delays, or of being put off by the hassle of applying for EC money. Indeed, says Bourguignon, "the situation got to such a point that, according to a study conducted by the French government, the best labs were ignoring European funding because it was not flexible enough and the bureaucracy was too heavy."

Increased flexibility and autonomy are key improvements, agrees Bijan Saghai, who serves as a liaison to the EC for the department of nuclear, elementary particle, and astrophysics in France's Atomic Energy Commission (CEA), where he is a hadron theorist. "This will give more possibility to adapt research to updated levels, and not just finish projects suggested three years ago. [FP6] plays the role of catalyst for me. It is a new way of working and thinking. I think it will evolve whole institutions in Europe. That's more than a 5% impact. It's a cultural evolution."

TONI FEDER

OSTP Issues Blueprint for Improving US Neutron-Scattering Capabilities

There is a shortage of neutron sources available to US scientists, and while the SNS will help, demand is expected to eventually outstrip even that facility.

The demand for neutron sources in the US nearly doubled during the past decade while the availability of first-rate instruments at neutron facilities declined more than 15%. Add to that the 1999 closing of the High Flux Beam Reactor (HFBR) at Brookhaven National Laboratory, and the US science community is left at a significant disadvantage in neutron-scattering capability compared to Western Europe and Japan. That is the conclusion of a new Office of Science and Technology Policy report that calls for improving, through better instrumentation and more efficient use, the overall quality of the handful of US neutron source facilities.

In a document entitled *Report on the Status and Needs of Major Neutron Scattering Facilities and Instruments in the United States*, an interagency working group of scientists, chaired by Patrick Gallagher of the NIST Center for Neutron Research (NCNR) in Gaithersburg, Maryland, compared the efficiency of the four major neutron facilities now operating in the US and then looked at where the US will stand when the Spallation Neutron Source (SNS) goes online in 2006.

The report said that the neutron facility at NIST "is the only US facility which currently provides a broad range of world-class capability." The report noted that the anticipated completion of the SNS at Oak Ridge National Laboratory in Tennessee in 2006 "is the most significant new opportunity to provide world-leading neutron-scattering capability in the United States." But the report warned that the SNS alone "cannot provide the necessary neutron-scattering capability [to meet demand] and ways must be found to enhance the effectiveness of other sources as well."

There are four major sources for neutron scattering research in the US, of which two are reactor based and two are accelerator-based spallation neutron sources. The High Flux Isotope Reactor (HFIR) at the Oak Ridge National Laboratory and the NCNR are the reactor-based sources. The Intense Pulsed Neutron Source (IPNS) at Argonne National Laboratory in Illinois, and the Los Alamos Neutron Science Center (LANSCE) at Los Alamos National Laboratory are the two accelerator-based sources.

Brookhaven's HFBR ceased regular operations in 1997 and was permanently closed in 1999 due to a tritium leak into groundwater from a fuel storage pool. The void left by the loss of the HFBR has been filled in part by increased operations at NCNR and ongoing upgrades to HFIR. The US still lags far behind Europe, however, and the report notes that the gap won't be narrowed until the completion of the $1.4 billion SNS, scheduled to become operational in 2006. The SNS will be "the world's first advanced-design, high-power spallation neutron source," the report says. However, the full potential of the SNS will not be realized without a full instrument suite, which is not part of the current construction budget. To remedy that problem the report calls for immediately establishing "a framework for an interagency partnership to provide funding . . . to develop and operate a robust suite of instruments."

James Rhyne, a University of Missouri physicist and president of the Neutron Scattering Society of America, said that while a fully instrumented SNS is critical, "it would be unfortunate to put all of our eggs in the SNS basket." Rhyne, who termed the neutron report "outstanding and very comprehensive," said its recommendations that instruments at existing facilities be modernized are important. "NIST has a number of new and upgraded instruments, but others there and at other labs are 25 to 30 years old," he said. "We can gain a lot by modernizing instrumentation."

Data tells the story

Patricia Dehmer, the associate director for DOE's Office of Basic Energy Sciences and a member of the study's working group, said, "I think the report is very objective in that it relies heavily on an awful lot of data that we collected on the facilities and on the user base and the user demographics." The data were "very compelling and essentially told a story," she added. "And that story is that the user base is becoming increasingly heterogeneous, just like for the light sources."

Although the traditional fields of condensed matter physics, materials science, and chemistry continue to make up a large element of the research program at neutron facilities, the report says, the largest growth in neutron-scattering use over the past decade has been in fields that exploit low-Q diffraction and high-resolution spectroscopy instrumentation at high-intensity cold sources. "These include polymer science; materials science and nanomaterials; complex fluids and other areas of 'soft' condensed matter physics and biology," the study says. The use of neutron scattering for biological research, which totaled about 5% of facility use in 2000, could increase significantly as improved instruments are added to existing facilities and the SNS comes online, according to the report.

To meet the changing nature of the user base and to try to regain world-class capability in the field, the report offered four recommendations:

- Fully develop at least 85% of available beam lines with instrumentation that exceeds, or is at least competitive with, international instruments. The recommendation also calls for maximizing beam time available to a broad scientific community by using independent, peer-review programs, and increasing the scientific staff at the facilities.
- Form partnerships between the "steward" agency at each facility and other federal agencies to ensure both stable funding and wide access by researchers to the neutron sources.

