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Statement of
The Honorable Charles F. Bolden, Jr.
Administrator
National Aeronautics and Space Administration

before the

Subcommittee on Space
Committee on Science, Technology and Space
U.S. House of Representatives

Mr. Chairman and Members of the Committee, I am pleased to have this opportunity to discuss NASA's FY 2014 budget request. The requested budget of $17.715 billion will support continuing progress toward implementing the bi-partisan program for NASA agreed to by the President and Congress, which will ensure the United States continues to lead the world in space exploration, technology, innovation, and scientific discovery. A summary of the FY 2014 budget request is appended to this statement.

American astronauts are living and working in space on board the International Space Station (ISS), conducting an expanding research program with an array of partners. By partnering with American companies, we are cost-effectively resupplying the space station from U.S. soil, and we are on track to end our sole reliance on Russia for astronaut transport to and from the Space Station by 2017. NASA is developing spaceflight capabilities to send humans to an asteroid by 2025 and on to Mars in the 2030's. To accomplish these goals, we are building the world's most powerful rocket, the Space Launch System (SLS), and a deep space exploration crew vehicle, the *Orion* Multi-Purpose Crew Vehicle (MPCV). In critical support of the Agency's broader mission, we are developing and testing space technologies that will enable us to move and operate faster and more efficiently in space, land more mass accurately on another planet, and enable new destinations to be visited. These technologies include solar electric propulsion, learning to store and transfer fuel in orbit, radiation protection, laser communications, high-reliability life support systems, and human and robotic interfaces. Our aeronautics research is making air travel cleaner, safer, and more efficient. With many missions actively observing Earth, the planets, the Sun, and the Universe, we remain the world's premier space science organization and the critical source of information for an understanding of Earth's climate that can only be gained from the global perspective of space. We are extending these cutting-edge capabilities with major new developments, including the James Webb Space Telescope and a new Mars rover. Despite an uncertain budget climate, NASA is delivering the world's preeminent space program, supporting an innovation economy, and broadening our understanding of the universe around us.

As is briefly described below, NASA's resources are directed to accomplish the goals set for the Agency by the Congress and the President. Our improved processes for cost estimating and program management play a critical role in our ability to manage our resources, and we remain on track in our major developments. NASA is confident that we can continue to execute the program described below within the budget levels anticipated in the President's FY 2014 request for NASA. We will attempt to maintain and implement long-term development plans within future budgets as they are appropriated. The Agency stands committed to executing our programs as efficiently as possible.

An Integrated Exploration Mission

The President's Fiscal Year 2014 budget request continues to implement the bi-partisan strategy for space exploration approved by Congress in 2010, a plan that advances U.S. preeminence in science and technology, improves life on Earth, and protects our home planet, all while helping create jobs and strengthening the American economy. This budget reflects current fiscal realities by aligning and leveraging relevant portions of NASA's science, space technology, and human exploration capabilities to achieve the President's challenge of sending astronauts to an asteroid by 2025.

As part of the agency's overall asteroid strategy, NASA is planning a first-ever mission to identify, capture, and redirect an asteroid into orbit around the Moon. The overall mission is composed of three separate and independently compelling elements: the detection and characterization of candidate near-Earth asteroids; the robotic rendezvous, capture, and redirection of a target asteroid to the Earth-Moon system; and the crewed mission to explore and sample the captured asteroid using the Space Launch System (SLS) and the *Orion* crew capsule. This mission represents an unprecedented technological challenge -- raising the bar for human exploration and discovery, while helping protect our home planet and bringing us closer to a human mission to Mars in the 2030s.

Each mission element would heavily leverage on-going activities across the Human Exploration and Operations, Space Technology, and Science Mission Directorates. We are currently working to align on-going activities across these directorates to affordably achieve the objectives while we plan this mission. Progress will continue conditional on feasibility and affordability. Funding provided within the President's FY2014 budget request will augment our existing activities in Space Technology, Science, and Human Exploration and Operations to: enhance our near-Earth asteroid detection and characterization assets; accelerate advanced solar electric propulsion development; and design and test capabilities to capture a small, yet slowly tumbling asteroid in space.

