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May 9, 2002

Statement of
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Before the

Subcommittee on Space and Aeronautics
Committee on Science
House of Representatives

Mr. Chairman and Members of the Subcommittee:

It is my great pleasure to be here today and to talk to you about NASA's Space Science program. In my testimony, I would like to tell you about some of our recent science highlights and accomplishments and lay out the contents of the President's FY 2003 budget request and what scientific outcomes we can expect as a result. I also plan to discuss the Space Science Enterprise's approach to prioritizing its science objectives – a topic that I know is of interest to this Committee. I look forward to working with the Committee to continue delivering the excellent return on investment that the American taxpayers have come to expect from NASA's Space Science program.

Recent Space Science Highlights

I am happy to report to you that during FY 2001 and the first half of FY 2002, the Space Science Enterprise has produced many notable scientific results and discoveries. In 2001, Hubble Space Telescope (HST) scientists using archival data discovered a supernova blast that occurred very early in the life of the Universe, bolstering the case for the existence of a mysterious form of "dark energy" pervading the Universe. The concept of dark energy, which pushes galaxies away from each other at an ever-increasing speed, was first proposed, and then discarded, by Albert Einstein early in the last century. This important Hubble discovery also reinforces the startling idea that the expansion of the Universe has only recently begun speeding up.

The Chandra X-ray Observatory, which was launched in July 1999, continued its impressive performance and delivered data and images, which have enhanced our current understanding of black holes on many fronts. Chandra took the deepest X-ray images ever and found the early Universe teeming with black holes, probed the theoretical edge of a black hole known as the event horizon, and captured the first X-ray flare ever seen from the super massive black hole at the center of our own Milky Way galaxy.

In addition to these discoveries that have enhanced our understanding of the origin, evolution, and structure of the Universe, there have been many other recent discoveries related to the rapidly growing field of extrasolar planet (planets outside our Solar System) detection. NASA and National Science Foundation-funded astronomers discovered eight new extrasolar planets, bringing the total number to about eighty. Observations from the Submillimeter Wave Astronomy Satellite (SWAS) provided the first evidence that extrasolar planetary systems contain water, an essential ingredient for known forms of life. Also in this field, astronomers using the HST have made the first detection and chemical analysis of the atmosphere of a planet outside our Solar System.

Within our Solar System, NASA Space Science spacecraft made stunning achievements as well. In a risky flyby, the Deep Space-1 (DS-1) spacecraft successfully navigated past comet Borrelly, giving researchers the best look ever inside the comet's glowing core of icy dust and gas. DS-1 passed just 1,400 miles from the rocky, icy nucleus of the more than 6-mile-long comet. The NEAR (Near Earth Asteroid Rendezvous) Shoemaker spacecraft achieved the first soft landing on an asteroid – the culmination of a yearlong orbital mission at the asteroid Eros during which it returned enormous quantities of scientific data and images.

A pair of spacecraft, the Mars Global Surveyor and the HST, teamed up to provide astronomers with a ringside seat to the biggest global dust storm seen on Mars in several decades. The Martian dust storm, larger by far than any seen on Earth, raised a cloud of dust that engulfed the entire planet for several months. The sun-warmed dust raised the atmospheric temperatures by 80 degrees F while the shaded surface chilled precipitously. The Mars Odyssey 2001 spacecraft also successfully achieved orbit around Mars following a six-month, 286-million-mile journey. [Following aerobraking operations, Odyssey entered its science-mapping orbit in February 2002. The orbiter is now characterizing the composition of the Martian surface at unprecedented levels of detail.]

The Sun-Earth Connections program, which seeks to develop a scientific understanding of the physical interactions in the Sun-Earth system, had several important scientific accomplishments in 2001. The Solar and Heliospheric Observatory (SOHO) observed the largest sunspot in ten years, with a surface area as big as the surface area of thirteen Earths. This area proved to be a prolific source of stormy solar activity, hurling clouds of electrified gas (known as Coronal Mass Ejections) towards Earth. SOHO also provided the first clear picture of what lies beneath sunspots – swirling flows of electrified gas that create a self-reinforcing cycle which holds a sunspot together.

