Department of Energy and National Science Foundation
Nuclear Science Advisory Committee
Hilton Hotel and Executive Meeting Center, Rockville, Md.
March 2, 2011

Members Participating:

Susan Seestrom, Chairman
Robert Atcher
Jeffrey Binder
Jeffery Blackmon
Gail Dodge
Alexandra Gade
Carl Gagliardi
Susan Gardner
Peter Jacobs
David Kaplan
Dmitri Kharzeev
Joshua Klein
Karlheinz Langanke
Zheng-Tian Lu
Curtis Meyer
Julia Velkovska

Members Absent:

Michael Bronikowski
Richard Furnstahl
Allison Lung
William Zajc

Others Participating:

Joseph Dehmer
Jehanne Gillo
Donald Geesaman
Timothy Hallman
Eugene Henry
Meredith Howard
Bradley Keister
Noemie Koller
Witold Nazarwicz

Presenters in Order of Appearance:

William Brinkman
Edward Seidel
Timothy Hallman
Bradley Keister
Patricia Dehmer
Jehanne Gillo
Krishna Kumar
Gűnther Rosner

About 40 others were in attendance during the course of the meeting.

Morning Session

Before the meeting, the Committee members received their annual ethics briefing from **Brian Plesser** of the DOE Office of General Counsel.

The Chair, **Susan Seestrom**, called the meeting to order at 9:02 a.m. She asked the members to introduce themselves. She noted that a partnership among NSAC, DOE, and NSF sets directions, delivers programs, and provides information to the agencies to justify their activities.

She introduced **William Brinkman** to discuss DOE's proposed FY12 budget. The Office of Science (SC) has done well in science, supporting more than 100 Nobel Prize winners; 45% of federal support of basic research in the physical sciences; and 27,000 Ph.D.s, graduate students, undergraduates, and high school students.

President Obama noted that the United States faces greater competition now than ever before and that competition will be focused on energy and new energy technologies. SC is in a good position to respond to that national need. The FY12 budget will make a three-fold attack on energy problems by addressing materials by design (for nuclear power and photovoltaics), biosystems by design (for environmental remediation and bioenergy), and modeling and simulation (of climate, biofuels, and reactor design). The Cray XT5 at Oak Ridge National Laboratory (ORNL) and the Blue Gene/P at Argonne National Laboratory (ANL) are important in this process.

SC is asking for a 14.8% increase in its budget: 21.0% in the Office of Advanced Scientific Computing Research (ASCR), 0.6% in High Energy Physics (HEP), and 19.9% in Nuclear Physics (NP). The Fuels from Sunlight Energy Innovation Hub was begun in FY10 and serves as an integrating focal point for the solar-fuel R&D community with collaborations with 20 Energy Frontier Research Centers. This year, SC is proposing the establishment of a Batteries and Energy Storage Energy Innovation Hub to push energy storage closer to the theoretical energy density.

ASCR is delivering world-leading computational and networking capabilities to the energy R&D community. It is proposing investments for exascale computing to leverage new chip technologies; to develop libraries, tools, and software for these new technologies; and to create public–private partnerships to develop platforms and codes. Big trucks get an average 6.7 miles per gallon. There are 1.3 million trucks on the road with 300,000 being added each year. Computer modeling and simulation have shown that a simple redesign can increase their mileage by 6.9%.

In Basic Energy Sciences (BES), DOE is proposing science for clean energy, computational materials and chemistry, and enhancements at user facilities. The free-electron laser at SLAC can hit a liquid jet with an X-ray pulse and produce diffraction patterns for proteins. SC R&D has produced high-energy lithium batteries, increasing the energy density of the batteries by a factor of 2.

The Office of Biological and Environmental Research (BER) is working on climate and bioenergy through clean-energy biodesign on plant and microbial systems, a comprehensive Arctic-environmental-system model, and support for the Bioenergy Research Centers and other facilities. It is also tackling major climate uncertainties.

Fusion Energy Science is working on the International Thermonuclear Experimental Reactor (ITER), which would produce 10 times as much power than goes into heating the plasma. The United States is providing management and is establishing cost and schedule baselines. Precision manipulation of the magnetic field of a tokomak can prevent dangerous heat-flux transients.

