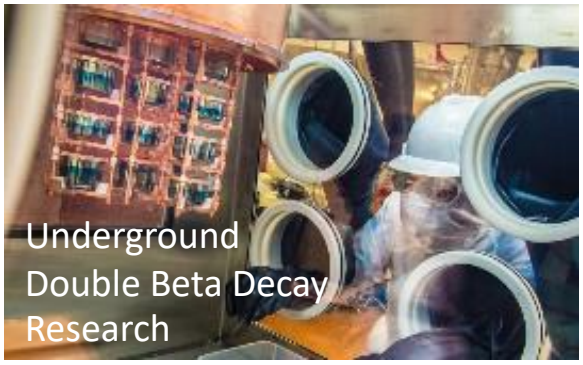
From “Forty-Thousand Feet” Things Look Good



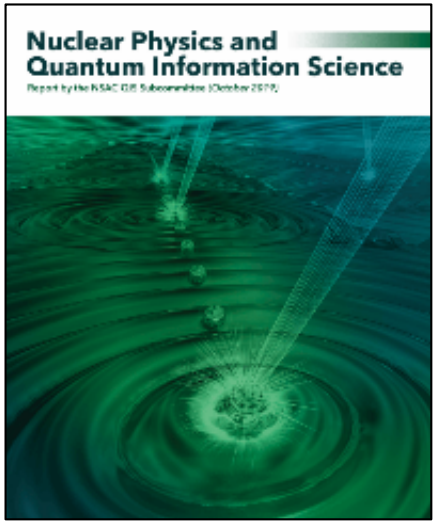
World leading research supported at state-of-the-art NP National User Facilities

The vision to maintain U.S. leadership continues to be implemented: EIC construction; FRIB construction





Pioneering experiments and research tools (MIEs) are created



Groundbreaking contributions to national cross-cutting priorities continue

Zooming In Closer....

The FY2020 Appropriation occasions both exciting new prospects and significant challenges. One of the challenges is that once directed steps are taken (facility ops, new starts, construction), the remaining budget for research is reduced by ≈ 5.5% . The Research Division Program Managers have worked diligently to mitigate the most negative immediate impacts of this reduction for FY 2020.

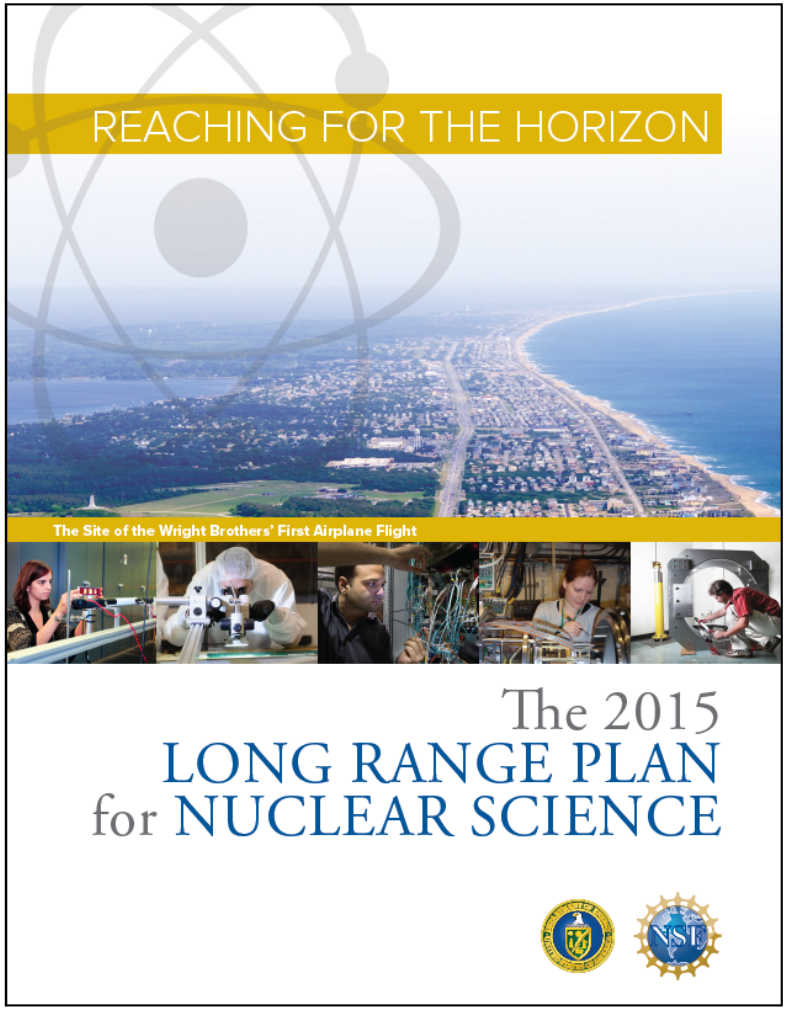
The biggest impact so far has been loss of flexibility to fund new proposals.

This continues a concerning trend of erosion of support for core research

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. ✓

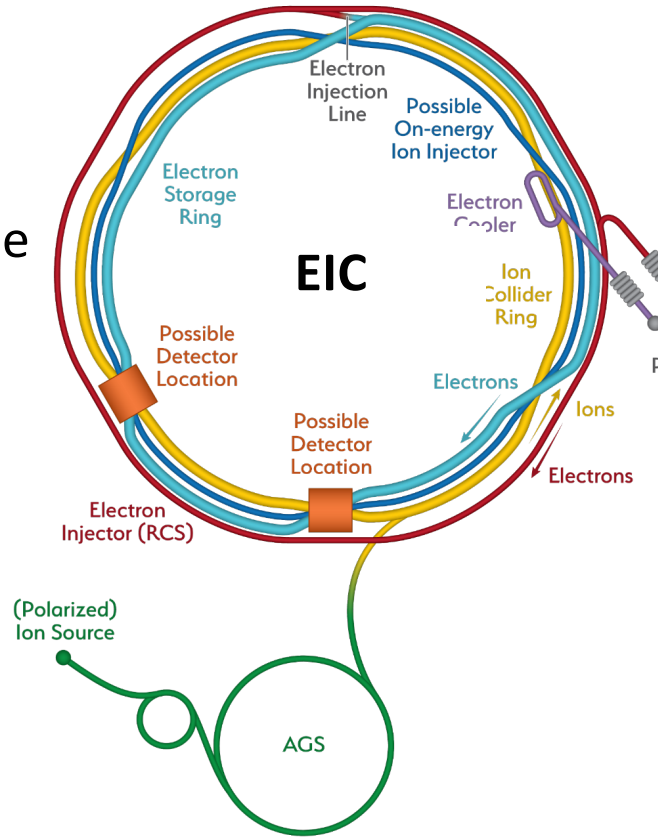


NP continues to execute on the 2015 LRP Vision

EIC Receives CD0 and Will be Sited at BNL

An SC "Prime Directive": The Project will be carried out as a full intellectual partnership between the BNL and JLAB teams (and other collaborators) with major participation by all

- TPC range of EIC is $1.6B – $2.6B; complete early next decade
- TPC and completion of project dependent upon congressional appropriation and final agreed upon scope when baselined
- Magnitude of reprioritized funds ranges from ~$0.6B – $1.2B over the lifetime of the project.
- Reprioritization of activities towards the EIC also decreases the amount of new funding required
- The EIC could be implemented with caps on amount of new funds needed on an annual basis and still be implemented successfully and in a timely manner.