As we entered FY 2002, the Microwave Anisotropy Probe (MAP) completed its three-month journey and arrived at its destination half a million miles from Earth. MAP is a NASA Explorer mission that is measuring the temperature of the cosmic background radiation over the full sky with unprecedented accuracy. This map of the remnant heat from the Big Bang will provide answers to fundamental questions about the origin and fate of our Universe. The year 2001 ended with the successful launch of the TIMED (Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics) mission in December 2001. TIMED is studying a region of the Earth's atmosphere that has never been the subject of a comprehensive, long-term scientific investigation.

On February 5, 2002, we launched the High-Energy Solar Spectroscopic Imager (HESSI), which is a mission to study solar flares and the gamma rays they emit. Just over one month after launch, HESSI made its debut by observing a huge explosion in the atmosphere of the Sun. The solar flare was equal to one million megatons of TNT and gave off powerful bursts of X-rays.

In March of this year, the crew of the STS-109 made a house call to the Hubble Space Telescope. This was the fourth time that astronaut crews have serviced our most prolific science satellite and this was the most challenging servicing mission to date. But, as usual, the crewmembers rose to the occasion and performed their jobs flawlessly. The result of their extraordinary efforts is a Hubble that is more scientifically robust than at any other time of its 12-year life. It has new, more efficient solar arrays, a new power control unit, a resuscitated NICMOS (Near Infrared Camera and Multi-Object Spectrometer), and a powerful new resource called the Advanced Camera for Surveys (ACS). The ACS improved the telescope's discovery power by ten times its previous capability and allows detection of light from the ultraviolet to the near infrared. The first results from this new instrument were released on April 30, 2002, and made news around the world. The remarkable images let us see deep into the Universe with unprecedented detail. One image of the Tadpole galaxy had a bonus: a background that showed approximately 6,000 galaxies – twice the number of galaxies that are visible in the now-famous Hubble Deep Field image.

And the second half of this year promises to deliver even more scientific discoveries and insights. At the beginning of July, we will launch CONTOUR – the Comet Nucleus Tour mission. CONTOUR is a Discovery mission that will visit and study at least two comets. For the first time, we will assess how diverse these original building blocks of the Solar System really are. CONTOUR will also clear up the many mysteries of how comets evolve as they approach the Sun and their ice begins to evaporate.

FY 2003 will see the launch of NASA's fourth and final "Great Observatory". SIRTF – the Space Infrared Telescope Facility – promises to continue the incredible science legacy of its predecessor Great Observatories. For more than a decade the Compton Gamma Observatory, the Hubble Space Telescope, and the Chandra X-ray Observatory have literally rewritten astronomy textbooks in their respective ranges of the electromagnetic spectrum (gamma ray, visible/ultraviolet, and x-ray). We are confident that SIRTF will do the same during its two-and-a-half-year prime mission. By looking at the Universe through its infrared eyes, SIRTF will obtain images and spectra by detecting the heat radiated by objects in space between wavelengths of 3 and 180 microns (1 micron is one-millionth of a meter). Most of this infrared radiation is blocked by the Earth's atmosphere and cannot be observed from the ground.

Space Science will continue its quest to unlock the secrets of Mars, by sending twin rovers to different parts of the Red Planet's surface. The rovers will be launched in May and June 2003 and will reach their destinations in the spring of 2004. Once there, the almost golf-cart-sized rovers will be able to travel far greater distances than the famous Sojourner rover did in 1997. Each rover will carry a sophisticated set of instruments that will allow it to search for evidence of liquid water that may have been present in the planet's past. The rovers will be identical to each other, but will land at different regions of Mars.

FY 2003 President's Budget Request

The President's FY 2003 Budget Request of $3.4 billion (including institutional support) for the Space Science program recognizes our past successes and provides a solid foundation that will ensure that we are able to continue delivering the world-class science for which we have become known. The budget request for FY 2003 features two very significant changes from the previous baseline program: a reformulated planetary program and new investments in nuclear power and nuclear electric propulsion technologies.

In the field of planetary exploration, the FY 2003 budget takes a fundamentally different approach from previous years. Given doubling costs and multi-year schedule delays, we cancelled the Europa Orbiter mission. The funding that was associated with this mission has been reallocated to a revamped planetary program called New Frontiers. The National Research Council is preparing a comprehensive report on planetary science priorities, and this report will help guide the goals and priorities of the New Frontiers program. All New Frontiers missions will be selected through a fully open, competitive, and peer-reviewed process. Our Discovery Program has proven that this approach to selecting and managing planetary missions is highly successful at delivering world-class planetary science while maintaining cost commitments. New Frontiers fills a critical need, providing regular opportunities to undertake high-priority planetary research using the best program management approaches we know of today.

