

**Testimony of
Dr. Debra M. Elmegreen
President of the American Astronomical Society
Before the
House Appropriations Subcommittee on Commerce, Justice, Science, and Related Agencies
On
Astronomy and Astrophysics in the FY 2012 Budget
March 22, 2012**

Thank you for the opportunity to comment on astronomy and astrophysics in the fiscal year 2013 budget from my perspective as President of the American Astronomical Society (AAS).

The AAS supports the NSF request of \$7,373.1 million and the Division of Astronomical Sciences request of \$244.55 million within the Directorate for Mathematical and Physical Sciences. AAS also supports other areas of NSF conducting astronomical research, such as the Division of Antarctic Sciences request of \$75.8 million within the Office of Polar Programs and the Division of Atmospheric and Geospace Science request of \$264.06 million within the Directorate for Geosciences.

The AAS supports the NASA budget request of \$17,711.4 million. Within the NASA Science Mission Directorate, the AAS supports the Astrophysics Division request of \$659.4 million, the James Webb Space Telescope request of \$627.6 million, the Heliophysics Division request of \$647.0 million, and the Planetary Science Division Technology Program request of \$132.9 million that includes support for the critical restart of production of plutonium-238, necessary for missions that explore the remote parts of our solar system.

The AAS is deeply concerned about the cuts to NASA's Planetary Science Division and insufficient funds for medium and small-scale missions in the Astrophysics Explorer Program, the Heliophysics Explorer Program and the equivalent explorer programs in Planetary Science called New Frontiers and Discovery. The AAS asks for funding the NASA Science Mission Directorate at the same level as FY2012 at \$5,073.7 million to support the science and missions in the decadal surveys and maintain a commitment to the astronomical science enterprise.

Chairman Frank R. Wolf and ranking member Rep. Chaka Fattah, thank you for your bipartisan leadership in ensuring the long-term success of the United States by supporting advanced research in science, engineering and technology.

The American Astronomical Society is the preeminent membership organization for research astronomers in North America. With nearly 7,100 members overall, and more than 6,200 in the United States, the AAS serves its community by publishing the most important research journals in our field, organizing the largest astronomy meetings in the world, and providing career development, education and outreach activities. I am honored to serve the Society as its President and grateful to be able to provide testimony to the Commerce, Justice and Science Appropriations Subcommittee on behalf of the American Astronomical Society and the community it represents.

Your support has made the United States a world leader in astronomy and astrophysics. The 2011 Nobel Prize in Physics was awarded to three U.S. scientists, Saul Perlmutter, Brian P. Schmidt, and Adam G. Riess for the discovery of the accelerating expansion of the Universe through observations of distant supernovae. Since the inception of the Nobel Prize, 14 of the 18 astronomy-related Nobel Prize Laureates are from the United States.

The National Science Foundation (NSF) and the National Aeronautics & Space Administration (NASA) are agencies under the jurisdiction of this appropriations subcommittee that deserve credit for their role in supporting Noble prize-winning research through ground-based and space-based facilities such as the National Optical Astronomy Observatory and the Hubble Space Telescope. Although the Department of Energy (DOE) Office of Science is not in the jurisdiction of this subcommittee, it also deserves recognition for supporting Nobel prize-winning research in cosmology.

Your support of the James Webb Space Telescope (JWST) is a testament to your foresight and understanding of the United States being a leader in advanced scientific research. We thank you for your support of the new baseline and ensuring diligence of the budget for the mission. JWST has made great progress in 2011 and continues to do so in 2012, meeting milestones within cost and schedule of the new baseline. JWST is the top-ranked mission of the 2001 decadal survey and successor to the Hubble Space Telescope. JWST is 100 times more powerful than Hubble Space Telescope and will revolutionize our understanding of the birth of the Universe, reveal much about the first stars and galaxies, and play a crucial role in the quest to find life on distant planets.

Discovering the potential habitability of Mars, our neighboring planet, may be possible in the next year. The NASA Mars Science Laboratory (MSL), the largest rover yet built to cruise the Martian surface, will land on the red planet in August of this year. Mars Science Laboratory is a rover that will assess whether Mars ever was, or is still today, an environment able to support microbial life and help plan for a human mission to Mars.

