Report of the Committee of Visitors of the Office of Nuclear Physics

(FY 2016, 2017, 2018)

December 9-11, 2019
Rockville, MD

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Table of Contents

Acronyms

AD – Associate Director
ANL – Argonne National Laboratory
ASCR – Office of Advanced Scientific Computing Research
ATLAS – Argonne Tandem Linac Accelerator System
BES – Office of Basic Energy Sciences
BNL – Brookhaven National Laboratory
CEBAF – Continuous Electron Beam Accelerator Facility
CUWIP – Conferences for Undergraduate Women in Physics
DEI – Diversity, Equity and Inclusion
ECA – Early Career Award
EDM – Electric Dipole Moment
EIC – Electron-Ion Collider
ESIPP – Enriched Stable Isotope Prototype Plant
FOA – Funding Opportunity Announcement
FPD – Facilities and Projects Division of the Office of Nuclear Physics
FRIB – Facility for Rare Isotope Beams
FRIB-TA - Facility for Rare Isotope Beams Theory Alliance
FS – Fundamental Symmetries and Neutrinos
GRETA – Gamma-Ray Energy Tracking Array
HEP – Office of High Energy Physics
HRIBF – Holifield Rare Isotope Beam Facility (Oak Ridge National Laboratory)
HRS – High Rigidity Spectrometer
INT – Institute for Nuclear Theory
IPA – Intergovernmental Personnel Act

IUPAP – International Union of Pure and Applied Physics
JLab – Thomas Jefferson National Accelerator Facility
LANL – Los Alamos National Laboratory
LEAF – Low Energy Accelerator Facility at Argonne National Laboratory
LENP – Low Energy Nuclear Physics
LMBB – Laboratory Manager's Budget Briefing
LRP – Long Range Plan
MIE – Major Items of Equipment
MSU – Michigan State University
MURR – University of Missouri Research Reactor
NLDBD – NeutrinoLess Double Beta Decay
NSAC – Nuclear Science Advisory Committee
NSCL – National Superconducting Cyclotron Laboratory
NSNA – Nuclear Structure and Nuclear Astrophysics
NP – Office of Nuclear Physics
NT – Nuclear Theory
OPA – Office of Project Assessment
OPC – Other Project Costs (supports project R&D)
ORNL – Oak Ridge National Laboratory
PAMS – Portfolio Analysis and Management System
PI – Principal Investigator
PNNL – Pacific Northwest National Laboratory
QCD – Quantum ChromoDynamics
QIS – Quantum Information Science
RHIC – Relativistic Heavy Ion Collider
SBIR/STTR – Small Business Innovation Research/Small Business Technology Transfer
SC – Department of Energy Office of Science
SciDAC – Scientific Discovery through Advanced Computing
SECAR – Separator for Capture Reactions
SIPF – Stable Isotope Production Facility
SIPRC – Stable Isotope Production and Research Center
sPHENIX – Super Pioneering High Energy Nuclear Interaction eXperiment
SRNL – Savannah River National Laboratory
TC – Topical Collaborations
TJNAF – Thomas Jefferson National Accelerator Facility
TUNL – Triangle Universities Nuclear Laboratory
WNSL – Wright Nuclear Structure Laboratory (Yale)

I. Executive Summary

The Committee of Visitors (COV) for the Department of Energy (DOE) Office of Nuclear Physics (NP) convened at Hilton Rockville, Maryland, December 9-11, 2019, to address the charge to NSAC on assessing the activities of NP with focus on two major elements: (1) the efficacy and quality of the processes and (2) the quality of the resulting portfolio, including its breadth and depth, and its national and international standing, for the review period of FY 2016– FY2018. The charge to NSAC is provided in Appendix 1.

The agenda for the COV meeting (see Appendix 2) included presentations, breakout sessions for further investigation, and meeting with the program managers. A list of committee members is provided in Appendix 3. To supplement the presentations by NP, the committee was provided with the COV book, containing an array of materials, through the Portfolio Analysis and Management System (PAMS). The committee was very impressed with the dedication and accomplishments of NP staff. Requested materials were provided in a timely manner and staff were forthcoming, responding frankly to our questions and helping us to understand the complexities of their work.

Following the roadmap laid out through the NSAC Long Range Plans (LRP), the NP science program is world-leading in many areas, and supports a broad range of research programs from hot and cold QCD, nuclear structure and nuclear astrophysics (NSNA), to fundamental symmetries and neutrino physics (FS) and isotopes production and research. NP's program is of vital importance domestically: in addition to contributing to a highly trained technical workforce, it carefully stewards a unique suite of major accelerator facilities – CEBAF, RHIC, ATLAS, and soon FRIB, and maintains a highly visible isotope program that supplies critical stable and radioactive isotopes for medical, industrial, and research needs.

The committee was impressed with the growth and capability of the DOE isotope program and with the exciting nuclear science being produced at the major facilities, concurrent with two major construction projects, one already completed (12 GeV upgrade) and another 92% complete (FRIB). The committee welcomes the recent creation of the fundamental symmetries program and the recent hires of the program managers of NSNA and FS. Other positive developments under the period reviewed include: the superb performance of the SBIR program; the reestablishment of domestic stable isotope enrichment and availability of the alpha-emitting isotope ^{227}Ac; the additional topical collaborations in nuclear theory and expansion of the FRIB theory alliance.

The NP proposal and oversight procedures are efficient and effective, processes are well documented, and funding decisions are consistent with reviews. The committee commends the efforts of NP in the formulation and execution of budgets, given the unique challenges faced during the time period reviewed. We found that the program has implemented fair review and selection processes.

It is our assessment that NP has been executing the priorities of the NSAC LRP through its funding decisions and overall program stewardship. Facilities are operating well and producing excellent research (LRP Recommendation 1) and significant investment is being

directed into major items of equipment (LRP recommendation 4). There have been careful planning and initial steps toward executing LRP recommendation 2 (neutrino-less double beta decay) and LRP recommendation 3 (electron ion collider).

With the exception of the first 2016 COV recommendation, NP was able to make good progress on all the recommendations of the last COV.

NP leadership has made incredible efforts during FY2016-FY2018 to steward the nuclear physics community and program managers ensured good balance and alignment of its programs with the NP mission. Due to several vacant positions, many NP staff have shouldered significant additional work to make sure all programs continue to run smoothly.

However, there are reasons for concern. The heroic effort of the leadership is clearly unsustainable and the committee has identified several potential points of critical failure. Most importantly, the full engagement of the Research Division director, a position that has been unfilled for nearly a decade, has become even more urgent. For example, there are important changes in the scientific landscape, bringing unique challenges and opportunities, and there are imminent critical decisions in the office that will occur roughly within a year, including the development of the next long range plan activity, the launching of a major new construction project, the next comparative review, and the response to new Presidential priorities.

The previous COV highlighted the risk posed by leaving the Research Division director position unfilled. Our assessment is that this risk is materializing, as demonstrated by several delays in actions: an FOA has gone out late, quadrennial reports have been shared late, NP joined the QIS initiative late, and the handling of the nuclear data proposals was delayed. The COV assessment is that, while these delays may have occurred in part due to the changes in administration, the absence of the Research Division director is the predominant factor. This individual is essential, not only to provide leadership to the research portfolio as detailed above, but also to perform the much-needed daily activities in the office, including recruitment, mentoring and workforce development, establishing consistent practices in the Research Division, and providing oversight in managing the changing science portfolios. Therefore, our highest priority recommendation is to fill this position within a year. Given the limitations in hiring federal employees, NP should consider all alternative options to accomplish this goal.

Recommendation 1. It is urgent that the Research Division director position be filled within a year. The Research Division director is imperative for the health of the NP office and the community it serves. The division directors, in conjunction with the AD, are essential to lead new initiatives aligned with national priorities.

While NP has successfully recruited new program managers since the last COV, new programs have been created, some program managers have recently retired, and others are close to retirement. Several support staff positions are also vacant. Most importantly, the COV noted that the operations at NP hinge heavily on a few key individuals. Developing and

implementing a succession plan for NP staff will mitigate the risks of a crisis. This plan should accommodate areas of potential future growth.

Recommendation 2. The COV recommends that the NP leadership develop a succession plan for the entire office. This plan needs to mitigate the risk involved in the potential loss of critical staff in the office.

The COV noted the workload of the Theory program manager and considers it critical to reduce this burden, even after the Nuclear Data and Computing program managers are in place. Given the size and diversity of the theory program, it is important to attract to NP an additional scientist to work together with the current program manager in handling the large proposal load. This scientist could be a detailee.

Recommendation 3. In addition to filling the current vacancies, the office should bring on board an additional scientist to support the nuclear theory program.

The committee was extremely impressed with the progress NP made on diversity, equality and inclusion (DEI) since the last COV. NP established clear expectations of conduct for all awardees and is broadly disseminating this information to ensure all PIs have a clear understanding of these expectations. NP has also been proactive by discussing diversity and inclusion issues at the start of panel sessions, establishing significant representation in panels, and reviewing the annual SC Laboratory Diversity and Inclusion Plans. The Office is commended for starting to monitor the demographics of the PIs on grant submissions and awards. Having these records will enable the office to monitor progress on efforts to enhance the diversity of the nuclear physics research community.