Although not part of NASA's FY 2002 budget request, Congress provided $30M in FY 2002 and direction to proceed with the selection of a Pluto-Kuiper Belt mission study. A selection was made in October 2001, and the "New Horizons" mission is currently under contract for a Phase B design study effort. The scientific value of this mission is highly dependent on a 2006 launch that achieves a flyby of Pluto well before 2020. To ensure this launch date, NASA has established two conditions that must be successfully met at the conclusion of Phase B. First, the mission must pass a confirmation review that will address significant technical and schedule risks, including regulatory approval for launch of the mission's nuclear power source on new launch vehicle designs. Second, funds must be available. Total mission costs are estimated at $480 million over the 15-year life-cycle of the mission. NASA's FY 2003 budget request includes no funding for a Pluto-Kuiper Belt mission. Although competition has helped reduce costs somewhat, this estimate still represents a 60 percent increase over the original budget estimate for a Pluto-Kuiper Belt mission. We believe a Pluto-Kuiper Belt mission should not be pursued at this time given the substantial cost increase, technical and schedule challenges, and the ongoing NRC review of planetary science priorities. The New Frontiers Program will provide future competitive opportunities to address these research targets if they are identified as priorities in the NRC review. Future missions will also be able to take advantage of technology investments for faster or more capable spacecraft.

In addition to providing regular opportunities for high-priority planetary research through the New Frontiers program, NASA's FY 2003 budget request makes critical investments towards faster, more frequent, more flexible, and more capable planetary missions for the future. Our FY 2003 budget request includes new funding for a Nuclear Systems Initiative (NSI) to develop nuclear power and nuclear-electric propulsion technologies.

Although some of NSI's technologies are complex and will take the next decade to develop, the overarching objectives are actually quite straightforward. Nuclear power and nuclear electric propulsion will: dramatically increase the operational lifetime of landed spacecraft, allow the exploration of regions of our solar system that are inaccessible with solar power, expand launch windows to planetary targets, enable faster spacecraft, and increase science return per mission dollar. NSI's investments in technology over the next few years will be aimed at developing safe, capable systems that can be used in a wide range of planetary research applications. In some cases, NSI investments may enable entirely new types of missions that are unaffordable or technically impossible to undertake today.

One part of the program will develop a new generation of radioisotope power systems (RPS), which can generate several hundred watts of electrical power for spacecraft and scientific instruments for missions in deep space and on planetary surfaces. NASA has used RPS safely for approximately 30 years on a variety of missions, including Apollo, the Voyagers, and Cassini. In fact, the Voyagers, which were launched in 1977, amazingly are still returning data from beyond Pluto today. The first use of the new RPSs will be for the Mars Smart Lander/Mobile Laboratory mission. This mission will now be launched in 2009 instead of 2007 and will incorporate nuclear power to extend mission life from a few months to potentially a few years, increasing science return many-fold.

The successful flight of the DS-1 spacecraft proved the operational utility of electric propulsion, which requires kilowatts of power to be effective. In deep space, only nuclear fission can provide this amount of electrical power. Therefore, the second part of NSI will develop a uranium-fueled nuclear fission reactor that powers an advanced electric propulsion system, enabling far more capable spacecraft to make potentially faster trips through the Solar System and visit multiple destinations on the same mission. These powerful reactors (tens of kilowatts of electrical power) will allow spacecraft to reach locations where we expect the most revealing clues to life's origins might be found and to carry out a robust scientific mission and transmit data at rates not feasible today.

Under NSI, NASA will work closely with the Department of Energy (DOE), who is responsible for the handling of nuclear fuel and nuclear system development. We have established a management review team that includes participation by DOE. The NSI will be managed by NASA Headquarters and will capitalize on the expertise residing at NASA's field centers. To maximize and attract the most advanced science and technology, the majority of research and development efforts under this initiative will be selected through full and open competition. This will encourage participation by industry, academia, and not-for-profit institutions.

