NUCLEAR SCIENCE ADVISORY COMMITTEE
to the
U.S. DEPARTMENT OF ENERGY and NATIONAL SCIENCE FOUNDATION

PUBLIC MEETING MINUTES

Crystal City Marriott at Reagan National Airport
1999 Jefferson Davis Highway, Arlington, VA 22202

March 12, 2018

NUCLEAR SCIENCE ADVISORY COMMITTEE
SUMMARY OF MEETING

The U.S. Department of Energy (DOE) and National Science Foundation (NSF) Nuclear Science Advisory Committee (NSAC) was convened at 8:30 a.m. EST on Monday, March 12, 2018, at the Crystal City Marriott at Reagan National Airport in Arlington, VA, by **Committee Chair David Hertzog**. The meeting was open to the public and conducted in accordance with Federal Advisory Committee Act (FACA) requirements. Attendees can visit http://science.energy.gov for more information about NSAC.

Committee Members Present

David Hertzog (Chair)
Helen Caines
David Dean
Frederic Fahey
Lynn Francesconi
George Fuller
Geoffrey Greene
Hafidi Hafidi
Kate Jones
Silvia Jurisson
Cynthia Keppel
Yury Kolomensky
Michael Lisa
Jeffrey Nico
Daniel Phillips
Mark Pitt
Sofia Quaglioni
Krishna Rajagopal

Committee Members Participating by Webcast:
Mei Bai

Committee members unable to attend:
Zein-Eddine Meziani
Martin Savage

NSAC Designated Federal Officer:
Timothy Hallman, U.S. Department of Energy, Office of Science (SC), Office of Nuclear Physics (NP), Associate Director

Others present for all or part of the meeting:

David Asner, Brookhaven National Laboratory (BNL)
Ethan Balkin, DOE NP
Ted Barnes, DOE NP
Elizabeth Bartosz, DOE NP
Denise Caldwell, NSF
Joseph Carlson, Los Alamos National Laboratory (LANL)
Tiffani R. Conner, Oak Ridge Institute for Science and Energy (ORISE)
Scott Dewey, National Institute for Science and Technology (NIST)
Michelle Dolinski, Drexel University
George Fai, DOE NP
Glenn Fox, Lawrence Livermore National Laboratory (LLNL)
Marc Garland, DOE NP
Edmundo Garcia, NSF
Jehanne Gillo, DOE NP
Thomas Glasmacher, MSU
Giorgio Gratta, Stanford University
Roxanne Guenette, Harvard University
Michael Gustella, Council on Radionuclides and Radiopharmaceuticals, Inc. (CORAR)
James Harvey, NorthStar Medical Radioisotopes, LLC
Stuart Henderson, Jefferson Laboratory (JLab)
William C. Horak, Brookhaven National Laboratory (BNL)
Takeyasu Ito, LANL

Ben Jones, University of Texas at Arlington (UTA)
Anne Kinney, NSF
Robert McKeown, JLab
Berndt Mueller, BNL
Allena Opper, NSF
Mateusz Ploskon, LBNL
Wayne Powell, Society of Nuclear Medicine and Molecular Imaging (SNMMI)
Robert Redwine, Massachusetts Institute of Technology (MIT)
Susan Seestrom, Sandia National Laboratory (SNL)
Bradley Sherrill, National Superconducting Cyclotron Laboratory
Michelle Shinn, DOE NP
Nigel Smith, SNOLAB
Alejandro Sonzogni, BNL
Paul Sorensen, DOE NP
James Sowinski, DOE NP
Alan Stone, DOE, HEP
Robert Tribble, BNL
Brent VanDevender, PNNL
Boleslaw Wyslouch, MIT

Monday, March 12, 2018
Morning Session

WELCOME AND INTRODUCTIONS

NSAC Committee Chair **David Hertzog** welcomed everyone and asked the NSAC members to introduce themselves.

PERSPECTIVES FROM THE DEPARTMENT OF ENERGY

Steve Binkley, Acting Director, DOE, Office of Science discussed messaging from DOE leadership, political appointees, and the fiscal year (FY) 2019 budget. The budget for DOE is $30.6B and includes funding for the science portfolio and nuclear weapons programs.