▶ Improve coordination between participating agencies, facility managers, and user organizations to make sure that the limited neutron source capability in the US is "wisely exploited."
▶ Focus efforts among several federal agencies to ensure that neutron source facilities receive funding for ongoing upgrades of instruments and can enhance research and development in neutron source technology.

Dehmer, who controls funding for most of the neutron-scattering work at DOE, said that, "to take the best advantage of our facilities, we have to have a fleet of world-class instruments—world-class being important—that are supported well by beam line scientists. So what I'm planning on doing in the short term is investing in upgraded instruments at HFIR and LANSCE, and new instruments, of course, for the Spallation Neutron Source." She added, "When those instruments are commissioned, we will support them with beam line scientists to help that large user population that is expected."

Even with the instrument upgrades and an operational SNS, it is unclear if the neutron source supply will meet the US demand. "We have yet to determine [the demand] because what we saw at NIST was a huge growth in user population—it went up by a factor of three—in the 1990s," Dehmer said. She anticipates a similar jump in demand when existing facilities are upgraded and the SNS becomes operational. "I think there is a latent community out there that is waiting for instruments that are easy to use and that will help them with their own science."

When user demand outstrips even the SNS, Rhyne noted that plans for a second target station and instrument building are included in the SNS design. "Make sure the first target station and instrument hall is fully equipped," he said. "Then, 10 or 20 years out, you could build the second target station. Beyond that we should think of another, more powerful neutron source." **JIM DAWSON**

Solar System Report Sets 10-year Exploration Priorities

In a comprehensive, 417-page report designed to serve as a roadmap for the next decade of solar system exploration, a committee of planetary scientists is urging NASA to launch a reoriented Pluto–Kuiper Belt (PKB) mission and is advocating a return to costly, once-a-decade flagship missions in the $650 million to $1 billion range. The National Research Council (NRC) report, entitled *New Frontiers in the Solar System: An Integrated Exploration Strategy*, was compiled at NASA's request and is modeled after the decadal reports in astronomy and astrophysics.

After reviewing 27 missions proposed by six panels, a 15-member steering committee, chaired by astronomer Michael Belton, president of Belton Space Exploration Initiatives in Tucson, Arizona, recommended that NASA conduct 12 missions. Dimitri Papanastassiou, a committee member and cosmochemist with the Jet Propulsion Laboratory in Pasadena, California, said NASA asked the committee to "identify and prioritize potential missions, separately for the Solar System and for Mars. The steering group was keenly aware of the need to reach a consensus and I believe we did so." He added, "The final decisions were based on scientific merit, technical readiness, and cost."

The National Research Council report considers "compelling science," technology, and cost in recommending a wide range of missions to be launched by 2013.

The recommended missions are intended to answer scientific questions that stem from four crosscutting themes: the first billion years of Solar System history, the volatile and organic materials that make up "the stuff of life," the origin and evolution of habitable worlds, and the processes that reveal "how planets work." Committee members developed 12 scientific questions based on the four themes, then measured the proposed missions against their ability to answer the questions.

Underlying premise

The report's underlying premise is that "it is crucial to maintain a mix of mission sizes and complexities in order to balance available resources against potential schemes for implementation." To achieve that proper mix, the committee recommended that NASA establish three classes of planetary missions.
▶ Small missions would launch once every 18 months and would cost less than $325 million. This class of missions would essentially be a continuation of NASA's Discovery program, which has sent spacecraft to asteroids, comets, Mars, Mercury, and the Moon. These missions could be developed quickly in response to discoveries during the decade, the report says. "We see them as an essential component because they allow the ability to follow up on new science discoveries and allow individual scientists to propose highly creative and new concept missions," Belton said in a press conference following the report's release.
▶ Medium-sized missions, approximately on the scale of the New Frontiers exploration program NASA created earlier this year, would consist of flights costing from $325 million up to $650 million. The report recommends that during the next decade, in order of priority, NASA fly a PKB mission, a lunar South Pole sample return mission, the Jupiter Polar Orbiter with probes, the Venus In-Situ Explorer mission, and a comet surface sample return mission.
▶ Large flagship missions that exceed $650 million are recommended at the rate of one per decade. These costly missions were abandoned in the early 1990s under the "faster, better, cheaper" approach of Dan Goldin, who stepped down as NASA's administrator a few months ago. "Experience has shown that large missions, which enable detailed, extended, and scientifically multifaceted observations, are an essential element of the mission mix," the report says. Placing a spacecraft in orbit around Jupiter's moon Europa is recommended as the highest priority large mission. Belton said NASA's projected budget should allow one flagship mission per decade, but NASA's Colleen Hartman, head of the Solar System Exploration office, says there isn't enough money in the budget for Europa-scale missions.

The report also recommends that NASA continue with its Mars Exploration program, including two small-mission programs, two medium-sized missions involving several landers, and plans for flagship-level Mars sample return missions that can begin "early in the decade 2013–2023." The Mars subcommittee recommended that a sample return mission be undertaken in 2011; however, it would cost at least $2 billion, the steering committee bumped the program into the next decade and recommended that NASA seek international partners.

Problematic recommendations

Most problematic for NASA are the report's recommendations that high