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New Worlds, New Horizons A Performance Assessment of NASA's Astrophysics Program **Science Explorer: Astronomy Science Explorer: Astronomy NASA Thesaurus** *A Performance Assessment of NASA's Heliophysics Program* **Assessment of Mission Size Trade-offs for NASA's Earth and Space Science Missions Report Series: Committee on Astronomy and Astrophysics** *Prentice Hall Science Explorer* **Assessment of Mission Size Trade-offs for NASA's Earth and Space Science Missions Assessment of Recent Changes in the Explorer Program Science Explorer: Astronomy NASA SP.** *Space Studies Board Annual Report 2017* Solar and Space Physics and Its Role in Space Exploration **Looking for Earths 1973 NASA Authorization, Hearings Before ...** An Assessment of Balance in NASA's Science Programs *New Worlds, New Horizons in Astronomy and Astrophysics* **1978 NASA Authorization** Evaluation of the Implementation

of WFIRST/AFTA in the Context of New Worlds, New Horizons in Astronomy and Astrophysics Progress Toward Implementation of the 2013 Decadal Survey for Solar and Space Physics *Earth Science and Applications from Space* **Review of the Draft 2014 Science Mission Directorate Science Plan** Assessment of Programs in Solar and Space Physics 1991 **Science Explorer: Cells and Heredity NASA Scientific and Technical Reports A Selected Listing of NASA Scientific and Technical Reports** NASA Scientific and Technical Publications **Prentice Hall Science Explorer: Astronomy Assessment of Impediments to Interagency Collaboration on Space and Earth Science Missions Proposed Rule on Environmental Impact Assessment of Nongovernmental Activities in Antarctica** *Astronomy Education* **The Cosmos on a Shoestring** Principal-Investigator-Led Missions in the Space Sciences **Russell W. Porter, Arctic Explorer, Artist, Telescope Maker Multiple Messengers and Challenges in Astroparticle Physics** *NASA: Assessment of Large-Scale Projects* **Assessment of Solar System Exploration Programs, 1991** *Scientific and Technical Aerospace Reports*

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The 2010 astronomy and astrophysics decadal survey, New Worlds, New Horizons in Astronomy and Astrophysics, laid out an exciting portfolio of recommended activities to guide the agencies' research programs over the period 2012-2021. The newly constituted Committee on Astronomy and Astrophysics (CAA) is tasked with monitoring the progress of the survey's recommended priorities. The CAA met in conjunction with Space Science Week 2017 in Washington, D.C., on March 28- 30, 2017. This was the first meeting at which the CAA could produce a report, and in advance of that meeting, the CAA received a question from NASA about an upcoming Small Explorer (SMEX) mission call. This report addresses whether there may or may not be sufficient compelling science motivations for a SMEX-sized mission to justify a SMEX Announcement of Opportunity (AO) in 2018 or 2019 (as is currently planned). Through an examination of case studies, agency briefings, and existing reports, and drawing on personal knowledge and direct experience, the Committee on Assessment of Impediments to Interagency Cooperation on Space and Earth

Science Missions found that candidate projects for multiagency collaboration in the development and implementation of Earth-observing or space science missions are often intrinsically complex and, therefore costly, and that a multiagency approach to developing these missions typically results in additional complexity and cost. Advocates of collaboration have sometimes underestimated the difficulties and associated costs and risks of dividing responsibility and accountability between two or more partners; they also discount the possibility that collaboration will increase the risk in meeting performance objectives. This committee's principal recommendation is that agencies should conduct Earth and space science projects independently unless: It is judged that cooperation will result in significant added scientific value to the project over what could be achieved by a single agency alone; or Unique capabilities reside within one agency that are necessary for the mission success of a project managed by another agency; or The project is intended to transfer from research to operations necessitating a change in responsibility from one agency to another during the project; or There are other compelling reasons to pursue collaboration, for example, a desire to build capacity at one of the cooperating agencies. Even when the total project cost may increase, parties may still find collaboration attractive if their share of a mission is more affordable than funding it alone. In these cases, alternatives to interdependent reliance on another government agency should be considered. For example, agencies may find that buying services from another agency or pursuing