Recommendation 4. The office should continue their efforts to increase diversity and inclusion in the community of PIs and those supported by their grants. Such a process should be informed by data to the extent possible.

The NP program is developed in close consultation with the nuclear physics community, and this partnership is crucial for the vitality of its programs and their national and international standing. A primary link in this consultation is the advice provided by the DOE-NSF Nuclear Science Advisory Committee (NSAC) through charges from the agencies to create long range plans for nuclear science and specialized advice on individual nuclear science topics. For over 40 years, the LRPs developed by NSAC have driven the scientific pursuits of the field. NSAC is chartered under the Federal Advisory Committee Act and it is important that it continue to play its significant advisory role.

Recommendation 5. The COV recommends that the Office of Science maintain the strong relationship between the Office of Nuclear Physics and the U.S. research community through the Nuclear Science Advisory Committee.

The COV makes the above five recommendations to NP and SC. The COV requests that NP report back to NSAC on progress within a year of the presentation of this report.

II. Major findings, comments and recommendations

An array of information was shared with the COV. Most materials were available through PAMS. During the weeks preceding the COV meeting, the committee members had access to a wide range of materials encapsulated in the COV book. In addition, selected proposals and annual reports were made available during the COV meeting. The COV made an effort to ensure that the selected proposals were representative of the multitude of activities carried out by NP. We included proposals awarded, declined, a range of award amounts and different examples of nearly all solicitations. Unfortunately, the COV was not able to review the selection statements on awards (these are buried in PAMS and instructions on how to access these arrived only in the last day). Progress reports and quadrennial reviews from laboratories were made available (these were not in PAMS). Project proposal folders, as well as all project monitoring documentation, were accessible to the COV. Included were the 2016 COV report and NP response and documentation on NP budgeting, project oversight and review mechanisms. Concerning the DOE Isotope Program, the COV had access to the list of available isotopes for sale and active initiatives, policies for entering/exiting markets, mitigating foreign supply, and the overall strategic plan. In providing access for individual COV members to this array of materials, the NP conflict of interest policy was ensured by NP staff.

The COV meeting ran for three days: the first day was mostly used for presentations by the NP; the second day was structured with time allocated for the committee to absorb the information provided during the first day and discuss it amongst the subcommittee members and with the program managers, and for the NP to respond to homework questions from the COV that were generated during the first day; and the third day mostly focused on integrating findings and comments, developing the recommendations, and presenting the findings and recommendations to the NP in a closeout session. The subcommittee meetings with program managers and the closed sessions with the NP leadership were essential to further understand processes, decisions and challenges. The agenda for the COV meeting is attached to the report in Appendix 2.

All presentations during the COV meeting were made available in PAMS and, in addition, each program manager prepared a focused presentation with the highlights of their respective program (available through PAMS). Additional materials relevant to the charge were collected during discussions and from homework exercises (Appendix 4).

A. The effectiveness, efficiency and quality of the processes used to solicit, review, recommend, and document proposal actions.

Findings:

NP Staffing

The theory program manager is handling a very large theory portfolio, which covers all national laboratories and a wide array of university PIs, in addition to more complex initiatives such as topical collaborations, the INT, SciDAC and the Facility for Rare Isotope Beam Theory Alliance (FRIB-TA). The last COV pointed out that the program manager for theory was overburdened. Since then, the program manager for nuclear data and computing has retired and the theory program has grown, further increasing the workload.

The low energy nuclear physics (LENP) program managers provide support for the research groups at the national laboratories and universities. The program manager for fundamental symmetries and neutrinos (FS) joined the office in 2016 as an IPA and has transitioned into a permanent position. The program manager for nuclear structure and nuclear astrophysics (NSNA) was hired in summer 2019 (after the period of consideration for this COV) and is the most recent addition to the office.

The administrative specialist position aiding the Associate Director is vacant, as is the financial advisor position, responsible for budget formulation. The COV heard that the fact that these positions have not been filled poses additional burden on those that have to step in to execute these functions.

A federal detailee has been identified for Heavy Ions, enabling the detailed staff member from the Facilities Division to go back to their full-time duty.

General processes for proposals

The primary mechanism for soliciting proposals to the programs is through the general Funding Opportunity Announcement (FOA) by the Office of Nuclear Physics. New proposals need to be submitted to NP by September 30 each year to receive full consideration in the following fiscal year. Renewals are handled on a rolling schedule.

For the open FOA there are no panels, but some program managers make an extra effort to institute a “pseudo-panel” review by sending several proposals simultaneously to a group of reviewers, with the aim of normalizing the scores across the subset of proposals.

Large university groups can be funded through umbrella grants. Typically, a senior faculty member in such an umbrella grant becomes the PI and receives all communication from the NP office.

The proposal review and managing is done using PAMS. Progress reports for active grants are submitted by the PIs in PAMS.

The selection statements explaining the decisions to award/decline were not readily available to the COV. Instructions on how to access these statements were shared on the last day of the COV meeting.

Laboratory research funding differs from university grants as there are typically long-standing research efforts that are part of a base program. Proposals for funding new research ideas or expansion of existing research are handled by four mechanisms: the quadrennial reviews, the Lab Managers' Budget Briefings, and the annual continuation reports and targeted FOAs .

Laboratory research efforts have been normalized in the past with university research via the comparative review process, the last of which occurred in 2013.

During the period of this COV, quadrennial reviews of national laboratory research groups were carried out for the NT (2016) and NSNA & FS (2018) programs. The reports for the NSNA & FS quadrennial reviews did not contain a numerical score and were less detailed than previous reports.

Theory

The theory portfolio includes all areas of research from hot-QCD and cold-QCD, hadronic matter, nuclear structure and reactions and nuclear astrophysics, and fundamental symmetries. During the funding period FY16-18, there were 141 proposals submitted and 82 awards, most of them renewals. The theory program has very limited turnover on renewals, and in the theory program the primary mechanism for obtaining new funding is the ECA.

We note that the theory portfolio involves the largest number of grants managed by any single program manager (roughly double of other subfields). In the review period the nuclear theory program manager also shared the burden of the nuclear data and scientific computing programs. We were told that this issue may be alleviated in the near future with the hire of program managers for nuclear data and computing.

The Topical Collaborations (TCs) in Nuclear Theory and the FRIB Theory Alliance (FRIB-TA) represent a robust part of the NP theory program, are covering a wide array of science topics, and addressing key areas in connection to NP facilities.

Heavy Ions

The heavy ion portfolio includes most experimental efforts at RHIC and a considerable experimental program at LHC. During FY2016-FY2018 there were 43 proposal awards, 16 declined and 3 withdrawn. Although the program manager during FY2016-FY2018 has now moved back to the Facilities Division within NP, he met with the subcommittee to discuss heavy ion program details.

The program manager shared an analysis performed on his portfolio showing: a) an overall increased funding amount for laboratory groups compared to universities, and b) an apparent correlation of performance ratings and amount of funding for university funded awards.

Medium Energy

The medium energy portfolio includes experimental cold QCD at Jefferson Lab, RHIC, Fermilab, and TUNL, as well as several experiments in fundamental symmetries (*e.g.*, Qweak, Moller, TREK, etc.). The program manager was on vacation and unavailable for discussion during the COV meeting.

For the three years under examination there were 68 medium energy proposals awarded, 8 declined, and 11 withdrawn. The other program areas had a significantly lower award rate.

Low energy and fundamental symmetries

The program supported about 55 grants for universities each year during the review period of FY2016 to FY2018. The total number of applications during this period was 118. The data provided to the COV were already divided into the two separate program components: Nuclear Structure and Nuclear Astrophysics (NSNA) with a total of 70(39) proposals submitted (awarded), and Fundamental Symmetries and Neutrinos (FS), starting in FY 2017 with a total of 48(23) proposals submitted(awarded). The number of university grants funded in NSNA in FY2017 and FY2018 was constant at 32. There was a slight increase in the number of FS grants from 23 in FY 2017 to 28 in FY 2018. Some of the growth in the FS program during this period is associated with researchers on the nEXO R&D project transitioning from HEP to NP.

Expert input on proposal reviews is obtained via mail reviews. The success rate for renewal applications in these programs during this three-year review period is high, greater than 95%. The success rate of new proposals in these programs is about 30% during this same period.

The FS program manager has worked toward establishing standardized procedures and tools for the activities and business operations of these programs. He has also demonstrated initiative in using tools such as PAMS for an analysis of demographics in grant applications.

Facilities

Priorities for the accelerator R&D FOAs and awards were set by an FY2017 panel review. The research priorities have been updated since, as the design options for EIC have evolved and labs have retired some issues. Beyond the FOAs, some accelerator R&D projects are approved at individual labs to maintain and advance core competencies.