The Deputy Secretary of Energy, Dan Brouillette, was sworn in to office August 7, 2017, and the Under-Secretary for Science, Paul Dabbar, was sworn in to office on November 7, 2017. Dabbar, a naval academy graduate and nuclear submarine reactor operator has been a member of the advisory board for the DOE's Environmental Management (EM) Program, is familiar with the operation of the national laboratories (labs), and has served on Science Advisory Boards.

SC's current budget has been restored back to the enacted FY17 budget, approximately $5.4B. SC remains the largest supporter of physical sciences in the U.S. Of the $5.4B, 40% ($2.15B) is spent on research at universities or national labs, 39% on operations, and 21% on investment in capital facilities. Operations of the national labs, development of exascale computing, quantum information science (QIS), cybersecurity, early-stage research, and interagency and international collaborations are the priorities in the FY19 budget guidance.

Construction projects include the Advanced Light Source (ALS) upgrade at LBNL, and the Linac Coherent Light Source (LCLS) at Stanford Linear Accelerator Center (SLAC). The approach taken for QIS focuses on quantum computing as well as technologies such as quantum sensors and detectors. There are large budget allocations in computing (predominantly quantum computing), in basic energy science (quantum materials such as qubits), in the biological area (detectors and sensors), and larger programs in high energy physics (HEP) and NP.

Discussion

David Hertzog asked if the $8.3M in NP for QIS is on top of the $600M in the FY19 President's Budget Request (PBR). **Binkley** stated it was included in $600M. In some cases it is a redirection and in other cases it is extra money.

PERSPECTIVES FROM THE NATIONAL SCIENCE FOUNDATION

Anne Kinney, Assistant Director for Mathematical and Physical Sciences (MPS), started her position January 2, 2018, replacing Jim Ulvestad who is now the NSF Chief Officer for Research Facilities. Two exciting results have been the Nobel Prize for the Detection of Gravitational Waves, a 40-50 year investment, and a neutron star-neutron star collision recorded in August 2017.

MPS supports fundamental research in math 64% and physical sciences 45% in the U.S. NSF is supporting the 10 Big Ideas, of which Quantum Leap lives principally in MPS. MPS supports 28,400 people; 30% are graduate students and 30% are senior researchers.

NSF has a draft policy on sexual harassment in the Federal Register which explicitly states how NSF will handle charges and evidence of sexual harassment at universities. NSF is ensuring that they are not supporting someone found guilty of sexual harassment.

Kinney requested that NSF funded scientists talk about NSF in conjunction with their science. The current priority investments for physics are Quantum Leap, NSF's laser interferometer, Laser Interferometer Gravitational-Wave Observatory (LIGO), and the Large Hadron Collider (LHC). NSF has continued investment in the NSF research infrastructure, including LIGO, the large synoptic survey telescope, the Atacama Large Millimeter/ submillimeter Array (ALMA), the Daniel Inouye Solar Telescope (DKIST), and the National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University (MSU). NSCL will transfer to DOE's Facility for Rare Isotopes Beams (FRIB) and is on-track.

The overall NSF budget request for FY19 is $7.47B (MPS = $1.345B). The FY19 PBR is <1% below FY17. Within the Big Ideas, MPS is coordinating Windows on the World and Quantum Leap, and participating heavily in Harnessing the Data Revolution and Mid-scale. NSF's three international offices are closing signifying improvements in communication methods, not a decrease international commitment.

Discussion

Jones asked about prioritizations in shifting budgets. **Kinney** said the Big Ideas were allocated $30M per idea coming from the core requiring a small decrease in research and related activities (R&RA) funding. "Advanced convergence", which includes the future of work, how NSF works in an increasing technological environment, and harnessing the data revolution were eliminated.

Kolomensky asked how information on Mid-scale infrastructure will be used. **Kinney** said from the Request for Information (RFI) responses it was obvious Mid-scale was important. $60M was put into Mid-scale in FY19.

