

Guide to FY2015 Research Funding at the National Aeronautics and Space Administration (NASA)

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Executive Summary and Index

This document provides succinct insights into the various NASA funding opportunities for University research, with special attention to significant changes anticipated in FY2015. NASA's mission is to pioneer the future in space exploration, scientific discovery, and aeronautics research. Funding for university research at NASA is principally distributed among the four - Science, Aeronautics, Human Exploration and Operations, and Space Technology - Mission Directorates. As a primary premise for research funding, NASA is only interested in work that utilizes or contributes to its space or airborne assets, or the data derived from them. More information on the NASA opportunities, including the NASA charts identified in the following text, is provided at the Central Desktop "Mission Agency Program Summary" (MAPS) website.

Descriptive of NASA basic research funding opportunities pages 2-11

An overview of the NASA headquarters directorate/office and NASA Center-based funding opportunities pertinent to Universities. Note in the descriptive that there is a planned major restructuring of the Aeronautics research effort.

Table 1: FY10/12 NASA basic and applied research funding at Universities (~\$400M/yr) 10

Table 2: NASA Budget for FY13 (actual), FY14 (estimated) and FY15 (request) 11

Appendix 1: FY2015 New Programs and/or Significant Change

NASA is essentially level funded in the FY2015 budget - up 3.5% from the 2013 actual, down 1% from the 2014 enacted. Space Technology and Commercial Spaceflight increases significantly, while the education account is decreased from \$116M to \$89M. NASA has a large claim (\$885M) in the Opportunity, Growth, and Security Initiative; this is where most of the new opportunities occur.

	<u>Projected Funding (\$M)</u>	<u>page(s)</u>
Opportunity, Growth and Security Initiative	+885	12
Big Earth Data Initiative	unspecified	12
Unmanned Aircraft Systems	unspecified	12
Fundamental Engineering Sciences	unspecified	13

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Overview

NASA's mission is to pioneer the future in space exploration, scientific discovery, and aeronautics research. Funding for university research at NASA is principally distributed among four directorates, each with its own particular research interests:

Science Mission Directorate (SMD)

Focus: the frontiers of earth science, heliophysics, planetary science, and astrophysics.

Aeronautics Research Mission Directorate (ARMD)

Focus: research in traditional aeronautical disciplines and emerging fields to help transform the nation's air transportation system and future air and space vehicles.

Human Exploration and Operations Mission Directorate (HEO)

Focus: develop capabilities and supporting research and technology that will make human and robotic exploration possible

Space Technology Mission Directorate (STMD)

Focus: develop and demonstrate advanced space systems concepts and technologies

As a primary premise for research funding, NASA is only interested in work that utilizes or contributes to its space or airborne assets, or the data derived from them. Each of the Directorates has continuing research programs. Research opportunities appropriate to University PIs are advertised through NASA research announcements (NRAs). NSPIRES (nspires.nasaprs.com/external/) is the NASA website through which announcements can be accessed and proposals submitted. Those announcements are amended periodically during the fiscal year to open additional, or modify existing, topics. Not all topics are competed in any given year.

Useful guidance on proposal preparation is provided at the website Service and Advice for Research and Analysis (SARA, <http://science.nasa.gov/researchers/sara/how-to-guide/>). Proposers may opt to submit proposals in response to NRAs via either of two different electronic proposal submission systems: either the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) (<http://nspires.nasaprs.com>), or the Grants.gov (<http://www.grants.gov>). Paper submission is not accepted. Peers of the proposing personnel will be used to assess the proposal using the criteria:

- intrinsic scientific and technical merit,
- relevance to NASA's stated objectives, and
- cost realism.

For further details on these criteria and their relative weights see Appendix C.2 of the *NASA Guidebook for Proposers* (www.hq.nasa.gov/office/procurement/nraguidebook). In addition, a given program may have specific guidance incorporated into its announcement.

Table 1 shows data on the NASA funding to University/College by academic discipline for FY2010 and FY2012 (the most recent available). In addition to basic research (which correlates with the NASA Technology Readiness Levels (TRL) 1-2, NASA also funds applied research (TRLs 2-3), and advanced technology demonstration (TRLs 3-5). The NASA research budget has declined somewhat since 2006 (but innovative technology funding has grown significantly). The NASA FY2015 budget lines more closely associated with University PI research are shown in Table 2, parsed vertically by the identified Directorate program.

