Minutes of the Meeting of the
Department of Energy and National Science Foundation
Nuclear Science Advisory Committee
DoubleTree Hotel, Washington, D.C.
March 17, 2008

Members Participating:

Robert Tribble, Chairman
Douglas Bryman
Vince Cianciolo
Charlotte Elster
Rolf Ent
Roy Lacey
I-Yang Lee
Christopher Lister
Naomi Makins
Michael Ramsey-Musolf
Hendrik Schatz
Susan Seestrom
Johanna Stachel
John Wilkerson

Members Absent:

Ulrich Heinz
Xiangdong Ji
Richard Milner
Thomas Ullrich
Ubirajara van Kolck

Others Participating:

Tony Chan
Joseph Dehmer
Eugene Henry
Bradley Keister
Jonathan Kotcher
Michael Kreisler
Raymond Orbach
Jehanne Simon-Gillo

Presenters in Order of Appearance:

Glenn Young
Raymond Orbach
Tony Chan
Joseph Dehmer
Bradley Keister
Jehanne Simon-Gillo
Brian Fulton
Michael Holland
Joel Parriott
John Pantaleo

About 25 others were in attendance during the course of the meeting.

Before the meeting, the new members of the Committee were sworn in and the annual ethics briefing was presented by a member of the DOE General Counsel's Office.

Chairman **Robert Tribble** called the meeting to order 9:06 a.m. An interim report on performance measures is being reported on. Tribble expressed a desire to (1) set a schedule for completion and (2) set up a mechanism for Committee review so the report can be approved expeditiously at the next NSAC meeting. He asked the Committee members and visitors to introduce themselves.

Glenn Young was asked to report on the progress of the Performance Measures Subcommittee. They are behind schedule in completing the measures.

The charge letter called for metrics for program activities. A previous report was prepared. The Office of Management and Budget (OMB) has defined what performance measures are. The 2003 long-term performance measures addressed four areas; it has a two-tier grading scheme (Minimally Effective or Successful), each with enumerated physics goals; it covers the period through 2015; and it has expert review every 5 years to rate progress as Excellent, Good, Fair, or Poor.

A definition of what the measures mean and a statement on why they are important was added, and examples of performance measures were drawn up in 2007. Milestones were put in as measures of progress, and budget assumptions were made out to 2013. A grading guide (which uses the terms exceeded, achieved, not fully achieved, and no significant progress) was defined both for programs that have been completed and for those that are still under way. Example milestone evaluations (about 50) and an example summary table were developed.

New milestones were added to the 2007 version of the report to reflect new developments in the fields under consideration (hadronic physics; high-temperature, high-density matter; nuclear structure; nuclear astrophysics; and neutrinos, neutrino astrophysics, and fundamental interactions). The Subcommittee believes that all these milestones are defensible.

A grading scale (Excellent, Good, Fair, or Poor) for performance measures was defined in both general terms and specific terms for each of the fields. These scales have to be reviewed every 5 years to make sure the questions still make sense and to make modifications where they do not still make sense.

At the present time, all four areas are making at least "Good" progress, and three of the four will likely continue to maintain progress. (Fundamental interactions is a point of concern because double-beta decay and the precision solar pp neutrino experiment may have difficulty reaching the Excellent level by 2015.) No performance-measure changes will be proposed. An arithmetic average of milestone evaluations (Excellent = 4; Poor = 1) have been calculated. A healthy program should have an average score somewhere above 3.0.

Certain milestones make assumptions about increased investment. Delays and reschedulings that reflect deviations from those assumptions will affect those milestones and subsequent scores based on those milestones.

Henry noted that, once one puts a number on a report card, one loses the nuances of the full report. It is too easy to grab hold of such a value, which is basically just a "sanity check." In addition, such scores imply that one program is better than another.

Wilkerson stated that grading is a reasonable thing to do and gives an indicator of the adequacy of funding. Also, these grades are unweighted, implying little difference among programs, some of which are large and some small.

Ramsey-Musolf said that the measures for neutrino research do not seem to be the right measurements. It is unrealistic to grade the whole field on the basis of the four projects selected. Two new performance measures should be selected for this area.

Elster asked if these performance measures were consistent with and on the same scale as those of other offices of DOE. Simon-Gillo replied that the Office of Nuclear Physics (NP) standards are very high and its goals are more technical. There are no black-and-white ground rules. Henry pointed out that the guidance given to the Subcommittee was based on what other offices were doing. Elster said that the negative language should be taken out of the definition of a good grade, then.

Makins stated that a textual assessment is good, but the numerical statement is not good.

Lee asked if one got less funding or more funding if one got a lower grade. Young replied that the current milestones assumed constant effort; however, some programs require increases in investment. Simon-Gillo noted that the OMB uses these grades along with other input to score the effectiveness of a program; those scores may influence future funding.