The SBIR/STTR programs managed by NP encompass cumulative annual funding of approximately $20M, corresponding to the mandated 3.65% of overall extramural NP funding. In FY2018, 145 Letters of Intent were filed, resulting in 90 considered proposals. The NP solicitation for SBIR proposals now includes a requirement that Phase I proposals

present a plan to produce a working prototype of the proposed technology to be tested at an NP facility by the end of a possible follow-up Phase II project. NP provides technical reviews of SBIR/STTR proposals, while the SBIR Office provides reviews of commercialization potential. Awards are decided based on positive reviews, including of commercialization potential, and a match to priorities of the NP research portfolio.

One NP staff member is assigned lead responsibility for the SBIR/STTR program and also serves as the liaison between NP and industry.

The accelerator R&D portfolio is managed separately by the Advanced Technologies R&D program manager, who also helps with the SBIR and STTR programs.

Projects

NP reported that the NSAC Long-Range Plan (LRP) process gives guidance on priorities for major projects. Projects can arise from the Laboratory Manager Budget Briefings (LMBB), from FOAs generated to call for project work, or from self-organized initiatives directly from the community. GRETA, SECAR and HRS are good examples of the latter: the LMBB showed an FRIB need for instrumentation and the FRIB Users Organization was instrumental in helping and self-organizing.

University-based projects come in through their respective research program. Communication with the community on projects happens through the relevant facilities. It is the facility that takes charge of interacting with the community to work on plans and proposals to the office of Nuclear Physics. Currently there is no designated laboratory representing neutrinoless double-beta decay as a whole, though there are lead labs for individual project stewardship.

Concerning the review processes: large Projects >$50M, follow standard DOE Order 413.3B rules; projects between $20M and $50M may propose to be considered for delegation to the Laboratories for oversight, upon successfully achieving CD1; and MIEs >$10M follow principles of the DOE0413.3 and the Office of Project Assessment (OPA).

The Office of Nuclear Physics discusses with OPA, on a case by case basis, projects between $10M-$20M and they adjust their oversight and tailor their approaches based on the cost, complexity, risk and the track record of the project management organization and the project team. Projects between $10-20M are typically carved out of base funding and must be carefully managed.

To improve labor tracking, projects include all labor in the project plans – even if they are at a cost of $0 to the project.

Concerning documentation, everything related to projects is documented and archived in a single NP shared drive with each project identified. Every charge letter, closeout report, and all review documentation can be found in one place.

Isotopes

The DOE Isotope Program manages a broad-based R&D portfolio composed of competitive bi-annual and annual base activities at national laboratories including ANL, BNL, LANL, ORNL, PNNL, SRNL, and TJNAF with the competitive FOA opportunities following normal NP processes for solicitation and review.

Universities also participate in a separate FOA process: during FY2016-FY2018 the office received 41 proposals and awarded 25.

Key areas of isotope production research include development of novel or improved processes for recovery and purification of critically needed radioisotopes, thermal hydraulics and particle transport modeling associated with target irradiation, and enrichment science associated with electromagnetic and gas centrifuge isotope separation methods. Funding for isotope production R&D increased from $6,329K to $9,900K from FY2016 to FY2018.

We note that documentation for declination of proposals is maintained on a spreadsheet that is accessible by all program managers in the DOE Isotope Program.

The program manager stated that it continues to be challenging to find a sufficient number of non-conflicted, qualified reviewers for the Isotope R&D FOA. This was stated to be a reflection (in part) of the relatively small number of people in the field. Managing the review process is also made more difficult due to review panel conflict of interest issues arising from required specialized technical subject matter expertise and concurrent solicitations from ECA and SBIR/STTR calls.

The DOE Isotope program consults with all levels of government as well as many commercial stakeholders on the need and use of isotopes, through engagement in working groups and advisory boards. The program benefits from the Nuclear Science Advisory Committee Isotopes Subcommittee that provides important input into long-term strategic planning.

The DOE Isotope Program has successfully grown the base budget and investments for research and mission readiness, which has enabled the program to increase the quantity and range of isotope product lines. Overall, including both appropriations and revenues, the DOE Isotope Program funding grew from about $70M in FY2016 to over $110M in FY2018. These investments have led to the current isotope production at 8 locations (both national laboratories and universities) and the program is in the process of adding 3 new sources for isotopes. During the period of FY 2016-2018, the DOE Isotope Program added new isotope production capability from additional LANL processing, irradiations at LEAF at ANL, stable element enrichment via Enriched Stable Isotope Prototype Plant (ESIPP) at ORNL, and two university production sites at the University of Washington Cyclotron and the MURR research reactor.

The ESIPP equipped with an electromagnetic isotope separator began producing 500 mg of Ru-96 in 2017. Ru-96 was unavailable anywhere in the world in quantities and enrichment needed for a fundamental physics experiment at RHIC in 2018.

Early Career Awards (ECA)

The COV was given statistics for FY2017, 2018, and 2019. In those three years there were about 50 applicants per year, of which 15 – 20% were awarded. Of the 24 ECA proposals funded in FY 17-19, one was in the area of isotope research.

ECA proposals are sent out for mail review. There is no consistent process for ECAs: some years there is an external panel, while in others the panel is composed of program managers only. Program managers send external reviewers multiple proposals to review to provide some normalization in the review.

Diversity

NP was strongly involved with the effort within the Office of Science to establish clear expectations of conduct for all awardees. The AD has brought this message to the community in no uncertain terms.

NP (as well as other SC offices) has been proactive in reviewing the annual SC Laboratory Diversity and Inclusion Plans, providing critical assessments. Additionally, NP has had interactions with the SC laboratories it supports to promote infant nursing stations consistent with laboratory policies.

NP has established the process of starting each of its review panels with a diversity discussion. There is no evidence that similar information is provided for mail reviews.

Representation of women on panels has increased significantly, with review panels typically at 20% and NSAC at 50%.

SC has instituted a provision for ECAs to extend eligibility past the 10-year-since-PhD mark for individuals who have had a major life event requiring an extended absence from the workplace, including but not limited to active military service, an absence due to personal disability, or an absence covered by the Family Medical Leave Act. No instructions are given to reviewers on how to take this into account when evaluating the proposal.

Changes in PAMS have resulted in collection of demographic data on almost all of the PIs in the program. While the changes require people to respond to the demographic questions, there is an option to choose that they do not wish to provide the information.

NP has just begun to track statistics regarding performance on diversity issues.

NP supplies funds for the Conferences for Undergraduate Women in Physics and for the American Chemistry Society Division of Nuclear Chemistry and Technology summer school, which has 50% female participants.

Comments:

NP Staffing

The NP leadership has performed admirably during the review period and should be commended for excellent stewardship of this vital national program. This is even more impressive given that the three-year period under review included unusual challenges and uncertainty.

Nevertheless, the COV notes that both NP senior management and program managers cited extreme stress due to insufficient staff to manage the growing workload throughout the Nuclear Physics program.

Research Division Director Position:
The COV is very concerned with the fact that the Research Division Director position has now been unfilled for ten years. We are at a particularly crucial time, a time that needs the undivided attention of a Research Division Director, working hand-in-hand with the Facilities Division Director and the Associate Director of NP. In the near future, the NP office will engage in steering forward the construction of the nation's next major accelerator facility – the Electron Ion Collider – a high priority recently endorsed by a special National Academy of Sciences study. The EIC represents an innovative accelerator development having potentially significant impact not only on nuclear physics scientific questions, but also on advanced accelerator science. Similarly, the NP office, in response to Recommendation #2 of the most recent Long Range Plan, will initiate a ton-scale neutrinoless double beta decay experiment, a worldwide, high-priority experimental endeavor whose outcome has potentially profound scientific consequences.

Recently, the National Quantum Initiative act has set the nation on a direction of advancing quantum computing and quantum information science. Nuclear physics, as evidenced by the recently completed comprehensive evaluation contained in the NSAC report Quantum Information for Nuclear Science, has a tremendous talented workforce that is expected to have impact on QIS national priorities. Similarly, we can expect that the new national priorities on Artificial Intelligence and Machine Learning (AI/ML) will benefit from expertise of nuclear scientists. The landscape is also evolving in nuclear data and nuclear security. These major new initiatives will require effective and concentrated stewardship.

The NP office is planning its next comparative review in the next year, the details of which are still being worked out; it could be a cross-subdiscipline review. This major periodic exercise is a significant undertaking of the office and requires the Research Division leadership. In addition, it is expected that a new Long Range Plan will be initiated, again benefiting from Research Division leadership.

Within the NP office, the Research Director is needed to hold weekly program manager meetings, provide training, workforce development, and to help negotiate and manage the portfolio migration as the science program evolves. Establishing consistent policies in grant reviews and maintaining an appropriate funding balance among the various research

programs are other crucial roles that require the attention of a dedicated Research Division Director.

All these activities require the full engagement of a Research Division Director. It is urgent that this position is filled now. It is most desirable to fill it with a Senior Executive Service appointee, but the urgent need necessitates consideration of temporary measures, such as recruitment of an experienced and broadly respected IPA for a 2-4 year interval.

Succession plan:
Some program managers have recently retired and others are close to retirement. Critical senior staff have an extraordinarily heavy load of responsibilities with an understaffed office, which has become visibly unsustainable. There is a high risk of losing institutional knowledge in NP. Having a succession plan in place will mitigate the risks of a crisis. This plan should accommodate areas of potential future growth.