In NP, the 12-GeV upgrade of the Continuous Electron Beam Accelerator Facility (CEBAF) is being continued, the Facility for Rare Isotope Beams (FRIB) is being designed, and the Holifield Radioactive Ion Beam Facility (HRIBF) in Oak Ridge is being closed. A new form of antimatter has been discovered at the Relativistic Heavy Ion Collider (RHIC). The Isotope Development and Production Program is making hundreds of radioactive and stable isotopes available, 20% to scientific research, 20% to industry, and 60% to the medical community. The nuclear community has two major projects to support and is unlikely to get large increases. That situation prompted the decision to close the HRIBF. The decision had to be made quickly with no time to consult with the scientific community.

HEP has had successes with the Fermi Gamma-Ray Space Telescope. The Tevatron at Fermilab has been running extremely well as has the Large Hadron Collider (LHC). An extended Tevatron run was considered, but a doubling of the integrated luminosity would take several years, so the President's budget request does not call for running the Tevatron beyond 2011. The Long Baseline Neutrino Experiment at Fermilab and the Deep Underground Scientific and Engineering Laboratory (DUSEL) is a high-priority experiment and is being reconsidered in light of the refusal of the National Science Board (NSB) to endorse the DUSEL. (The NSB will be meeting again in May or June.) New accelerator technologies have far-reaching benefits and are reducing the size of accelerators by factors of ten to one hundred.

The Office of Workforce Development for Teachers and Scientists is supporting the Science Bowl, research experiences at national laboratories for teachers and students, and graduate fellowships.

Kharzeev asked if there were a way for the scientific community to be involved in budgetary discussions. Brinkman replied that SC uses the top priorities of the scientific community's lists, which come out of these advisory committees. Hallman added that there is a working partnership between NP and NSAC. It was unfortunate that the wild budget process did not allow more time for discussion.

Blackmon noted that NP plays a great role in national security and in other fields and that this importance is often not recognized. Brinkman said that the importance *is* recognized, but the role of NP in clean energy is not clear.

Klein pointed out that Brinkman had not said anything about the FY11 budget. Brinkman stated that the scientific community is going to have to tighten its belt under the continuing resolutions. It is not clear what is going to happen.

Meyer commented that the scientific community was out of the loop on the Holifield decision.

Jacobs said that the United States has put in a large investment into the LHC but is not a member state in the CERN [Conseil Européen pour la Recherche Nucléaire (now Organisation Européenne pour la Recherche Nucléaire)] management team. He asked if that situation were sustainable. Brinkman replied that it was not sustainable. There is ongoing discussion about the United States' making a contribution to LHC operations in the future.

Edward Seidel was asked to review the NSF FY12 budget request, focusing on the Mathematical and Physical Sciences (MPS) Directorate, the largest unit of NSF. The overall budget request is $7.767 billion. A priority theme in the FY12 NSF budget is investing in catalyzing breakthroughs and promoting competitive markets. The new director is molding NSF to achieve its new goals by integrating the efforts of the directorates. The concept is to support fundamental research in all disciplines, address multidisciplinarity, spark greater innovation and opportunities, create networks and infrastructure, improve organizational efficiency, and catalyze human-capital development. The MPS request is for $1.43 billion, about a 6% increase overall. It will support innovation; invest in research; advance a strong scientific and technical workforce; support multidisciplinary research through centers, institutes, and networks; and invest in facilities. The largest increases are in chemistry, mathematical sciences, and material sciences. MPS supports researchers investigating the structure and evolution of the universe, the behavior and control of molecules, and new mathematical

statistical theories. This research can catalyze advances in science impacting innovation in medicine, industry, and technology.

The Science, Engineering, and Education for Sustainability (SEES) initiative includes $160 million in MPS and $998 million NSF-wide. This is a large increase; the core programs of all divisions are participating in this initiative. It is aimed at sustainable energy pathways, materials, and chemistry. It fosters development of sustainability research networks so groups can work together.

Another NSF-wide activity is the Cyberinfrastructure Framework for 21st-Century Science and Engineering (CIF21) . To get to the exascale, will require, studies of data-enabled science, new computational infrastructure, community research networks, and access and connections to cyberinfrastructure facilities. It will address such questions as: Can one discover physical laws simply through data mining? . The exascale is a decade off. In the process, eXtreme Digital is replacing the Teragrid as the NSF framework for high-performance computing infrastructure.

The Science and Engineering Beyond Moore's Law initiative including $42.18 million within MPS and $96.18 million NSF-wide. MPS is looking at partnering with the Computer and Information Science and Engineering (CISE) Division and the Engineering Division on fundamental research for economic competitiveness.