interagency coordination of spaceflight data collection is preferable to fully interdependent cooperation. Was a member of the Fiala-Ziegler Expedition, 1903-1905. The 2013 report Solar and Space Physics; A Science for a Technological Society outlined a program of basic and applied research for the period 2013-2022. This publication describes the most significant scientific discoveries, technical advances, and relevant programmatic changes in solar and space physics since the publication of that decadal survey. Progress Toward Implementation of the 2013 Decadal Survey for Solar and Space Physics assesses the degree to which the programs of the National Science Foundation and the National Aeronautics and Space Administration address the strategies, goals, and priorities outlined in the 2013 decadal survey, and the progress that has been made in meeting those goals. This report additionally considers steps to enhance career opportunities in solar and space physics and recommends actions that should be undertaken to prepare for the next decadal survey. Along the way we meet all the major players, from astronomer Peter van de Kamp, whose dreams of discovery lived on undeterred even after years of painstaking observations proved futile, to maverick NASA administrator Daniel Goldin, who dared to suggest in 1992 that "perhaps, just perhaps, the next generation's legacy will be an image of a planet 30 light years from Earth." We watch as the brilliant innovators Michel Mayor and Didier Queloz invent a new method for detection and, defying all odds, make the first major discovery by looking in territory where seasoned astronomers said no planets could ever be

found. Assessment of Mission Size Trade-offs for NASA's Earth and Space Science Missions addresses fundamental issues of mission architecture in the nation's scientific space program and responds to the FY99 Senate conference report, which requested that NASA commission a study to assess the strengths and weaknesses of small, medium, and large missions. This report evaluates the general strengths and weaknesses of small, medium, and large missions in terms of their potential scientific productivity, responsiveness to evolving opportunities, ability to take advantage of technological progress, and other factors that may be identified during the study; identifies which elements of the SSB and NASA science strategies will require medium or large missions to accomplish high-priority science objectives; and recommends general principles or criteria for evaluating the mix of mission sizes in Earth and space science programs. Assessment of Mission Size Trade-offs for NASA's Earth and Space Science Missions considers not only scientific, technological, and cost trade-offs, but also institutional and structural issues pertaining to the vigor of the research community, government-industry university partnerships, graduate student training, and the like. Driven by discoveries, and enabled by leaps in technology and imagination, our understanding of the universe has changed dramatically during the course of the last few decades. The fields of astronomy and astrophysics are making new connections to physics, chemistry, biology, and computer science. Based on a broad and comprehensive survey of scientific opportunities,

infrastructure, and organization in a national and international context, New Worlds, New Horizons in Astronomy and Astrophysics outlines a plan for ground- and space- based astronomy and astrophysics for the decade of the 2010's. Realizing these scientific opportunities is contingent upon maintaining and strengthening the foundations of the research enterprise including technological development, theory, computation and data handling, laboratory experiments, and human resources. New Worlds, New Horizons in Astronomy and Astrophysics proposes enhancing innovative but moderate-cost programs in space and on the ground that will enable the community to respond rapidly and flexibly to new scientific discoveries. The book recommends beginning construction on survey telescopes in space and on the ground to investigate the nature of dark energy, as well as the next generation of large ground-based giant optical telescopes and a new class of space-based gravitational observatory to observe the merging of distant black holes and precisely test theories of gravity. New Worlds, New Horizons in Astronomy and Astrophysics recommends a balanced and executable program that will support research surrounding the most profound questions about the cosmos. The discoveries ahead will facilitate the search for habitable planets, shed light on dark energy and dark matter, and aid our understanding of the history of the universe and how the earliest stars and galaxies formed. The book is a useful resource for agencies supporting the field of astronomy and astrophysics, the Congressional committees with jurisdiction over those agencies, the scientific community,

