Solar Electric Propulsion Nasa

Fundamentals of Electric Propulsion
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Green Aviation
Compass Final Report
A Review of United States Air Force and Department of Defense Aerospace Propulsion Needs
Maintaining U.S. Leadership in Aeronautics
Advanced Electric Propulsion for Space Solar Power Satellites

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Fundamentals of Electric Propulsion Createspace Independent Publishing Platform

In 2003, NASA began an R&D effort to develop nuclear power and propulsion systems for solar system exploration. This activity, renamed Project Prometheus in 2004, was initiated because of the inherent limitations in photovoltaic and chemical propulsion systems in reaching many solar system objectives. To help determine appropriate missions for a nuclear power and propulsion capability, NASA asked the NRC for an independent assessment of potentially highly meritorious missions that may be enabled if space nuclear systems became operational. This report provides a series of space science objectives and missions that could be so enabled in the period beyond 2015 in the areas of astronomy and astrophysics, solar system exploration, and solar and space physics. It is based on but does not reprioritize the findings of previous NRC decadal surveys in those three areas.

Priorities in Space Science Enabled by Nuclear Power and Propulsion National Academies Press

Based on years of research conducted at the NASA Jet Propulsion Laboratory, Low-Energy Lunar Trajectory Design provides high-level information to mission managers and detailed information to mission designers about low-energy transfers between Earth and the moon. The book answers high-level questions about the availability and performance of such transfers in any given month and year. Low-energy lunar transfers are compared with various other types of transfers, and placed within the context of historical missions. Using this book, designers may reconstruct any transfer described therein, as well as design similar transfers with particular design parameters. An Appendix, “Locating the Lagrange Points,” and a useful list of terms and constants completes this technical reference. Surveys thousands of possible trajectories that may be used to transfer spacecraft between Earth and the moon, including transfers to lunar libration orbits, low lunar orbits, and the lunar surface Provides information about the methods, models, and tools used to design low-energy lunar transfers Includes discussion about the variations of these transfers from one month to the next, and the important operational aspects of implementing a low-energy lunar transfer Additional discussions address navigation, station-keeping, and spacecraft systems issues

Ion Propulsion for Space Flight John Wiley & Sons

The NASA Authorization Act of 2005 directed the agency to ask the NRC to assess the performance of each division in the NASA Science directorate at five-year intervals. In this connection, NASA requested the NRC to review the progress the Planetary Exploration Division has made in implementing recommendations from previous, relevant NRC studies. This book provides an assessment of NASA's progress in fulfilling those recommendations including an evaluation how well it is doing and of current trends. The book covers key science questions, flight missions, Mars exploration, research and

analysis, and enabling technologies. Recommendations are provided for those areas in particular need of improvement.

Orbital Refueling System (ORS) Createspace Independent Publishing Platform

Rocket and air-breathing propulsion systems are the foundation on which planning for future aerospace systems rests. A Review of United States Air Force and Department of Defense Aerospace Propulsion Needs assesses the existing technical base in these areas and examines the future Air Force capabilities the base will be expected to support. This report also defines gaps and recommends where future warfighter capabilities not yet fully defined could be met by current science and technology development plans.

Spinoff 2012 Government Printing Office

The propulsion module comprises six to eight 30-cm thruster and power processing units, a mercury propellant storage and distribution system, a solar array ranging in power from 18 to 25 kW, and the thermal and structure systems required to support the thrust and power subsystems. Launch and on-orbit configurations are presented for both modular approaches. The propulsion module satisfies the thermal design requirements of a multimission set including: Mercury, Saturn, and Jupiter orbiters, a 1-AU solar observatory, and comet and asteroid rendezvous. A detailed mass breakdown and a mass equation relating the total mass to the number of thrusters and solar array power requirement is given for both approaches. Sharp, G. R. and Cake, J. E. and Oglebay, J. C. and Shaker, F. J. Glenn Research Center NASA-TM-X-3473, E-8800 RTOP 506-22...