Science Mission Directorate (SMD)<http://science.nasa.gov/>

NASA's Science Mission Directorate conducts scientific exploration that is enabled by access to space. It projects humankind's vantage point into space with observatories in Earth orbit and deep space, spacecraft visiting the Moon, and other planetary bodies, and robotic landers, rovers, and sample return missions.

Broadly defined, research and analysis (R&A) covers the concept studies that provide the science basis for a mission, the necessary technology and techniques for implementing the mission, the calibration, validation, and analysis of data as a mission is underway, and the analysis of archived data after a mission ends. Dr. Max Bernstein, formerly of the NASA Ames Research Center, now focuses specifically on the operation and balance of the SMD's Data Analysis, Research, and Technology Development programs.

Most calls for proposals from SMD can all be found in the omnibus solicitation, called Research Opportunities in Space and Earth Science (ROSES, Research Announcement NNH14ZDA001N for 2014). A SMD website (nasascience.nasa.gov/researchers/) and a RSS feed provide up-to-date changes for the ROSES NRA. The website also provides a listing of the various program managers (and contact information). (See also MAPS NASA Charts 6-16)

The 2014 ROSES NRA itemizes some 80 topics (each as its own appendix) and provides a table that specifies the due dates for notice of intent (NOI – not always required) and proposal submission (see MAPS NASA charts 6-16). Awards range from under \$100K per year for focused, limited efforts (e.g., data analysis) to more than \$1M per year for extensive activities (e.g., development of science experiment hardware). The usual maximum period of performance is three-four years. It is possible for funded performers to reapply at the end of their project; those applications will be competed with neither advantage nor disadvantage.

The Stand Alone Mission of Opportunity Notice (SALMON, NNH12ZDA0060 for 2012) announcement of opportunity (AO) is intended to provide opportunities for science and technology investigations on space flight missions that advance the high priority science, technology, and exploration objectives of NASA's Mission Directorates. (See MAPS NASA chart 17)

Aeronautics Research Mission Directorate (ARMD)<http://www.aeronautics.nasa.gov/>

NASA's Aeronautics Research Mission Directorate (ARMD) works to solve the challenges that still exist in our nation's air transportation system: air traffic congestion, safety, and environmental impacts. NASA's ARMD pursues the development of new flight operation concepts, and new tools and technologies that can transition smoothly to industry to become products.

The Research Opportunities in Aeronautics (ROA), NRA NNH14ZEA001N for FY2014, identifies competitions for five ARMD programs: Fundamental Aeronautics Program; Aviation Safety Program; Airspace Systems Program; Integrated Systems Research Program; and the Aeronautics Strategy and Management Program. The typical period of performance for an award is three years, although a few programs may specify shorter or longer (maximum of five years) periods. (See MAPS NASA charts 18-20)

NASA's Fundamental Aeronautics Program <http://www.aeronautics.nasa.gov/fap/index.html>

NASA's Fundamental Aeronautics Program (FAP) works to enable a future where a variety of advanced aircraft exist that improve the flexibility, efficiency and environmental impact of air travel. The Fundamental Aeronautics Program consists of four research projects.

- [The Fixed Wing Project](#) explores and develops technologies and concepts for improved energy efficiency and environmental compatibility of fixed wing, subsonic transports.
- [The Rotary Wing Project](#) develops and validates tools, technologies and concepts to overcome key barriers for rotary wing vehicles.
- [The High Speed Project](#) enables tools, technologies and validation capabilities necessary to overcome environmental and performance barriers to practical civil supersonic airliners.
- [The Aeronautical Sciences Project](#) enables fast, efficient design and analysis of advanced aviation systems by developing physics-based tools and methods for crosscutting technologies.

Beginning in FY2015 the Aeronautics programs will be restructured from six to four programs. NASA recently developed a new and compelling strategic vision for the Aeronautics Research programs. A trend analysis indicated that NASA could best contribute to the nation's future societal and economic vitality by focusing efforts in six thrust areas. These six areas align to be responsive to a growing demand for mobility, severe challenges to sustainability of energy and the environment, and technology advances in information, communications, and automation technologies. The thrust areas are:

- Assured autonomy for aviation transformation
- Innovation in commercial supersonic aircraft
- Ultra-efficient commercial vehicles
- Transition to low-carbon propulsion
- Real-time system safety assurance
- Safe, efficient growth in global operations

The four programs will be:

AIRSPACE OPERATIONS AND SAFETY PROGRAM

The Airspace Operations and Safety Program develops and explores fundamental concepts, algorithms, and technologies to increase throughput and efficiency of the National Airspace System (NAS) safely. The program also provides knowledge, concepts, and methods to the aviation community to manage increasing complexity in the design and operation of vehicles and the air transportation system. This program continues the research of the Airspace Systems Program and the aircraft state awareness research and system wide safety research previously conducted within the Aviation Safety Program.