Ent stated that there should be a mechanism for changing performance measures. Young agreed that an appropriate timeframe for revising the milestones should be set. If one did not put new milestones in within 5 years, one would not be representing the program well. However, OMB needs consistent goals to measure progress against.

Wilkerson noted that a “moving-the-goalposts” statement was not fair; scientific reality changes. Young replied that one needs to add more hurdles, not move any goalposts.

Tribble observed that these measures were coupled with the long-range plan (LRP). He asked Young to tell the Committee later in the day what has been done, what has to be done, and when it will be done.

A break was declared at 10:42 a.m. At 11:00 a.m., the Committee was called back into session, and **Raymond Orbach** was invited to talk about the FY08 and 09 DOE budgets. The Office of Science (SC) is currently still trying to work out the FY08 Omnibus Bill budget, is testifying on the Hill about the FY09 budget, and is developing a 10-year FY10 budget. It now has authorization to prepare a 10-year-trajectory budget. The first-half five-year plan will be presented this summer. The national laboratory business plans are also being updated and being matched to the appraisal process. It takes a long time to build new facilities, and budgeting stability is important.

The President in his State of the Union Address tied basic research to the dynamism of our country. It is now up to us to prove it can happen. The FY09 request is extraordinary. The FY07 request for SC was reduced by $300 million, and the FY08 request was reduced by $500 million. That $0.8 billion was lost forever. The FY09 request asks for $0.75 billion more than the past year’s, a 20% increase for SC in one year. The request for Nuclear Physics is up by 18% over the past year.

The fact that congressmen had to ask what happened to the Nuclear Physics program indicates that the scientific community is not communicating to them. SC was a donor in FY08. Its current request is now three quarters of a billion dollars over the FY08

appropriation and is a sitting duck for reductions. If the President's Request is reduced for a third year in a row, all our hopes, planning, and directions will be reduced. The consequences will be with us for years to come.

NP is doing extraordinarily well: The 12-GeV upgrade Continuous Electron Beam Accelerator Facility (CEBAF) is moving forward to offer scientists insight into the structure of the nucleon and the nature of confinement. The program is positioning itself to initiate conceptual-design activities for a Facility for Rare-Isotope Beams. But there have been costs. The FY08 Omnibus Bill cut CEBAF and the Relativistic Heavy Ion Collider (RHIC). NP research programs are nearly flat-funded with FY07. Operations at all four national user facilities have been severely impacted. Support for the Advanced Fuel Cycle Initiative and theoretical topical collaboration was curtailed. These cuts have eaten away at NP's ability to perform, a surprise to Congress. The FY08 appropriation did support the 12-GeV upgrade project within the appropriated amount.

The FY09 budget request for NP is $510 million. The United States today is a world leader in the study of quark structure of the atomic nucleus and behavior of matter under extreme conditions. Maintaining that status in studying the underlying structure of protons and neutrons, the CEBAF has been working beautifully. RHIC has been conducting leading studies on the nature of the Universe several microseconds after the Big Bang. And there will be a competition in 2008 for developing advanced capabilities for rare-isotope beams and the next-generation U.S. facility for nuclear-structure studies and astrophysics, the Facility for Rare Isotope Beams (FRIB). The draft solicitation has been issued.

Isotope production for the nation has been transferred to NP from the Office of Nuclear Energy (NE); this program means a lot to the medical community and to the Office of Biological and Environmental Research (BER). $19.8 million was requested for FY09 for this program.

NSAC is to be congratulated for its Long-Range Plan that sets priorities for NP for Congress to read and understand. This is a major contribution. Now the case has to be made for this plan to the public, to Congress, and to related interests.

The challenge is to support the President's Request. The President's Request for SC was reduced $289 million for FY07 and $501 million for FY08. The President's Request for FY09 is $819 million more than the FY08 appropriation. It is now up to DOE and the physics community to make the case.

He thanked the Committee for the Long-Range Plan.

Tribble asked how his testimony before the House Committee was received. Orbach replied that it was received very well for the past 3 years. The Committee is genuinely interested in science; but when push comes to shove, its priorities are obvious. He will argue for science but needs the help of the community.

Bryman asked if there were a lesson to be learned from High-Energy Physics this year. Orbach said that they learned that they need a long-range plan that unifies the community, the users, and the national laboratories. P5 will put together a draft plan by the end of April.

Elster asked what piece of communication broke down. Orbach replied that he could not lobby. There is a message to be delivered. The President's Request is not an arbitrary number. Congress needs to hear from the community what it means to cut out requested funds. In the past, scientists have not talked directly to their congressmen. Congressman

Ellers had pointed out to Orbach that his office was jammed with scientists when the National Institutes of Health (NIH) funding increases occurred but not when physics was considered.