Since 1964, the astronomical community has worked with the National Research Council of the National Academy of Sciences to produce decadal surveys to plan for the future of our discipline. We recognize that discovering the secrets of the Universe requires a coordinated effort to maximize the availability of our resources and increase the benefits of astronomical research for the scientific discipline and for the nation.

The astronomical decadal surveys represent the consensus of the scientific communities' review of the current state of understanding of the science and have a prioritized list of projects, programs and missions to address key science goals in the next decade. The surveys provide policy makers with a prioritized set of initiatives for federal support. The current decadal surveys are the New Worlds, New Horizons in Astronomy & Astrophysics (2010) and Visions and Voyages in Planetary Sciences (2011). The heliophysics community is scheduled to release its new decadal survey on April 30, 2012. These surveys are based on input from thousands of astronomers, an independent assessment of costs and risks, and budgetary constraints. The recommended programs are a balance of small, medium, and large projects, and build on

international, private, and inter-agency partnerships. This well-respected survey process has helped to make the United States a world leader in astronomy.

All of the astronomical decadal surveys recommend preserving healthy funding for research and analysis programs and for technology development as the core of every program. In tight fiscal times, we commend the Administration for recognizing this in the requested level of funding. However, research and analysis is one piece of a balanced program, which also requires ongoing support for medium and large activities.

JWST and MSL are large-scale science paradigm-changing missions. Large-scale missions are essential for balance to the discipline as they push the boundary of what is known and bring discoveries of new science. There are key scientific goals that can only be addressed through investment in large missions. However, future large-scale missions to Mars are now on hold and development on the highest priority large-scale space-based astronomy mission, the Wide-Field Infrared Survey Telescope (WFIRST), is delayed.

Augmenting medium and small explorer missions is the second highest priority of the astronomical decadal surveys. The advantages of explorers are that they are cost capped, competed on the best science return, and on a regular launch cadence. Explorer programs and experiments offer excellent return for the investment and are essential to the capability for responding flexibly to new scientific opportunities, for demonstrating novel techniques and instruments, and for training the experimental scientists, engineers, and managers who will execute the major missions and observatories of tomorrow.

For example, the COsmic Background Explorer (COBE) was an explorer-class satellite. Two of COBE's principal investigators, John C. Mather and George F. Smoot, were awarded the Nobel Prize in Physics for 2006 for their discovery of the blackbody form and anisotropy of the cosmic microwave background radiation. Other explorer-class missions include the Mars Pathfinder, which investigated the structure of the Martian atmosphere and the surface meteorology and surface geology of Mars, and the Kepler mission, which has discovered 2,321 planets orbiting 1,790 host stars.

Funding for the explorer programs in both Astrophysics and Heliophysics is proposed to decrease. Explorer missions are likely to be the backbone of the next heliophysics decadal survey since that community has the foreknowledge of budget restrictions for large-scale missions. The equivalent planetary explorer missions are called New Frontiers and Discovery. Although these line items are proposed to increase, insufficient funds will delay the regular cadence for launch.

The AAS calls upon Congress and the Administration to support the balance of NASA activities by ensuring a healthy, affordable progression of large and medium scale missions across all three NASA's space science divisions: Astrophysics, Planetary Science, and Heliophysics Divisions.

The AAS continues to support restarting domestic production of Plutonium-238. Pu-238 is of critical importance to the development of planetary science missions. There is no viable alternative to power deep space missions, as solar panels cannot produce enough electricity far

from the Sun. There are at least three National Academy reports that recommend restarting domestic production of Pu-238 immediately. The finding of the latest report, “NASA Space Technology Roadmaps and Priorities: Restoring NASA's Technological Edge and Paving the Way for a New Era in Space,” (2012) is consistent with findings of previous National Research Council reports on the subject of plutonium-238 (2009, 2011)¹: “Restarting the fuel supply is urgently needed...if the funds to restart the fuel supply are not authorized and appropriated, it will be impossible for the United States to conduct certain planned, critical deep-space missions after this decade.”