Science

With 60 missions observing Earth, the Sun, the planets, and the Universe, NASA remains the world's premier space science organization and the critical source of information on the home planet. NASA's Budget request for the Science Mission Directorate includes $5,017.8 million with $1,846.1 million for Earth Science, $1,217.5 million for Planetary Science, $642.3 million for Astrophysics, $658.2 million for the James Webb Telescope, and $653.7 million for Heliophysics.

Earth Science

Seventeen NASA Earth Science research missions currently in orbit study the home planet as an integrated system, including the recently launched Landsat Data Continuity Mission (LDCM), which is undergoing on-orbit checkout. NASA is also beginning work on land imaging capabilities beyond LDCM as well as climate sensors that were previously part of the Joint Polar Satellite System (JPSS). NASA missions continue to give us a global perspective on how Earth works as a system and how our climate is changing over time. Few products of NASA's research can be as valuable, in a material sense, as an accurate understanding of the future of our planet's environment – on land, in the oceans, and throughout the atmosphere. The FY 2014 request supports the launch of two new Earth science missions in FY 2014, and final preparations for launch of two more before the end of the calendar year. The Global Precipitation Measurement (GPM) mission, a cooperative mission with the Japan Aerospace Exploration Agency (JAXA), will provide unprecedented global precipitation observations and the Orbiting Carbon Observatory-2 (OCO-2) will provide accurate global measurements of atmospheric carbon dioxide levels. In the fall of 2014, NASA will launch the Soil Moisture Active Passive (SMAP) mission to study the Earth's hydrologic cycle. At the end of the calendar year, in a collaboration among NASA's Science Mission Directorate, Human Exploration and Operations Mission Directorate, and the European Space Agency; NASA will launch and install the Stratospheric Aerosol and Gas Experiment III

(SAGE III) on the ISS to continue critical long-term measurements of the vertical structure of aerosols, ozone, water vapor, and other important trace gases in the upper atmosphere.

Astrophysics and James Webb Space Telescope

NASA is on track and making excellent progress on the James Webb Space Telescope, the most powerful space telescope in history. The Webb telescope is the next in a series of astrophysics missions, including the venerable, yet still unrivaled Hubble Space Telescope and the incredibly productive Kepler exoplanet mission, which are revolutionizing our understanding of the universe. After launching in 2018, the Webb telescope will travel one million miles from Earth, unfold its sunshield to the size of a tennis court, and keep its instruments cooled to a temperature of 370-387 degrees below zero Fahrenheit (40-50 kelvins). The Webb telescope will allow us to observe objects even fainter than the Hubble Space Telescope can see, which will allow us to study every phase in the history of our universe, ranging from the first luminous glows after the Big Bang, to the formation of solar systems capable of supporting life on planets like Earth, to the evolution of our own solar system. The FY 2014 request will support work to finish the Webb science instruments, begin their testing as an integrated science payload, and commence construction on the spacecraft that will carry the science instruments and the telescope. NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA) airborne observatory is making its second year of science observations. Operating at altitudes of between 39,000 to 45,000 feet (12-14 kilometers) and above 99 percent of the water vapor in the atmosphere, SOFIA makes observations that are unobtainable from telescopes on the ground. In the coming year, SOFIA will begin its next set of science observations. Flying out of Palmdale, California, and Christchurch, New Zealand, SOFIA will observe star-forming regions in our galaxy from its vantage point at the top of the Earth's atmosphere.

Planetary Science

Building on the brilliant success of NASA's new *Curiosity* rover on Mars, the 2014 request supports plans for a robust multi-year Mars program, including a new robotic science rover based on the *Curiosity* design set to launch in 2020. The current portfolio includes the *Curiosity* and *Opportunity* rovers, the Mars Recognizance Orbiter, the Mars Odyssey orbiter, and our collaboration with the European Space Agency Mars Express orbiter. Future missions include the 2013 Mars Atmosphere and Volatile EvolutioN (MAVEN) orbiter to study the Martian upper atmosphere; the 2016 Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) mission (which will take the first look into the deep interior of Mars); participation in the European Space Agency's 2016 and 2018 ExoMars missions; and the new Mars rover planned for launch in 2020.