Tony Chan was asked to present the outlook from the NSF's perspective. The NSF FY09 request includes $772.52 million dollars for research and related activities (R&RA), a 16% increase over the FY08 Omnibus Bill appropriation. NSF and DOE have joint facilities and users, joint funded projects, joint R&D, and joint advice, and NSF is committed to advancing the frontiers of nuclear physics in partnership with DOE.

The President in his State of the Union Address tied science funding to the America Competes Initiative (ACI), which in turn ties fundamental discoveries to marketable technologies, emphasizes the need for facilities and instrumentation, and emphasizes a world-class science and engineering workforce.

The Directorate for Mathematical and Physical Sciences (MPS) is the largest entry in the R&RA budget and has the highest percentage increase in the President's Request. MPS had a small increase in FY08.

Within MPS, the budget allocation in the President's Request breaks down into: astronomical sciences (14.8%), chemistry (26.0%), materials research (24.7%), mathematical sciences (16.0%), physics (18.8%), and multidisciplinary activities (22.3%).

NSF is involved in all areas of the sciences. MPS is the largest of seven directorates and five offices, representing about 20% of the total NSF budget. It supports 7,500 university-based principal investigators (PIs), 2,300 postdocs, and 14,300 students. It has a broad portfolio, from individual PI grants to centers and institutes to more than 12 major facilities. It supports a spectrum of research from fundamental discoveries to marketable technologies. And it has strong internal ties throughout programs.

The range of things that MSP does includes quantum nature, molecular construction, living world, mathematics, and cosmology.

MPS supports workforce development through programs for young investigators, undergraduates, K-12 science educators, broadening participation, and the pilot ACI Fellows Program.

The Major Research Equipment and Facilities Construction (MREFC) projects of interest to MPS - the Atacama Large Millimeter Array (ALMA), Advanced LIGO [Laser Interferometer Gravitational Wave Observatory], and IceCube - are progressing well.

Turning to the Division of Physics:

The impact of the FY08 budget was to defer the new Physics Frontier Centers (PFCs) to 2009, decrease funding to three facilities, cut most programs by 5%, and make planned investments in two new programs [the Physics of Living Systems and Deep Underground Science and Engineering Laboratory (DUSEL)].

Most funding went to investigators (70%), followed by centers and institutes (11%), and facilities (19%). New activities include Science and Engineering Beyond Moore's Law, Cyber-Enabled Discovery and Innovation, Adaptive Systems Technology, MPS–Life Science Interface, and Quantum Information Sciences.

The PFCs began in 2001; there are nine in 2008; they are expected to expand to 13 in FY09. NSF operates a number of facilities. The MREFC budget includes funding for Advanced LIGO, ALMA, IceCube, and a solar telescope. There are others being planned

and developed [DUSEL, Large Synoptic Survey Telescope (LSST), and Giant Segmented Mirror Telescope (GMST)].

In summary, there is a substantial increase in the President's Request for MPS to increase the number of PI grants; start new centers and institutes; operate, construct, and develop new facilities; and maintain and expand investments in workforce development.

A break for lunch was declared at 12:14 p.m., and the meeting was reconvened at 1:10 p.m. **Joseph Dehmer** was asked to report on the activities at NSF. Three important events happened for DUSEL in the past year:

- Selection of the Homestake Mine as the site,
- The Nuclear Science Long-Range Plan, and
- The long-range planning effort by the Particle Physics Project Prioritization Panel (P5) of the High Energy Physics Advisory Panel (HEPAP).

A town meeting was held on DUSEL in November of 2007 with 220 attendees. A lot of people want to do experiments, so a DUSEL Experiment Development Committee was set up. It will hold a workshop in April. The focus after the site selection was on selecting the initial suite of experiments (ISE). Three solicitations have been issued. The fourth will develop the ISE. Both DOE and NSF are involved in the science. An internal review will be held in July 2008. Solicitation 4 (S4) will provide funds for experiment preliminary design reports (PDRs). In December, an NSF review of DUSEL will be held. Credible Critical Decision-2 (CD-2) baselines have to be set. In the fall, the FY10 plan will be developed. The State of South Dakota will be conducting experiments all this time.

S4 will be a call for proposals to develop project plans for potential candidates for the ISE. It will provide design funds; will include limited, targeted R&D; and will be open to all disciplines. It will offer up to $15 million from Physics/MPS over 3 years for physics, engineering, biology, geology, and independent research.

Solicitation 5 (S5) will take the superset that arises from S4. The S5 proposals will produce the ISE. Then there will be multiple generations of experiments. This asset will serve the U.S. science community for many years.

One issue is how NSF can manage all these PIs. Another is how to fund DUSEL and the other ongoing facilities and programs of NSF. A 20-year master plan is being developed to achieve strategic portfolio balance.