The Biological, Mathematical, Physical Sciences, and Beyond initiative including $25.57 million within MPS and $76 million NSF-wide. It is looking at renewable fuels, computational modeling for visualizing the geometric structure of photosynthetic vesicles, and improved mathematical models.

The Faculty Early Career Development (CAREER) awards request is for $53.78 million; MPS accounts for 25% of all CAREER awards. 93% of the participants go on for a Ph.D.

The Enhancing Access to the Radio Spectrum initiative includes $3 million within MPS and $15 million NSF-wide. It is to develop new algorithms for radio astronomy and wireless technology in general. Money from the auctioning of surplus radio spectrum would go back into the NSF.

MPS supports the Office of Multidisciplinary Studies, institutes, centers (Physics Frontier Centers, Materials Research Centers and Teams, and the Mathematics Institutes Program), and networks.

MPS supports many large facilities to a total of $268.77 million. In 2012, the top facility is the Atacama Large Millimeter Array (ALMA) in Chile; and very important is the National Superconducting Cyclotron Laboratory (NSCL).

Klein asked about DUSEL. Seidel replied that DUSEL has complex partnerships among different agencies. The National Science Board came to understand better what DUSEL meant and what the NSF should steward, and came to the conclusion that NSF should not be the steward of DUSEL. NSF will continue DUSEL funding to keep its investments viable. With the National Academy of Sciences (NAS) study coming out, NSF might still support experiments, while DOE might provide stewardship.

Timothy Hallman was asked to discuss the NP FY12 budget request. There are healthy increases in the FY12 budget request for some SC offices, including NP (which got a proposed increase of about 13.1%). Within NP's FY12 budget request,

- Medium-energy research has a 6.8% increase,

- Heavy-ion research has a 7.3% increase,
- Low-energy research has the largest increase of 8.9% (driven by FRIB's construction design), and
- Construction has a 230.0% increase (an increase of $64 million driven by the 12-GeV upgrade of CEBAF).

RHIC is scheduled for a decrease of operations (to 24 weeks in FY11). Other facilities will increase operations, producing an overall increase in operations. Core research is held flat from FY10 except for some targeted investments. Those increases are partly offset by decreases for Scientific Discovery Through Advanced Computing (SciDAC), the shutdown of the Yale accelerator, and termination of the radioactive isotope beam activity at Oak Ridge National Laboratory (ORNL).

Research is up 6.8%, scientific user facility operations are off 0.6%, other facility operations are up 24.5%, the category of major items of equipment (MIE) is off 61.3%, FRIB is up 150.0%, the 12-GeV CEBAF upgrade is up 230.0%, and other general plant and equipment is up 2.0%.

Of the FY12 request, 49% is for facility operations, 33% is for research, 16% is for major projects, 1% is for MIE, and 1% is for other. The total requested for FY12 is $605.3 million in comparison to the $535.0 million appropriated for FY10.

A scientific highlight was the production of a heavy isotope at the High-Flux Isotope Reactor (HFIR) that led to the discovery of element 117. The HRIBF has made several significant advances in the past several years (e.g., doubly magic nuclei). The shutting down of HRIBF does not reflect on the science done there or on the quality of the staff. DOE is responsible for providing the best facilities 5 or 6 years in the future, and the financial burdens of doing that leave no funds for continuing operations at the HRIBF. NP will continue to cooperate with and support small universities and will continue to support its university centers of excellence. The closure of HRIBF will impact science opportunities and result in the loss of some unique capability before FRIB turns on. This is a challenge that will have to be dealt with. This subfield is not the only one impacted by a major construction project. Furthermore, the HRIBF decision was not related to any DUSEL decisions.

Basic research goals stretch one's capabilities, leading to new technology and innovations (although sometimes not for 50 or 60 years). Superconducting radiofrequency (SCRF) technology is an example. Advanced SCRF technology was needed to advance science. It had its first major application in CEBAF in the 1990s. The technology has been transferred to industry (after enabling many great scientific discoveries). It now enables nuclear energy, onboard naval missile defense, etc. Accelerators will become more compact and widely used, producing new jobs, increased revenues, and international leadership.

NP is producing radioisotopes for medical diagnosis and therapy. Basic research has led to muon tomography and proton radiography, and provides fundamental data to the National Nuclear Data Center, which compiles and evaluates nuclear data for research and applications.