ADVANCED AIR VEHICLES PROGRAM

The Advanced Air Vehicles Program conducts fundamental research to improve aircraft performance and minimize environmental impacts from subsonic air vehicles; develops and validates tools, technologies and concepts to overcome key barriers, including noise, efficiency, and safety, for rotorcraft vehicles; and explores theoretical research for potential advanced capabilities and configurations for low boom supersonic aircraft. The program will also conduct research to reduce the timeline for certification of composite structures for aviation, and will ensure the strategic availability, accessibility, and capability of a critical suite of aeronautics

ground test facilities to meet Agency and national aeronautics testing needs.

This program continues much of the research that was in the Fundamental Aeronautics Program, with a new focus on research that is directly related to the newly defined strategic thrusts. It now houses the Advanced Composites Program that was previously in the Integrated Systems Research Program. It also includes the ground test portion of the former Aeronautics Test Program.

INTEGRATED AVIATION SYSTEMS PROGRAM

The Integrated Aviation Systems Program conducts research on promising concepts and technologies at an integrated system level. The program explores, assesses, and demonstrates the benefits of these potential technologies in a relevant environment. The program includes research into environmentally responsible aviation and unmanned system integration into the national airspace. The program will also support the flight research needs across the ARMD strategic thrusts, programs and projects, and will complete flight demonstrations, which will be a collaborative effort across the aeronautical industry and will include international partners as appropriate. This program continues the Environmentally Responsible Aviation and UAS in the NAS projects, and now includes the flight test portion of the former Aeronautics Test Program.

TRANSFORMATIVE AERONAUTICS CONCEPTS

The Transformative Aeronautics Concepts Program cultivates multi-disciplinary, revolutionary concepts to enable aviation transformation and harnesses convergence in aeronautics and non-aeronautics technologies to create new opportunities in aviation. The program's goal is to knock down technical barriers and infuse internally and externally originated concepts into all six strategic thrusts identified by ARMD, creating innovation for tomorrow in the aviation system. Using sharply focused activities, the program provides flexibility for innovators to explore technology feasibility and provide the knowledge base for radical transformation. The program solicits and encourages revolutionary concepts, creates the environment for researchers to become immersed in trying out new ideas, performs ground and small-scale flight tests, allows failures and learns from them, and drives rapid turnover into new concepts. Three projects are proposed for this program:

CONVERGENT AERONAUTICS SOLUTIONS

The Convergent Aeronautics Solutions (CAS) Project uses short-duration activities to establish early-stage concept and technology feasibility for high-potential solutions. Internal teams propose ideas for overcoming key barriers associated with large-scale aeronautics problems associated with ARMD's six strategic thrusts. The focus is on merging traditional aeronautics disciplines with advancements driven by the non-aeronautics world to advance innovative solutions to these barriers to open and enable new capabilities in commercial aviation. One initial activity that will be piloted in CAS is related to low-altitude civilian applications of UAS, which have been imagined for goods delivery, infrastructure surveillance, agricultural support, search and rescue, and medical services delivery. In order to explore the concept's feasibility, CAS will study a system concept called UAS Traffic Management (UTM). The goal of UTM is to enable safe and efficient low-altitude airspace operations by providing critical services such as airspace design, separation management, weather avoidance, routing, and contingency management. UTM will support UAS ranging from those with minimal avionics capability, to those that are autonomous, and allow safe operations in presence of current vehicles (e.g., gliders, general aviation, helicopters).

REVOLUTIONARY TOOLS AND METHODS

The Revolutionary Tools and Methods (RTM) Project advances state-of-the-art computational and experimental tools that are vital to aviation applications in the six strategic thrusts. The project develops new computer-based tools, models, and associated scientific knowledge that will provide first-of-a-kind capabilities to analyze, understand, and predict performance for a wide variety of aviation concepts. These revolutionary tools will be applied to accelerate NASA's research and the community's design and introduction of advanced concepts. Examples include the development and validation of new computational tools that are used to predict the complex turbulent airflow around vehicles and within propulsion systems, ultimately leading to greater abilities to predict future vehicle performance in flight. Another important area of research, applicable across a number of air vehicle types, is the understanding of new types of strong and lightweight materials that are vital to aviation.