DOE OFFICE OF NUCLEAR PHYSICS OVERVIEW

Timothy J. Hallman, Associate Director, DOE NP thanked NSAC for their service. The FY19 PBR has NP at $600M, a decrease by 3.45% from the annualized continuing resolution (CR) for FY18. 12 GeV Continuous Electron Beam Accelerator Facility (CEBAF) was completed on budget and on schedule in 2017 and is beginning its science program.

Construction of FRIB is continuing as well as the Gamma Ray Energy Tracking Array (GRETA). There is increased funding for the isotope program and QIS.

CEBAF and Relativistic Heavy Ion Collider (RHIC) both operate for 19 weeks representing 52% and 68% of utilization respectively, and Argonne Tandem Linac Accelerator System (ATLAS) operates for 34 weeks (80% of optimal operation). Support is provided for mission readiness for safe and reliable operations of the isotope production and processing facilities and for the operation of the stable isotope enrichment operation.

sPHENIX succeeds Pioneering High Energy Nuclear Interaction eXperiment (PHENIX) and Major Items of Equipment (MIE) is proposed to begin with $1.2M redirected from RHIC. $2.5M was requested in FY19 for GRETA and $5M for the stable isotope production facility at ORNL.

Hallman shared examples of great scientific outcomes and experiments including the prediction of the electromagnetic spectrum from a neutron star merger providing an important multi-messenger signal confirming the discovery of neutron star mergers via their gravitational signature in LIGO, the vorticity observed in the quark gluon plasma at RHIC, isomer depletion, Q-weak, and fundamental symmetries. A statement, "DOE/NSF Coordination of R&D Investments in Neutrino-less Double Beta Decay" was released in February 2018 indicating a change in approach with respect to R&D support for neutrinoless double-beta decay whereby both agencies will focus their R&D support most strongly on technologies approaching readiness for deployment on a ton-scale experiment.

HEP, NP, Air Force, and National Aeronautics and Space Administration commissioned a National Academies of Science (NAS) assessment on testing the radiation effects on electronics that fly in outer space. Recommendations that touch NP are to establish a joint body to define the usage needs for parts radiation testing and assure the adequacy and viability of radiation test facilities out to 2030; and at the LBNL cyclotron, to determine a method to increase beam time availability and provide resiliency.

SC is exploring the development of an official statement regarding expectations for professional behavior. In the interim before that statement is release, NP is emphasizing that it embraces the Code of Conduct adopted by the American Physical Society (APS), and NP will remind attendees at meetings it convenes, including review panels and site visits, that it expects a standard for professional behavior that is consistent with the APS declaration.

Discussion

Lisa asked if the LBNL cyclotron facility is over-subscribed. **Hallman** indicated that Texas A&M University and LBNL, the two main locations for the parts radiation tests, are both oversubscribed.

Hafidi asked about support for experimental efforts in QIS. **Hallman** said there will be financial support for experimental efforts.

Kinney asked about DOE's position on sexual harassment. **Hallman** said that DOE / SC would define what actions would be taken. **Binkley** stated there are policies in place to cover sexual harassment. Cases of sexual harassment are tracked through the federal reporting system and principal investigators (PI) confirmed to be involved in sexual harassment would be debarred.

Pitt asked about increased funding in MIE projects. **Hallman** noted that GRETA and the stable isotope production facility demonstrate progress, but if budgets remain flat NP will have to reevaluate its investments.

Hertzog asked about fundamental symmetries. **Hallman** said NP continues to support the experiments in fundamental symmetries which are in the budget line of low energy.

Mei Bai asked about action items in the Electron Ion Collider (EIC) report from NAS. **Hallman** hopes the report will provide a basis for CD-0.

Kolomensky asked about the process development on neutrinoless double-beta decay. **Hallman** said that although not the scale of a facility construction, that CD-0 is needed to advance. Once CD-0 is received the process would follow the standard CD steps. **Dean** asked about the necessity of an NAS study for neutrinoless ββ-decay. **Hallman** said such a study, from an independent body, may be useful.

Hertzog expressed concern about 19 weeks run at two major facilities. **Hallman** said while significant accomplishments can be achieved in 19 weeks, it is not a sustainable model to operate the facilities without capital equipment and accelerator improvement project bases.