Seestrom asked Hallman if he had thought about a worst-case scenario for the HRIBF budget debate. Hallman replied that there was not any time to consult with anyone because of the time demands produced by the congressional budget actions. The office will certainly consult with the scientific community when that is possible.

Gagliardi stated that there could be a couple of hundred million dollars of cuts in SC. SC needs to protect some things for next year while trading off some things for the long-term benefit. Hallman replied that there will not be a full-year continuing resolution, and receiving a budget well into the funding year will make it difficult to conduct business.

Jacobs asked what the DOE perspective was on DUSEL. Hallman answered that SC wants to continue support for several scientific programs (e.g., the neutrino program). A panel has been convened to take input from stakeholders and to try to determine the most cost-effective means of conducting these programs. That panel will inform the FY13 budget request. DOE has ensured the dewatering of the Homestake Mine, but the long-term outcome is still to be determined.

Langanke asked if it would be more reasonable to compare the total budget to the requested budget. Hallman agreed and showed the comparative data for MIE funding.

Lu noted that ANL deserves to be included on the SCRF slide. Hallman agreed and said that about six other institutions also belong on that slide, so he would try to correct that omission.

Dodge asked whether the $8 or 10 million medical imaging program costs were absorbed by NP. Hallman said that the scope was transferred by congressional committee reports and that would have a $15 million impact on NP's budget; however, that action was deferred when the budget was not passed.

Seestrom stated that the FY12 budget request would come close to affecting the top priorities of the Long-Range Plan and that NSAC should consider what could be done if the worst budget scenario occurs. Hallman said that to the community should not be alarmed about something that may not occur. The Office will continue to watch the situation and talk about it.

Bradley Keister was asked to review the current state of nuclear physics at NSF.

Nuclear physics at NSF is spread over several programs. Proposals are co-reviewed by several programs. In FY11, NSF is under a continuing resolution, and there are wild variations in potential NSF funding. The nuclear physics program is attempting to continue managing the American Recovery and Reinvestment Act (ARRA) funding impact from FY09.

The research highlights are the Government Performance Results Act (GPRA) measures themselves. The agency is now collecting highlights covering March 2010 to March 2011. The Physics Division budget request includes an overall increase of 3.7% with research getting a 20.3% increase. Additional funding sources that NSF provides include Major Research Instrumentation (both small and large awards to university laboratories and user groups at national laboratories), Cyber-Enabled Discovery and Innovation (a 5-year initiative begun in FY08 at more than $50 million per year), Petascale Computing Resource Allocations (which will fund testbed access for Blue Waters code development at the University of Illinois Computing Center), and the Department of Homeland Security (DHS) Domestic Nuclear Detection Office (a multi-year initiative begun in FY07 for which NSF reviews proposals and makes recommendations to DHS).

Subra Suresh has now been confirmed as the new NSF director. Cora Merrett has completed a term as acting deputy director, and is awaiting confirmation as the official deputy director.

Gagliardi asked how the ending of ARRA funding would be managed. Keister replied that multi-year awards using program funds has had the effect of spreading the impact of exipiring ARRA-based awards over several years. This will distribute the impact under flat funding, but will not eliminate it J. Dehmer amplified this point.

A break was declared at 11:32 a.m.; the meeting was reconvened at 11:40 a.m.

Patricia Dehmer was asked to discuss data management and the new charge to the Committee on dissemination and long-term stewardship of research data. The different disciplines have different approaches. A snapshot of what each community is doing is being sought. NSAC is being asked to report current policies, practices, dissemination models, and opportunities for enhancing public-access policies and practices. Laura Bivens took the lead in writing the charge.

Geesaman asked what subtext and politics were behind the charge. P. Dehmer commented that this is not a new issue. It has a long history of people wanting to make use of research data. Keister noted that, at NSF, each proposal has to have a data-management plan. This charge would be a good way to find out about best practices.

Jacobs noted that the Large Electron-Positron Collider (LEP) data are still being used more than a decade after the collider was shut down. P. Dehmer noted that the charge addresses that issue. A first step is to collect information about what is currently being done.

Jehanne Gillo was asked to review the status of the NP Isotope Program. The mission of the program is to:

- Produce and/or distribute radioactive and stable isotopes that are in short supply, associated byproducts, surplus materials, and related isotope services;
- Maintain the infrastructure required to produce and supply isotope products and related services; and
- Conduct R&D on new and improved isotope production and processing techniques.