and the public. The original charter of the Space Science Board was established in June 1958, three months before the National Aeronautics and Space Administration (NASA) opened its doors. The Space Science Board and its successor, the Space Studies Board (SSB), have provided expert external and independent scientific and programmatic advice to NASA on a continuous basis from NASA's inception until the present. The SSB has also provided such advice to other executive branch agencies, including the National Oceanic and Atmospheric Administration (NOAA), the National Science Foundation (NSF), the U.S. Geological Survey (USGS), the Department of Defense, as well as to Congress. Space Studies Board Annual Report 2017 covers a message from the chair of the SSB, David N. Spergel. This report also explains the origins of the Space Science Board, how the Space Studies Board functions today, the SSB's collaboration with other National Academies of Sciences, Engineering, and Medicine units, assures the quality of the SSB reports, acknowledges the audience and sponsors, and expresses the necessity to enhance the outreach and improve dissemination of SSB reports. This report will be relevant to a full range of government audiences in civilian space research - including NASA, NSF, NOAA, USGS, and the Department of Energy, as well members of the SSB, policy makers, and researchers. While a number of remarkable discoveries in astronomy and astrophysics have taken place over the past 20 years, many important questions remain. Continued progress in these fields will require NASA's leadership. To help determine if NASA can meet this

challenge, Congress, in the 2005 NASA Authorization Act, directed the agency to have "[t]he performance of each division in the Science directorate...reviewed and assessed by the National Academy of Sciences at 5-year intervals." In early 2006, NASA asked the NRC to conduct such an assessment for the agency's Astrophysics Division. This report presents an assessment of how well NASA's current program addresses the strategies, goals, and priorities outlined in previous Academy reports. The report provides an analysis of progress toward realizing these strategies, goals, and priorities; and a discussion of actions that could be taken to optimize the scientific value of the program in the context of current and forecasted resources. The Earth is a dynamic planet whose changes and variations affect our communications, energy, health, food, housing, and transportation infrastructure. Understanding these changes requires a range of observations acquired from a variety of land-, sea-, air-, and space-based platforms. To assist NASA, NOAA, and the USGS develop these tools, the NRC was asked by these agencies to carry out a decadal strategy survey of Earth science and applications from space. In particular, the study is to develop the key scientific questions on which to focus Earth and environmental observations in the period 2005-2015, and a prioritized list of space programs, missions, and supporting activities to address these questions. This interim report outlines a key element of the studyâ€"the rationale for tying Earth observations to societal needâ€"and identifies urgent near-term actions needed to achieve this goal. A final report, due in late 2006, will provide

the list of recommended space missions, programs, and supporting. Small spacecraft have become popular for a number of reasons, most prominently the needs to reduce overall cost, be built more quickly, and spread mission risks. NASA has been challenged with crafting a program that continues to produce meaningful science within the constraints of the available budget. Still, pound for pound, small spacecraft are not precisely inexpensive, given the effects of complexity, launch costs, and a greater degree of risk. Historically, science spacecraft have demonstrated increasing reliability, but this trend might not continue, given the shift to managed risk. There is generally less money available to smaller programs to test spacecraft functions and operational procedures prior to launch. Small spacecraft are also generally less robust. Efforts to reduce failure potentials through the application of more reliable components, better testing, and advanced design techniques should receive greater attention. Despite the risks, however, small spacecraft fulfill important roles in earth science, astrophysics, space physics, and planetary science. NASA's current generation of small spacecraft is capable of impressive levels of performance. When the space exploration initiative was announced, Congress asked the NRC to review the science NASA proposed to carryout under the initiative. It also asked the NRC to assess whether this program would provide balanced scientific research across the established disciplines supported by NASA in addition to supporting the new initiative. In 2005, the NRC released three studies focusing on a portion of that task, but changes at NASA forced the postponement of the last

phase. This report presents that last phase with an assessment of the health of the NASA scientific disciplines under the budget requests imposed by the exploration initiative. The report also provides an analysis of whether the science budget appropriately reflects cross-disciplinary scientific priorities. Assessment of Mission Size Trade-offs for NASA's Earth and Space Science Missions addresses fundamental issues of mission architecture in the nation's scientific space program and responds to the FY99 Senate conference report, which requested that NASA commission a study to assess the strengths and weaknesses of small, medium, and large missions. This report evaluates the general strengths and weaknesses of small, medium, and large missions in terms of their potential scientific productivity, responsiveness to evolving opportunities, ability to take advantage of technological progress, and other factors that may be identified during the study; identifies which elements of the SSB and NASA science strategies will require medium or large missions to accomplish high-priority science objectives; and recommends general principles or criteria for evaluating the mix of mission sizes in Earth and space science programs. Assessment of Mission Size Trade-offs for NASA's Earth and Space Science Missions considers not only scientific, technological, and cost trade-offs, but also institutional and structural issues pertaining to the vigor of the research community, government-industry university partnerships, graduate student training, and the like. Principal Investigator-Led (PI-led) missions are an important element of NASA's space science enterprise. While several NRC