Jones asked about the impact of FRIB operations and expressed concern that large cuts get attention but small decreases are more damaging over time. **Hallman** said some operation of FRIB starts in 2019. Flat budgets will demand a change in vision from the 2015 Long Range Plan (LRP) if they continue.

Keppel asked about the process of balancing investments. **Hallman** said those balances are judgement calls made in SC, and based in part on lab presentations in February. SC tries to understand how to adjust the funding, to keep everyone moving in a positive direction at the labs.

Hafidi asked how NSAC can help make the case in support of SC. **Hallman** said to continue doing the best science possible and to articulate the value of what SC does for the nation.

Giorgio Gratta remarked that timeliness for tonne-scale double beta decay is important because there is international competition. **Hallman** acknowledged that SC is sensitive to international competition and understands the urgency.

NSF NUCLEAR PHYSICS OVERVIEW

Allena Opper, Program Officer, Nuclear Physics, NSF discussed the FY19PBR focusing on the Physics (PHY) Division, nuclear physics in particular, and highlights from the field. The FY19 PBR investment in the Big Ideas calls for $30M for Harnessing the Data Revolution, $30M for Quantum Leap, $30M for Windows on the Universe, and $60M for Mid-scale infrastructure. FY19 PBR for PHY is $266.73M, a 5% decrease from FY17. The intent for FY19 is to support the facilities almost at the current levels, with LIGO receiving an additional $30M due to significant vacuum problems that needed to be addressed, and R&RA funds will be reduced by 11%.

PHY Mid-scale (total cost $4M -$11M) support will continue at FY17 levels. Proposal pressure on the experimental nuclear physics program continues to increase. CAREER Program proposals are due July 20, 2018, and Alliances for Graduate Education and the Professoriate (AGEP) Graduate Research supplements are available to Principal Investigators (PI) at AGEP or AGEP Legacy institutions.

Opper highlighted Major Research Instrumentation (MRI) awards to Southern Illinois University in Edwardsville, University of Notre Dame, and The University of Virginia. The Nab experiment will take place in Oak Ridge at the Spallation Neutron Source (SNS). Super-Enge Split-Pole Spectrograph was moved to Florida State University for use at its Tandem-LINAC. The Joint Institute for Nuclear Astrophysics Center for the Evolution of the Elements (JINA-CEE), a Physics Frontier Center, hosted a Livestream panel connecting nuclear physics,

observations, chemical evolution models, and LIGO's recent discoveries that had 400 live participants and has been viewed over 900 times.

Opper mentioned the joint statement DOE/NSF on double beta decay noting two key points that the agencies are coordinating very closely and will continue their coordinated approach. Edmundo Garcia, an Intergovernmental Personnel Act (IPA) rotator at NSF, will be returning to Chicago State University in August 2018.

Discussion

Kolomensky asked how the community can help the CAREER program. **Opper** asked that the community make strong cases for funding science. **Denise Caldwell** said bringing new junior investigators on board is valuable and program directors are typically able to provide more funding than is in the budget for CAREER proposals.

Geoffrey Greene asked if Mid-scale research funds are available for suitable proposals. **Opper** noted two types of Mid-scale funds, those set aside by the Division for projects up to $11M for physics, and the NSF Mid-scale Big Ideas initiative for projects up to ~ $80M. In the FY19 PBR funding is directed to the Mid-scale Big Idea and NSF is working out the mechanism for the proposals and review process.

Pitt asked about nuclear physics projects received in response to the NSF RFI on Mid-scale. **Opper** speculated there were 12 such projects submitted to the RFI.

Lisa asked about heavy ions funding. **Opper** said heavy ions are within nucleon and hadron quantum chromodynamics (QCD) category.

Hafidi requested an update on accelerator R&D with universities. **Caldwell** stated there was not a new call for proposals in FY18 because the proposals from the past years did not fit the purpose of the program.

Hertzog expressed concern that Physical Review Letters (PRL) was losing importance compared to glossier journals. **Opper** and **Hallman** said there is no particular push towards glossier journals. **Kinney** noted that science is paid for by taxpayers and good visuals help to share the science with the public.