Last summer, NASA's Dawn mission completed more than a year in orbit around the asteroid Vesta, and departed for its 2015 rendezvous with Ceres, the largest known asteroid. NASA is developing a robotic asteroid rendezvous and sample return mission, dubbed OSIRIS-REx (for Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer), which is planned to launch in 2016. After traveling three years, OSIRIS-REx will approach the Near Earth Asteroid 1999 RQ36, map the asteroid, and collect a sample of up to 2.2 pounds for return to Earth. This mission will provide valuable data and experience in support of NASA's planned human exploration of a Near Earth Asteroid. In addition, the FY14 budget request includes enhanced funding for NASA's Near Earth Object survey and characterization activities in support of human exploration and to protect our planet.

Heliophysics

Perhaps even more dynamic than the Earth's climate are the processes taking place within the Earth's nearby star, the Sun. NASA's Heliophysics Program operates nearly 20 spacecraft to expand our understanding of the Sun, its complex interaction with Earth, other planetary systems, the vast space within the solar system, and the interface with interstellar space. Last year saw the successful launch of the Van Allen Probes, which, in a few short months, have already redefined our understanding of the Earth's radiation belts. The FY 2014 request will support final development and launch of the Interface

Region Imaging Spectrograph (IRIS), as well as continued development of the Magnetospheric Multiscale (MMS) mission, which is planned for launch in 2015 to investigate how the Sun's and Earth's magnetic fields connect and disconnect. NASA continues to formulate the Solar Probe Plus (SPP) mission and develop its contribution to the European Space Agency's Solar Orbiter mission.

Aeronautics Research

NASA's FY 2014 request includes $565.7 million for NASA's program of innovative aeronautics research. This research supports the Nation's aviation industry's efforts to maintain competitiveness in the global market, and helps to provide the flying public with an improved flying experience and fewer delays, while also maintaining an outstanding safety level. NASA's breakthrough research into more efficient air traffic management and environmentally friendly aircraft helps U.S. air carriers to operate their fleets more efficiently while reducing operating costs. Today, we are pursuing an ambitious research agenda for substantially reducing fuel consumption, emissions and noise to make the Next Generation Air Transportation System (NextGen) a reality. NASA begins a new $25 million a year Advanced Composites Project in FY 2014 that will focus on reducing the timeline for development and certification of innovative composite materials and structures. Looking ahead, NASA is paving the way for further industry innovation through demonstration in flight of new aircraft wing technology designed to save fuel by reducing weight and drag, and continued flight research of low-boom technology designed to reduce sonic booms enough to eliminate the barrier to overland civil supersonic flight. By advancing the state of the art in vehicle and air traffic management technology, NASA is directly contributing to the Nation's bottom line.

Space Technology

NASA's FY 2014 request includes $742.6 million for Space Technology. Space Technology enables our future in space by drawing on talent from the NASA workforce, academia, small businesses, and the broader national space enterprise to deliver innovative solutions that dramatically lower costs and improve technological capabilities for NASA and the Nation. In 2012, we successfully fabricated a 2.4 meter composite cryogenic propellant tank. We will scale this design up and test a 5.5-meter diameter tank to enable lower-mass rocket propellant tanks that will meet future SLS needs. The Small Businesses Innovation Research and Small Business Technology Transfer (SBIR and STTR) programs saw six previously funded technologies make their way to Mars last August with the landing of Curiosity and provide the critical detector in the infrared instrument on the LDCM spacecraft. In 2013, we will fly a cluster of eight small satellites that will make coordinated space science observations. We will conduct high-altitude tests of the largest planetary parachute ever developed and drag devices designed to enable precise landing of higher-mass payloads to the surface of planets, with particular focus on infusing advanced capabilities into the Mars 2020 mission. In addition, NASA will launch the Sunjammer Solar Sail, which will demonstrate solar sail propulsion as an enabler for advanced space weather warning systems. Space Technology is also systematically addressing technology barriers in preparation for a future solar electric propulsion demonstration to an asteroid. By the end of FY 2014, NASA will test and deliver two candidates for large deployable solar array systems, power processing units, and advanced thrusters to support this flight demonstration. The Game Changing Program is delivering advanced life-support, robotics, and battery technologies for the system demonstrations planned by the Advanced Exploration Systems Division of NASA's Human Exploration and Operations Mission Directorate.