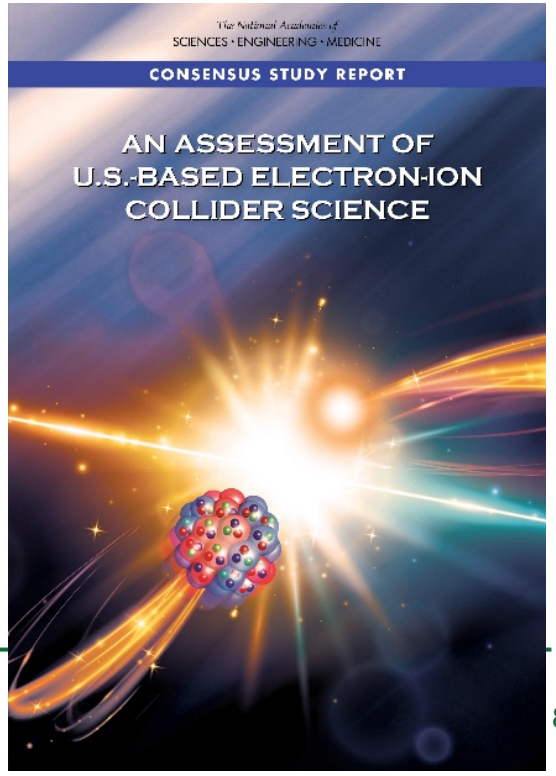
NAS Assessment of a U.S. Based Electron-Ion Collider

"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? "

" An EIC would be a unique facility in the world and would maintain leadership in nuclear physics."

" An EIC would maintain leadership in the accelerator science and technology of colliders and help to maintain scientific leadership more broadly."

The NAS EIC study and the extensive, comprehensive rollout to stakeholders which ensued was absolutely central to stakeholder acceptance of the necessity of this groundbreaking accelerator for the nation. The independence of the study was key.



FY 2021 SC President's Budget Request

(Dollars in Thousands)

	FY 2019		FY 2020	FY 2021 President's Request		
	Enacted Approp.	Current Approp.	Enacted Approp.	President's Request	President's Request vs. FY 2020 Enacted	
Office of Science						
Advanced Scientific Computing Research	935,500	910,031	980,000	988,051	+8,051	+0.8%
Basic Energy Sciences	2,166,000	2,105,873	2,213,000	1,935,673	-277,327	-12.5%
Biological and Environmental Research	705,000	680,246	750,000	516,934	-233,066	-31.1%
Fusion Energy Sciences	564,000	549,181	671,000	425,151	-245,849	-36.6%
High Energy Physics	980,000	955,905	1,045,000	818,131	-226,869	-21.7%
Nuclear Physics	690,000	669,888	713,000	653,327	-59,673	-8.4%
Workforce Development for Teachers and Scientists	22,500	22,500	28,000	20,500	-7,500	-26.8%
Science Laboratories Infrastructure	232,890	232,890	301,000	174,110	-126,890	-42.2%
Safeguards and Security	106,110	106,110	112,700	115,623	+2,923	+2.6%
Program Direction	183,000	183,000	186,300	190,306	+4,006	+2.2%
SBIR/STTR (SC)		169,376	...	...	...	...
Total Budget Authority and Obligations, Office of Science	**6,585,000**	**6,585,000**	**7,000,000**	**5,837,806**	**-1,162,194**	**-16.6%**
SBIR/STTR (DOE)	...	123,254	...	...	...	...
Total, Office of Science	**6,585,000**	**6,708,254**	**7,000,000**	**5,837,806**	**-1,162,194**	**-16.6%**

The experience with FY18 —FY20 budgets maybe similar in the next budget cycle: significant uncertainty will persist for much of the fiscal year

NP FY 2021 President's Request

(Dollars in thousands)

Office of Nuclear Physics	FY 2019	FY 2020	FY 2021 President's Request		
	Enacted	Enacted	President's Request	President's Request vs. FY 2020 Enacted	
Medium Energy Nuclear Physics					
Research	43,508	41,454	35,500	-5,954	-14.4%
Operations	118,440	123,610	118,000	-5,610	-4.5%
Other Research	2,934	3,467	2,800	-667	-19.2%
SBIR/STTR	20,112	20,858	19,438	-1,420	-6.8%
Total, Medium Energy Nuclear Physics	**184,994**	**189,389**	**175,738**	**-13,651**	**-7.2%**
Heavy Ion Nuclear Physics					
Research	35,854	37,211	31,508	-5,703	-15.3%
Operations	191,771	195,151	194,928	-223	-0.1%
Total, Heavy Ion Nuclear Physics	**227,625**	**232,362**	**226,436**	**-5,926**	**-2.6%**
Low Energy Nuclear Physics					
Research	70,565	70,698	60,636	-10,062	-14.2%
Operations	31,331	56,039	50,241	-5,798	-10.3%
Total, Low Energy Nuclear Physics	**101,896**	**126,737**	**110,877**	**-15,860**	**-12.5%**
Nuclear Theory					
Theory Research	47,345	43,062	46,750	+3,688	+8.6%
Nuclear Data	8,881	8,950	7,726	-1,224	-13.7%
EIC OPC Funding	-	10,000	1,500	-8,500	-85.%
Tota, Nuclear Theory	**56,226**	**62,012**	**55,976**	**-6,036**	**-9.7%**
Isotope Development and Production for Research Applications					
Research	9,808	11,500	22,000	+10,500	+91.3%
Operations	34,451	38,000	44,000	+6,000	+15.8%
Total, Isotope Production and Applications	**44,259**	**49,500**	**66,000**	**+16,500**	**+33.3%**
Subtotal, NP	**615,000**	**660,000**	**635,027**	**-24,973**	**-3.8%**
Construction					
14-SC-50 Facility for Rare Isotope Beams	75,000	40,000	5,300	-34,700	-86.8%
20-SC-51, U.S. Stable Isotope Production and Research Center	-	12,000	12,000	-	-
21-SC-52, Electron Ion Collider	-	1,000	1,000	-	-
Total, Construction	**75,000**	**53,000**	**18,300**	**-34,700**	**-65.5%**
Total, Nuclear Physics	**690,000**	**713,000**	**653,327**	**-59,673**	**-8.4%**

Summary of 2021 NP Changes Relative to FY 2020

FY 2020 Enacted	FY 2021 President's Request
Core Research reduced 5.5% from FY19 Enacted (including COL, this is an 8.3% cut from constant effort in FY19). New ECA awards are made.	**Core research** reduced 10.6% from FY20 Enacted. (including COL, this is a 13.2% cut from FY20 constant effort and a 20.4% cut from FY19 constant effort.) This reduction also includes the elimination of new ECA awards in FY21.
LHC M&O commitments met.	**LHC M&O** commitments delayed until FY 2022.
FRIB Research supported as planned.	**FRIB Research** ramping is slowed down relative to plans.
nEDM supported modestly below planned profile.	**nEDM** supported significantly below planned profile, possibly impacting schedule.
SciDAC maintained relative to FY 2019	**SciDAC** maintained relative to FY 2020
Nuclear Data held flat with FY19 Enacted	**Nuclear Data** decreased 12.2% from FY20 Enacted
QIS at $10.3M (a $2M increase in IP QIS, NP QIS flat)	**QIS** at $13M (NP QIS increases 2.7M, IP QIS is flat)
Accelerator R&D is increased	**Accelerator R&D** is cut 15.5% from FY19 enacted levels
	New Accelerator Strategic Initiative (+1M)
-	**New ML/AI Initiative** ($4M)