Hertzog adjourned NSAC for a break at 11:00 a.m. The meeting was reconvened at 11:20 a.m.

COMMITTEE REPORT ON DOUBLE BETA DECAY

Nigel Smith talked about the physics payoff of neutrinoless ββ-decay, characteristics of experimental challenges, experimental techniques, and current and future experiments. His central message was that the physics payoff of neutrinoless ββ-decay is highly compelling, progress has been made on the challenge of tonne-scale detectors, and support for infrastructure exists within underground labs.

Smith discussed experimental techniques being used for each isotope and the corresponding experiments utilizing Xenon (Xe), Tellurium (Te), Molybdenum (Mo), Selenium (Se), and Germanium (Ge).

The underground lab directors are coordinating more to ensure the infrastructure is provided to the community. The Cryopit at SNOLAB is held open for the next generation double beta decay project. The U.S. program is critical and must be done in conjunction with the international community.

In sum, the physics goals of double beta decay are still as strong as they were in the 2015 LRP. Substantial progress has been made with the demonstrators, multiple experiments, and sensitivities. Tonne-scale detectors are underway and being developed by large international collaborations.

Discussion

Kolomensky asked about European coordination developments. **Smith** said the lab directors are developing greater coordination to ensure that future experiments can be undertaken across multiple labs without needing to slow down the science program.

Dean asked for time scales for technology selection in the LRP. **Hallman** said the time-scale is dependent on the upcoming budgets. SNOLAB has CD-0 and there is process to decide which program goes into Cyropit. CD-0 is a statement that the science is compelling, that a new capability is needed for the success of the mission. **Opper** noted the NSAC subcommittee on neutrinoless ββ-decay that has produced two reports, both of them suggested that years' worth of data from existing generation experiments is necessary to make important decisions.

PRESENTATION OF ^{99}MO SUBCOMMITTEE REPORT

Susan Seestrom discussed the charge and ^{99}Mo subcommittee process, provided background, gave an overview of the NNSA Material Management and Minimization ^{99}Mo program, and shared the subcommittee's findings and recommendation.

The ^{99}Mo subcommittee was charged to look at how NNSA runs the ^{99}Mo program and to identify progress made since the last report. The subcommittee met in December 2017. The program included briefings from NNSA, Organization for Economic Co-operation and Development (OECD), and the cooperative agreement partners, information on the most recent NAS study on ^{99}Mo, and a community input session. Technetium (^{99}Tc), daughter of ^{99}Mo, is the most common radiopharmaceutical in the U.S., 80% of all nuclear medicine treatments come from ^{99}Tc. Approaches to ^{99}Mo production include production close to the point of use, utilizing generators (U.S.), direct production of ^{99}Mo using cyclotrons (Canada), and neutron capture of U235 (global). There is no producer of ^{99}Mo in the U.S. or the western hemisphere.

The three major generators of ^{99}Mo supply a number of U.S. radiopharmacies. The majority of these are either already converted to low enriched uranium (LEU) or completing their conversion from highly enriched uranium (HEU) to LEU. There are three cooperative agreement partners – NorthStar, SHINE, and General Atomics in the NNSA ^{99}Mo program. NNSA spends <15% of the capital cost consistent with the precepts of the American Medical Isotopes Act (AMIPA). All the cooperative agreements are currently limited to $25M which has been awarded but not yet fully reimbursed.

NorthStar's new generator technology has received FDA approval. SHINE & General Atomics technologies use existing generators requiring a supply of uranium from the NNSA program on uranium lease and take-back (ULTB). The first uranium has been supplied but no ULTB contracts have been issued.

The subcommittee concluded that the ^{99}Mo program has moved forward consistent with AMIPA requirements, long-term financial viability for producers is problematic, and one technology may enter the market in early 2018. However, no technology will have sufficient capacity to mitigate shortages before 2020, and ULTB is the major challenge. The only recommendation was that DOE issue a ULTB contract and use the lessons learned in this process to identify opportunities for ULTB process improvements.

Hertzog adjourned NSAC for lunch at 12:36 p.m.