A year ago, someone asked about the Physics Division, which has increased an average of 6.1%. NP has not grown at the same rate. Why? There have been other, higher priorities (e.g., POU, PFCs and Biological Physics). With the development of DUSEL, 5 years from now, the balance will be different.

Ramsey-Musolf asked what the roles of the NSF panel and the laboratory management would be in selecting the ISE. Kotcher replied that the panel is analogous to a program advisory committee (PAC), and its recommendations go to the laboratory management and then to the agency. Beyond that, it is not known what will happen. Partnerships with the laboratory management have to be mapped out. Dehmer added that there has to be close collaboration between the agency and the laboratory management. Kotcher noted that the Homestake management has already set up a PAC.

Wilkerson asked how the long-range plan from the community is to be folded into the panel, which is made up of representatives of many disciplines. Dehmer replied that there

are multiple long-range plans, ad hoc reviews, panel reviews, and the laboratory PAC to be considered. All of these constituencies have to be coordinated so everyone is heard.

Wilkerson noted that there was a real change of scope, including consideration of the long-baseline instrument in the ISE and asked if funding will be increased. Dehmer replied that how much is spent will depend on the pressure and liquidity. Quality will be paramount. The situation is challenging and complicated.

Wilkerson stated that S4 only lasts for a year, and it looks like S5 will be in FY10. Dehmer agreed. It will be adapted as the process progresses.

Bryman asked how one assures that the centers go into core research. Dehmer replied that the Committee of Visitors (COV) audits all of the activities. The 2006 COV considered that exact question. They concluded that the balance between facilities and principal-investigator (PI) research was appropriate. As a result, it is felt that the centers are a good investment.

Bradley Keister was asked to talk about nuclear physics at the NSF. NSF supports 200+ faculty, 80+ postdocs, 200+ graduate students, and 150+ undergraduates. DOE and NSF partner in the National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University and the tandem or linac laboratories at Florida State University and Notre Dame.

Some highlights of activities include the production of magnesium-40 at the NSCL, results from an initial 50-day run at Borexino, and a new muon-lifetime measurement at the Paul Scherrer Institute (PSI).

As an outcome of the NSF appropriation from the Omnibus Bill for the Physics Division, NSCL operations have been held flat rather than an anticipated $1M increase. Most investigator programs in the division, including Nuclear Theory and Experiment, are down 5%. The programs are struggling to deal with this impact, following on a cut three years ago that affected many of the same grantees. There will likely be a ripple effect on other grantees in the out-years. In FY09, the division will try to restore NSCL to its former trajectory. The division is also committed to move forward in partnership with DOE in support of the Neutron EDM Experiment.

Special programs being supported in the Physics Division this year are DUSEL R&D, Physics at the Information Frontier, and the Physics Frontier Center program. In Cyber-Enabled Discovery and Innovation (an NSF-wide program), there is some NP participation in proposals and reviewing. The Major Research Instrumentation program now has a 30% cost-sharing requirement mandated by Congress. A solicitation is now out (second year) for Domestic Nuclear Detection (funded by the Department of Homeland Security).

The Nuclear Physics Program needs personnel to fill Intergovernmental Personnel Act staff openings.

Wilkerson noted that CUORE [Cryogenic Underground Observatory for Rare Events] is another joint program between DOE and NSF.

Jehanne Simon-Gillo was asked to describe activities at the Office of Nuclear Physics (NP). The funding from the Omnibus Bill was about $42.5 million less than the request, giving a flat budget. In FY08, the Office had to address crises. There were some modest increases. Major items of equipment (MIE) was stretched out, and research got only a very small increase.

Funding for the Pioneering High-Energy Nuclear Interaction Experiment (PHENIX) Forward VerTeX Detector, PHENIX Nosecone Calorimeter, the first stage of the Gamma-Ray Energy Tracking Array (GRETINA), and the Neutron Electric Dipole Moment (nEDM) were reduced, increasing project risks and causing schedule delays. Impacts to project costs are being evaluated. Funding for the Electron Beam Ion Source (EBIS) project at RHIC, which had been reduced in the FY07 Appropriation, is not restored in FY08. Funds have been requested in FY09 to complete the project.

Planned increases in research efforts that support ongoing initiatives, such as the Fundamental Neutron Physics Beamline (FNPB) and Large Hadron Collider (LHC), are reduced. Generic R&D related to rare-isotope-beam capabilities is reduced. The facilities were affected. RHIC operations are reduced from a planned 30 to 19 weeks. CEBAF operations are reduced from a planned 34 to 24 weeks. Important experiments in the current 6-GeV science program are not completed prior to the shutdown for the implementation of the 12-GeV CEBAF Upgrade Project. Operations of the ATLAS [Argonne Tandem Linac Accelerator System] and HRIBF [Holifield Radioactive Ion Beam Facility] are reduced. Efficiency improvements are deferred. Increased support for the Advanced Fuel Cycle initiative and theoretical topical collaboration is deferred. Loss of support across the program results in reductions of approximately 10 permanent PhDs, 10 postdoctoral fellows, and 10 graduate students. Support for about 30 engineering/technical/administrative personnel is lost.