Summary of 2021 NP Changes Relative to FY 2020

FY 2020 Enacted	FY 2021 President's Request
Facility operations at constant effort - **RHIC** operates 28 weeks (100 % optimal) - **CEBAF** operates 22.5 weeks (100 % maximum) - **ATLAS** operates 41 weeks (90 % optimal)	**Facilities operations** at constant effort - **RHIC** operates 20 weeks (100 % (70%) maximum) - **CEBAF** operates 23 weeks (68 % optimal) - **ATLAS** operates 20 weeks (44 % optimal)
FRIB operations supported at planned level $28.5M	**FRIB ops** supported below planned levels ($25.6 vs 59.8M)
FRIB construction at baselined $40M	**FRIB construction** at baselined $5.3M
EIC construction at TEC of $1M and OPC of $10M	**EIC construction** at TEC of $1M and OPC of $1.5M
Ongoing Major Item of Equipment: - **GRETA** reduced below planned levels ($6.6M) - **sPHENIX** at planned baseline level ($9.52M) - **SIPF** at planned baseline level ($1.5M)	**Ongoing Major Item of Equipment:** - **GRETA** below planned levels ($2.5M) - **sPHENIX** below baseline level ($3M)
New Major Items of Equipment initiated - **MOLLER** at $2M TEC - **TSNLDBD** at $1M TEC - **HRS** at $1M TEC	**Major Items of Equipment initiated in FY 2020** - **MOLLER** reduced to $300k TEC - **TSNLDBD** at $1.44M TEC - **HRS** at $1M TEC

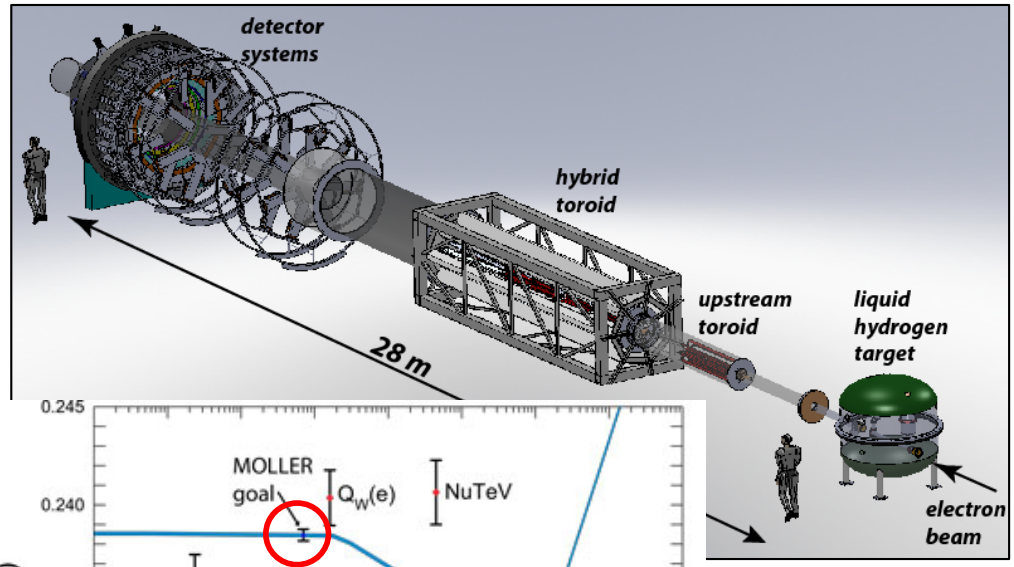
Marks may happen in June-July time frame

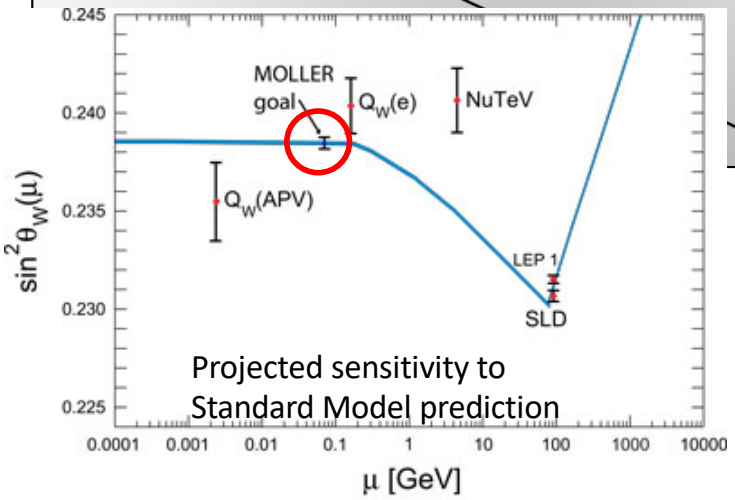
General Outlook on FY 20201 President's Request

- The experience with FY18, FY19 and FY20 budgets has required readiness for big swings in the budget. FY2021 is 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!

MOLLER: 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.