Monday, March 12, 2018
Afternoon Session

The NSAC meeting was reconvened at 1:33 p.m. **Hallman** and **Opper** gave Certificates of Appreciation on behalf of DOE and NSF to NSAC members Frederic Fahey, Michael Lisa, Mark Pitt, Laetitia Helene Delmau, Martin Savage, and Michael Thoennessen for their service.

DISCUSSION OF ^{99}MO SUBCOMMITTEE REPORT, NSAC

Hertzog opened the floor for discussion of the ^{99}Mo report.

Jones asked about advantages of the low activity generator. **Jim Harvey**, Chief Science Officer at NorthStar, confirmed that NorthStar received FDA approval on February 8, 2018. NorthStar's approach was to make ^{99}Mo without uranium, meaning no waste. NorthStar is the first domestic production of ^{99}Mo in almost 30 years.

Rajagopal asked which country picked up Canada's production and the end-date for the ^{99}Mo reports. **Seestrom** said South Africa and Australia have new processors.

Hallman stated that closure of the NSAC reporting requirement would need to be occasioned by agreement by all concerned that the reports are of diminishing value. **Seestrom** added that last year the subcommittee suggested that the returns are diminishing and a new domestic producer supplying the U.S. market will make a difference in the necessity of NSAC to continue assessing the NNSA program.

Fahey commented that 85% of the activity in nuclear medicine involves ^{99}Te. The U.S. uses 40% of the world supply but produces none. AMIPA called for two things 1) DOE to support domestic production, and to 2) move away from HEU in target materials. A very important factor in the latter consideration remains is Uranium Lease and Take Back (ULTB) agreements by DOE.

Nico asked why the direct production method was not amenable in the U.S. and about the timely removal of radiological waste. **Seestrom** said NNSA's ground rule was that a project had to be able to produce 3,000 6-day curies. Because of the reliance on the six hour half-life of ^{99}Te, direct production with cyclotrons was not feasible. The lack of a ULTB is problematic for two of the potential suppliers.

Kolomensky asked about the quantity of ^{100}Mo required and the relationship to the U.S. program in isotopic production. **Seestrom** said NorthStar has enough for a number of years of production of gamma-N. **Jehanne Gillo** said the DOE Isotope Program plans to produce ^{100}Mo and ^{98}Mo and currently can only produce research quantities. **Harvey** stated that NorthStar has over 20-kilograms of ^{98}Mo in inventory, more than sufficient for neutron capture conversion initially. NorthStar envisions the need for 15 to 20 kilograms of ^{100}Mo.

Jurisson asked if there are plans to recover unused enriched ^{98}Mo and ^{100}Mo. **Harvey** indicated NorthStar has been working with Argonne National Laboratory to develop a recycling program and can recover >95% of what is expended.

Bai asked if the current three cooperative agreement companies are able to fully satisfy the entire U.S. needs for ^{99}Mo. **Seestrom** said that if all the companies are fully successful they will produce three times the U.S. need.

Hertzog asked about reserves. **Seestrom** stated that in this recent crisis all producers and processors were running at ~100% capacity and there is enough in reserve to accommodate losing one of the main suppliers. Canada's processing partner Nordion is now in partnership with General Atomics, implying that processing could be ramped up quickly.

Hertzog called for a vote to accept the report. NSAC unanimously agreed to accept the report with minor typos fixed. Hertzog thanked Seestrom and the subcommittee for an excellent report, their professionalism, and the experts gathered. He said the cooperative agreement partners have been very fair in their presentations and very innovative and creative in their technologies. **Seestrom** acknowledged the work at BNL for noticing contaminants in samples.

NEUTRON PHYSICS STATUS

Scott Dewey, NIST, provided a status update of neutron physics which deals primarily with neutron scattering and the study of condensed matter science. Four places provide quantities of neutrons, High Flux Isotope Reactor (HFIR) at Oak Ridge (not currently usable), NIST Center for Neutron Research with continuous beams, ORNL Spallation Neutron Source (SNS) with pulsed beams, and Los Alamos Neutron Science Center (LANSCE) Spallation Source with ultracold neutrons. The facilities are operated by DOE-BES, NNSA, and the Department of Commerce (DOC).