NSAC said in 2006 that funding at or below $430 million would not be sufficient to sustain operation of both CEBAF and RHIC. This year's budget is really on the edge of sustaining operations at both facilities. The NP budget increased 18%, but without the transfer of isotope production, it would be 13%.

The FY09 request represents a 13% increase in research operations, 28% in research capital equipment, 8% for RHIC, and healthy increases for others. This budget will continue to handicap RHIC operations. Most university and national laboratory research increased. A broad range of experiments is being funded.

In facilities, RHIC is at 25 weeks of operation, and CEBAF is at 34 weeks.

The 10-year plan is revisited each year. The high-priority initiatives in this plan will all be supported by the FY09 President's Request, which is $324 million over the FY08 Request of $4,398 million (+7.4%).

NP is at a crossroads. This is the last year of possibly implementing the President's ACI. No one knows what the position of the new Administration will be. FY06 was a dismal year for NP. FY07 and FY08 appropriations were also difficult despite verbal support from Congress and despite positive House and Senate markups of the budget. If there is an FY09 Continuing Resolution, it will have a strong negative impact on the program. In FY08, NP is at the level at which NSAC acknowledged that it could not afford to operate both of its major facilities. This course is not sustainable. The case for long-term basic R&D and the importance of the NP program must be made to Congress.

Recent management activities include participation in the Organisation for Economic Cooperation and Development (OECD) Global Science Working Group on Nuclear Physics, which is coming to a close and which has operating funding of about $2 billion per year. Some OECD recommendations:

- They encouraged free and open access to beam usage.

- The proposed new and upgraded facilities within the global roadmap for nuclear physics are well coordinated and will produce outstanding science and discoveries.
- It should be recognized that there are important roles for nuclear physics research facilities with a wide diversity in both size and type; an appropriate balance of facilities must be maintained.
- The nuclear science community, funding agencies, and professional societies should continue to encourage awareness of the relevance and benefits of nuclear physics to national needs and society.
- A forum should be established to articulate a global scientific roadmap for nuclear physics.
- The national agencies should work together with international organizations to create an international plan to acquire and curate nuclear data for the wider community.
- Nuclear physics funding agencies should discuss plans for new large-scale facilities and for optimizing communication and cooperation at a global level.

The Nuclear Physics Decadal Study will be supported by DOE.

FY08 solicitations have largely closed. Proposals for theoretical topical collaborations have been deferred. Selected proposals may be supported in FY08. A new budget will be awaited before issuing FY09 solicitations.

The Rare Isotope Beam (RIB) Experiment, an initiative to allow the United States to participate in forefront rare-isotope-beam studies while FRIB is being constructed (about $50 million over 8 years). NP has issued a solicitation for pre-proposals in FY08. Formal applications will be accepted only from pre-applicants encouraged to submit a formal application. The criteria will be based on traditional considerations plus whether there is some particular outstanding scientific opportunity afforded by the facility and U.S. investments, there is the opportunity for significant role by U.S. participants, and the activity has relevance/impact on the planned U.S. FRIB facility and program.

A Draft Funding Opportunity for the U.S. FRIB has been released and is available for public comment until April 15, 2008. It follows the overall approach of the successful funding opportunity announcement for the GTL BioCenters tailored to the needs of the scope associated with the establishment of a facility. There is no FY08 funding associated with the award; it identifies a site that can proceed with facility establishment. Future funding depends on appropriations. A single award is anticipated in 2008, and the peer-review process is now being started.

GRETINA MIE is now at CD 2b/3b, HI [Heavy Ion] LHC ALICE [A Large Ion Collider Experiment] MIE is at CD 2/3, CUORE is at CD1, and the 12-GeV Upgrade is at CD2. Three reviews have been completed so far in 2008. About 15 other reviews are planned for this year.

The FY09 President's Request proposes to transfer the Isotope Production Program from NE to NP. The program is renamed the Isotope Production and Applications Program, and it includes the Isotope Production Infrastructure and a new initiative entitled Research Isotope Development and Production. The NP program has the expertise and experience in operating facilities and developing technologies that are relevant to the production of stable and radioactive isotopes. This brings "relevance to society" to our programs. The revamped program is being worked on for the FY10

budget year. Isotope staff [two full-time equivalents (FTEs)] will transfer from NE to NP along with assets (such as facilities, inventories, and account receivables), commitments, memoranda of agreement, and isotope-supply contracts. The isotope pricing policy will be reconsidered, especially for research isotopes. The program will communicate with federal agencies involved in isotope production and develop a strategic plan (a workshop is being organized for the summer). Peer-review mechanisms will be established for facilities in the Isotope Program; Small Business Innovative Research and Small Business Technology Transfer (SBIR/STTR) programs will be established; a peer-review mechanism will be established for research isotopes; and a working group will be established with NIH to address the National Academy of Sciences (NAS) study recommendations.