studies have considered aspects of PI-led missions in the course of other studies for NASA, issues facing the PI-led missions in general have not been subject to much analysis in those studies. Nevertheless, these issues are raising increasingly important questions for NASA, and it requested the NRC to explore them as they currently affect PI-led missions. Among the issues NASA asked to have examined were those concerning cost and scheduling, the selection process, relationships among PI-led team members, and opportunities for knowledge transfer to new PIs. This report provides a discussion of the evolution and current status of the PIled mission concept, the ways in which certain practices have affected its performance, and the steps that can carry it successfully into the future. The study was done in collaboration with the National Academy of Public Administration. Set of books for classroom use for teaching astronomy in a middle school science curriculum; all-in-one teaching resources volume includes lesson plans, teacher notes, lab information, worksheets, answer keys and tests. In February 2004, the President announced a new goal for NASA; to use humans and robots together to explore the Moon, Mars, and beyond. In response to this initiative, NASA has adopted new exploration goals that depend, in part, on solar physics research. These actions raised questions about how the research agenda recommended by the NRC in its 2002 report, The Sun to the Earth and Beyond, which did not reflect the new exploration goals, would be affected. As a result, NASA requested the NRC to review the role solar and space physics should play in support of the new goals.

This report presents the results of that review. It considers solar and space physics both as aspects of scientific exploration and in support of enabling future exploration of the solar system. The report provides a series of recommendations about NASA's Sun-Earth Connections program to enable it to meet both of those goals. Set of books for classroom use for teaching astronomy in a middle school science curriculum; all-in-one teaching resources volume includes lesson plans, teacher notes, lab information, worksheets, answer keys and tests. This book, designed as a tool for young researchers and graduate students, reviews the main open problems and research lines in various fields of astroparticle physics: cosmic rays, gamma rays, neutrinos, cosmology, and gravitational physics. The opening section discusses cosmic rays of both galactic and extragalactic origin, examining experimental results, theoretical models, and possible future developments. The basics of gamma-ray astronomy are then described, including the detection methods and techniques. Galactic and extragalactic aspects of the field are addressed in the light of recent discoveries with space-borne and ground-based detectors. The review of neutrinos outlines the status of the investigations of neutrino radiation and brings together relevant formulae, estimations, and background information. Three complementary issues in cosmology are examined: observable predictions of inflation in the early universe, effects of dark energy/modified gravity in the large-scale structure of the universe, and neutrinos in cosmology and large-scale structures. The closing section on gravitational physics reviews issues relating to

quantum gravity, atomic precision tests, space-based experiments, the strong field regime, gravitational waves, multi-messengers, and alternative theories of gravity. New Worlds, New Horizons in Astronomy and Astrophysics (NWNH), the report of the 2010 decadal survey of astronomy and astrophysics, put forward a vision for a decade of transformative exploration at the frontiers of astrophysics. This vision included mapping the first stars and galaxies as they emerge from the collapse of dark matter and cold clumps of hydrogen, finding new worlds in a startlingly diverse population of extrasolar planets, and exploiting the vastness and extreme conditions of the universe to reveal new information about the fundamental laws of nature. NWNH outlined a compelling program for understanding the cosmic order and for opening new fields of inquiry through the discovery areas of gravitational waves, time-domain astronomy, and habitable planets. Many of these discoveries are likely to be enabled by cyber-discovery and the power of mathematics, physics, and imagination. To help realize this vision, NWNH recommended a suite of innovative and powerful facilities, along with balanced, strong support for the scientific community engaged in theory, data analysis, technology development, and measurements with existing and new instrumentation. Already in the first half of the decade, scientists and teams of scientists working with these cutting-edge instruments and with new capabilities in data collection and analysis have made spectacular discoveries that advance the NWNH vision. New Worlds, New Horizons: A Midterm Assessment reviews the responses of