Dewey discussed three main themes of the neutron physics program: neutron beta decay, neutron electric dipole moment, and hadronic parity violation. There are ~100 PhDs and ~50 students involved in neutron physics research and conducting neutron physics experiments. NSF and DOE support 16 research groups with many others involved.

Neutron beta decay looks at how the neutron lifetime feeds into big bang nucleosynthesis. Neutron lifetime can be measured by bottle (trappable) and beam methods (not trappable). Experiments in neutron beta decay include Ultracold Neutron (UCN) Tau at LANL (continuing), Beam Lifetime (BL) 2 at NIST (data production), BL3 at NIST (proposed). The U.S. is now the leader in the world on correlation coefficient experiments which include UCNA at LANL, "a CORrelation in Neutron decay" (aCORN) at NIST, Nab at ORNL (under construction), and UCNA2 at LANL (proposed).

Neutron Electric Dipole Moment (nEDM), the best-known neutron experiment, will take place at SNS and is expecting to achieve two orders of magnitude increase in sensitivity. nEDM complements both the electron EDM and atomic EDM measurements. Other nEDM efforts include Paul Scherrer Institut (Switzerland), TRIUMF (Canada), Institut Laue Langevin (France), LANL, Petersburg Nuclear Physics Institute (Russia), and the European Spallation Source (Sweden).

Hadronic Parity Violation examines how neutrons interact with the neutrons in a target rather than neutron decay and tags the weak interactions inside the nucleus. Theoretical work in parity violation includes kinematic and dynamical models, effective field theory, and Standard Model lattice gauge theory. A flagship experiment in the U.S., conducted at ORNL SNS, is NPDGamma. Current experiments include Fragmentation Asymmetry in $n + {}^3He \rightarrow p + {}^3H$ at SNS, and Coherent Parity Non-Conserving (PNC) Spin Rotation at NIST. Additional parity violation experiments include "Radiative" neutron decay, determination of scattering lengths of light nuclei and determination of neutron charge radius (neutron interferometry), and search for non-SM interactions and short range forces.

Discussion

Kolomensky asked about the discrepancy between the beam and bottle experiments. **Dewey** said the neutron bottle experiments measure the disappearance of neutrons while the beam experiments measure the number of protons made. The uncertainties in the bottle experiments are extremely tight, <1 second, but are in disagreement with each other, while the uncertainty of the beam experiment is about 3 seconds.

Daniel Phillips stated that the argument that led to NPDGamma being a focus of the experimental program was that pion exchange would dominate the parity violating component of the nuclear force. Pion exchange is crucial for many properties of nuclei but apparently that is not true for parity violating. It is important to figure out the implications of that finding.

UPDATE NUCLEAR DATA PROGRAM

Alejandro Sonzogi, National Nuclear Data Center (NNDC) at BNL discussed the U.S. Nuclear Data program (USNDP) which started in 1910 at the 2nd Congress of Radiology and Electricity (precursor of Solway Conferences). USNDP focuses on compilation, evaluation, and dissemination of nuclear data. In 2014 USNDP added experiments to their mission. The program has at least one person embedded in a major nuclear energy facility in the U.S. Current USNDP groups include NNDC @ BNL, LBNL, LLNL, LANL, ANL, NIST, ORNL, TAMU, MSU, and Triangle Universities Nuclear Laboratory (TUNL).

Sonzogi discussed several databases: Nuclear Science References (NSR), Experimental Nuclear Reaction Data (EXFOR), eXperimental Unevaluated Nuclear Data List (XUNDL), Evaluated Nuclear Structure Data File (ENSDF), Evaluated Nuclear Data File (ENDF), and Nuclear Data Sheets (NDS). Web dissemination started in the mid-1980s and the first generation of web applications came in the mid-1990s. There were ~4.5 million retrievals in FY17. International collaborations exist with the International Atomic Energy Agency (IAEA) in Austria and the OECD Nuclear Energy Agency in France.

USNDP's future focus is on ensuring completeness and currency of all databases, improving nuclear data for nuclides, improving the description of the fission process, improving physics in nuclear reactions model codes, modernizing formats and infrastructure, and implementing technology advances in dissemination efforts.