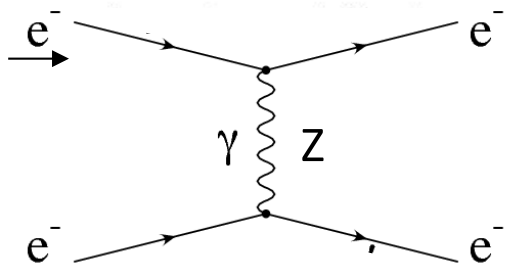




Projected sensitivity to Standard Model prediction

parity-violating Moller scattering

$\vec{e} + e \rightarrow e + e$

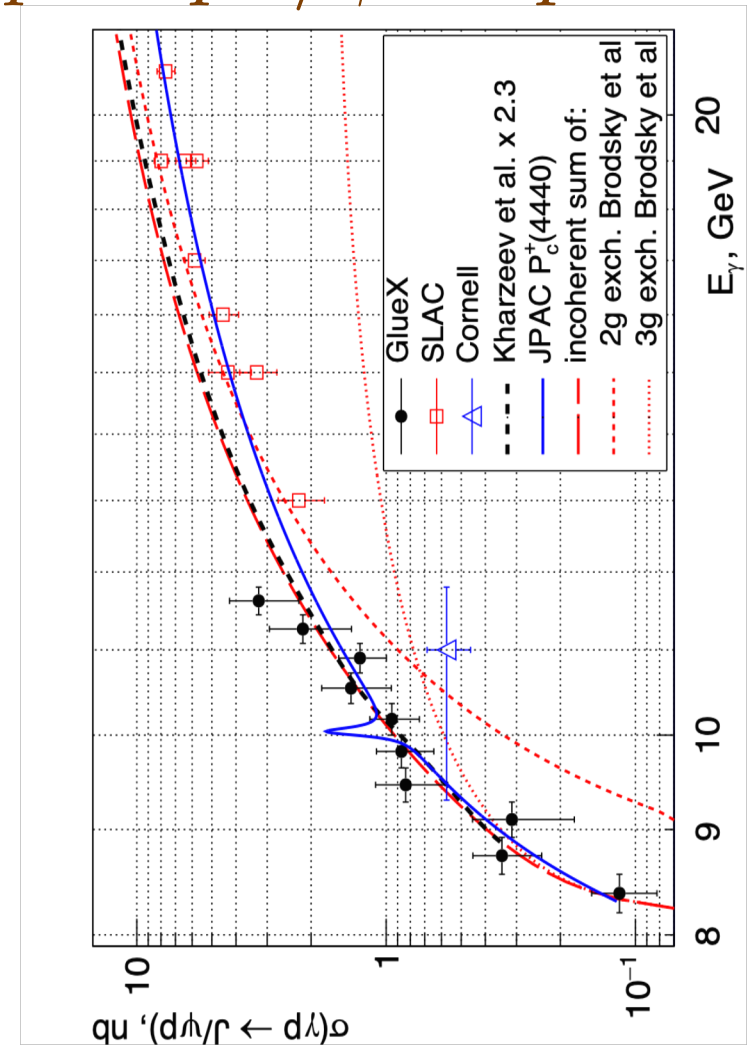


In MOLLER, polarized electrons are scattered of unpolarized electrons. The amount of parity violation due to interference of the two possible exchange mechanisms (γ or Z) is precisely predictable in QED. (No messy quarks or color charge, or QCD to worry about, only quantum electrodynamics). The theory 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 Enacted: $2M

12 GeV CEBAF Science Program is Underway

$$\gamma p \rightarrow pJ/\psi \rightarrow pe^+e^-$$



New results from GlueX illuminate the mechanism of threshold J/Psi production and the upper limit on the pentaquark. The latter provides constraints on the structure of the LHCb pentaquark, favoring a molecular description.

Phys. Rev. Lett. 123, 072001(2019)

(Based on ~25% of collected data.)

Facility for Rare Isotope Beams is > 93% 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

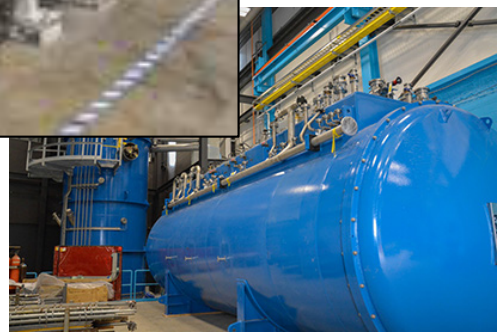
Nuclear Astrophysics

- 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.

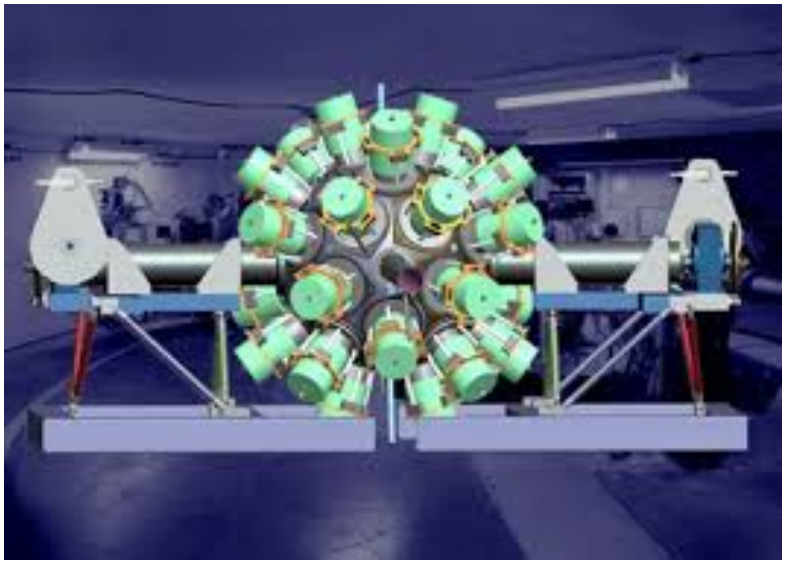


The FY 2021 Request supports:

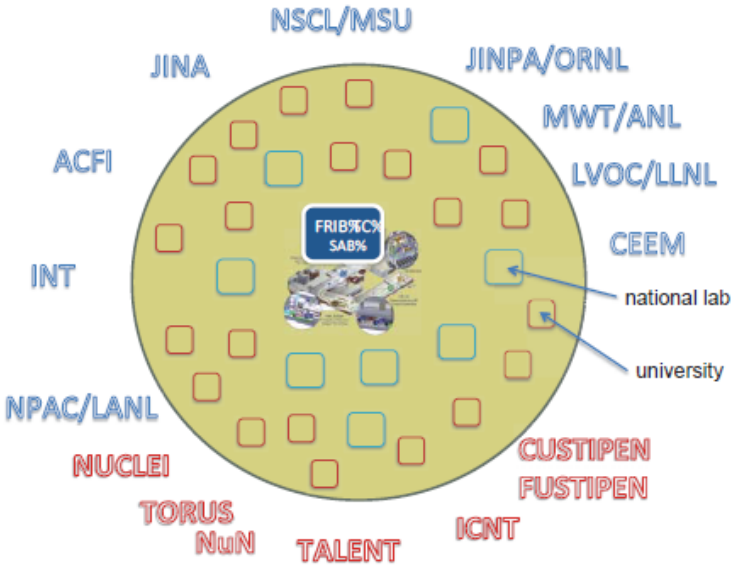
- Completed fabrication and assembly of the linear accelerator (linac) cryomodule, allowing continued installation and testing in the constructed tunnel.
- Fabrication, assembly, installation and testing of the experimental systems, and the commissioning of the linac and other components.

	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

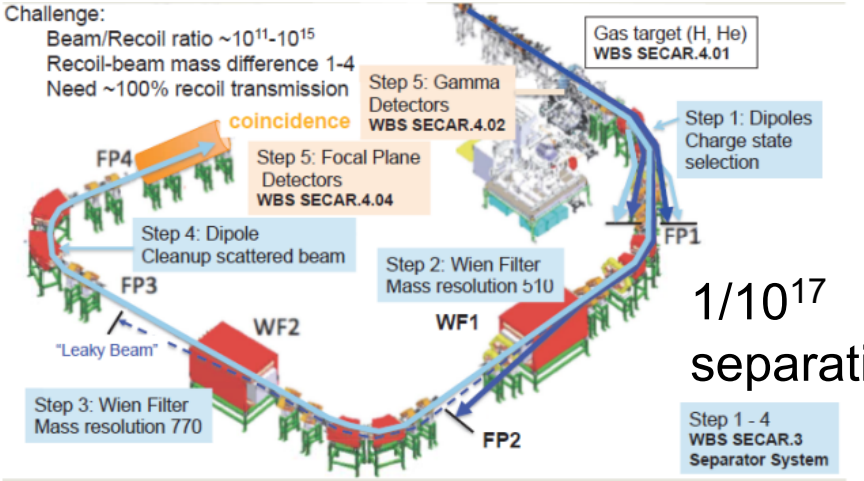
FRIB Instrumentation/Theory Effort Are Underway