Frontiers of Propulsion Science Baen Books

Primitive Meteorites and Asteroids: Physical, Chemical, and Spectroscopic Observations Paving the Way to Exploration covers the physical, chemical and spectroscopic aspects of asteroids, providing important data and research on carbonaceous chondrites and primitive meteorites. This information is crucial to the success of missions to parent bodies, thus contributing to an understanding of the early solar system. The book offers an interdisciplinary perspective relevant to many fields of planetary science, as well as cosmochemistry, planetary astronomy, astrobiology, geology and space engineering. Including contributions from planetary and missions scientists worldwide, the book collects the fundamental knowledge and cutting-edge research on carbonaceous chondrites and their parent bodies into one accessible resource, thus contributing to the future of space exploration. - Presents the most current data and information on the mission-relevant characteristics of primitive asteroids - Addresses the physical, chemical and spectral characteristics of carbonaceous chondritic meteorites and the bearings on successful exploration of their parent asteroids - Includes chapters on geotechnical properties and resource extraction

Mass Study for Modular Approaches to a Solar Electric Propulsion Module AIAA (American Institute of Aeronautics & Astronautics)

Solar sailing - using the sun as a propellant - offers the possibility of low-cost long-distance missions that are impossible with conventional spacecraft. This first comprehensive book on this propulsion method provides a detailed account of solar sailing, at a high

technical level, but in a way accessible to the scientifically informed layperson. Solar sail orbital dynamics and solar radiation pressure form the foundations of the book, but the engineering design of solar sails is also considered, along with potential mission applications.
Space Nuclear Propulsion for Human Mars Exploration Createspace Independent Publishing Platform
NASA's Evolutionary Xenon Thruster (NEXT) is a next-generation high-power ion propulsion system under development by NASA as a part of the In-Space Propulsion Technology Program. NEXT is designed for use on robotic exploration missions of the solar system using solar electric power. Potential mission destinations that could benefit from a NEXT Solar Electric Propulsion (SEP) system include inner planets, small bodies, and outer planets and their moons. This range of robotic exploration missions generally calls for ion propulsion systems with deep throttling capability and system input power ranging from 0.6 to 25 kW, as referenced to solar array output at 1 Astronomical Unit (AU). Thermal development testing of the NEXT prototype model 1 (PM1) was conducted at JPL to assist in developing and validating a thruster thermal model and assessing the thermal design margins. NEXT PM1 performance prior to, during and subsequent to thermal testing are presented. Test results are compared to the predicted hot and cold environments expected missions and the functionality of the thruster for these missions is discussed. Anderson, John R. and Snyder, John S. and VanNoord, Jonathan L. and Soulas, George C. Glenn Research Center; Jet Propulsion Laboratory ION PROPULSION; SOLAR ELECTRIC PROPULSION; PROPULSION SYSTEM CONFIGURATIONS; PROPULSION SYSTEM PERFORMANCE; ROBOTICS; ION ENGINES; THROTTLING; SOLAR SYSTEM; SOLAR ARRAYS
Solar Electric Propulsion Mission Architectures Createspace Independent Publishing Platform
Throughout most of the twentieth century, electric propulsion was considered the technology of the future. Now, the future has arrived. This important new book explains the fundamentals of electric propulsion for spacecraft and describes in detail the physics and characteristics of the two major electric thrusters in use today, ion and Hall thrusters. The authors provide an introduction to plasma physics in order to allow readers to understand the models and derivations used in determining electric thruster performance. They then go on to present detailed explanations of: Thruster principles Ion thruster plasma generators and accelerator grids Hollow cathodes Hall thrusters Ion and Hall thruster plumes Flight ion and Hall thrusters Based largely on research and development performed at the Jet Propulsion Laboratory (JPL) and complemented with scores of tables, figures, homework problems, and references, Fundamentals of Electric Propulsion: Ion and Hall Thrusters is an indispensable textbook for advanced undergraduate and graduate students who are preparing to enter the aerospace industry. It also serves as an equally valuable resource for professional engineers already at work in the field.
Scientific and Technical Aerospace Reports National Academies Press
Literaturangaben. - Originally published: New York, NY : McGraw-Hill, 1968
Vision and Voyages for Planetary Science