Theory program manager:
As in COV2016, this COV noted the workload of the Theory program manager and considers it critical to reduce this burden, even after the Nuclear Data and the Computing program managers are in place. Theory is an essential component of the NP program, and the size and diversity of the theory program requires two people. With the recent retirement of the other theorist in the office, it becomes even more critical to have an additional scientist that can work together with the current program manager in handling the large proposal load. This scientist could be a detailee.

Other vacant positions:
The NP should continue to work toward filling all vacant positions, including the administrative specialist aiding the Associate Director and the financial advisor responsible for budget formulation.

General processes for proposals

The NP proposal procedures are efficient, and funding decisions appear consistent with the reviews.

The program managers seem to be mostly satisfied with the capabilities and features of PAMS for grant management.

Now that PAMS is working well for the program managers, the office should consider how the interface used by PIs for submitting progress reports might be improved. For example, the submission of products, e.g., publications, is tremendously tedious. Each item must be submitted individually. One possible improvement would be to allow PIs to submit the products as a single file.

Limiting communications to the head PI on grants limits the exposure of the less senior Co-PIs, who are more likely to be from an under-represented group.

It is not clear to PIs how to communicate personnel issues affecting productivity, such as family leave, to the reviewers and program managers via their grant proposal.

We commend several program managers in developing standardized practices and tools for the management of their research portfolio and in considering new ideas for the fair selection and distribution of grants in support of the mission and scientific objectives of the program. We urge the Research Division to continue to develop the tools and operational procedures that strengthen the organizational structure of the office.

The Research Division should explore options to accommodate faculty who want to shift their research across different program areas. For example, heavy ion researchers may want to move to EIC physics at some point. Some medium energy researchers may be better suited to the FS program.

Theory

FRIB-TA, INT and TCs play an important role in pursuing new strategic directions and aligning theory efforts with the Long Range Plan. Continued support of these programs at healthy levels will provide long-term benefits not only to the theory portfolio but to the Research Division as a whole.

Heavy Ions

We commend the efforts for improved comparative review procedures. The availability of comparative review mechanisms is important to ensure uniformity in funding decisions. We commend current efforts to correctly sample the population demographics for mail-in referees. The sampling mechanism implemented by the heavy ion program manager is a simple, yet effective way to ensure proper involvement of under-represented groups.

Following the initiative of the program manager to analyze data concerning the distribution of funds and dependence on the size of the group, further analysis is encouraged across the Research Division to understand potential biases.

Medium Energy

Now that NP has separated out the program in Fundamental Symmetries, the office should consider whether to migrate the relevant parts of the medium energy portfolio to FS.

Low energy and fundamental symmetries

The increase in the FS grants from FY 2017 to 2018 appears to coincide with the period when some research groups in the nEXO collaboration were transitioning from HEP to NP support.

Laboratory Research

The Committee found that the quadrennial peer reviews provided a good assessment of the Laboratory research programs and the program mangers indicated that they were

valuable. The quadrennial reviews have not occurred on a regular basis, with some NP programs skipping years. This irregularity in the schedule can lead to a reduced opportunity for both the NP office and laboratory research efforts to have new research ideas peer reviewed.

Facilities

Six different Accelerator R&D projects were randomly selected for an in depth review with input from the program managers. The review process is well defined for accelerator R&D projects and relies on priorities established by a panel of experts. No issues of note surfaced in our review of these projects.

Management of the SBIR/STTR portfolio has been effective and proactive. Funding decisions have been made in consultation with Program Managers of affected NP research programs. Awarded proposals have been chosen and carefully monitored with an eye toward optimizing technical impact on the overall NP research portfolio. Several examples of significant impact from SBIR/STTR projects on the NP portfolio from the FY2016-2018 period were crisply presented during the COV review.

Projects

The review team was impressed with the processes used by the NP project team to oversee projects. The solicitation, reviewing, and tracking of projects makes sense and is being done in a way to best handle the portfolio, with a combination of standard reporting requirements and a tailored approach depending on project size, complexity and the experience of the laboratory and the project team.

The office is to be commended on the archive that they have developed to track project documentation, although having the ability to collect and analyze data would be an added benefit with a more modern data collection system. This collection of all documentation in one place was reported as being extremely useful to the NP staff.

Isotopes

The extremely heavy workload generated by the unfilled positions in the Research Division represents a significant future risk to the continued successful performance of the DOE Isotope Program, as leaders within the DOE Isotope Program help fill gaps within the overall NP program. The COV urges senior DOE management to consider increased priority for filling positions within NP to mitigate what is becoming a major risk to the whole program, including the DOE Isotope Program.

The increase in DOE Isotope Program funding for research into irradiation and separation techniques is leading to very positive impacts in the isotope community. In particular, establishing routine production of the alpha-emitter Ac-225 for targeted alpha therapy and the efforts to develop routine production of Ac-227 for the clinical use of the new prostate cancer treatment drug, Xofigo®, are especially impactful.

Planning for investments in infrastructure to increase the production capacity, efficiency and effectiveness of DOE Isotope Program activities throughout the network of isotope research and production sites is essential to the continued success of the program.

The DOE Isotope Program management team is highly commended for successfully implementing 2009 and 2015 NSAC Isotope Long Range Plan recommendations related to re-establishing domestic stable isotope production.

ECA

The COV's assessment is that the program managers are effective stewards of the ECA program. For some areas (such as theory), the ECA program is the primary mechanism for funding PIs for the first time, and as such plays a crucial role in the long-term vitality of the field and the international competitiveness of the U.S. nuclear physics programs.

We found the funded ECA proposals to be of exceptional quality and that even many declined proposals would have easily surpassed the merit threshold for funding.

We encourage NP to monitor the diversity demographics of ECA applicants and awardees.

To ensure a level playing field for more applied research proposals such as in isotopes, NP should consider including an isotope researcher on the next external ECA review panel.

Diversity

NP should be commended for the significant efforts it has put forth to increase the diversity and inclusion in the community.

NP should be commended for the progress in increasing the representation of women on panels.

NP, and the AD in particular, are commended for their efforts in getting the Office of Science to take a serious stance on the unacceptability of harassment. The Office of Science is encouraged to take the next step and ensure that procedures are developed to handle reports of Code of Conduct (CoC) violations.

All participants that are involved in grants/proposals should be entered in PAMS and demographics data for them collected and analyzed. The requirement of PAMS profiles existing for all senior personnel before a proposal gets sent out for review can capture important demographic data. Profiles for postdocs and students can be required as part of the annual reporting as is done by NSF.

SC should be commended for instituting a stop-the-clock provision in the 10-year rule for ECA proposals. The effectiveness of this change within the NP community could be enhanced by broadly communicating this provision to the community. It is also important to provide clear guidance to reviewers when these circumstances are relevant in both proposals for ECA and other solicitations.

NP should consider how it can help guide the community toward increasing diversity in dimensions beyond gender.

NP should consider expanding their diversity and inclusion efforts to include developing office-wide procedures aimed at reducing bias in the mail review process.

Recommendations:

1. It is urgent that the Research Division director position be filled within a year. The Research Division director is imperative for the health of the NP office and the community it serves. The division directors, in conjunction with the AD, are essential to lead new initiatives aligned with national priorities.

2. The COV recommends that the NP leadership develop a succession plan for the entire office. This plan needs to mitigate the risk involved in the potential loss of critical staff in the office.

3. In addition to filling the current vacancies, the office should bring on board an additional scientist to support the nuclear theory program.

B. The monitoring of active projects and programs.

Findings:

General processes for monitoring

Progress on awards is monitored by the program managers mainly via annual progress reports that are submitted in PAMS by the PIs and via periodic requests for research highlights.

Laboratory research programs are, in principle, reviewed by panels every four years (by subfield), however, the same is not done for renewals of university awards.

Some program managers have engaged with the community through individual meetings and visits, through interactions at the annual Division of Nuclear Physics meeting, and at topical meetings and reviews as appropriate.

Program managers are working toward executing the priorities established in the last NSAC Long Range Plan.

Theory

Of the 82 awards made during FY16-18, 72% were renewals. All proposals submitted for renewal were awarded.

Low energy and fundamental symmetries

The LENP program is growing in terms of researchers, research scope and facilities. With the hire of the FS and NSNA program managers, the important areas of nuclear structure and astrophysics as well as neutrinos and fundamental symmetries each have now the attention of individual program managers. During the period of this review the program of LENP was partly managed by the current FS program manager, with his main focus on neutrinos and fundamental symmetries, while another IPA supported nuclear structure and nuclear astrophysics.

Of the 32 NSNA grants in FY2018, five (16%) supported research led by women PIs. The FS program supported 28 grants in FY 2018, of which four (14%) were led by women PIs. The program manager for FS stated he is drawing on a broad set of experts in the community for reviews and is aware of potential bias issues and the impact on diversity and inclusion in the review process. He is applying the criterion of relevant expertise in the selection of the reviewers while paying attention to issues of diversity.

Laboratory Research

Laboratory research is monitored through two mechanisms: the annual continuation progress report and the quadrennial reviews. Financial aspects and highlights of laboratory research are presented in the Laboratory Managers' Budget Briefings.