NAS published *Advancing Nuclear Medicine Through Innovation*. It noted that the DOE-NE Isotope Program is not meeting the needs of the research community. Requiring full cost recovery is an impediment to radioisotope availability. There is an inadequate domestic supply of most medical radionuclides for routine use in nuclear medicine practice, and no domestic source for some. Deteriorating infrastructure and loss of federal research support are jeopardizing the advancement of nuclear medicine. There is no short- or long-term programmatic commitment by any agency to funding basic research and high-technology infrastructure for nuclear-medicine-technology R&D. The role that NP plays in instructing and training students is not understood.

The Office is short of staff. New federal positions are being advertised, and one IPA position needs to be filled.

Lee asked if the isotope-production effort included stable isotopes. Simon-Gillo replied, yes, it does.

Wilkerson noted that, in FY09, the increases to the national laboratories seemed to outstrip university support. Simon-Gillo replied that an attempt was made to increase both national-laboratory and university support. There are also new initiatives that require increasing the base support at the laboratories.

Kreisler asked if a site selection could be made under a continuing resolution. Simon-Gillo answered that it could if there were no funding that goes with the site selection.

Makins asked what was meant about not understanding the need to train the next generation. Simon-Gillo replied that that situation occurs within the medical community. They understand the technical process of isotope production but not the need to keep the workforce pipeline full.

Brian Fulton was asked to report on the activities of the Nuclear Physics European Collaboration Committee (NuPECC), an expert committee linked to the European Science Foundation. Currently, there are 28 members from 20 countries. It is *not* a body that dictates national policies or European policy or reacts to specific charges. NuPECC decides on its own agenda and actions. NuPECC strives to maintain its independence and to maintain the trust of the community it serves.

The committee meets three times a year. Meetings are hosted in turn by each country. A chair is elected to serve for 3 years. A scientific secretary looks after the administration and maintains the website. Working groups are established as required, town meetings are organized when issues of particular importance are being considered, and the chair

represents NuPECC on various related bodies. It has published a long-range plan that makes recommendations for new facility construction.

The European Strategic Forum for Research Infrastructure (ESFRI) seeks to consolidate facility planning and construction throughout Europe. Its role is to advise the Commission on what large-scale research infrastructures are needed in Europe, in particular which might be funded under the next Framework Programme (FP; a funding cycle). The ESFRI working group on nuclear physics approached NuPECC for input on the most important research-infrastructure projects in nuclear physics.

The ESFRI roadmap identifies 35 large-scale facilities for construction, of which two are for nuclear physics: the Facility for Antiproton and Ion Research (FAIR) at Gesellschaft für Schwerionenforschung (GSI) in Germany and the rare-isotope radioactive-beam facility Spiral2 at Grand Accelerateur National d'Ions Lourds (GANIL) in France. Both have funding approved by the national governments, and both have been approved for pre-funding in FP7.

Some recent developments include

- High-intensity stable-ion beams, detailing the science case, high-intensity sources, high-power accelerators, high-power targets, and high-speed data recording
- Personnel survey, which provides the numbers of personnel by country, the split between sub-fields, and change during the past decade for all European countries
- A survey of small facilities, which raises the profile of the work conducted and stimulates collaborative work
- Mass evaluations (concern was expressed at the lack of European support for data stewardship, and we have responded to this criticism)
- Nuclear Physics Network (NuPNET), one of a number of European research area networks (ERANETs) funded by the European Union. Three networks are designed to bring together the different national funding agencies in a forum where they can discuss how to coordinate and fund particular areas of science. It could solve the problem of coordinating the funding for projects. It is hoped to have this network up and running in 2010.

FAIR is a major extension at GSI. The gain factors are beam intensities up by factors of 100 to 10,000, beam energies up by a factor 20, production of antimatter beams, an increase in beam brilliance by a factor of 10,000 via cooling, and efficient parallel operation of programs. Funding is being provided by the federal government of Germany, the State of Hessen, and partner countries. It is slated to open in 2016.

Spiral2 at GANIL has a budget of €136 million, and construction is planned for 2006 to 2012. It has elicited a large number of proposals. The directors of both laboratories have emphasized that participation from the United States would be very much welcomed, either through formal agreements or as individual groups.

Two new funding bids that were just submitted would provide transnational access, joint research activities, and networks. They are ENSAR (European Nuclear Science and Applications Research) and Hadron Physics 2. The OECD Global Science Forum, at the instigation of the United States, has established a Working Group on Nuclear Physics.