NASA's Astrophysics program, NSF's Astronomy program, and DOE's Cosmic Frontiers program to NWNH. This report describes the most significant scientific discoveries, technical advances, and relevant programmatic changes in astronomy and astrophysics over the years since the publication of the decadal survey, and assesses how well the Agencies' programs address the strategies, goals, and priorities outlined in the 2010 decadal survey. Since the 1990s, the pace of discovery in the field of solar and space physics has accelerated, largely owing to NASA investments in its Heliophysics Great Observatory fleet of spacecraft. These enable researchers to investigate connections between events on the Sun and in the space environment by combining multiple points of view. Recognizing the importance of observations of the Sun-to-Earth system, the National Research Council produced a solar and space physics decadal survey in 2003, laying out the Integrated Research Strategy. This strategy provided a prioritized list of flight missions, plus theory and modeling programs, that would advance the relevant physical theories, incorporate those theories in models that describe a system of interactions between the Sun and the space environment, obtain data on the system, and analyze and test the adequacy of the theories and models. Five years later, this book measures NASA's progress toward the goals and priorities laid out in the 2003 study. Unfortunately, very little of the recommended priorities will be realized before 2013. Mission cost growth, reordering of survey mission priorities, and unrealized budget assumptions have delayed nearly all of the recommended

NASA spacecraft missions. The resulting loss of synergistic capabilities in space will constitute a serious impediment to future progress. NASA's Science Mission Directorate (SMD) is engaged in the final stages of a comprehensive, agency-wide effort to develop a new strategic plan at a time when its budget is under considerable stress. SMD's Science Plan serves to provide more detail on its four traditional science disciplines - astronomy and astrophysics, solar and space physics (also called heliophysics), planetary science, and Earth remote sensing and related activities - than is possible in the agency-wide Strategic Plan. Review of the Draft 2014 Science Mission Directorate Science Plan comments on the responsiveness of SMD's Science Plan to the National Research Council's guidance on key science issues and opportunities in recent NRC decadal reports. This study focuses on attention to interdisciplinary aspects and overall scientific balance; identification and exposition of important opportunities for partnerships as well as education and public outreach; and integration of technology development with the science program. The report provides detailed findings and recommendations relating to the draft Science Plan. Astronomy is a popular subject for non-science majors in the United States, often representing a last formal exposure to science. Research has demonstrated the efficacy of active learning, but college astronomy instructors are often unaware of the tools and methods they can use to increase student comprehension and engagement. This book focuses on practical implementation of evidence-based strategies that are supported by

research literature. Chapter topics include an overview of learner-centered theories and strategies for course design and implementation, the use of Lecture-Tutorials, the use of technology and simulations to support learner-centered teaching, the use of research-based projects, citizen science, World Wide Telescope and planetariums in instruction, an overview of assessment, considerations for teaching at a community college, and strategies to increase the inclusivity of courses. Evaluation of the Implementation of WFIRST in the Context of New Worlds, New Horizons in Astronomy and Astrophysics assesses whether the proposed Astrophysics Focused Telescope Assets (AFTA) design reference mission described in the April 30, 2013 report of the AFTA Science Definition Team (SDT), WFIRST-2.4, is responsive to the overall strategy to pursue the science objectives of New Worlds, New Horizons in Astronomy and Astrophysics, and in particular, the survey's top ranked, large-scale, space-based priority: the Wide Field Infrared Survey Telescope (WFIRST). This report considers the versions of WFIRST-2.4 with and without the coronagraph, as described in the AFTA SDT report. The report compares the WFIRST mission described in New Worlds, New Horizons to the AFTA SDT WFIRST-2.4 design reference mission, with and without the coronagraph, on the basis of their science objectives, technical complexity, and programmatic rationale, including projected cost. This report gives an overview of relevant scientific, technical, and programmatic changes that have occurred since the release of New Worlds, New Horizons, and assesses the

responsiveness of the WFIRST mission to the science and technology objectives of the New Worlds report.

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