The National Science Foundation (NSF) supports astronomy through the Division of Astronomical Sciences, the Division of Atmospheric and Geospace Sciences, and the Office of Polar Programs, and the AAS applauds their budget increases. However, we note that new starts on decadal priorities in astronomy will be difficult with the current budget.

We appreciate pre-construction planning for the unique Large Synoptic Survey Telescope (LSST), the highest priority ground-based astronomy decadal recommendation. The LSST is a large field-of-view 8-meter class telescope. It will revolutionize our exploration of the sky by surveying half the sky every few days. The rapid response system will alert astronomers to transient events within one minute for quick follow-up observations. The 10,000 Gigabytes of data acquired each night will require development of a very accessible database and will drive innovations in high-tech data mining, an NSF priority for big science. LSST will be applied to everything from Near-Earth asteroids (a Congressionally mandated study) to observations of billions of galaxies and a mapping of our Galaxy's stars, to supernovae and mapping of large-scale matter distributions that will help our understanding of cosmic acceleration and put constraints on dark energy and dark matter. It will be a facility that is unique in the world, and the U.S. leadership in this endeavor will emphasize some of the U.S. optical astronomy technical strengths. Keeping a strong Major Research Equipment and Facilities Construction (MREFC) line will enable projects such as LSST to proceed.

The AAS supports NSF MREFC funding to construct the world's largest solar telescope, the Advanced Technology Solar Telescope (ATST). ATST will provide unprecedented data on the Sun's magnetic fields, which can impact Earth and orbiting spacecraft. We also support operations costs for the Atacama Large Millimeter Array (ALMA). This unique radio telescope will observe disks forming planets around Sun-like stars, and gas in distant young galaxies. These projects are top-ranked in previous decadal surveys.

The second highest priority for ground-based astronomy is the Mid-Scale Innovations Program, which recognizes the need for smaller investments in instrumentation and infrastructure that can respond quickly to new scientific priorities in an innovative manner. The recommended Mid-Scale Innovations Program would allow a competed program in NSF for medium-cost projects. The top-ranked medium project is CCAT, a 25-meter sub-millimeter telescope that will complement ALMA by surveying regions forming planets and galaxies. Without an increase in the AST division's funding level, or a reprogramming of existing AST funds, or an NSF-wide

¹ [Radioisotope Power Systems: An Imperative for Maintaining U.S. Leadership in Space Exploration \(2009\)](#) and [Visions and Voyages for Planetary Science in the Decade 2013 - 2022 \(2011\)](#)

mid-scale competed program, the recommendation for an augmented mid-scale program within astronomy cannot be implemented.

The Division of Astronomical Sciences (AST) is currently undergoing a Portfolio Review. Over half of AST's budget is used to support current operations and future development of large multi-user astronomy facilities. New major facilities will come online, with strong increasing pressure on the budget. The goal of the Portfolio Review is to recommend to AST how support for all existing facilities, programs, and activities should be prioritized and interleaved with new initiatives recommended by the NWNH.

The American Astronomical Society lauds the commitment to STEM research in the budget. For decades, the U.S. has been preeminent in astronomical research on the Sun, Solar System, and the rest of the Universe. It is critical to maintain a balance among large, medium, and small projects, as recommended in the heliophysics, planetary, and astronomy and astrophysics decadal surveys, in order to sustain a vibrant astronomical research community that is essential to our nation's economic, scientific, and technological future.

We recognize that these are austere times. However, the economy is threatened to be more austere from cuts by sequestration. Science and innovation are economic drivers for the nation. Sequestration would make cuts across all agencies, including NASA and NSF. We are encouraged that you are leading the nation in funding scientific research and innovation by your recent public support for NASA planetary science.

Support for astronomy provides inspiration to the public and to the next generation of America's scientists, engineers, and educators, from Nobel prize-winning Hubble Space Telescope discoveries of supernovae that revealed the acceleration of the Universe, to the Kepler mission detection of thousands of planets orbiting other stars, to the Mars Science Laboratory robotic mission.

AAS members are committed to enhancing our understanding of the universe. Publicly funded programs help develop and operate world-class facilities, support research, enable us to educate our students and fellow citizens, and maintain U.S. leadership in science, engineering and technology. Thank you.