Two developments that NuPECC is interested in encouraging are EURISOL and the Electron Ion Collider. EURISOL is a multi-megawatt isotope separator on-line (ISOL) facility. The feasibility study for it was published in 2004. The main challenges are

designing a 5-MW, 1-GeV driver; a post-accelerator; targeting; safety, etc. The project's technology will be in place in 2009. The question is where to go from there.

Future lepton scattering facilities are the subject of a NuPECC working group. Europe does not have a good history on producing electron accelerators. An electron beam would be injected into the LHC and be referred to as the LeHC. The feasibility study has been endorsed by Conseil Européen pour la Recherche Nucléaire (CERN; now Organisation Européenne pour la Recherche Nucléaire) and the European Committee for Future Accelerators (ECFA). The first ECFA-CERN Workshop on the LHeC was held in September of 2008. The goal is to produce a conceptual design report by early 2010. We see electron-accelerator research shifting to Europe in 2017. However, the physics priorities are not yet established, it is not a foregone conclusion that LHeC will be the choice, and interaction between the U.S. and European communities should be stimulated.

Wilkerson asked where the LeHC was in respect to Super LHC. Fulton replied that it would come after the Super LHC, but that decision has not been officially stated.

Michael Holland and **Joel Parriott** were asked to discuss the shift of isotope production from the Office of Nuclear Energy (NE) to NP. Holland started by saying that nuclear physics is a field that is very productive, but it is difficult to sell as a pure, discovery-oriented science. This transfer of isotope production is a first attempt to fix that situation. The customers for isotopes are medical researchers and diagnosticians. Isotope production does not fit into NE's mental model, which is fixed on power-generating reactors deployed on land and in space.

Lister said that isotope production looks like a poisoned chalice being handed to NP. Holland responded that the program has problems, and NP is more likely to be able to solve those problems. There was no confidence that those problems could be solved in NE.

Lee asked if there would be full-cost recovery for research isotopes. Holland replied that the law requires full-cost recovery, but NE was not enthusiastic about exercising that authority.

Bryman noted that, in imaging technology, NIH has a diagnostic interest but not an instrument bent. Holland observed that, in BER, such imaging research has been done for decades, although all that is left is the artificial-retina program. BER should be encouraged to get back into that research. It might fit into NP, but absorbing the isotope-production business might be enough to handle at the present time, and it is not clear that BER would want to cede imaging technology R&D to NP.

Parriott noted that there are enormous differences between NSF and DOE. NSF's pot of money is amorphous, and NSF turns the crank on how it is doled out. It seems that NSF will get more into facility operations in the future. DOE does a lot of reviews that NSF avoids. OMB is still influenced by the NAS report, *Cooperative Stewardship*, which recommends that one agency be in charge of a facility and that there be one funding stream for core activities. However, that approach raises several questions: What happens to a competition, such as for FRIB or DUSEL? What are the relationships? What should happen to Fermilab? The answers to these questions have not been figured out.

Tribble asked how the day-to-day operating costs of DUSEL should be parceled out. Parriott responded that DUSEL is a strange case. It is what everyone has always wanted. The core-activity costs could be covered by NSF; they will not be the dominant costs. For

each instrument, costs could be handled by one agency. To get an MREFC grant, the cost has to be greater than 10% of the NSF funding, causing the bundling of projects in order to get above that hurdle. No thoughtful process went into selecting that 10% value. Historically, the availability of operating costs has never been documented; that should change for DUSEL. New procedures are needed.

Tribble called attention to another issue on isotope production that was raised in the NAS report, the disappointing accelerator R&D that was going on. That comment was ignored by DOE. Holland replied that that was a fair comment. SC is not perfect, but it tries to understand the question. That is another motivation to move isotope production to SC from NE. In effect, this move is a vote of confidence in SC. SC's due diligence and performance can be the basis for additional funding in the future. Solving the problem will demonstrate to Congress that NP is providing value to society. Within the ACI budget, there is a lot of money to move around.

Wilkerson noted that there are a lot of SBIR funds involved with isotope production and asked if there would be additional funds for SBIR. Holland replied that SBIR is funded through a tax on R&D funding. Pantaleo commented that the commercial sector is taking off. Instituting a research program would be a big plus.

Stachel asked if other sciences are a hard sell in Washington. Holland replied that, in the main, pure science is a hard sell, although there are exceptions, like turning off the Hubble Telescope. Space exploration is seen as an extension of American exploration and expansion. The Hubble's support comes because of its contribution to the public imagination. Nuclear physics thinks that it is selling science, and politicians think that it is selling national laboratories. High-energy physics' payoff has not been politically significant.