in the Decade 2013-2022 Createspace Independent Publishing Platform
Power limited, low-thrust trajectories were assessed for missions to Jupiter, Saturn, and Neptune utilizing a single Venus Gravity Assist (VGA) and a primary propulsion system based on either a 3-kW high voltage Hall thruster, of the type being developed by the NASA In-Space Propulsion Technology Program, or an 8-kW variant of this thruster. These Hall thrusters operate with specific impulses below 3,000 seconds. A trade study was conducted to examine mission parameters that include: net delivered mass (NDM), beginning-of-life (BOL) solar array power, heliocentric transfer time, required launch vehicle, number of operating thrusters, and throttle profile. The top performing spacecraft configuration was defined to be the one that delivered the highest mass for a range of transfer times. In order to evaluate the potential future benefit of using next generation Hall thrusters as the primary propulsion system, comparisons were made with the advanced state-of-the-art (ASOA), 7-kW, 4,100 second NASA's Evolutionary Xenon Thruster (NEXT) for the same mission scenarios. For the BOL array powers considered in this study (less than 30 kW), the results show that the performance of the Hall thrusters, relative to NEXT, is largely dependant on the performance capability of the launch vehicle, and that at least a 10 percent performance gain, equating to at least an additional 200 kg dry mass at each target planet, is achieved over the higher specific impulse NEXT when launched on an Atlas 551.Witzberger, Kevin E. and Manzella, DavidGlenn Research CenterHALL THRUSTERS; SOLAR ELECTRIC PROPULSION; DEEP SPACE 1 MISSION; SPACECRAFT CONFIGURATIONS; NASA SPACE PROGRAMS; SOLAR ARRAYS; POWER CONDITIONING; MATHEMATICAL MODELS; SPECIFIC IMPULSE; HIGH VOLTAGES; NEPTUNE (PLANET); SATURN (PLANET); LAUNCH VEHICLES

Primitive Meteorites and Asteroids
Independently Published
In March 2000, NASA's Office of Space Flight asked the Aeronautics and Space Engineering Board of the National Research Council to perform an independent assessment of the space solar power program's technology investment strategy to determine its technical soundness and its contribution to the roadmap that NASA has developed for this program. The program's investment strategy was to be evaluated in the context of its likely effectiveness in meeting the program's technical and economic objectives.

Low-Energy Lunar Trajectory Design
National Academies Press
The technology of the next few decades could possibly allow us to explore with robotic probes the closest stars outside our Solar System, and maybe even observe some of the recently discovered planets circling these stars. This book looks at the reasons for exploring our stellar neighbors and at the technologies we are developing to build space probes that can traverse the enormous distances between the stars. In order to reach the nearest stars, we must first develop a propulsion technology that would take our robotic probes there in a reasonable time. Such propulsion technology has radically different requirements from conventional chemical rockets, because of the enormous distances that must be crossed. Surprisingly, many propulsion schemes for interstellar travel have been suggested and await only practical

engineering solutions and the political will to make them a reality. This is a result of the tremendous advances in astrophysics that have been made in recent decades and the perseverance and imagination of tenacious theoretical physicists. This book explores these different propulsion schemes – all based on current physics – and the challenges they present to physicists, engineers, and space exploration entrepreneurs. This book will be helpful to anyone who really wants to understand the principles behind and likely future course of interstellar travel and who wants to recognizes the distinctions between pure fantasy (such as Star Trek's 'warp drive') and methods that are grounded in real physics and offer practical technological solutions for exploring the stars in the decades to come.