The program was transferred to NP with the FY09 appropriation. Funding is from a combination of appropriations and sales.

NSAC has conducted two studies on the subject of isotope production. NP has introduced peer-review into the mode of operations, created an R&D program for new and improved isotope-production techniques, restructured the federal organization of the program, and created the National Isotope Development Center (NIDC). The program is now set up and being staffed. The Director of the new Center is Robert Atcher.

One recommendation of the NSAC studies was to initiate R&D on the development of new and improved isotope-production techniques. A funding opportunity announcement (FOA) was issued in FY09, and $15.2 million was awarded in FY09 and FY10 of which $8.6 million was ARRA funding. These awards were for alpha emitters, diagnostic dosimetry, therapeutic applications, educational programs, and stable-isotope enrichment. An FY11 FOA is now on the street.

The production of alpha emitters for targeted radiotherapy is currently ongoing for actinium-225, actinium-227, and astatine-211. The program is investing in the coordination or production capabilities and supporting research. A new production solicitation is expected in April 2011.

NP is the sole provider of research isotopes for super-heavy element discovery research, which led to the discovery of element 117. NP is supporting production of 60

mg of berkelium-249, has established a reliable supply of californium-252 for the nation, and is working with the National Nuclear Security Administration (NNSA) to reestablish domestic production of americium-241. It also distributes NNSA-provided helium-3 to meet the highest-priority needs of the nation. It is supporting the reestablishment of domestic production and supply of stable isotopes through purchases and is conducting R&D on modern stable-isotope separation technology. The program is broadening its activities in education in nuclear chemistry and radiochemistry by collaborative efforts with Los Alamos National Laboratory (LANL) and the University of Missouri (to research the production and application of radioisotopes), Pennsylvania State University (to reestablish a thriving graduate program in nuclear and radiochemistry), conducting summer schools in nuclear chemistry and radiochemistry, and sponsoring symposia.

The NSAC Long-Range Plan called for improved communication, so the program held a workshop in August 2008 to identify shortages and to establish communication links with high-level federal agencies to understand their needs and priorities; asked NSAC to develop a long-term strategic plan for isotope production and development; improved public relations with stakeholders; became involved in DOE's strategic planning of accountable materials; hosted meetings with industry; and is planning a federal workshop to identify long-term agency needs.

The program will now be charging unit prices for a list of research isotopes instead of a batch cost. Recent research programs have been established at ORNL, LANL, and Brookhaven National Laboratory (BNL). The program is actively working on making other isotopes available in FY11. Currently, two facilities are stewarded primarily to operate in a parasitic mode. Both the NAS and NSAC recommended a dedicated facility. Other commercial entities are planning to build dedicated cyclotron facilities. The program is developing a multi-energy, multi-particle accelerator for radioisotope production; it is currently in conceptual development. The program is considering partnerships with industry and needs to complete a cost–benefit analysis and a study of potential business models, so it is issuing a call for letters of interest during the summer.

Krishna Kumar was asked for an update on the neutron charge to the Committee. Seestrom recused herself from this discussion; Jacobs assumed the chair pro tem.

In 2003, a subcommittee recommended launching the Neutron Electric Dipole Moment (nEDM) experiment and constructing a new facility at the Spallation Neutron Source (SNS) for that experiment. The agencies constructed the Fundamental Neutron Physics Beamline (FNPB) at the SNS and funded R&D for nEDM. The NSAC 2007 Long-Range Plan identified neutron physics as part of a targeted program of symmetry tests of the New Standard Model and precision electro-weak physics. The charge called for an evaluation of the current and proposed research program and recommended that the evaluation

- use a constant level of effort at FY11 funding,
- identify the most compelling opportunities,
- spell out the infrastructure and effort required,
- use both the U.S. and international capabilities as a backdrop,
- set priorities for incremental investments beyond the constant level funding, and
- assess the current scientific and technical workforce.

The Subcommittee has told senior physicists in the community, gotten agency guidance on the scope of the charge, sent invitations to potential Subcommittee members,

launched Subcommittee teleconferences, formulated a plan of work, and planned a first meeting. The physics themes include the nEDM experiment (which has a compelling physics case and a large fraction of funding and effort) and the investigation of weak interactions with neutrons (including semi-electronic weak interactions, hadronic parity violation, and an experimental program to evaluate recent progress).