To meet the challenges that we face in implementing our exploration plans, we are engaging the Nation's brightest and best. Over the past two years, Space Technology has engaged over 100 U.S. universities and academic institutions with approximately 350 activities, including fellowships, direct competitive awards, incentive prizes, and through partnerships with NASA Centers, small businesses, and commercial contractors. The FY 2014 request will support our plans to continue releasing a steady stream of new solicitations, tapping into the Nation's talent to ensure the availability of advanced technologies for NASA's missions and ultimately, through technology transfer, for American businesses. Following the

National Research Council's review of NASA's Space Technology Roadmaps, the Agency released and is implementing the Strategic Space Technology Investment Plan, which guides technology priorities across the agency's space-technology portfolio across its mission directorates. NASA's community of innovators is applying, testing, and reworking cutting-edge research into potentially "game-changing" solutions that can accelerate a timeline, slash projected costs, or multiply science return. NASA makes progress in essential space technologies daily, enabling more capable and far-reaching space systems for our Nation's future, and we are doing so through lean, agile programs and innovative approaches.

Exploration and Space Operations

NASA is building the capabilities and knowledge to send humans farther from the home planet than we have ever been before. The FY 2014 budget request for Exploration is $3,915.5 million with $2,730 million for Exploration Systems Development, $821.4 million for Commercial Space Flight, and $364.2 million for Exploration Research and Development. Space Operations, including the International Space Station and Space Flight Support form a critical component or the agency's exploration plans by enabling us to develop the knowledge, experience, and technology necessary for safely living and working in space. The FY 2014 request for Space Operations is $3,882.9 million.

Exploration Systems

The FY 2014 request will enable NASA to continue to meet its milestones in the development of the Space Launch System (SLS), a rocket system ultimately capable of bringing an unprecedented 130 metric tons of payload to Earth orbit. The *Orion* Multi-Purpose Crew Vehicle (MPCV) program continues on schedule for an uncrewed test flight in 2014. This test flight, Exploration Flight Test-1 (EFT-1), will see *Orion* conduct two orbits of Earth and reenter the atmosphere at a high-speed characteristic of a returning deep space exploration mission. The test will provide valuable data about the spacecraft's systems, most importantly, its heat shield. The flight test article for this mission is already in place at the Kennedy Space Center and being readied for this test. The FY 2014 request supports progress toward a first uncrewed test of the *Orion* and the SLS together, known as Exploration Mission-1 (EM-1) in 2017, with the first crewed mission of the two vehicles slated for 2021. These two missions will test and demonstrate these systems. Together, the SLS and *Orion* MPCV represent a critical step on the path to human deep space exploration. Because our commercial space partners continue to make rapid and cost-effective progress toward meeting the Agency's requirements for access to the ISS and to low Earth orbit, NASA is able to focus its human exploration resources to develop the deep space capabilities represented by the SLS and *Orion* MPCV.

International Space Station

The FY 2014 request supports the International Space Station (ISS) with its international crew of 6 orbiting Earth every 90 minutes. The Station is making deep space exploration possible, building on the knowledge and experience we are gaining from the astronauts living, working, and conducting research on the ISS. Our plans for the coming year include preparing for an extended duration, year-long human-crewed mission to explore human adaptation to space; continuing to utilize the ISS to improve our ability to live and work in space, including technology demonstrations enabling future exploration; and the addition of three Earth Science instruments that will exploit ISS' capabilities to study winds over the oceans and the movement of dust, smoke, and pollution through the atmosphere. The Center for the Advancement of Science in Space (CASIS) is now managing the National Laboratory research being conducted in the U.S. segment of the ISS by an array of organizations, including commercial researchers interested in taking advantage of this unique, microgravity facility.