Tribble and Young presented the following dates for completion of the performance-measures report:

March 21, a draft is submitted to the committee.
March 28, comments are due back from committee members.
April 11, the report is due back from laboratory offices.
April 18, the draft report is sent to NSAC.
May 2, comments are due back from NSAC members.
May 16, the revised report is to be presented to NSAC.

John Pantaleo was asked to report on the isotope-production activities. The mission of DOE's isotope program is to produce and sell radioactive and stable isotopes, associated by-products, surplus materials, and related isotope services and to maintain the infrastructure required to supply isotope products and related services. The program served more than 160 customers in FY07 and made 484 shipments, most to universities and hospitals. DOE provides these services because, since the 1940s, substantial dependency has been built around the use of the Department's isotope products and services for vital research and for biomedical, homeland security, and industrial applications. Approximately 12 to 15 million diagnostic procedures and several hundred thousand therapeutic treatments are conducted annually. The unique facilities, such as large reactors, accelerators, and isotope processing hot cells, are not available elsewhere. The primary authority is the Atomic Energy Act of 1954. In 1989, the Department requested and Congress established the Isotope Program as a single point at DOE headquarters for oversight of the Department's isotope activities. Public Law 101-101

created the Isotope Production and Distribution Program Fund (a revolving fund) and allowed prices charged for products and services to be based on production costs, market value, U.S. research needs, and other factors. The annual appropriation and revenues from isotope sales are deposited in the fund. Isotopes are priced such that the research customers pay the cost of production, and commercial isotopes are sold at full-cost recovery.

The revolving fund starts with appropriations, which have been restricted by Congress to facilities only. The short-term goals of the program are to continue to maintain isotope processing facilities; to include meeting the FDA's requirements; to work with universities and other private sector isotope producers to increase research-isotope availability; to develop at least two new isotope processing techniques, as requested by researchers; to continue to import irradiated targets from foreign suppliers to enhance supply; to continue sales from large inventories; to address the recommendations of the NIH study on the "State of Nuclear Medicine"; and to make limited investments to university infrastructure that can achieve production at lower cost than the national laboratories of small quantities of medical research isotopes.

Sources are scattered around the country and are a mix of national laboratories and private ventures and a mix of reactors and accelerators. With the proceeds, DOE is pulling the program along but not making any investments in research. There are new facilities for separating isotopes and converting their chemical forms at Oak Ridge National Laboratory (ORNL). The expertise of production managers and the advice from users are used to determine what products should be made. The program works in a parasitic mode, availing itself of available time on research reactors or accelerators. As a result, there are (1) insufficient dedicated isotope production capabilities to permit year-round isotope production and (2) aging facilities and equipment. Isotope R&D needs to be reestablished and to respond to the need for new isotope products and to support faster, better, more economical methods of isotope production. There is no lead sponsor for large commercial isotopes. Batch pricing caused by budget restrictions is impacting research. Researchers are forced to pay for the entire isotope batch. There is no guarantee that research isotopes will be produced when requested. And there has been a reduced isotope portfolio since 2002. A centralized business office has been established at ORNL.

Lee asked what the status was of stable-isotope production. Pantaleo said that DOE is not producing any stable isotopes. Some of them are ordered from Russia. The calutrons for producing stable isotopes are in deep shutdown. The nation is drawing off its inventory for research isotopes. A distinction is made between commercial and research isotopes. The situation needs to be studied.

Wilkerson asked about the status of the revolving fund. Pantaleo replied that it is low, about $800,000. A lot of services are provided, like packaging and shipping. That $800,000 is not a lot of money to cover all those services.

Makins asked what other countries were doing. Pantaleo responded that it depends on the isotope. For strontium-82, DOE and Nordion [under an agreement with the TriUniversity Meson Facility (TRIUMF)] are the only suppliers. There are other countries where the governments supply subsidies. Molybdenum-99 and technetium-99 are not made in the United States anymore; nobody wanted to commercialize that production. Now those isotopes are imported. Whether the United States should get back into the business is a big question. The National Nuclear Security Administration

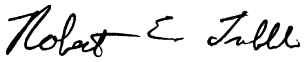
(NNSA) is conducting a study about the use of low-enriched uranium rather than highly enriched uranium for the production of molybdenum-99 (by uranium fission).

Simon-Gillo said that a charge to NSAC might be to look at demand and at foreign vs domestic production.

The floor was opened to public comment. Kreisler noted that the NSF runs a program on stockpile stewardship jointly with DOE, and a solicitation should be coming out of SC any day now on high-energy-density physics.

A call for further public comment was made. There being none, the meeting was adjourned at 4:51 p.m.

These minutes of the Nuclear Science Advisory Committee meeting held at the Doubletree Hotel, Washington, D.C., March 17, 2008 are certified to be an accurate representation of what occurred.



Robert Tribble
Chairman
Nuclear Science Advisory Committee