Because nEDM is a large part of the program, the Subcommittee wants to review the physics case, assess the status of the project, and study the international context. That international context should include a comparison of the sensitivity reach with competing experiments, pay attention to the projected timescales of the phases of all projects, and exercise best judgment on the progress of world-wide initiatives. Related issues are the status of the management plan, budget, and project timelines of nEDM; the identification of potential worries; fully understanding the capabilities of existing facilities; the optimization of existing and projected program resources to maintain balance and to maximize physics output; and assessing the competition in nEDM and weak-interaction physics as well as the unique U.S. capabilities.

The first two meetings will be fact-finding meetings with a focus on the U.S. program, and a third meeting will round out broad perspectives. The first meeting (April 1 and 2) will be focused on nEDM, and the second (April 15 and 16) on neutron weak-interaction physics. The third meeting will converge on evaluations and recommendations in late May or early June, for which the goals and format will evolve from the first two meetings. In early June, the principal recommendations and Executive Summary will be written. The full report will be submitted by early September.

Fundamental neutron physics is an important complement of the U.S. nuclear physics program. The Subcommittee must come to grips with maintaining balance, producing physics output, and providing guidance (especially around fiscal constraints).

Keister noted that NSF has been thinking of making significant funding available to nEDM and other new research.

Gardner was concerned that nEDM has significant international competition that has good funding and less oversight than the U.S. program does and that the additional U.S. scrutiny may delay nEDM and put it at a disadvantage. Kumar agreed that the Subcommittee should keep that in mind.

Kaplan asked how the Subcommittee would handle the financial aspects and whether that was outside the scope of the charge. Kumar replied that the Subcommittee will work closely with the agencies on that issue. Jacobs added that the Subcommittee will be limited by the scope but will go into R&D readiness etc. Some critical evaluation of the project will be made. Kumar said that the third meeting of the Subcommittee will consider FY11 funding levels.

Jacobs asked if there were any update on finances. Keister said that there will be trade-offs that will have to be made as time progresses.

There being no additional discussion, Seestrom resumed the chair. A break for lunch was declared at 12:26 p.m.

Afternoon Session

The meeting was called back into session at 1:31 p.m. with Seestrom as the chair. **Gűnther Rosner** was asked to discuss the activities of the Nuclear Physics European Collaboration Committee (NuPECC).

NuPECC is an expert committee of the European Science Foundation (ESF) that was founded in 1988 by subscribing National Research Councils who nominate nuclear scientists as their representatives to be appointed by the ESF. Its purpose is to strengthen European collaboration in nuclear science through the promotion of nuclear physics and its trans-disciplinary use and application in collaborative ventures between research groups within Europe. It currently has 28 members from 20 countries with more expected to join in 2011. It meets three times a year in different member states.

The ESF was founded in 1974 and has 79 member organizations (science ministries, research councils, and academies) from 30 countries. It has five standing committees and six expert boards and committees, including NuPECC.

NuPECC identifies key scientific issues, launches new projects, develops long-range plans, interacts with stakeholders, performs surveys of human resources, issues publications, and performs outreach activities. Under the European Union (EU) Framework 6 Programme, it sponsors (1) integrated infrastructure initiatives in strongly interacting matter and in nuclear structure and reaction dynamics and (2) design studies for the Facility for Antiproton and Ion Research (FAIR) and European Isotope Separation On-Line (EURISOL). It will continue as the EU Framework 7 Programme sponsor for Hadron Structure and Spectroscopy (HadronPhysics2), HadronPhysics3, European Nuclear Science and Applications Research (ENSAR), and the Support of Public and Industrial Research Using Ion-Beam Technology (SPIRIT) program. There are burgeoning new projects in the form of the Isotope Separation On Line (ISOL), Nuclear Physics, the Electron-Nucleon Collider (ENC), the Polarization Antiproton Experiment (PAX), and the Large Hadron Electron Collider.

Most theoretical physicists, experimental physicists, and support staff in NuPECC member countries are in Germany, Italy, France, Poland, and Romania, practicing in various key subfields. NuPECC publishes *Nuclear Physics News*, handbooks for facility access, surveys of resources, topical reports, and long-range plans. It also conducts outreach activities.