LEADING EDGE AERONAUTICS RESEARCH FOR NASA (LEARN)

The LEARN Project explores the creation of novel concepts and processes with the potential to create new capabilities in aeronautics research through awards to university and industry teams. The LEARN Project incorporates a competitive review process of the external teams' proposals to develop integrated solutions for complex technical problems captured in the ARMD strategic thrusts, followed by short duration activities for feasibility assessment. Follow-on phases of the most promising ideas are also funded. With this process, NASA funds also help catalyze external investments toward solving problems aligned with NASA interests. Like the CAS Project, the LEARN Project's goal is to identify and mature the new concepts and then infuse promising concepts into the ARMD research portfolio for further development or enable new avenues of aeronautics in the community. Developing new ideas – whether they originate within or external to NASA – are a critical part of NASA Aeronautics' approach to enabling transformation in aviation.

Human Exploration and Operations Mission Directorate (HEO)

<http://www.nasa.gov/directorates/heo/home/index.html>

HEO provides the Agency with leadership and management of NASA space operations related to human exploration in and beyond low Earth orbit. Exploration activities beyond low Earth orbit include the management of Commercial Space Transportation, Exploration Systems Development, Human Space Flight Capabilities, Advanced Exploration Systems, and Space Life Sciences Research & Applications.

Research opportunities in human research come available both directly through the Human Research Program (HRP, humanresearch.jsc.nasa.gov/) and the National Space Biomedical Research Institute (NSBRI, www.nsbri.org/Announcements/). The NSBRI is a nonprofit consortium funded by the HRP. The total annual cost (direct and indirect costs) for a NASA HRP award averages \$350K and cannot exceed \$400K; the typical duration is three years. (See MAPS NASA charts 21-24).

There is also a Research Opportunities for Flight Experiments in Space Biology opportunity (NRA NNH14ZTT002N)

Space Technology Mission Directorate (STMD)

<http://www.nasa.gov/directorates/spacetech/home/index.html>

STMD rapidly develops, demonstrates, and infuses revolutionary, high-payoff technologies through transparent, collaborative partnerships, expanding the boundaries of the aerospace enterprise. (See MAPS NASA charts 25-27).

Space Technology Research Grants: Space Technology Research Opportunities (STRO)

<http://www.nasa.gov/directorates/spacetech/strg/index.html#.U15nasfB2hI>

The Space Technology Research Grants Program is accelerating the development of "push" technologies to support the future space science and exploration needs of NASA, other government agencies, and the commercial space sector. Innovative efforts with high risk and high payoff are encouraged. The Program is composed of two competitively awarded components: STRO Early Career Faculty and STRO Early Stage Innovations Opportunities.

NASA Innovative Advanced Concepts (NIAC)

<http://www.nasa.gov/directorates/spacetech/niac/index.html#.U15n1sfB2hI>

NIAC projects study innovative, technically credible, advanced concepts that could one day "Change the Possible" in aerospace.

The Game Changing Technology

Program http://www.nasa.gov/directorates/spacetech/game_changing_development/index.html

The Game Changing Development (GCD) program investigates novel ideas and approaches that have the potential to revolutionize future space missions and provide solutions to significant national needs. GCD will identify and rapidly mature innovative, high-impact capabilities and technologies and complement them with "new start" and competitively selected projects by using a balanced approach of guided technology development efforts and competitively selected efforts from across NASA, academia, industry and other government agencies. GCD work is done primarily in the laboratory with ground testing instead of space work.

Small Spacecraft Technology Program

http://www.nasa.gov/directorates/spacetech/small_spacecraft/index.html

This program undertakes both development of small spacecraft technologies and flight demonstrations of new technologies, and does not perform operational missions with small spacecraft.

Office of the Chief Technologist (OCT)

http://www.nasa.gov/offices/oct/about_us/index.html

The Office of the Chief Technologist (OCT) is responsible for the coordination and tracking of all technology investments across the agency. The office is responsible for developing and executing innovative technology partnerships, technology transfer and commercial activities and the development of collaboration models for NASA.

Young (Early Career) Investigators

The SMD has a New (Early Career) Investigator Program (NIP, Appendix A.36 in ROSES 2014). Proposers must: a) be a U.S. citizen or have lawful status of permanent residency (i.e., holder of a U.S. Permanent Resident Card, also referred to as the Green Card), and b) be a recent Ph.D. recipient, defined as having graduated on or after January 1 of the year that is no more than five years before the issuance date of the NRA. The award range is between \$80-\$120K per year for a

period of up to three years. The selected Fellows have the opportunity to apply directly to the Early Career Fellowship program for up to \$100K in start-up funds when they obtain a tenure-track or equivalent position.