Some of the program managers expressed the opinion that the continuation reports could be improved to better convey the status of the laboratories' programs.

Program managers expressed the need for more frequent research highlights.

The reports from the NSNA & FS quadrennial review in 2018 were received by the laboratories 24.5 weeks after the reviews. New program managers expressed the concern that several interactions with laboratories that occurred prior to the arrival of the reviews were less formally documented, leading to less continuity and understanding of past decisions.

Facilities

NP provided funding for, and oversaw the operation of, three national user facilities at National Laboratories during this assessment period: RHIC (BNL), CEBAF (TJNAF), and ATLAS (ANL). Disposition activities were completed at HRIBF (ORNL) and WNSL (Yale).

Facility Operations accounted for approximately 50% of the overall NP budget with the three user facilities receiving consistent portions and the majority of the operations budget over FY2016 to FY2018, as follows: RHIC (28% of overall NP budget), CEBAF (16%) and ATLAS (3%).

The Facility for Rare Isotope Beams (FRIB) is under construction at MSU and the project is about 92% complete. Project completion (Critical Decision 4) is scheduled for FY2022. The program manager for Heavy Ions transitioned back to the Facilities Division from the Research Division in early FY18, and oversaw establishment of the cooperative agreement with MSU for FRIB operations. A five-year cooperative agreement was put in place and the transition from the construction project to operations is currently underway, with productive involvement and coordination with NSF, which currently funds NSCL operations.

The 12 GeV upgrade at TJNAF, another major construction project within NP during this assessment period, was completed in September 2017. TJNAF began operating CEBAF for the 12 GeV scientific program in FY2018.

The Low Energy electron cooling project at RHIC has made good progress, leading to the first-ever demonstration of bunched-beam electron cooling in 2019, fueling the research program associated with the second-phase beam energy scan.

NP was able to fund two major construction projects while continuing to operate the existing facilities. With relatively stable budgets, some funds were made available for some Major Items of Equipment (MIE) projects as well during this period, and no major cuts to existing programs were required.

NP is working to develop an operating model for the LBNL 88" cyclotron that is resilient to external funding sources. The 88" is utilized for radiation effects testing (important for national security), which provides some of the operating costs of the facility, but requires partnerships with external entities.

Facilities oversight is provided through a combination of biennial science and technology reviews, site visits to the facilities in the intervening years, operations reviews every four

or five years, monthly meetings with operations staff, biweekly phone calls with facility managers, and frequent informal participation by NP staff in regular status meetings at the various facilities.

At least one large funded accelerator R&D project experienced difficulties in achieving goal tests, with some of the problems attributed to issues in oversight of the project from the laboratory management.

Projects

Project monitoring occurs in multiple ways: regular calls (weekly for larger projects, monthly calls for medium projects, and quarterly for smaller ones). The calls discuss a good balance of high-level project review topics and details where there are issues.

Large projects are managed through the O413.3B formal process with regular reviews and standard reporting. While the oversight of mid-size projects ($20-50M) may be considered for delegation to the laboratories following CD1, the NP office remains strongly involved in project monitoring at this scale, and retains the main responsibility for oversight of smaller projects.

PAMS is used for monitoring projects at the universities.

When a large project runs into issues, an increase in OPA review frequency is applied to help solve issues. All projects can expect increasing calls with the office, intervention, or in extreme cases, a Stop Work order.

During times of challenge, the office manages to keep things moving and alive in innovative ways. Shared projects are of particular concern and require careful oversight by the office. When working with other funding agencies, like the NSF, joint calls and reviews occur and scope is shared.

All projects are proceeding on cost and on schedule (some of these actions lie outside the FY2016-2018 timeframe, but demonstrate significant progress):

- SIPF made a down-select of gas centrifuge machine designs
- GRETA procured three additional detector modules
- sPHENIX initiated long-lead procurements for detector component fabrication
- FRIB construction continued according to the baseline profile

Isotopes

The Facilities & Project Management Division has two deputies, one focused on nuclear physics activities and one for the DOE Isotope Program. Two program managers were recently hired to fill the isotope production accelerator and reactor facilities positions.

The DOE Isotope Program conducts bi-annual site reviews as well as one-day site visits in the off years to monitor the active programs within the DOE complex. Biennial facility science and technology reviews were conducted at the major accelerator (BNL and LANL) and reactor production facilities (ORNL) during FY2016-2018.

An annual strategic planning meeting is held for the DOE Isotope Program, where the program managers and all sites participate, to communicate within the program and gather input with respect to priorities and needs.

An extensive and detailed DOE Isotope Program National Strategy document has been prepared.

Workforce development is a stated priority for the DOE Isotope Program, and is supported through a variety of mechanisms including the Nuclear and Radiochemistry Summer School and DOE Isotope Program competitive and base R&D funding.

Additional isotopes are available from the DOE Isotope Program that mitigate dependence on foreign supply (including Sr-90, Cf-252, and Am-241) and/or address needs that are not able to be met from commercial suppliers. The program has mitigated dependence for 18 of 21 isotopes where domestic availability was previously dependent upon Russia and other countries.

DOE has added to the university supplier network, which is desired to address boutique isotopes and more cost-effective production of certain isotopes, with a strong component of workforce development.

The DOE Isotope Program has addressed the majority of recommendations from the 2015 NSAC Isotopes Subcommittee Report (*Meeting Isotope Needs and Capturing Opportunities for the Future)*, including the increases in R&D funding with an emphasis on alpha emitters, pursuing stable isotope separation capability, integration of university facilities, and improvements at the accelerator facilities. The one outstanding item, regarding capability for radioactive isotope separation, is in progress.

Two Accelerator Improvement Projects (AIP) were successfully completed at Brookhaven (BNL) and Los Alamos National Laboratories (LANL) that enhanced capabilities at each site.

Comments:

NP staffing

The growing and evolving research program of fundamental symmetries and neutrinos has benefited from the attention of a dedicated program manager. Over the last couple of years the FS program manager has established himself as an engaged and trusted program manager with the community, who is actively working towards leading and shaping a world-class program in neutrinos and fundamental symmetries. He has managed the portfolio of research in neutrinos and fundamental symmetries well and we commend him for leading this area at such a critical time.

General process for monitoring existing awards

The current mechanism and level of monitoring the progress of grants seem adequate.

We commend the program managers who engage the community through briefings, and solicit regular updates from PIs on their work, and in particular on R&D projects.

We commend the FS program manager that has worked towards shaping a process and vision for the development of a ton-scale double beta decay program. His active management will continue to shape the future of the field and position the U.S. program to seize upcoming scientific opportunities.

The fact that renewals of awards at universities are not reviewed by panels can limit the flexibility of the university portfolio to integrate new investigators and take advantage of emerging opportunities. This appears to impact theory more than other programs.

A smaller-scale comparative review, focusing only on a subfield at a time, could provide the required flexibility while maintaining the high quality of the university programs, particularly for theory.

Laboratory Research

There appears to be a miscommunication in the expectation for the laboratory continuation progress reports. Some of the program managers expressed the opinion that they could be made more useful. Some COV members feel the laboratories do not get adequate feedback on the reports. It would be worth a dialogue to improve this situation.

The delay in the NSNA & FS quadrennial review reports and the irregularity in the quadrennial review schedule were impacted by the vacancy in the Research Division Director position.

Facilities

NP communication with and oversight of the facilities is strong and effective. FPD program managers appear to be very well versed on both technical and research issues at all the facilities.

Oversight of FRIB as a major national user facility housed at a State University is likely to involve some unique issues and differences from oversight at national laboratories, for example, concerning safety management. The Facilities Division managers appear to be doing a good job of anticipating and planning for those unique issues.

Projects

The Office of Nuclear Physics does a thorough and appropriate job of monitoring the project portfolio, including working through the challenges associated with other funding agencies.

We note, additionally, the following FY2019 activities, illustrative of successful early project planning:

-HRS and MOLLER received modest Other Project Costs (OPC) funds for R&D activities in FY2019

-SIPRC received modest OPC funds to develop a conceptual design

In particular, the Office actively developed a path forward for a ton-scale neutrinoless double beta decay (NLDBD) experiment consistent with the 2015 Long Range Plan and guidance from the 2015 NSAC Report *Neutrinoless Double Beta Decay*. Specific actions included R&D on demonstrations of the technology for NLDBD, establishing an independent research program focused on fundamental symmetries and neutrinos, and obtaining a CD0 for the ton-scale effort. The size of the resulting ton-scale project (greater than $200M) will require active laboratory management and advocacy.

Isotopes

The DOE Isotope Program efforts to ensure continuing and increasing availability of high priority isotopes is very impactful for the medical, industrial, and research communities. Bringing university partners into the network will continue to broaden the portfolio and bring increased access to short-lived unique therapy isotopes such as At-211.

The workforce development efforts are commended and should be continued.

The DOE Isotope Program National Strategy (an Official Use Only document) is a broad and forward-thinking document that addresses a wide suite of needs and potential opportunities that would have long-term benefit to the Nation. The level of effort and detail in this document will facilitate robust growth and addresses near-term needs as well as high-risk, high-reward potential items. These types of strategic efforts are vital to the program and are encouraged to continue.

