▶ 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

priority be given to a PKB mission and the Europa orbiter, both of which the space agency canceled earlier this year for budgetary reasons. The report says that the Pluto mission that has been under development for several years is important but should be reoriented to focus on visiting two or three Kuiper Belt objects. Pluto and its moon, Charon, would get a flyby wave from the spacecraft, but would not be the mission's primary goal.

For the past two years, NASA has zeroed out the budget for the Pluto mission, but Congress, led by Senator Barbara Mikulski (D-Md.), has continued to fund the project. Mikulski put $30 million in NASA's budget last year for the mission. This past May, Ed Weiler, NASA's associate administrator for space science, told Congress that a "Pluto–Kuiper Belt mission should not be pursued at this time" given the cost, the technical challenges, and the need to launch by 2006. The launch date is important for the spacecraft to get a velocity boost from Jupiter and reach Pluto before 2020, when the planet's atmosphere is expected to collapse as its orbit carries it farther away from the Sun. In the wake of the NRC report, NASA officials have indicated that the agency's position on the PKB mission is being reviewed, and that $122 million will be required in the budget for fiscal year 2003 if the flight is to meet the 2006 launch date.

The mission to put an orbiter around Europa to study the ocean suspected to exist under the layer of ice that covers the moon would mark the return to very expensive missions, something NASA has been reluctant to do. Weiler told Congress in May that the Europa mission, whose price tag had doubled from $500 million to $1 billion, had been canceled. The money already allocated for the mission was reallocated to the medium-sized missions in the agency's New Frontiers program.

In recommending reinstatement of the Europa orbiter, the report says, "The first step in understanding the potential for icy satellites as abodes for life is a Europa mission with the goal of confirming the presence of an interior ocean, characterizing the satellite's ice shell, and understanding its geological history. Europa is important for addressing the issue of how far organic chemistry goes toward life in environments. . . ."

Joseph Burns, a member of the steering committee and astronomer from Cornell University, said NASA's Weiler and Hartman considered the report "exceedingly valuable" when they were briefed on the recommendations."We've proposed an ambitious program," Burns said. "They have to sit back and think about it. We have to give [NASA officials] time to see how they can fit it together."

JIM DAWSON AND PAUL GUINNESSY

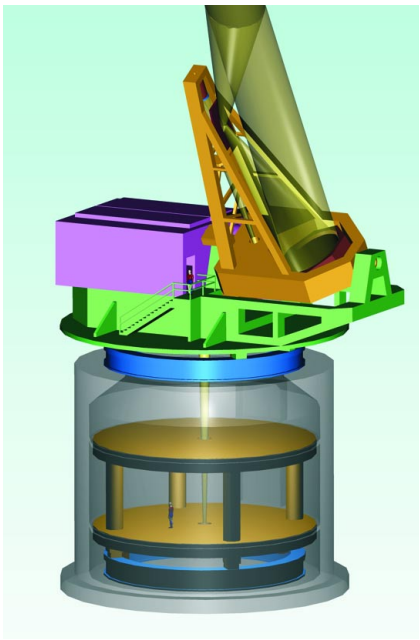
NSO Plans Large Telescope, Splits from Nighttime Astronomy

As it gears up to build a jumbo solar telescope, the US National Solar Observatory is reclaiming independence from the National Optical Astronomy Observatory.

Along with other mostly 20-year-old observatories, NSO was folded into the newly formed NOAO in the mid-1980s. The idea was to share resources and foster synergies among scientists from the daytime and nighttime astronomy communities. The experiment did not work out as well it could have, says John Huchra, who chairs the board of directors of the Association of Universities for Research in Astronomy, the organization that manages both observatories for NSF. "The nighttime and solar astronomers don't have goals that are quite enough in common." (AURA's longstanding contract was renewed in May, after being opened to competition for the first time.) NSO's share of the total NOAO budget hovered around 25–30% and, says NSO Director Stephen Keil, "the solar physics community felt that independence would give it the opportunity to pursue projects more efficiently, both in terms of implementation and funding."

A gradual split was begun in late 2000, driven by NSO's desire to have full control over the Advanced Technology Solar Telescope (ATST), the most ambitious project in ground-based solar astronomy in decades. NSO and NOAO still share space and staff in Tucson and Kitt Peak, Arizona, but they are programmatically and, increasingly, financially independent. The separation is expected to be completed in a few years, when construction of the ATST gets under way. By then, a single new site for NSO headquarters should have been chosen to replace NSO's current offices, which

NSO



THE ADVANCED TECHNOLOGY Solar Telescope, an artist's conception.

are spread between Tucson and Sacramento Peak, New Mexico.

The grand goals of the ATST are to seek answers to broad and basic questions. How are cosmic magnetic fields generated and destroyed? What role do cosmic magnetic fields play in the organization of plasma structures? What causes solar variability? Says Keil, "What [the ATST] will do for solar physics is open up a whole new regime of physical scales to explore."

Still in the design stage, the ATST is to have a 4-meter aperture, far larger than any existing solar telescope, and be outfitted with adaptive optics to correct for atmospheric disturbances. It will have a spatial resolution of 0.05 arcseconds—fine enough to see the Sun's magnetic features down to about 35 km in length, the scale of flux tubes predicted by theory but not yet observed. The telescope's large aperture will also collect enough light to temporally resolve explosive flares and other short-duration solar activity. To exploit both the resolution of visible wavelengths and the keen magnetic sensitivity of the infrared, the ATST's wavelength range will be 0.3 to 35 microns.

Six sites are being considered for the ATST. Four are in the US: on Sacramento Peak; Big Bear Lake, California; Haleakala, on the Hawaiian island of Maui; and Panguitch Lake in southern Utah. The other two are in northern Mexico's San Pedro Mártir mountains and on the Spanish island of La Palma. At each site, air turbulence, cloud cover, dust, and