There are also the Early Career Fellowship program for Planetary Science (See Appendix C.16 in ROSES 2014), and the Space Technology Mission Directorate Research Opportunities for Early Career Faculty http://www.nasa.gov/offices/oct/stp/strg/2012_space_tech_research_opps.html.

Teaming Research Efforts

NASA does not normally have the equivalent of the DOD Multidisciplinary University Research Initiative program or the various NSF Center competitions. Occasionally NASA competes center-scale efforts, such as the National Center for Advanced Manufacturing (Marshall Space Flight Center in concert with Univ. of New Orleans) and the now defunct NASA University Research, Engineering & Technology Institutes (URETI).

NASA Laboratory/Center Opportunities

In addition to the NASA headquarters solicitations, there are occasions when the NASA Centers themselves provide support to Universities/University students. Examples include:

Jet Propulsion Laboratory <http://surp.jpl.nasa.gov/collaborations/2012surpcallguidelines/>
 Glenn Research Center <https://rt.grc.nasa.gov/main/university-affairs/>
 Ames Research Center <http://www.nasa.gov/centers/ames/education/index.html>

There is also a University Affiliated Research Center at NASA Ames that is currently administered by UC Santa Clara (<http://uarc.ucsc.edu/>).

University Instrumentation

NASA does not have an equivalent of the NSF Major Research Instrumentation or DOD Defense University Research Instrumentation Program. The SMD has a Planetary Major Equipment (PME) topic where proposals may be submitted in conjunction with new science research proposals to ROSES or as an augmentation to Planetary Science Research Program multiple year awards. Instrumentation purchases or upgrades that may be requested through this program are to be over \$40K. Cost-sharing and substantial institutional contributions are encouraged but not required of Universities. The annual budget is ~\$1.5M with 5-10 awards typical.

High End Computing (www.hec.nasa.gov/)

SMD provides a specialized computational infrastructure to support its research community (NASA sponsored scientists/engineers), managed by NASA's High-End Computing (HEC) program. A proposal should include identification of the computing system and location, rationale and justification of the need, how it supports the investigation, when the resources will be required, and an estimate of needed processor hours and storage capacity. Computing time awards are for one year and nontransferable.

Office of Education

<http://www.nasa.gov/offices/education/about/#.U15q1MfB2hI>

NASA has been forced to implement a number of new cost-saving measures, policies, and reviews in order to minimize impacts to the mission-critical activities of the Agency. For specific guidance as it relates to public outreach and engagement activities reference the website. The budget provides \$15 million to NASA's Science Mission Directorate to fund the best application

of NASA Science assets to meet the Nation's STEM education goals.

Resources

[NASA e-mail alerts for ROSES clarifications/corrections/amendments](http://science.nasa.gov/researchers/sara/grant-solicitations/roses-2013/)

<http://science.nasa.gov/researchers/sara/grant-solicitations/roses-2013/>

[NASA open solicitations are posted at:](http://nspires.nasaprs.com/external/solicitations/solicitations.do?method=open&stack=push)

<http://nspires.nasaprs.com/external/solicitations/solicitations.do?method=open&stack=push>

Mission Agency Program Summaries (MAPS)

The DC Office of Research Advancement has created Federal Mission Agency Program Summaries (MAPS) websites to:

- connect PIs with appropriate funding agency programs/program officers
- assist in development of white papers/charts/elevator speeches

The Central Desktop MAPS site has:

- Under “Wiki” Tab - how to use the site
- Under “Files/Discussion” Tab select the appropriate left hand tabs
 - Mission Agency (DHS, DOD, DOE, ED, EPA, NASA, NIST, NOAA, USDA and cross-agency programs in Adv Manuf, Sustainability, STEM education
 - Guide to Agency Funding for FYXX
 - Agency Research Program Charts
 - Agency Planning Documents
 - Program Officer Data sheets (with contact info, biosketch, program descriptive, personal pubs)
 - Program Officer presentations (when available)
- Under “Database” Tab
 - USC MAPS - table of all program officers / programmatic interest

Contact Natasha Walker (nlwalker@usc.edu) for username and password to gain access.