There is benefit to the DOE Isotope Program being part of NP because many of the administrative functions can be supported by the entire organization as well as important synergy between the various portions of the programs.

The program managers in the DOE Isotope Program work cooperatively as a team and support the other program managers' needs. There is a concern that when the Nuclear Physics Major Initiatives Manager retires the depth of project management experience in the DOE Isotope Program will be diminished.

Diversity

NP is commended for their monitoring of the demographics of the PIs on grant submissions and awards. Having these records will enable the Office to monitor progress on efforts to enhance the diversity of the nuclear physics research community. The COV would like to see the efforts on monitoring diversity and inclusion extend to grant reviews and to inform the processes and policies of NP.

Recommendations:

4. The office should continue their efforts to increase diversity and inclusion in the community of PIs and those supported by their grants. Such a process should be informed by data to the extent possible.

C. The breadth and depth of the program as well as national and international standing of the portfolio elements.

Findings:

In the 2016 COV, the assessment of the national and international standing of the portfolio elements was drawn largely from the recently completed Comparative Review findings. They found that the NP programs were "very competitive in an international context to world-leading." While it is beyond the scope of this COV exercise to comprehensively evaluate the entire scientific portfolio, we note that NSAC has informally monitored progress on the Long Range Plan recommendations through featured science presentations during its meetings. These documented reports demonstrate the vitality and importance of the program domestically and in an international context. They serve to demonstrate that the Office has been executing the priorities of the Plan through its funding decisions and overall program stewardship.

An informal comparison of program portfolios around the world is featured in yearly IUPAP WG-9 meetings, where the equivalent of regional "long range plans" are presented in order to gain an overall world view of nuclear science facilities and priorities. At each meeting, the NSAC Chair describes the U.S. NP portfolio and describes its main facilities. It is abundantly clear that the U.S. program is world-leading in many areas, in particular where our major facilities such as RHIC and CEBAF have no equal. With the completion of FRIB, the U.S. will have a third world-leading accelerator-based program. The U.S. has further developed the science case, and conceptual accelerator design, which will result in the construction of an Electron Ion Collider. In the field of fundamental symmetries and neutrino physics, the U.S. has many leading programs and is spearheading a ton-scale NLDBD experiment.

At the August 2019 IUPAP meeting in London, the NP Associate Director and Facilities Division Director co-organized an *in-camera* meeting with their world-wide agency partners to discuss priorities related to both NLDBD and the future EIC.

Some program managers indicated their awareness of the international context of the program and are working towards maintaining and further developing the international leadership of the program.

Heavy Ions

Detailed understanding of the Quark Gluon Plasma properties, originally discovered at the NP-supported Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory, still poses theoretical challenges. Recent advances on both facility and experimental sides paved the way for several major breakthroughs in Heavy Ion physics: new data from RHIC provided strong evidence for collective effects in small systems, providing limits on the conditions required for the formation of the primordial matter. The collective behavior has been unambiguously established for particles containing rare heavy quarks, which was not originally expected by theoretical calculations. The latter result was only made possible by record luminosity achieved by the RHIC facility and the new state-of-the-art silicon

tracking detectors. The breadth and depth of the NP research portfolio could further be illustrated by the discovery of the "most vortical fluid" in the world: one of the most recent RHIC discoveries is that the QGP is swirling at the highest rate ever observed for any fluid.

Medium Energy

This program addresses both cold QCD topics and selected topics in fundamental symmetries. With the recently completed 12 GeV CEBAF upgrade at TJNAF, together with continuing runs of the RHIC polarized proton collider program at BNL, the U.S. is carrying out a broad suite of world-class and unique experiments covering topics such as the structure and spin structure of the nucleon, the search for exotic hadronic states, determination of the proton radius, and tests of fundamental symmetries. Four experimental halls are fully functioning at TJNAF and the new MOLLER parity-violating electron scattering experiment has obtained CD0. It is common that researchers in medium energy hadron physics are drawn from around the world to TJNAF and BNL. The DOE medium energy portfolio funds strong U.S. leadership on experiments of national and international importance and we judge the medium energy program to be world-leading.

Low Energy and Fundamental Symmetries

This area of nuclear physics aims to discover the origin of the elements, understand the properties of finite nuclei and nuclear matter and identify new ways for nuclear physics to benefit society.

The Facility for Rare Isotope Beams (FRIB) – the top new major construction project in the 2015 Long Range Plan -- is presently 92% complete. FRIB, together with its associated research instruments, will usher in a new era of nuclear structure and nuclear astrophysics studies at the limits of stability, with the promise of more than doubling the number of nuclei with measured properties. The research at this world-leading facility will be carried out by international collaborations that have more than one-third membership from other countries.

The Office also supports the operation of the ATLAS heavy-ion beam facility at the Argonne National Laboratory. The unique beam and research capabilities at ATLAS attract about a third of its users from other countries.

The program in neutrinos and fundamental symmetries is a world-class research program. It includes a range of research efforts (and projects) that demonstrate U.S. leadership in this field. U.S. groups are involved in three of the world's leading neutrinoless double beta decay experiments and they provide key leadership both in the science collaboration and technical projects. The U.S. is also developing the world's most sensitive neutron EDM experiment which will be hosted at ORNL. U.S. researchers have proposed and are now leading the R&D of a unique experiment to measure the absolute neutrino mass with sensitivity well beyond the current best measurement from the KATRIN experiment in Germany. They are involved in fundamental physics with neutrons and muons. These efforts are all discovery oriented with the potential for major impact beyond nuclear

physics. U.S. groups and researchers are both leading efforts in the U.S. and North America and participating in experiments overseas. PIs in this field come from some of the premier U.S. research universities, DOE NP Centers of Excellence, and are intellectual leaders in the field.

Theory

The nuclear theory program supports a very broad portfolio that includes efforts in all areas of nuclear physics. Theorists are continuously developing new ideas aimed at future investigations but also provide essential support for the ongoing (and planned) experimental programs. Their work is also involved in pioneering aspects of quantum simulation for many-body nuclear physics problems. The NP portfolio supports the Institute for Nuclear Theory (INT) and its unique visitor program (530 visitors in FY2017) and the Topical Collaborations. Current Topical Collaborations address: RHIC Beam Energy Scan Theory, Nuclear Theory for double beta decay, Fission in the R process, and the Transverse Momentum Dependent Structure in QCD. Most recently, the program helped usher in the FRIB Theory Alliance, the theory counterpart to the FRIB science program.

Facilities and projects

CEBAF and RHIC give the U.S. world-leading facilities for the exploration of QCD manifestations in cold and hot nuclear matter. FRIB, once completed, will be a world-leading facility for rare isotope beams needed for the exploration of the structure of nuclei far from stability and the nuclear reaction chains that produce heavy elements in stellar processes. The program also benefits from the stable beams, high-efficiency operation, and planned multi-user capability at ATLAS.

Accelerator R&D and preliminary design efforts at BNL and TJNAF, funded by NP during the FY2016-2018 period, have fueled sufficient progress toward a polarized, high-luminosity Electron-Ion Collider to facilitate the launch of a major new construction project in the early 2020s. An eventual EIC will not only maintain long-term U.S. leadership in the study of QCD manifestations in nuclear matter, but will also support innovative U.S. contributions to accelerator physics and technology.

The NP Office considers overall laboratory strength when making investment decisions. NP balances the most exciting opportunities with the scientific infrastructure, health of the national laboratories and of the associated communities.

Isotopes

The DOE Isotope Program is a highly visible effort that provides supplies of critical stable and radioactive isotopes for medical, industrial, and research needs. In particular, the DOE Isotope Program provides important leadership for global supply of isotopes for targeted alpha therapy, notably ^{227}Ac and ^{225}Ac.

During the review period many accomplishments were achieved on the international scale with production of isotopes, collaborations to acquire heavy water from Iran, as well as mitigation of dependence on foreign sources for a number of stable isotopes in addition to

the radioisotopes Sr-90, Cf-252, and Am-241. Production of heavy element isotope feedstocks contributes to super-heavy element research, including the discovery of new elements in the periodic table with international collaborators.

Quantum Information Science

This area represents a growing opportunity within the Office of Science. Furthermore, research in this area has been prioritized by the White House. Planning for QIS activities within SC started as early as 2014, with one of the first workshops being held by the Office of Advanced Scientific Computing Research (ASCR)[1] in February of 2015. The Office of High Energy Physics also began planning for QIS related work during the same timeframe and held its first roundtable[2] in February, 2016. The office of Basic Energy Sciences conducted a Basic Research Needs workshop on quantum materials[3] in 2016 and also held community round tables[4] in October 2017. In each of these cases the research community was ready for significant funding increases in the QIS area, which occurred in FY17-FY20. Furthermore, ASCR, BES, and HEP are actively pursuing the development of Centers under the National Quantum Initiative Act which became law in December 2018. Nuclear Physics became involved in planning efforts (through an NSAC sub-committee and an initial funding opportunity) in 2019.