In addition to the 2009 Mars Smart Lander/Mobile Laboratory mission mentioned above, we have a solid Mars plan throughout this decade. The nearer-term missions in the Mars Exploration Program remain essentially unchanged. The twin Mars Exploration Rovers will arrive at Mars in April and May of 2004 and begin their search for Mars' water history. The Mars Reconnaissance Orbiter (MRO) will be launched in 2005; this powerful scientific orbiter will focus on analyzing the surface at unprecedented levels of detail to follow tantalizing hints of water detected in images from the Mars Global Surveyor spacecraft. MRO will measure thousands of Martian landscapes at 8- to 12-inch resolution. It will be followed by a competitively selected Mars Scout mission in 2007 and the Smart Lander in 2009. This robust program of orbiters, landers, and rovers is poised to unravel the secrets of the Red Planet's past environments, the history of its rocks, the role of water and, possibly, evidence of past or present life.

The President's budget supports the completion of development of many significant missions, including the Space Infrared Telescope Facility (SIRTF), Gravity Probe-B (GP-B), and the Stratospheric Observatory For Infrared Astronomy (SOFIA). SIRTF, the fourth and final Great Observatory, and GP-B, which will test key aspects of Einstein's theory of general relativity, are both scheduled to be launched in FY 2003. SOFIA development activities will continue, with the telescope being installed and tested in 2003. Development activities supporting the Solar Terrestrial Relations Observatory (STEREO), the Gamma-ray Large Area Space Telescope (GLAST), the final HST servicing mission, as well as several key payloads such as Solar-B and Herschel, will also continue in 2003.

Following the successful launch of the Microwave Anisotropy Probe in June 2001, only one medium-class Explorer mission (MIDEX) remains in development: Swift, a multi-wavelength observatory for gamma-ray burst astronomy. Development activities continue for this mission, with launch scheduled for September 2003. Another MIDEX mission, the Full-sky Astrometric Mapping Explorer (FAME), did not pass confirmation review due to cost increases and was not approved for full-scale development. Selection of the MIDEX-5 and MIDEX-6 missions will occur in 2002, and an Announcement of Opportunity for MIDEX-7 and MIDEX-8 will be released in 2003. In the small-class (SMEX) mission series, three NASA missions and two non-NASA Missions of Opportunity are supported. The NASA missions include the Galaxy Evolution Explorer

(GALEX), Two Wide-Angle Neutral Atom Spectrometers (TWINS), and the High Energy Solar Spectroscopic Imager (HESSI). The Missions of Opportunity are the Coupled Ion Neutral Dynamics Investigation (CINDI; a cooperative mission with the Air Force), and ASTRO E-2, an X-ray astronomy mission (in cooperation with Japan) that will be a rebuild of ASTRO E, which was lost due to a failure of the Japanese launch vehicle in February 2000.

In the Discovery program, the Genesis mission was launched in August 2001; it has begun collecting samples of charged particles in the solar wind, and it will return these samples to Earth for analysis in 2004. Development activities continue on three other Discovery missions. The CONTOUR mission will be launched in July 2002 and will encounter comet Encke in 2003 and comet Schwassman Wachman-3 in 2006. The Mercury Surface, Space Environment, Geochemistry and Ranging (MESSENGER) mission to orbit Mercury, and the Deep Impact mission to fly by (and fire an impactor into) comet Temple-1, are both scheduled to launch in early 2004.

The FY 2003 budget also provides funding for focused technology programs in each of the four major Space Science Disciplines: the Astronomical Search for Origins, Solar System Exploration, Sun-Earth Connections, and Structure and Evolution of the Universe. These funds provide for early technology development of strategic missions such as the Next Generation Space Telescope and the Space Interferometry Mission. The goal is to retire technology risk as early as possible in a mission's life cycle, before proceeding to full-scale development. Funds are also provided to continue operations of approximately thirty existing spacecraft; for New Millennium Program flight validations of new technologies; and to conduct robust research and analysis, data analysis, and suborbital research campaigns.

Science Priorities

The Space Science Enterprise has benefited over a long period of time from its uniquely close relationship with its stakeholders in the scientific community. This relationship extends all the way back to 1958, when NASA and the National Academy of Sciences' Space Science Board (now Space Studies Board) were both established. Our science community stakeholders are instrumental in the implementation of NASA's Space Science research and flight programs in nearly all areas. For example, Space Science's major astronomical flight missions have relied heavily on the Decadal Surveys prepared by the National Academy of Sciences. Their consensus and expert guidance in the areas of astronomy and astrophysics have helped lay the groundwork for Space Science priorities in the long term.