The Keyword Searchable MAPS Site has:

In addition to the more extensive Central Desktop site, there is a MAPS website that can be accessed using one’s USC NetID and Password: http://web-app.usc.edu/web/ra_maps. At that website one can do keyword searches to locate the mission agency (DHS, DOD, DOE, ED, EPA, NASA, NIST, NOAA and USDA) programs and program officers associated with those keywords.

Chart numbers in the text above reference a file in the MAPS Central Desktop *Agency Research Program Charts* folder

Assistance in Locating Funding and Preparing Proposals

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**Table 1: FY2010 and FY2012 NASA Research Funding (\$M)
Obligations for Research Performed at Universities/Colleges**

	2010		2012	
	<u>Basic</u>	<u>Applied</u>	<u>Basic</u>	<u>Applied</u>
TOTAL NASA (\$M)	809	694	940	696
TOTAL University Performer	298	80	313	59
Physical Sciences	117	8	123	6
Astronomy	73	5		
Chemistry	5	-		
Physics	34	2		
Other	5	-		
Environmental Sciences	85	12	89	9
Atmospheric	52	9		
Geological	21	1		
Oceanology	5	2		
Other	7	1		
Mathematics and Computer	3	2	3	2
Computer Sciences	2	1		
Mathematics	-	-		
Other	1	1		
Engineering	55	51	58	37
Aeronautical	35	32		
Astronautical	8	17		
Chemical	-	-		
Civil	-	0		
Electrical	2	-		
Mechanical	1	-		
Metal/Materials	2	-		
Other	7	1		
Life Sciences	13	6	14	4
Agriculture	-	-		
Biological	9	2		
Environmental	1	-		
Medical	2	4		
Other	2	-		
Psychological	1	1	1	-
Social Sciences	-	0	-	0
Other Sciences	24	1	25	-

From NSF "Federal Funds for Research and Development: FY2010-2012" NSF 13-326, July 2013

Basic	2010	Tables 27, 31 and 65-71
Applied Research	2010	Tables 38, 42 and 45-48
Basic	2012	Table 29, 33 and 67
Applied Research	2012	Table 40, 44 and 75

Table 2: NASA Budget Request for FY2015

	Directorate/Topic	2013 (\$M) actual	2014 (\$M) Est.	2015 (\$M) Req.
SMD Heliophysics		603	654	669
	Heliophysics Research	165		217
	Research and Analysis	35		34
	Sounding Rocket Operations	56		66
	Other Missions and Data Analysis	54		97
	Living with a Star	175		266
	Heliophysics Explorer	59	95	124
SMD Astrophysics		617	668	607
	Astrophysics Research	156		191
	Research and Analysis	65		66
	Balloon Project	33	33	38
	Other Missions and Data Analysis	58		86
	Cosmic Origins	219		120
	Physics of the Cosmos	125		109
	ExoPlanet Exploration	53		48
	Astrophysics Explorer	65		140
SMD Planetary Science		1275	1345	1280
	Planetary Science Research	196		256
	Research and Analysis	129		165
	Other Missions and Data Analysis	43		46
	Near Earth Object Observations	21	41	40
	Discovery	215	285	231
	New Frontiers	159	258	282
	MARS Exploration	370	288	279
	Outer Planets	148	159	96
	Technology	123	146	137
SMD Earth Science		1659	1826	1770
	Earth Science Research	423		450
	Research and Analysis	317		329
	Computing and Mgmt	106		121
	Earth Systematic Missions	816		786
	Earth System Science Pathfinder	177		266
	Earth Science Multi-Mission Operations	162		176
	Earth Science Technology	49		56
	Applied Sciences	33		36
Aeronautics		530	566	551
	Fundamental Aeronautics	168		
	Transformative Aeronautics Concepts			80
	Airspace Operations and Safety			131
	Advance Air Vehicles			213
	Integrated Aviation Systems			127
Exploration Research and Development		297	302	343
	Human Research Program	147		161
Space Technology		615	576	706
	Cross cutting Space Technology Development	247		257
	Exploration Technology Development	173		224

Appendix 1: New Project or Significant Change in FY2015

Opportunity, Growth, and Security Initiative

From 0 in FY2014 to \$885M

The Opportunity, Growth, and Security Initiative, which will be split evenly between defense and non-defense funding, shows how additional discretionary investments in 2015 can spur economic progress, promote opportunity, and strengthen national security. The Opportunity, Growth, and Security Initiative is to be fully paid for with a balanced package of spending cuts and tax loophole closers. Selected NASA components of OGSi are:

Science	\$187M
Earth Science research and efforts related to the Big Earth Data Initiative and Climate Data Initiative	18
Research and Analysis	20
Aeronautics	\$ 44M
UAS operations in low-altitude airspace	6
Advance CFD and simulator capabilities	24
Space Technology	\$100M
Composite Structural Technologies	18
Robotics Challenge	10
Advanced Manufacturing	7
Exploration	\$350M
Space Operations	\$100M
Education	\$ 10M
Construction of Facilities and Environmental Compliance Restoration	\$ 94M

Science Mission Directorate

The FY 2015 budget includes support for the interagency Big Earth Data Initiative, which will improve coordination and management of Federal Earth system observations, data, and information. NASA will develop and implement an agency-wide framework for managing and curating data. NASA will also prioritize data sets to be treated, and a plan for completing this work, with the goal of 100 percent compliance of all agency data sets by the end of 2016. NASA's data sets will be used by Federal scientists, academia, and the private sector to study and develop solutions for challenges in climate resilience, water sustainability, landscape-level management of lands and resources, understanding and valuing ecosystem services, and green infrastructure.

The FY 2015 Budget provides \$15 million to support SMD-wide education and public outreach projects and activities. During FY 2015 SMD will assess its portfolio of education activities and competitively allocate funding to the highest priority education projects within NASA Science. These investments will provide a return on the public's investment in NASA's scientific research by sharing the story, the science and the adventure of NASA's scientific explorations of our home planet, the solar system, and the universe beyond.

Aeronautics Mission Directorate

Within the research related to assured autonomy for aviation transformation, NASA will deliver data, analysis, and recommendations based on an integrated flight test series. These tests will utilize simulated airspace/traffic and a live vehicle (manned UAS surrogate) to inform development of preliminary performance standards by the responsible rule-making organization (RTCA Special Commission on Minimum Performance Standards for Unmanned Aircraft Systems). This is the second in a continual flight test campaign over three years, progressively increasing complexity of UAS integration testing. The test campaign will integrate live flying UAV

(or manned surrogate) with ground stations and real-time and simulated air traffic data.

Space Technology Mission Directorate

Game Changing Development will initiate the development of oxygen recovery technology to reduce consumables for deep space human exploration missions, and competitively develop an advanced battery to increase the energy storage capability of future science and exploration systems.

In addition, NASA will place an emphasis on foundational engineering science, targeting collaboration with the fundamental research community, with the objective of advancing key space engineering and science disciplines important to the Nation. This effort will be conducted in collaboration with the Offices of the Chief Scientist, the Chief Technologist, and the Chief Engineer.

Appendix 2: Example (abbreviated) Program Officer Data Sheet

Dr. Madhulika (Lika) Guhathakuta

NASA SMD/HD

202 358 1992

Madhulika.Guhathakurta@nasa.gov

Biosketch:

As a NASA astrophysicist, Dr. Madhulika Guhathakurta (also known as Lika) has had the opportunity to work as a scientist, mission designer, instrument builder, directing and managing science programs and teacher and spokesperson for NASA's mission and vision in the Heliophysics Division. Also Research Associate Professor with Catholic University of America. She has been a Co-Investigator on five Spartan 201 missions and has authored over 70 publications.

Education

BS in physics from Delhi Univ, India

MS in physics and astrophysics from Delhi Univ, India

Ph.D. in Physics from University of Denver and Univ of Colorado at Boulder

Program:

NASA ROSES 2012

Appendix B6: Living with a Star Targeted - Research and Technology

The goal of NASA's Living With a Star (LWS) Program is to develop the scientific understanding needed for the United States to effectively address those aspects of Heliophysics science that may affect life and society.

Appendix B7: Living with a Star Targeted Research and Technology - Strategic Capability

A primary goal of NASA's Living With a Star (LWS) Program is the development of first principles-based models for the coupled Sun-Earth and Sun-Solar System, similar in spirit to the first-principles models for the lower terrestrial atmosphere.

Illustrative Papers Reflecting Personal Research Interests:

Semiempirically derived heating function of the corona heliosphere during the Whole Sun Month
Guhathakurta M.; Sittler E. C. Jr.; Ofman L.