Comments:

Low Energy and Fundamental Symmetries

It is anticipated that in the coming two years the research areas funded under Low-Energy will experience two field-changing transitions. The FRIB will move from the construction stage to operation and the construction of a US-led large-scale NLDBD experiment will start. Shepherding the field toward these major events will require devoted attention by the program managers in these research areas. Dealing with the demands that these program components will put on the budget will present significant challenges. The Office should continue to give substantial attention to the strategic planning to deal with these major events.

Neutrinos and fundamental symmetries is a growing field in low-energy nuclear physics. U.S. groups and researchers provide leadership in both domestic experiments and R&D efforts as well as experiments overseas. U.S. PIs are recognized amongst the world leaders

[1] https://prod-ng.sandia.gov/techlib-noauth/access-control.cgi/2015/155022r.pdf
[2] https://science.osti.gov/-/media/hep/pdf/Reports/DOE_Quantum_Sensors_Report.pdf?la=en&hash=B2378FA2253DF340A218D6B37C44293403389C59
[3] https://science.osti.gov/-/media/bes/pdf/reports/2016/BRNQM_rpt_Final_12-09-2016.pdf?la=en&hash=E7760711641883FFC9F110D70385937D6A31C64F
[4] https://science.osti.gov/-/media/bes/pdf/reports/2018/Quantum_systems.pdf?la=en&hash=291099097EBCCFAB99D86F60F62EA061F996424C

in the field of neutrinos and fundamental symmetries. Together with the NP Office, U.S. researchers are partners in the worldwide planning effort towards next-generation experiments. The Office has demonstrated leadership in coordinating with international partners, leveraging overseas facilities and investments, and positioning the U.S. program at the worldwide frontier in neutrinos and fundamental symmetries. U.S. scientists contribute critical expertise, management, and technical experience. To stay at the frontier of this field it is important to continue to aggressively pursue the recommendation of the last Long Range Plan to mount a ton-scale double beta decay experiment with U.S. leadership.

Theory

Many of the theory efforts under NP are world-leading, and the U.S. nuclear theory community has provided the intellectual underpinning for many experimental efforts in nuclear physics both domestically and around the world. Our assessment is that the INT, the topical collaborations and FRIB-TA are playing an important role in raising the visibility of the U.S. nuclear theory effort, and also in addressing key issues in high-priority experimental programs.

Facilities and projects

The development of the unique suite of major accelerator facilities – CEBAF, RHIC, ATLAS, soon FRIB, and eventually EIC – has been very effectively stewarded over decades by NP, in realizing priorities established in a series of carefully developed Long Range Plans produced by the U.S. NP research community, under the leadership of NSAC.

Today, the U.S. is among the leaders in Nuclear Physics Research because of the project investments that have been made at NP facilities and institutions.

Isotopes

The DOE Isotope Program demonstrates clear national and international leadership for supplying critical isotopes, supporting infrastructure for isotope production and research needs, mitigating dependence on foreign supply, and developing workforce required for programmatic needs.

The steps towards establishing a robust stable element enrichment capability through a new Stable Isotope Production and Research Center at ORNL will return the ability to produce these vital feedstocks to the Nation. Continuing to support this project is of vital importance.

The Program's efforts to communicate broadly with the user community to understand future needs and to execute to meet these needs is essential.

Quantum Information Science

QIS is an emerging new area that has many interesting connections to nuclear physics. As a consequence, there are opportunities for nuclear physics to gain visibility, and to attract new funding within the Office of Science. During the period covered by the COV, some of the opportunities were missed, in part due to the absence of a Research Division Director, and the vacancy in NP computing. Since the period covered by the COV, a more vigorous effort has emerged.

While Nuclear Physics has now become more involved in planning efforts through an NSAC subcommittee, and in initial funding of limited QIS related activities, our sense is that earlier involvement of NP in this priority area would likely have occurred if there had been an appointed Research Division Director in the Office of Nuclear Physics. It is important to continue to pursue this opportunity in the coming years.

Nuclear Science Advisory Committee

As described in the findings, the NP program is developed in close consultation with the nuclear physics community. A primary link in this consultation is the advice provided by the DOE-NSF Nuclear Science Advisory Committee (NSAC) through charges from the agencies to create long range plans for Nuclear Science and specialized advice on individual nuclear science topics. For over 40 years, the LRPs developed by NSAC have driven the development of the field. This committee will continue to be crucial in the upcoming LRP and to maintaining world leadership of the U.S. NP program into the future.

Recommendations:

5. The COV recommends that the Office of Science maintain the strong relationship between the Office of Nuclear Physics and the community through the Nuclear Science Advisory Committee.

D. Progress made towards addressing action items from the previous COV review

Findings:

A total of 5 Recommendations were included in the 2016 COV Report. The 2016 COV report was presented to NSAC on June 27, 2016. The NP response to the COV report was posted on the COV website on August 2, 2016. An updated NP response to the 2016 recommendations, dated November 25, 2019 was also provided in briefing material to this COV. These 2016 recommendations are presented below along with findings of the present COV on the progress toward addressing these recommendations.

1. Our highest priority recommendation is that NP fill the Physics Research Division Director position. NP should consider creating a search committee or task force in the community to identify and recruit candidates for the research director position. The search committee might also be helpful in identifying obstacles to filling the position. NP should report on progress at the next NSAC meeting after receiving the report.

The AD for the Office of Nuclear physics formed a community committee chaired by Gail Dodge to identify candidates for the Physics Research Division Director position. Some potential candidates were identified. However, in the last few years NP has not been allowed to open a search for this position primarily from a cap on Senior Executive Service positions.

2. Filling the program manager positions in the Physics Research Division is of critical importance. NP should develop and implement a recruitment strategy to fill these positions as soon as possible.

In the Research Division, NP has been successful in filling some of the program manager positions. The two positions in Fundamental Symmetries and in Nuclear Structure/Nuclear Astrophysics were both filled initially with IPAs and then the positions were filled permanently. Following their recent hires, the current program managers for FS and NSNA have quickly transitioned into the work of their programs. They have found a collegial and supportive atmosphere that has allowed them to quickly adapt to their new roles. The program manager of the Heavy Ion program during FY16 – FY18 has moved back to the Facilities Division and a detailee was appointed to manage the Heavy Ion program in FY19. Following the retirement of the program manager for nuclear data and computing in FY18, the program was split in two: the searches to fill the Nuclear Data program manager and the Nuclear Physics Computing program manager positions are well underway.

In the Facilities Division, two program managers have been added, one for Isotope Accelerator Facilities and one for Isotope Reactor Facilities. The program manager for

Isotope R&D retired and this position was filled. One vacancy exists for a Nuclear Physics and IP Projects program manager, which would be a new role.

In total there were three new program manager positions created during the period under review.

3. A mechanism should be developed to provide support to the proposal review process so that new program managers can effectively and efficiently execute funding decisions. Explore options such as convening an expert panel or engaging a short-term detailee or a consultant.

NP has successfully used IPAs and detailees to provide extra help to program managers to facilitate an efficient review process. New program managers receive extensive assistance and mentoring from office staff.

4. The Office of Science should redouble efforts to get a fully functional PAMS system in place and populated.

The PAMS system manager, from the Office of the Deputy Director for Science Programs, gave a presentation on the status of the PAMS system. PAMS is the support tool for SC programs. She reported that a new contractor was selected for the PAMS system and that several improvements and fixes have been integrated to the system; including 22-point releases since March 2017. In response to a homework question, NP program managers expressed general satisfaction with features of the updated PAMS.

Changes have been made to the PAMS system to improve collection of demographics data. PIs of awards are required to update their demographic information when they undertake actions in PAMS. However, they can choose not to respond to demographic questions. Currently only 12.9% of PIs have chosen not to provide information on gender. The non-response rate is higher for race (20.4%), ethnicity (27.4%), and disability (31.7%). Demographic information is not collected for co-PIs, post-docs, graduate students, or for proposals more broadly.

This was the first COV that used PAMS to access proposal/award files.

5. Create a plan for the Office of Nuclear Physics to promote diversity and inclusion throughout its portfolio of programs.

NP has led the effort within the Office of Science to establish clear expectations of conduct for all awardees by strongly adopting the APS code of conduct. The AD has brought this message to the nuclear physics community in no uncertain terms.

Regarding diversity within the portfolio, the office increased the representation of women on review panels by requiring 20% representation of scientific review panels and 50% representation on NSAC. In addition, changes in the PAMS system has improved the ability of the office to collect demographic data and the NP Office has instituted a provision to

extend eligibility past the 10-year-from-Ph.D. rule for Early Career Awards in specific circumstances. Further actions that have been taken to improve diversity and inclusion are outlined in Sections A and B of this report.

Other suggestions in COV2016

There was a comment in the report of the previous COV that more applied programs do not have equal access/priority for ECA awards within NP. In the FY2016-2018 award period, one ECA was awarded within isotopes.

Comments:

It is extremely concerning that NP has not hired the Research Division Director. As detailed elsewhere in this report, this situation is urgent and is affecting the functioning of the office. We commend the AD for Nuclear Physics for his efforts to obtain permission to fill this position. We are gravely concerned about the ability of NP to pursue important national priorities and international opportunities without having the Research Division Director in place.