Commercial Crew and Cargo

A top priority for NASA and the Nation is to affordably and safely launch American astronauts and their supplies from U.S. soil, ending our reliance on foreign providers and bringing that work back home. Under NASA's Commercial Resupply Services (CRS) contracts, Space Exploration Technologies

(SpaceX) was awarded 12 cargo flights to the space station, and Orbital Sciences Corporation (Orbital) was awarded 8. SpaceX executed its first cargo mission to the ISS in October 2012, successfully delivering its cargo and returning scientific samples to Earth. SpaceX successfully completed its second CRS mission and its Dragon spacecraft safely returned to Earth on March 26. Orbital successfully completed the maiden flight of its *Antares* rocket on April 21st and will conduct a demonstration flight of the *Antares* with the Cygnus spacecraft this spring under the Commercial Orbital Transportation Services (COTS) effort. Orbital's first contracted cargo resupply mission under CRS is slated for later this year. NASA continues to work with its commercial partners to develop a U.S. commercial capability for human spaceflight. NASA intends to procure commercial crew services to ISS by 2017, and full funding of the FY 2014 request is essential to restore a human spaceflight capability to the United States in this timeframe. Through the successful execution of this partnership, we will return to the United States the vital capability to launch astronauts to the ISS and return them to Earth.

Education

NASA supports the President's goal to utilize existing resources to achieve improvements in science, technology, engineering, and mathematics, or STEM, education and instruction. The Administration is proposing a comprehensive reorganization of STEM education investments. The 2014 Budget will enhance the impact of the Federal investment by reorganizing STEM education programs across agencies and redirecting funding in support of a cohesive national STEM strategy focused on four priority areas: K-12 instruction; undergraduate education; graduate fellowships; and informal education activities. Within NASA, STEM education investments previously distributed across the Agency will be consolidated and focused within the Office of Education, the National Science Foundation, and the Smithsonian Institution. During FY 2013 and FY 2014, NASA's education teams will develop transition plans that minimize impacts to students and organizations currently served by NASA. The Agency will also conduct studies to determine which NASA education assets should and can be made available to the new STEM consolidation partners.

The FY 2014 request of $94.2 million includes education activities in the Office of Education and NASA's mission directorates. The funding request for the Education account includes funding for the National Space Grant College and Fellowship Program, the Experimental Program to Stimulate Competitive Research (EPSCoR), and the Minority University Research and Education Program (MUREP). These education investments link to NASA's research, engineering, and technology missions. Each of these investments provides unique NASA experiences and resources to students and faculty. Starting in FY 2014, mission-based K-12 education, and engagement activities, traditionally funded within programmatic accounts, will be incorporated into the Administration's new STEM education paradigm.

Cross Agency Support

NASA's Cross Agency Support (CAS) account funds all of the operations and maintenance of NASA's nine Centers, component facilities, and Headquarters, including, the Agency's safety offices, independent technical authority, NASA's engineering safety center, procurement, and others that oversee activities to reduce the risk and loss of life and/or mission in all of NASA's human, satellite, aeronautic, and robotic programs. NASA's FY 2014 request of $2.85 billion supports critical efforts to modernize NASA's information technology security processes and expanding security operations efforts to provide early warning of cyber vulnerabilities. The request will support the Agency's continuing efforts to reduce its facilities costs by consolidating capabilities and disposing of unneeded assets.

Conclusion

NASA thrives on the synergy created by a critical mass of brilliant scientific and engineering talent, supported by a broad range of expert professionals. We work, as an Agency, to send humans to an asteroid and on to orbit Mars. We work, as an Agency, to understand the universe from the beginning of

time to the future of Earth's climate. The people working to put the next rover on Mars are refining the systems necessary to put humans there in the future. The people testing advanced ring-sail parachutes for landing payloads on planetary surfaces are also learning how flight through an atmosphere at super-high speeds works. The astronauts running physical science experiments on the ISS are themselves life science experiment subjects, and at the same time, they are demonstrating the science and technology for living and working in space. The Agency is on track and making steady progress executing the space and aeronautical program defined for us by Congress and the President in the 2010 Authorization Act, and we are confident we can accomplish these programs under that direction. NASA's confidence that we can execute the program described here is based primarily on the demonstrated expertise, flexibility, and dedication of our people. The reason why NASA ranks as the best place to work in the Federal government may simply be this: we all are contributors to a mission greater than ourselves, extending beyond the current generation. We tackle national and global challenges. We are explorers.