GRETA CD3a 8/2018

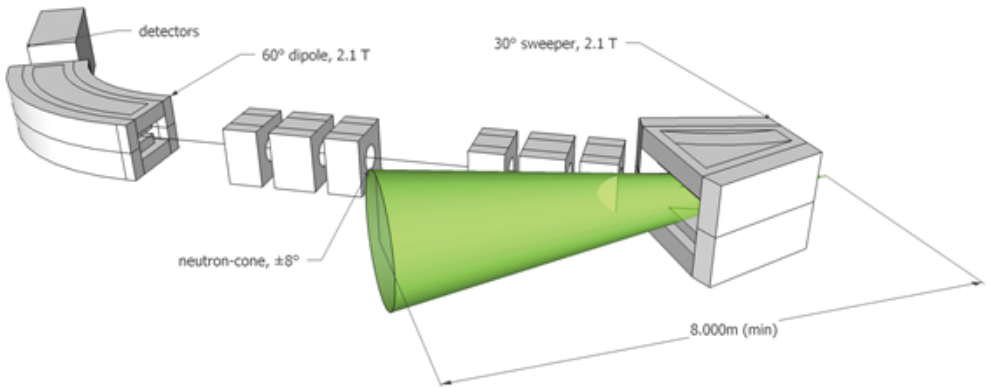


FRIB Theory Alliance



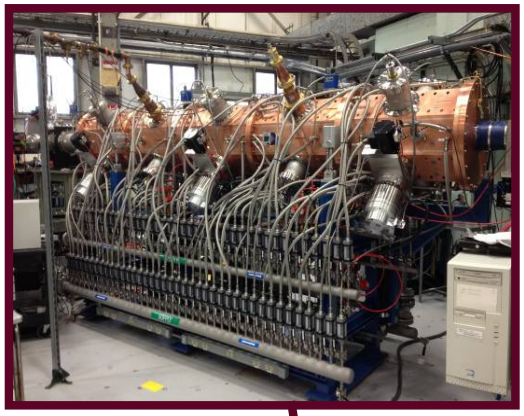
$1/10^{17}$ separation

SECAR Complete FY20/21



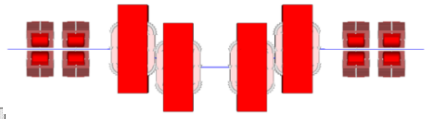
High Rigidity Spectrometer (HRS)

ATLAS Continues as a Premier Stable Beam Facility



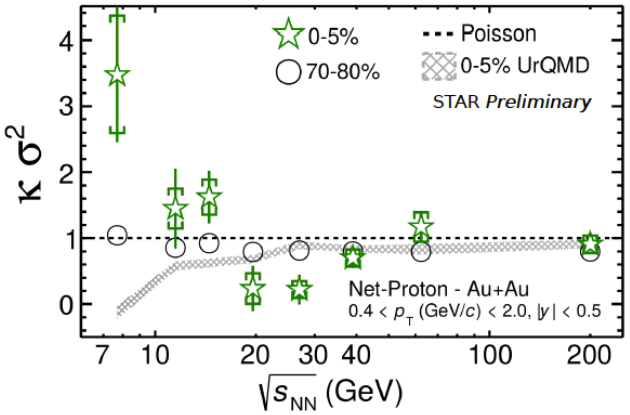
ATLAS is a unique premier Stable Beam Facility for research on Nuclear Structure & Nuclear Astrophysics

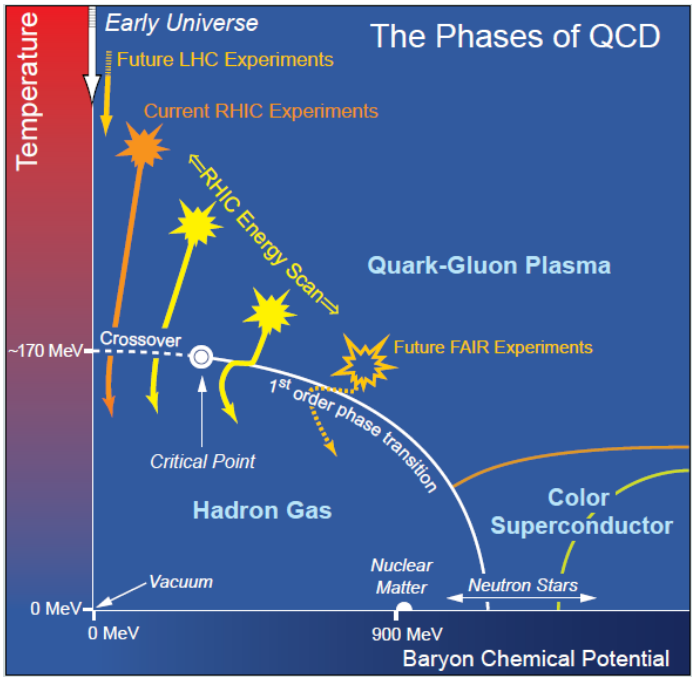
Multi-User Upgrade AIP Planned



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





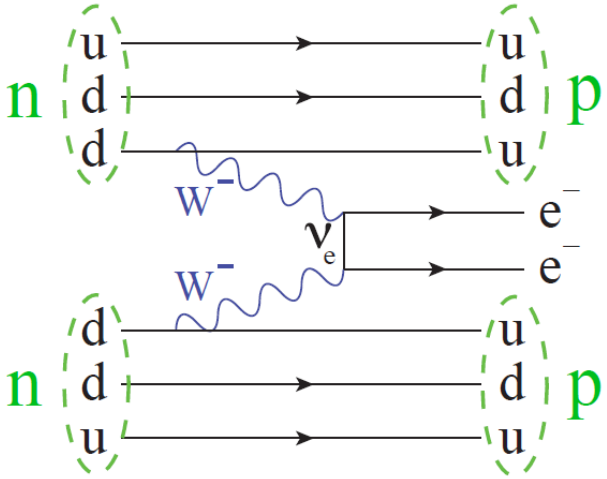
A primary signature of the Critical Point: non-Poissonian scaled kurtosis (net baryon number fluctuations)

- RHIC has 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.

The Campaign to Determine the Fundamental Nature of the Neutrino

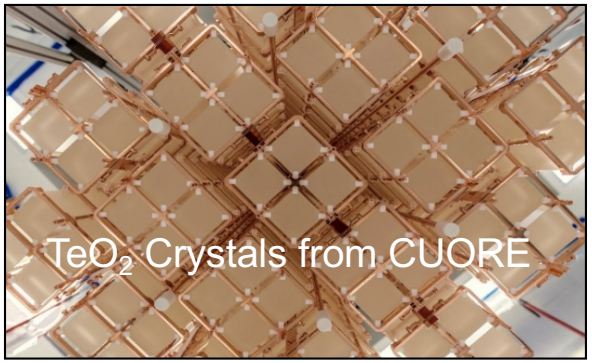
How can it be determined whether the neutrino is a Majorana Particle?