J OF GEOPHYSICAL RESEARCH-SPACE PHYSICS 111(A11), Article N0: A11215 2006

The large-scale density structure of the solar corona and the heliospheric current
sheet Guhathakurta M; Holzer TE; MacQueen RM

ASTROPHYSICAL JOURNAL 458(2), 817-831 FEB 20 1996

Appendix 3: Acronym Glossary

Agency Specific

ACT	Advanced Component Technologies (ESTO Program)
AES	Advanced Exploration Systems
AIST	Advanced Information Systems Technology (ESTO Program)
AO	Announcement of Opportunity
ARC	Ames Research Center
ARCD	Aerospace Research and Career Development
ARMD	Aeronautics Research Mission Directorate
CAS	Convergent Aeronautic Solutions
CAS	Cross Agency Support
E/PO	Education and Public Outreach
ESD	Exploration Systems Development Division (in HEO)
ESM	Earth Systematic Missions
ESTO	Earth Science Technology Office (in SMD)
ETD	Exploration Technology Development (program in STMD)
FAP	Fundamental Aeronautics Program (in ARMD)
HEC	High end Computing
HEO	Human Exploration and Operations Mission Directorate
HRP	Human Research Program
GCD	Game Changing Development
GNSS	Global Navigation Satellite System
GOES	Geostationary Operational Environmental Satellite
HRP	Human Research Program (in HEO Directorate)
LEARN	Leading Edge Aeronautics Research for NASA (ARMD project)
LWS	Living with a Star
MO	Missions of Opportunity
MUREP	Minority University Research and Education Project
NEO	Near Earth Orbit
NIAC	NASA Innovative Advanced Concepts (program in STMD)
NIP	New (Early Career) Investigator Program
NOI	Notice of Intent
NOX	Nitrogen oxides
NRA	Notice of Research Opportunity
NSBRI	National Space Biomedical Research Institute
NSPIRES	NASA Solicitation and Proposal Integrated Review and Evaluation System
OCT	Office of the Chief Technologist
PCOS	Physics of the Cosmos
PME	Planetary Major Equipment
POES	Polar Operational Environmental Satellite
R&A	Research and Analysis
RALV	Reliable Air breathing Launch Vehicles
ROSES	Research Opportunities in Space and Earth Sciences (NRA for SMD)
ROA	Research Opportunities in Aeronautics (NRA for ARMD)
RTM	Revolutionary Tools and Methods (ARMD Project)
SALMON	Stand-alone Missions of Opportunity Notice (from SMD)
SARA	Service and Advice for Research and Analysis (NASA website)

SEA	STEM Education and Accountability
SMD	Science Mission Directorate
STMD	Space Technology Mission Directorate
STP	Solar Terrestrial Probes
STRG	Space Technology Research Grants (program in STMD)
STRO	Space Technology Research Opportunities
URETI	University Research, Engineering & Technology Institutes
UAS	Unmanned Aircraft Systems
UTM	UAS Traffic Management

General

BAA	Broad Agency Announcement
CFDA	Catalog of Federal Domestic Assistance Number
CMOS	Complementary Metal Oxide Semiconductor (electronics)
DHS	Department of Homeland Security
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DoEd	Department of Education (alternative)
DoI	Department of Interior
ED	Department of Education
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
FFO	Federal Funding Opportunity
FFDRC	Federally Funded Research and Development Center
FY	Fiscal Year
HTM	Hierarchical Temporal Memory
IHE	Institutions of Higher Education
IMI	Institute for Manufacturing Innovation
MAPS	Mission Agency Program Summary (provided by USC Res. Adv.)
MEMS/NEMS	Micro- Nano-ElectroMechanical Systems
MRL	Manufacturing Readiness Level
NASA	National Aeronautics and Space Administration
NDI/E	Non-Destructive Inspection/Evaluation
NIST	National Institute for Standards and Technology (in DOC)
NNMI	National Network for Manufacturing Innovation
NOAA	National Oceanic and Atmospheric Administration (in DOC)
NRI	Nanoelectronics Research Initiative
NSF	National Science Foundation
NTIA	National Telecommunications and Information Administration
OMB	Office of Management and Budget
OPM	Office of Personnel Management
PBR	President's Budget Request (submitted to Congress)
PCAST	President's Council of Advisors on Science and Technology
PTSD	Post-traumatic Stress Syndrome
RDT&E	Research, Development, Test and Evaluation
RF	Radio-frequency
RFA	Request for Application

SBIR	Small Business Innovative Research
S&T	Science and Technology
STEM	Science, Technology, Engineering and Mathematics (education)
TBA	To be announced
TBI	Traumatic Brain Injury
TRL	Technology Readiness Level
USDA	US Department of Agriculture