Discussion

Phillips remarked that high profile journals allow supplementary materials such as uncertainties. **Sonzongi** said that the USNDP is working with Physical Review C yielding an opportunity to gather the covariances and uncertainties.

Dean asked which government entities work with USNDP. **Sonzoni** said the government agencies include DOE: Nuclear Physics, Nuclear Energy, Isotope Program, NNSA: NA-22 (Counter-proliferation), NA-113 (Defense Programs), and Department of Homeland Security/ Domestic Nuclear Detection Office, Defense Threat Reduction Agency (DHS/DNDO DTRA).

Hertzog called for a break at 3:41 p.m. NSAC was reconvened at 3:55 p.m.

REGULATORY REFORM

Hallman discussed the Secretarial Memorandum on Regulatory Reform (memo) from Secretary Rick Perry. The memo asks that the DOE FACA committees to consider regulatory reform recommendations and add the topic to their agendas. **Hallman's** interpretation was

Federal Advisory Committee Act (FACA) committees carry out their charges and give advice on obvious ways that regulations or requirements could be streamlined or reformed.

Discussion

Hertzog mentioned ending the ^{99}Mo commission. **Hallman** shared that currently this is statute written into law.

Dean asked for the timeline related to Secretary Perry's memo. **Hallman** said the memo does not specify, rather it is open ended. As FACA committees carry out their work they should articulate possible improvements

Hertzog asked if the memo was related to next year's Committee of Visitors (COV). **Hallman** noted that if the COV process could be improved or if the COV uncovered something that should be improved, that could become part of the report.

Hafidi mentioned putting the topic on the agenda for the next meeting. **Hallman** believed NSAC was compliant with what the Secretary directed because it was on this meeting's agenda.

Jones asked if NSF has anything similar. **Hallman** reiterated the memo was from the Secretary of Energy which only applies to DOE. **Opper** was unaware of anything similar from NSF. **Hallman** mentioned that former Secretary of Energy Chu requested something similar.

Rajagopal sought clarification on the end-point for the ^{99}Mo sub-committee. **Hertzog** said the sub-committee's report indicates a turning point. **Hallman** added that NNSA has found great leverage in receiving the recommendation of the ^{99}Mo sub-committee and it has made a difference on important matters such as the ULTB program.

Quaglioni suggested less reporting from PIs as an example improvement.

Public Comment

Berndt Mueller mentioned foreign travel regulations and asked if that was covered under the directive. **Hallman** offered that anything with substance should be flagged and called out. Foreign travel requirements would need more specifics such as details in the description to clarify the nature of the problem.

Lisa mentioned groups from Russia who are not able to come into national labs. **Hallman** explained that an embargo existed under the former administration on travel by Russian nationals to national labs because of world events, however, exemptions were possible. With the new administration a new process for requesting and adjudicating exemptions has to be defined. Hallman recently collected impacts from the travel rule and transmitted them up to the Undersecretary for Science. This memo is about regulatory requirements that are overly burdensome for no particular reason. While there is a qualitative difference, it does not mean that the travel rule cannot be raised as something that is impacting science in the U.S.

Hafidi mentioned Memorandums of Understanding with Europeans and hurdles in the DOE system. **Hallman** said that was a perfect example of what is being discussed in the memo and directed Hafidi to communicate with Jehanne Gillo about problems being experienced.

Bob McKeown mentioned the HTC401 training for lab personnel, a five hour on-line course for certain countries. The training is about what to do if you are kidnapped or how to get out of a minefield. Within a year, in 2019, it will be required for all foreign travel, no matter the destination, and seems particularly inappropriate for the kind of travel lab personnel generally do.

Hallman suggested a more deliberate exercise on identifying regulatory burdens or other problematic issues.

Hertzog adjourned the March 2018 NSAC meeting at 4:19 p.m.

The minutes of the U.S. Department of Energy and the National Science Foundation/Nuclear Science Advisory Committee meeting, held on March 12, 2018, at the Crystal City Marriott at Reagan National Airport, Arlington, Virginia, are certified to be an accurate representation of what occurred.

David Hertzog, Chair of the Nuclear Science Advisory Committee on 5/11/2018.