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

FY 2020 Enacted: $1M

Office of Science Continuing Research Initiatives

- Machine Learning/Artificial Intelligence
- Bio (security, materials, manufacturing)
- Quantum Information Science - includes quantum sensing, computing, networking, and isotope production
- Exascale Computing
- Microelectronics Innovation
- National Isotopes Strategy
- U.S. Fusion Program Acceleration

Jefferson Lab On the Move

Workshop on AI for Nuclear Physics

Announcement of the creation of a new Computational Science Division

Joint SC-NIH Workshop November 9 2020,

A cross-cutting FOA lab call on AI was released in FY2020

Latest SCGSR NP Applicants

First Name	Last Name	Current Graduate Institution	Primary Graduate Thesis Advisor	Graduate Thesis Title	Research Proposal Title	Scientific User Facility
David	Mathews	University of Kentucky / Physics and Astronomy / Nuclear Physics	Christopher Crawford / University of Kentucky / Physics and Astronomy /	GPU algorithms for particle detection and tracking in low energy neutron experiments	Utilizing GPUs for High-Performance Data Analysis and Simulations	Spallation Neutron Source (SNS) Pending Proposal?: No Access Secured?: Yes
Jaclyn	Schmitt	Michigan State University / Physics and Astronomy / Nuclear Physics	Remco Zegers / Michigan State University / Physics and Astronomy	Probing Spin-Isospin Excitations in Proton-Rich Nuclei via the (p,n) Charge-Exchange Reaction	Digital Filter Algorithm for Dark Count Rate Reduction in Silicon Photomultipliers	High Flux Isotope Reactor (HFIR) Pending Proposal?: Yes Access Secured?: Yes
Casey	Morean	University of Tennessee, Knoxville / Physics / Nuclear Physics (5/2023 - Semester: 5.51)	Nadia Fomin / University of Tennessee, Knoxville / Physics / Associate	Short Range Correlation measurements in the quasielastic region with an 11 GeV beam	Short Range Correlation measurements in the quasielastic region with an 11 GeV beam	Continuous Electron Beam Accelerator Facility (CEBAF) Pending Proposal?: No Access Secured?: Yes
Sean	Jeffas	University of Virginia / Physics / Physics	Nilanga Liyanage / University of Virginia / Physics	Measurement of the Neutron Electromagnetic Form Factor Ratio GEn/GMn at High Q-squared	Gas Electron Multiplier Testing and Instllation in the Super BigBite Spectrometer	None
John	Boyd	University of Virginia / Physics / Experimental Nuclear Physics	Nilanga Liyanage / University of Virginia / Physics /	U-V GEM Fabrication and Implementation at Jefferson Laboratory for Measurement of the Ratio GEn/GMn by the Double-Polarized 2H(e, e'n) Reaction	U-V GEM Fabrication and Implementation at Jefferson Laboratory	Continuous Electron Beam Accelerator Facility (CEBAF) Pending Proposal?: No Access Secured?: Yes
Benjamin	Hall	Michigan State University / Department of Physics and Astronomy / Physics and	Morten Hjorth-Jensen / Michigan State University / Physics and Astronomy /	Applications of Quantum Computing to Many-Body Nuclear Physics	Solving Nuclear Many-Body Hamiltonians via Variational Quantum Algorithms	None