NuPECC is linked with ESF, EU Framework Programs 4 to 7, European Strategy Forum for Research Infrastructures (ESFRI), the European Physical Society's Nuclear Physics Board, and the Particle Physics Committee of the European Committee for Future Accelerators. It has cross membership with NSAC, the Asian Nuclear Physics Association, Asociació Latino Americana de Física Nuclear y Aplicaciones/Associaçã Latino Americana de Física Nuclear e Aplicações (ALAFNA), the International Union of Pure and Applied Physics, and the Organization for Economic Cooperation and Development.

The NuPECC Long-Range Plan was issued in December 2010 because nuclear physics projects need a strong science case, strong support of the entire scientific community, strong support of policymakers, and coherent action of funding agencies and because they have long lead times. The Long-Range Plan reviews the status of the field, issues recommendations, develops an action plan, collaborates closely with Framework Program 7 projects, and puts European nuclear physics into a worldwide context. To produce the Long-Range Plan, working groups were established on hadron physics,

phases of strongly interacting matter, nuclear structure and dynamics, nuclear astrophysics, fundamental interactions, and nuclear physics tools and applications. An assessment was conducted of existing research infrastructures and upgrades, future research infrastructures, and networks.

FAIR investigates nuclear structure and astrophysics, hadron physics, the QCD [quantum chromodynamics] phase diagram, fundamental symmetries and ultra-high electromagnetic fields, materials science and radiation biology, dense bulk plasmas, and accelerator physics. The major FAIR experiments are Plasma, and Applied Physics (APPA), Compressed Baryonic Matter (CBM), Superconducting Fragment Separator (Super FRS), Nuclear Structure – Astrophysics and Reactions (NUSTAR), and Antiproton Annihilations at Darmstadt (PANDA).

The projected cost of Système de Production d'Ions Radioactifs en Ligne - Generation 2 (SPIRAL2) at the Grand Accélérateur National d'Ions Lourds (GANIL) is €200 million. It will include facilities for low-energy exotic nuclei, a super separator spectrometer, neutrons for science, a superconducting linear accelerator, an electron cyclotron resonance (ECR) source, a deuteron-proton source, a target-source ensemble, and a cyclotron for accelerating exotic nuclei.

The Long-Range Plan recommends completing the ESFRI facilities, performing major upgrades, supporting A Large-Ion Collider Experiment (ALICE) at CERN, supporting theory, and fully exploiting the existing facilities. It recommends supporting nuclear physics applications in education by securing and developing nuclear physics skills; developing nuclear-energy, medical, and security applications; and developing novel sources, beams, targets, and instrumentation. It also recommends promoting planning for future large-scale facilities, such as EURISOL, ISOL at the Multipurpose Hybrid Research Reactor for High-Tech Applications (MYRRHA), PAX, ENC, technical design for the Large Hadron Electron Collider (LHeC), and other nuclear physics programs. A roadmap (time and cost schedule) for these new large-scale facilities was developed.

Geesaman noted that the timescale for EURISOL has lengthened rapidly and asked if this was because of technical or funding difficulties. Rosner said that the community did not want to wait for the ultimate accelerator but wanted to go ahead on better-understood projects. Progress has been made on some of EURISOL's technical difficulties. Plus, $2 billion is not even close for the cost. Langanke added that the real cost of FAIR is much greater than the stated cost.

Jacobs asked what the uncertainty was on the start date for CBM. Rosner replied that the date is established but is delayed. The management decided to stage the experiment rather than delay its start.

Seestrom recused herself, and Jacobs assumed the chair for further discussion of the nEDM charge. Kumar said that the executive summary and outline will be submitted for approval before the full report is written. Jacobs noted that the report is to be completed by June 2011, and asked what could be expected by then. Keister replied that the final report would be needed by June or July. How the process progresses after that depends on the recommendations. Henry said that the NSF is the main driver for the schedule. DOE is interested in the executive summary and recommendations. The details are still being worked through. The report may be reviewed at an NSAC meeting, by an exchange of e-mails, or by some other process. The full committee should review the

recommendations in June. Jacobs stated that the Subcommittee should prepare the recommendations by the first week of June. NSAC would need time to read it and could then discuss it. Kumar said that the Subcommittee could get the executive summary and recommendations to NSAC two weeks before a July NSAC meeting. Keister pointed out that the charge is to deliver a final report by July 1, which would require a mid-June NSAC meeting and the delivery of the Subcommittee's executive summary and recommendations by June 1.