The first astronomy Decadal Survey was delivered in 1964; the most recent one was released in 2001. These Surveys, which render concrete prioritization recommendations, have been so successful that the Space Science Enterprise has requested that the Academy go beyond providing purely scientific advice in astronomy to providing comparable mission prioritization in non-astronomical fields as well.

The science goals and objectives for the entire Space Science program are elaborated in the Space Science Strategic Plan and its associated Science Roadmaps, which are developed by our Space Science Advisory Committee (SSsAC) and its aggregate subcommittees. These publications are also informed by guidance from the National Academy. These comprehensive, long-term vision documents are published every three years, with the next release planned for late 2003.

Peer-review panels made up of external scientists determine the relative science merit of all proposals to our science grants program in close alignment with the science priorities and objectives as outlined in our Strategic Plan. Space Science fully competes 82% of its grants program, as well as flight proposals to our Discovery, Explorer, and New Frontiers programs. Even those portions of the program that are awarded in-house are subject to review for scientific merit.

The science community also participates in the assessment of the health of the research program. Once a year, SSsAC assesses the scientific progress in major Strategic Plan goal areas as part of the Government Performance and Results Act reporting process.

The Space Science Enterprise further expands its involvement in and discussions with the broad space science community through our many partnerships with other government agencies, academia, industry and international partners. The results of our science prioritization process and our inclusive relationship with the larger space science community have been vital to the success of our programs.

Education and Public Outreach

The National Aeronautics and Space Act of 1958 charges NASA to "contribute to the expansion of human knowledge of phenomena in the atmosphere and space" and to "provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof." I am very proud of so many parts of the Space Science program, but none more so than how we share our incredible scientific discoveries with the citizens of the world – especially with school children. I know that this particular Committee shares my enthusiasm for and dedication to this effort.

With a focus on pre-college education and the public understanding of science, NASA's Space Science Education and Public Outreach (E/PO) program is now one of the largest programs in astronomy and space science education ever undertaken. E/PO activities are embedded in every OSS flight mission and research program. Significant funding is provided as an integral part of each mission/program's budget, and substantial E/PO efforts are developed and conducted by personnel associated with each mission/program in close collaboration with educators across the country. OSS E/PO efforts are characterized by focus on fulfilling the needs of educators; on creating long-term partnerships between the space science and education communities; on providing meaningful opportunities for underserved/underutilized groups; and on building on and adding value to existing programs, institutions, and infrastructure. In FY 2001, more than 400 E/PO products and activities were developed or carried out under OSS-sponsorship. Taking into account the fact that many of the activities involved multiple events that took place in a variety of venues, nearly 3,000 OSS E/PO events took place in FY 2001. More than 100 OSS missions and research programs; nearly 900 OSS-affiliated scientists, technologists, and support personnel; and nearly 500 external partner institutions and organizations contributed to these E/PO efforts.

To help coordinate and integrate OSS E/PO efforts, an OSS E/PO Support Network and Education Council have been established. These bodies collectively address cross-OSS issues such as coordinating the E/PO efforts of OSS's individual space science missions; actively helping the space science community to become involved in education and outreach; ensuring that products and programs developed locally become national resources; fostering relationships with a wide variety of organizations such as community organizations, science museums, and planetariums; coordinating diversity efforts; and tracking and reporting of the many OSS E/PO efforts underway.

Evaluation of the OSS E/PO program for quality, impact, and effectiveness is accomplished through a variety of means including peer review, evaluation by an external education group, and, currently, through the efforts of a special E/PO task force of the Space Science Advisory Committee.

We in Space Science are committed to maintaining a strong focus in this area and continuing to inspire people as only NASA can.

Closing

Mr. Chairman, I believe that the programs and initiatives that are proposed in the FY 2003 President's budget represent a strong commitment to a healthy and robust Space Science program. I believe it is deserving of the Committee's strong support. I look forward to working with this Committee to make the President's budget request a reality, so that we in Space Science can continue unlocking the secrets of the Universe and delivering world-class science to the American public.