We commend NP for their success in filling program manager positions and for obtaining two new program manager positions. Overall the situation in subprograms has improved over the past three years but vigilance will be necessary to continue filling vacancies in a timely way.

It is reassuring that the areas of NSNA and FS are now well staffed. We applaud the efforts of the Office and in particular the AD and the Facilities and Project Management Division director to support and mentor their new hires and quickly integrate them into the workflow despite the many competing demands on their time.

However, we also understand that covering the activities associated with the vacant program manager positions pulls attention from primary assignments, resulting in inefficiencies and decreases in the overall amount of effort for strategic planning and maintaining coherence between the various research programs.

The COV was pleased to learn about the progress on hiring program managers for the Nuclear Data and Nuclear Physics Computing programs. We urge the Office to give priority to following through on filling these positions as soon as possible. The COV supports breaking these portfolios into two separate program manager positions.

The Office of Science has made substantial progress on the PAMS system, which is generally operational and functional for the purpose of assessing and acting on university grants. In the future, this new functionality can provide the NP Office with better demographic data on grant reviews and actions.

The COV is pleased to see that NP has made substantial progress in promoting diversity and inclusion, especially in the panel review process. As detailed elsewhere in this report, the COV hopes that NP can build on that momentum to take actions that will encourage diversity and inclusion gains in the broader nuclear physics community.

Other suggestions in COV2016

Attention is recommended to ensure that ECA applications in more applied areas have a level playing field as the value proposition may be different. For example, the efforts to mentor young investigators in the Isotope area to enhance quality of the Isotope submissions should continue.

Recommendations:

none

E. Suggestions regarding the COV process

The concise presentations from the various program managers posted on PAMS were helpful for highlighting various accomplishments.

The COV was not able to access the decision statements that are part of the packet justifying an award or declination. NP should provide specific instructions on how to access the decision statements as part of the COV book. This is important for the COV to determine whether the process of making funding decisions is fair and appropriate.

The DOE Isotope Program covers a very diverse set of activities. Beyond grant awards, it also
oversees and engages in routine production operations, establishment of new capabilities and upgrade initiatives at various sites as well as extensive interaction with the various user communities, to name a few. It would be appropriate to consider adding new COV charge elements or additional language to existing charge elements that will direct future COV's to also evaluate the impact of these activities and their associated processes on the communities served by NP. This comment from the last COV report is still valid.

F. Appendices

1. 2018 Charge to NSAC
2. Agenda
3. Member of the Committee of Visitors
4. Homework List

Appendix 1: 2018 Charge to NSAC

This letter requests that the Nuclear Science Advisory Committee (NSAC) assemble a Committee of Visitors (COV) to review the management processes of the Department of Energy (DOE) Office of Science's Office of Nuclear Physics (NP). The panel should provide an assessment of the processes used to solicit, review, recommend, and document proposal actions and monitor active projects and programs for both the DOE laboratory and university programs.

The panel should assess the operations of the Office's programs during the fiscal years 2016, 2017, and 2018. The panel may examine any files from this period for all actions administered by the program for the period under review, including funding at national laboratories, universities, and other activities handled by the NP subprograms. The panel should consider and provide evaluation of the following major elements:

(a) the efficacy and quality of the processes used to solicit, review, recommend, monitor, and document application, proposal, and award actions; and
(b) the quality of the resulting portfolio, including its breadth and depth, and its national and international standing.

In addition to these findings, comments on observed strengths or deficiencies in any component or sub-component of the Office's portfolio and suggestions for improvement would be very valuable. The panel should also comment upon what progress has been made towards addressing action items from the previous COV review. You should work with the Associate Director of the Office of Science for Nuclear Physics to establish the processes and procedures. The results of this assessment should be documented in a report with findings, comments, and recommendations clearly articulated; the report should be submitted to NSAC by summer of 2019.

Appendix 2: Agenda

Monday, December 9

8:00 am	Executive Session (Eisenhower Conf. Room) COV charge, etc..., procedures	
8:50 am	Welcome	Tim Hallman
9:00 am	Office of Nuclear Physics Overview (30+15)	Tim Hallman
9:45 am	Physics Research Division Overview (30+15)	Tim Hallman
10:30 am	Break	
10:45 am	Facilities & Project Management Division Overview (30+15)	Jehanne Gillo
11:30 pm	Isotope Program Overview (30+15 min)	Jehanne Gillo
12:15 pm	Working Lunch (Eisenhower Conf. Room)	
1:30 pm	Q&A with Office on morning discussions	
2:30 pm	Budget Process (20+10)	Brian Knesel
3:00 pm	Status of PAMS (15+10)	Mariam Elsayed
3:30 pm	Response to COV Recommendations (15+10)	Tim Hallman
4:00 pm	Break then Closed Session	
4:15 pm	Discussion with Hallman and Gillo	
4:45 pm	Committee Breakouts (Program Managers available for discussion with breakout groups as requested)	

Grants 1 (Eisenhower)	Grants 2 (Jackson)	Lab Res. (Lincoln)	Facilities* (Monroe)	Projects (Truman)	Isotopes (Wilson)

*Facilities includes operations, accelerator R&D and SBIR program

6:00 pm	Executive Session (Eisenhower) – Committee generates list of additional information desired for presentation on Tuesday or Wednesday.7:00 pm Adjourn	
7:30 pm	Dinner	

Tuesday, December 10

8:00 am Report on Homework (Eisenhower Conf. Room)

9:00 am Executive Session

10:30 am Break

10:45 am Committee Breakouts (Program Managers available for discussion with breakout groups as requested)

Grants 1 (Eisenhower)	Grants 2 (Jackson)	Lab Res. (Lincoln)	Facilities* (Monroe)	Projects (Truman)	Isotopes (Wilson)

*Facilities includes operations, accelerator R&D and SBIR program

12:00 pm Working Lunch (Eisenhower Conf. Room)

1:15 pm Continue Committee Breakouts (Program Managers available for discussion with breakout groups as requested)

Grants 1 (Eisenhower)	Grants 2 (Jackson)	Lab Res. (Lincoln)	Facilities* (Monroe)	Projects (Truman)	Isotopes (Wilson)

*Facilities includes operations, accelerator R&D and SBIR program

2:30 pm Break

2:40 pm Executive Session (Eisenhower Conf. Room)

4:30 pm Committee work or Meet with program managers

6:30 pm Adjourn

7:30 pm Dinner

Wednesday, December 11

8:00 am Report on Homework (Montgomery Conf. Room)

9:30 am Executive Session - Preparation of Report

12:00 pm Working Lunch (Montgomery Room)

1:00 pm Preparation of Report

2:00 pm Meet with Tim Hallman/Jehanne Gillo

2:30 pm Closeout

Appendix 3: Members of the Committee of Visitors

Joseph Arango, DOE TJNAF Site Office
Eva Birnbaum, Isotope Production and Distribution Program LANL
Vincenzo Cirigliano, LANL Theoretical Division
David Dean, ORNL Physical Sciences Division
Gail Dodge, Old Dominion University
Olga Evdokimov, University of Illinois Chicago
Renee Fatemi, University of Kentucky
Donald Geesaman, ANL Physics Division
Kevin Hart, ORNL DOE Isotope program
Diane Hatton, BNL NPP Office of project planning and oversight accelerator projects
Karsten Heeger, Yale University
David Hertzog (NSAC chair), University of Washington
Calvin Howell, Duke University (TUNL)
Cynthia Keppel, TJNAF
Jonny Moore, ORNL Site Office
Filomena Nunes (COV chair), Michigan State University
Erich Ormand, LLNL Physical and Life Sciences Directorate
Rosi Reed, Lehigh University
Thomas Schaefer, North Carolina State University
Rebecca Surman, University of Notre Dame
Brent Vandervender, PNNL
Steven Vigdor, Indiana University
Sherry Yennello, Texas A&M University

Appendix 4: Homework for NP (Monday 9 Dec 2019)

1. Summarize options for filling the Research Division director position (pros and cons of each option)

2. To help understanding the impact, list of actions that were slowed down due to the vacant research director position.

3. Research division report (pg 12 slides)– please provide broken down numbers (NT and LE) for everything possible for FY18 and also provide table without MIE

4. ECA declined – what feedback is provided?

5. What fraction of new awardees (less than 10 yr from PhD) come in through ECA versus regular solicitation.

6. What steps are being taken to level the playing field for large and small research groups?

7. Withdrawals: why?

8. Demographics on PIs: what is response rate in PAMS to demographics questions? (it was 25% last time). Of those that responsed: totals and per program manager including award/declines and including funding level (Paul's analysis).

9. Is there any information on demographics on PD and Students? none

10. ECA demographics (at the various stages of review)

11. How is the 15% female representation in mail reviews implemented?

12. Assessment from the office on the usefulness of PAMS.

13. Table with net additions and subtractions in FTE in NP with names since COV2016

14. Description of SBIR projects with significant technical impact on NP program

15. Provide strategic plan for isotope program (hardcopy to Isotope Subcommittee