Gardner asked what experiments at NSF set the early timescale. Keister could not cite any.

The discussion of nEDM being at an end, Seestrom resumed the chair. She asked for a discussion of the charge on research-data stewardship. She said that a broad-based subcommittee would be formed. Keister pointed out that there had been internal working groups attending to this problem; having them address the Subcommittee would be helpful. Some best practices may emerge from this exercise. Jacobs noted that this is not a trivial issue nor one that has a clear answer. Keister said that the NSF approach was to make everyone have a data-management plan in their proposals to be evaluated by the peer review committee, allowing flexibility from field to field.

Dodge reminded the Committee that the charge called for the production of a snapshot of current practices. Seestrom said that that is the main thrust of the charge but that it also calls for suggestions for what to do in the future. Dissemination in peer-reviewed publications would be one answer. Geesaman cautioned that the Subcommittee should not overlook the costs involved with each model.

The floor was opened for public comment. **Witold Nazarwicz**, Scientific Director of the HRIBF, said that the amount to have been spent on HRIBF in FY12 was $10,259,000. The requested budget was also to include $46 million for the 12-GeV upgrade at CEBAF and would contain an $18 million increase for FRIB. The research done at Holifield has great significance in several fields of science. The facility is unique. It was the first to accelerate neutron-rich fission fragments above the Coulomb barrier. In FY10 and 11, it served 320 researchers from 22 states and 20 countries. It has produced high-impact science and is a service to society. Investments in HRIBF from 2001 to 2011 totaled $39 million, and in the past 5 years have included $9.7 million to the facility, $9.5 million to experimental systems, and $4.8 million to the High-Power Target Laboratory, totaling $25 million. It is the highest-power ISOL in the world. In the past two weeks, four new isotopes have been produced and characterized at the HRIBF. It is unique worldwide; it is the only U.S. ISOL facility; it trains the next generation of scientists; and it builds the instruments and techniques. It forms a bridge to a future FRIB. A recent workshop defined an exciting research plan for HRIBF. He urged finding a way to preserve these unique capabilities. More than 200 U.S. and 400 international signatories joined a petition to continue operation of HRIBF.

Noemie Koller, an HRIBF user, pointed out that the termination of HRIBF would interrupt the doctoral studies of many students. Their work requires the HRIBF; that work cannot be continued at their universities. Shutting it down would provide a short-term gain and produce a long-term difficulty. This action is a signal to the universities. The closure of laboratories and the turning away of students are disturbing to the university community.

Gardner asked how the R&D mission of the Isotope Production Program would be affected by the absence of HRIBF. Gillo replied that the Holifield accelerator is not currently producing isotopes. There is a synergy between the individuals at Holifield and the Isotope Program. The Holifield upgrade plan could lead to isotope production, which would be impacted. The closure of the research program at Holifield does not preclude the use of the facility for isotope production if funds were available.

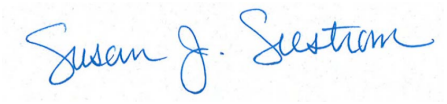
Meredith Howard, a student conducting research at the HRIBF, asked if alternatives were considered, and if so, what they were. Hallman replied that the time urgency has been mentioned. A lot of alternatives were not considered. Through the year, the Office considers many scenarios. The reality did not become clear until it was too late to consider other options. The Office of Management and Budget and other agencies hinted that construction of new facilities would have to be accompanied by the phasing out of older facilities. This was not the time frame the Office had been planning on.

Seestrom wondered whether more information on the impact of the closure could have been gathered by NSAC and DOE. Hallman stressed that DOE is very aware of the quality of work lost and the impacts produced. However, the agency needs to ensure that there are bright prospects for the future with other activities leading up to the startup of FRIB. What was lost was not lost on the agency.

Blackmon pointed out that the Long-Range Plan made it clear that the HRIBF could be affected by other recommended facilities. If something stops FRIB from coming to fruition, this loss will be for nothing.

Seestrom said that she will poll members for their availability for a June meeting. There being no additional comments, the meeting was adjourned at 3:08 p.m.

These minutes of the Nuclear Science Advisory Committee meeting held at the Hilton Hotel, Rockville, Maryland, on March 2, 2011, are certified to be an accurate representation of what occurred.



Susan J. Seestrom
Chair, Nuclear Science Advisory Committee