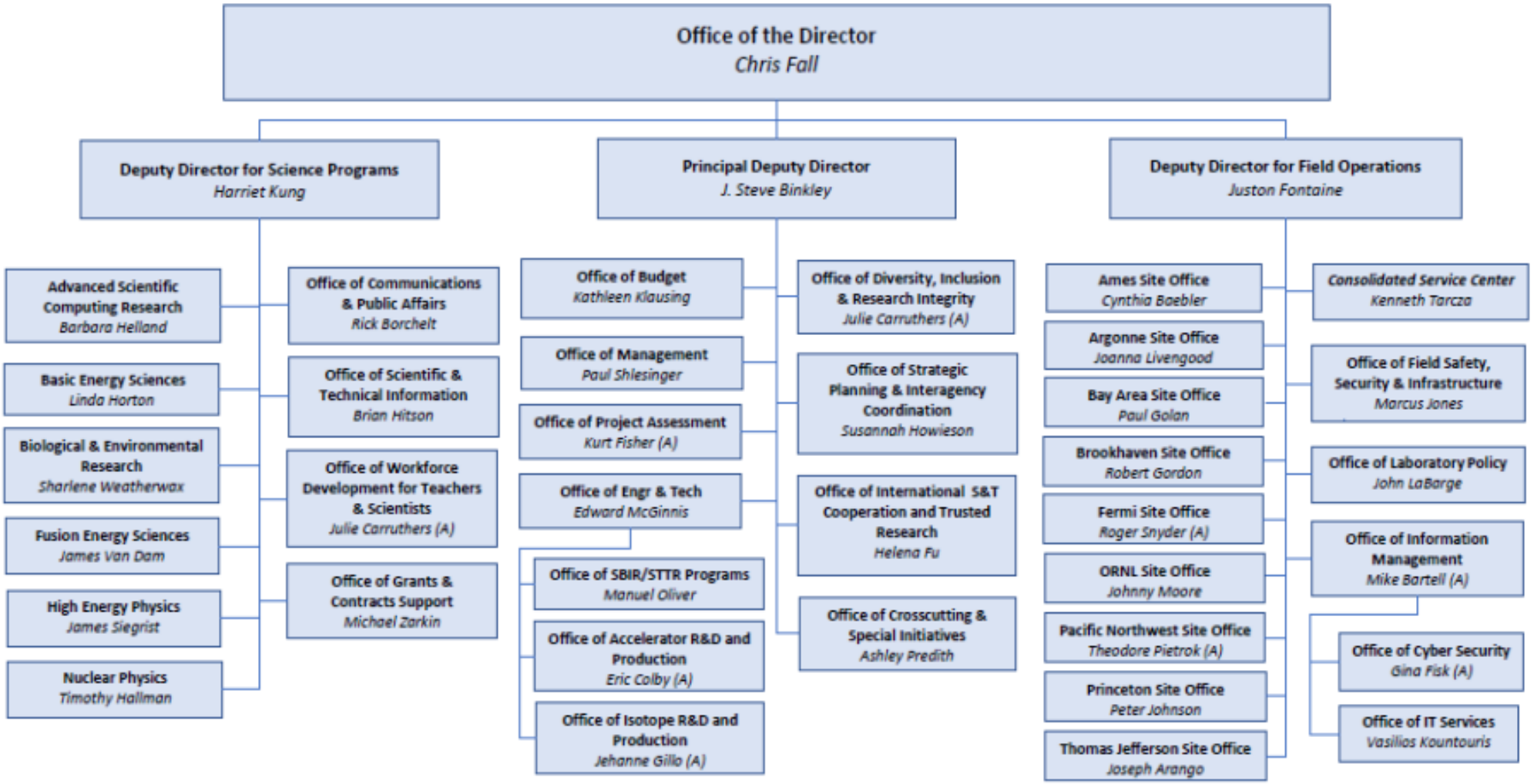
Changes to the SC Organization Chart

New SC Org Chart

U.S. DEPARTMENT OF ENERGY | Office of Science

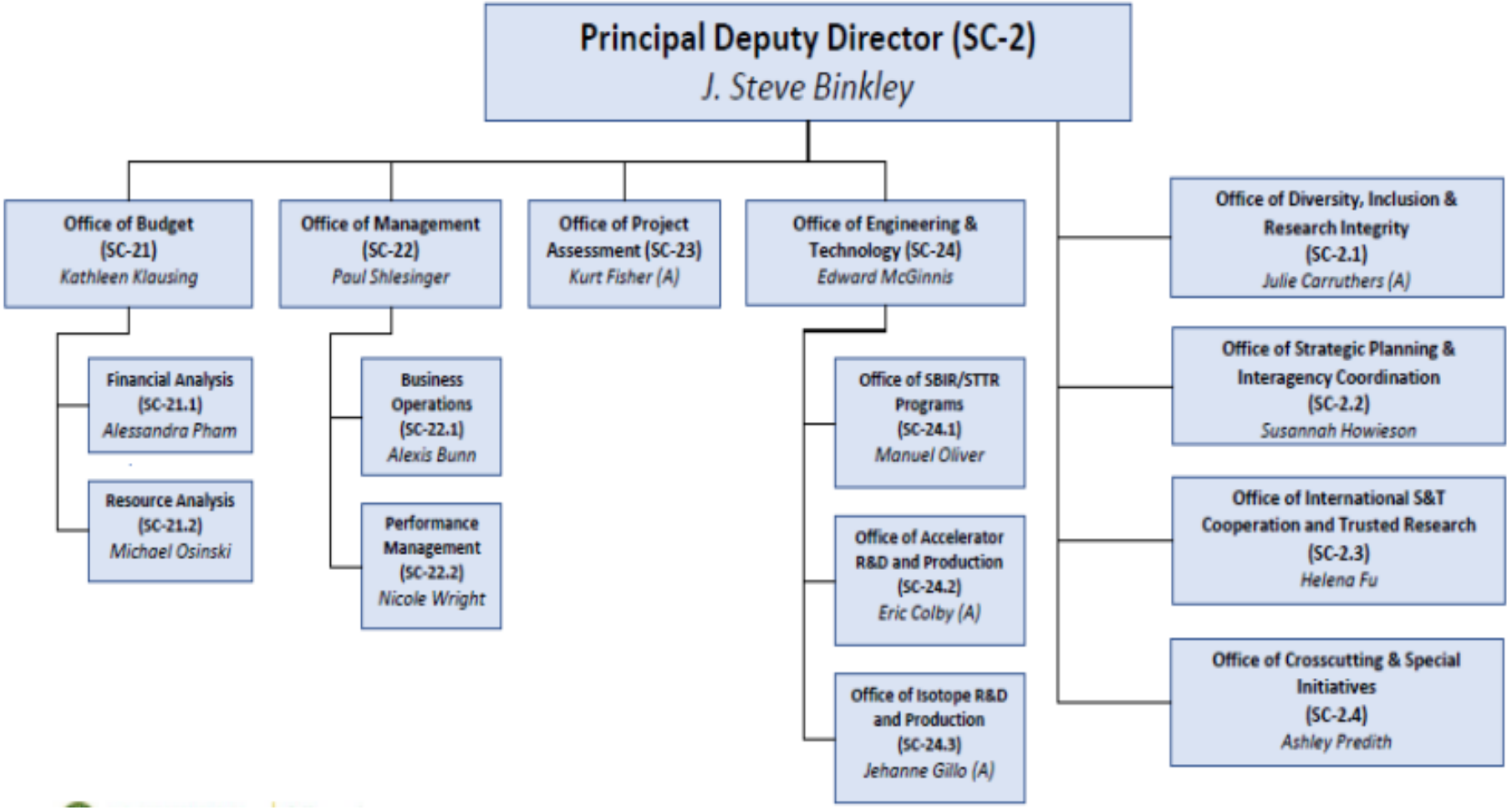
Office of Science

04/13/2020



New Reporting Line for Isotopes

Office of Principal Deputy Director (SC-2)



HQ Decampment in Mid-March

- The Office of Science and NP went to 100% telework on or around mid-March
- DOE lab managements were responsible for making “their own calls” . All are currently in “min-safe” mode
- No one is allowed into DOE HQ unless they are listed on an approved list. The list evolves with successive phases.
- The DOE Isotope Program is the only SC program deemed “mission critical”
- All NP HQ functions continue via telework: awards, reviews, proposal reviews, lab manager budget briefings, weekly EIC meetings, 2 Division meetings/week, 1 all hands meeting, regular “share-a-mug” meetings, office “retreat”
- HQ in Phase II, Labs are restarting operations.

Other News Items

- New Feds in DOE NP
  - Sharon Stephenson — Nuclear Structure & Astrophysics
  - Paul Sorensen — Fundamental Symmetries
  - Keith Jankowski — Nuclear Data
  - Arne Freyberger — Isotope Accelerator Facilities
  - John Neuhoff — Isotope Reactor Facilities
  - Linnette Quick (CONTR) — Program Assistant
- Jim Hawkins has retired
- Guidance for NP solicitations being updated; research will be prioritized over out-sized summer salary; strict adherence to guidance will be required for responsiveness to be satisfied
- Manouchehr Farkhondeh is the NP POC for AI/ML and the SC Strategic Accelerator Technology Initiative
- Gulshan Rai (Paul Sorensen) is the NP POC for QIS/QC

Other News Items

- Sharon Stephenson is stewarding the NP SC Graduate Student Research selection process
- Richard Witt is stewarding the annual Early Career Award selection Process
- Tanja Horn is NP's representative on a joint pan-SC-program FACA exercise examining activities in nuclear science relate to AI/ML
- A cross-cutting, cross-program lab only FOA on AI/ML was released
- The Workshop for Applied Nuclear Data (WANDA) meeting was March 3-6, 2020 in Washington, D.C.
- There was a workshop on "AI for Nuclear Physics" workshop at TJNAF on March 4-6,2020
- A joint NIH-SC-NP workshop on imaging technologies of mutual interest at TJNAF later this year. The Lead POC on the NP side is Cynthia Keppel.
- Barbara Jacak selected to be in the first-ever SC cohort of Distinguished Scientists

The SC Microsite on Diversity, Equity & Inclusion.

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…"

High Level Assessment

The program has approval to build a suite of new tools, big and small, which if successfully constructed promise discoveries and world leading science “as far as the eye can see”

A host of exciting new initiatives are being opened up, many with serious implications for U.S. competitiveness and security

Nuclear Physics is able to pursue a significant participation in several of these initiatives

Erosion of resources to pursue core research is a continuing serious concern. The balance between research, projects, and facility operations needs to be watched

Thus far the community is staying resilient and focused, continuing to deliver important outcomes for the nation: exciting discoveries, important scientific knowledge, technological advances, and workforce training

The current situation with COVID-19 holds a number of lessons which must be lasting

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

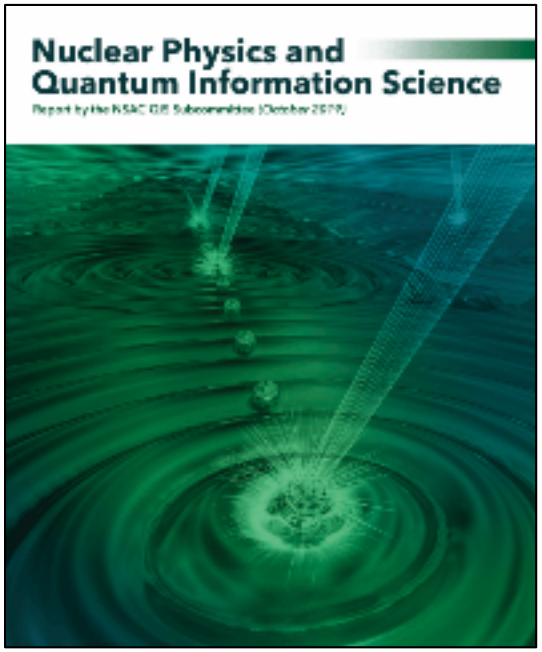
The last thing needed right now…

Noun
(*plural* circular firing squads)
1.(idiomatic) A political party or other group experiencing considerable disarray because the members are engaging in internal disputes and mutual recrimination

Additional Information

NSAC Assessment of the QIS Role of Nuclear Science is Complete

Decades of accumulated intellectual capital, extensive experience in interdisciplinary research, considerable technical infrastructure at labs and universities, and a long history of international leadership in collaborative research have positioned the DOE Office of Nuclear Physics and the NSF nuclear physics research programs to engage in QIS relevant research. However, QIS is newly emergent as a priority area for Research & Development (R&D) investment in nuclear science. Furthermore, private sector R&D investment in QIS, as well as investment by other Federal agencies, has been ongoing for some time. NSAC is therefore requested, in the context of Federal and private sector research efforts already underway, to articulate the unique role nuclear science research, aligned with the DOE and NSF nuclear physics programs, can and should play in Quantum Information Science. While unique, this role should nevertheless align broadly with the goals outlined in the national strategy for QIS[1].



Peer review process for proposals received in respond to NP FY2019 FOA is continuing

SC peer review process for proposals received in response to FOA on establishing QIS Centers is in progress

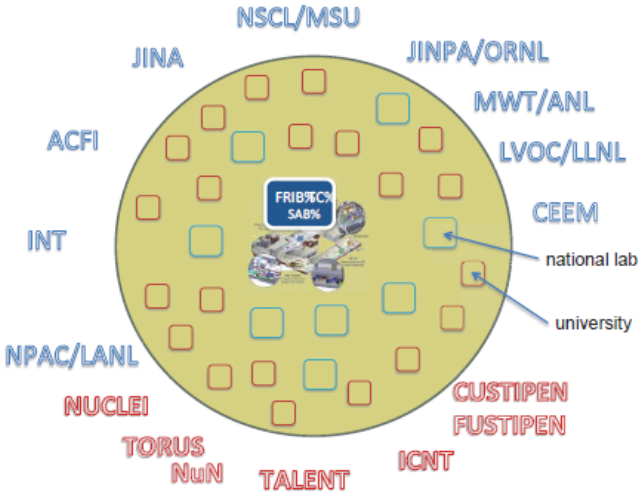
Nuclear Theory

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.

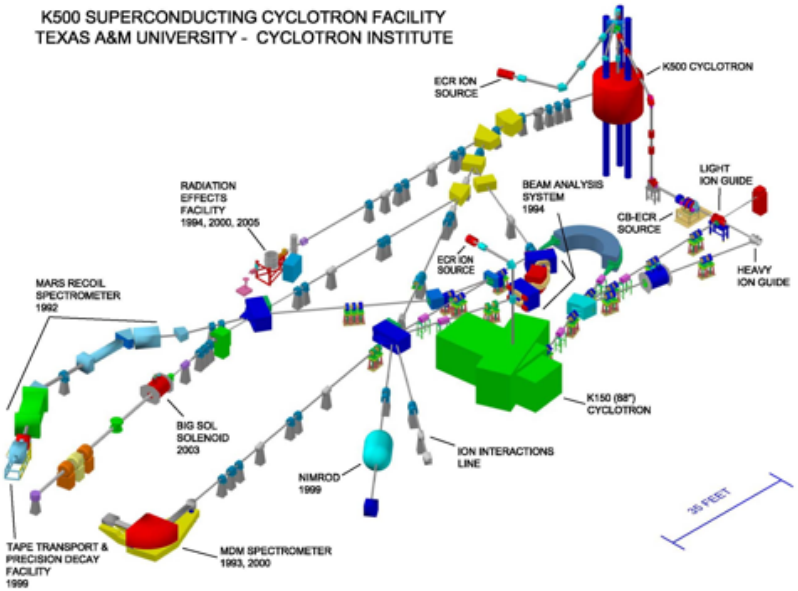
- In FY20, 4 fixed-term, multi-institution Theory Topical Collaborations are continued to investigate specific topics
- The FRIB Theory Alliance is continued
- LQCD computing is restored
- Funding maintains support for SciDAC-4 projects that received 5-year awards starting in FY17



FRIB Theory Alliance

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

CYCLOTRON INSTITUTE
TEXAS A&M UNIVERSITY

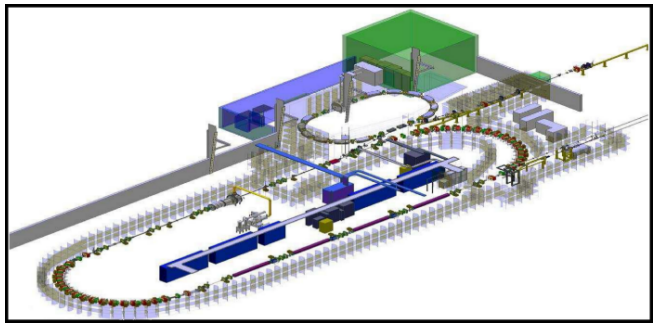


The Texas A&M University Cyclotron Institute jointly supported by DOE and the State of Texas focuses on conducting basic research, educating students in accelerator-based science and technology, and providing technical capabilities for a wide variety of applications in space science, materials science,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

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

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.



A New Inter-Agency FOA on Nuclear Data is Anticipated

DEPARTMENT OF ENERGY
OFFICE OF SCIENCE, NUCLEAR PHYSICS
OFFICE OF SCIENCE, NUCLEAR PHYSICS, ISOTOPES PROGRAM
OFFICE OF NUCLEAR ENERGY
NATIONAL NUCLEAR SECURITY ADMINISTRATION, OFFICE OF DEFENSE NUCLEAR NONPROLIFERATION R&D

….Accordingly, the purpose of the research program associated with this FOA is to support new activities (*e.g.* experiments, infrastructure, models, and so forth) that will provide new nuclear data or related predictions where needed in areas in which the existing data is inadequate or does not exist, and insure that the new data is transferred to the appropriate nuclear databases in a timely manner.

Technical/Scientific Program Contacts:

DOE NP:	**Timothy Hallman**	**DOE IP: Ethan Balkin**
DOE NE:	**Dave Henderson**	**DOE NNSA DNN: Donald Hormback**

NP - FY 2020 Highlights
Nuclear Physics *(NP: FY 2019 $690M; FY 2020 $713M)*

- Continued support of critical nuclear physics research and operations
  - FY 2020 supports highest priority research in all scientific thrusts.
  - FY 2020 features NP FOAs for exciting new science in QIS, advances in Interagency Nuclear Data efforts, and Accelerator R&D.
  - RHIC, CEBAF, and ATLAS facilities on the average operate at >90% operations in FY 2020, and FRIB, which is more than 93% complete, is supported at Cooperative Agreement levels in preparation of construction completion in FY 2022.
  - The first year of OPC and TEC funding for the Electron Ion Collider, which received CD-0 in Q1 FY 2020 and a site selection at BNL in Q2 FY2020, enabling research and development, conceptual design, and early engineering designs for this revolutionary, next-generation NP facility.
  - The High Rigidity Spectrometer at FRIB, MOLLER, and Ton-Scale Neutrinoless Double Beta Decay MIEs receive TEC starts. GRETA and sPHENIX MIEs continue to be supported.