Performance of Solar Electric Powered Deep Space Missions Using Hall Thruster Propulsion Elsevier

Green Aviation is the first authoritative overview of both engineering and operational measures to mitigate the environmental impact of aviation. It addresses the current status of measures to reduce the environmental impact of air travel. The chapters cover such items as: Engineering and technology-related subjects (aerodynamics, engines, fuels, structures, etc.), Operations (air traffic management and infrastructure) Policy and regulatory aspects regarding atmospheric and noise pollution. With contributions from leading experts, this volume is intended to be a valuable addition, and useful resource, for aerospace manufacturers and suppliers, governmental and industrial aerospace research establishments, airline and aviation industries, university engineering and science departments, and industry analysts, consultants, and researchers.

Nuclear Space Power and Propulsion Systems Createspace Independent Publishing Platform

Space Nuclear Propulsion for Human Mars Exploration identifies primary technical and programmatic challenges, merits, and risks for developing and demonstrating space nuclear propulsion technologies of interest to future exploration missions. This report presents key milestones and a top-level development and demonstration roadmap for performance nuclear thermal propulsion and nuclear electric propulsion systems and identifies missions that could be enabled by successful development of each technology.

Development of an Ion Thruster and Power Processor for New Millennium's Deep Space 1 Mission National Academies Press

In recent years, planetary science has seen a tremendous growth in new knowledge. Deposits of water ice exist at the Moon's poles. Discoveries on the surface of Mars point to an early warm wet climate, and perhaps conditions under which life could have emerged. Liquid methane rain falls on Saturn's moon Titan, creating rivers, lakes, and geologic landscapes with uncanny resemblances to Earth's. Vision and Voyages for Planetary Science in the Decade 2013-2022 surveys the current state of knowledge of the solar system and recommends a suite of planetary science flagship missions for the decade 2013-2022 that could provide a steady stream of important new discoveries about the solar system. Research priorities defined in the report were selected through a rigorous review that included input from five expert panels.

NASA's highest priority large mission should be the Mars Astrobiology Explorer Cacher (MAX-C), a mission to Mars that could help determine whether the planet ever supported life and could also help answer questions about its geologic and climatic history. Other projects should include a mission to Jupiter's icy moon Europa and its subsurface ocean, and the Uranus Orbiter and Probe mission to investigate that planet's interior structure, atmosphere, and composition. For medium-size missions, Vision and Voyages for Planetary Science in the Decade 2013-2022 recommends that NASA select two new missions to be included in its New Frontiers program, which explores the solar system with frequent, mid-size spacecraft missions. If NASA cannot stay within budget for any of these proposed flagship projects, it should focus on smaller, less expensive missions first. Vision and Voyages for Planetary Science in the Decade 2013-2022 suggests that the National Science Foundation expand its funding for existing laboratories and establish new facilities as needed. It also recommends that the program enlist the participation of international partners. This report is a vital resource for government agencies supporting space science, the planetary science community, and the public.

On to the Asteroid Springer Science & Business Media

The NASA Office of the Chief Technologist Game Changing Division is sponsoring the development and testing of enabling technologies to achieve efficient and reliable human space exploration. High-power solar electric propulsion has been proposed by NASA's Human Exploration Framework Team as an option to achieve these ambitious missions to near Earth objects. NASA Glenn Research Center (NASA Glenn) is leading the development of mission concepts for a solar electric propulsion Technical Demonstration Mission. The mission concepts are highlighted in this paper but are detailed in a companion paper. There are also multiple projects that are developing technologies to support a demonstration mission and are also extensible to NASA's goals of human space exploration. Specifically, the In-Space Propulsion technology development project at NASA Glenn has a number of tasks related to high-power Hall thrusters including performance evaluation of existing Hall thrusters; performing detailed internal discharge chamber, near-field, and far-field plasma measurements; performing detailed physics-based modeling with the NASA Jet Propulsion Laboratory's Hall2De code; performing thermal and structural modeling; and developing high-power efficient discharge modules for power processing. This paper summarizes the various technology development tasks and progress made to date Kamhawi, Hani and Manzella, David H. and Smith, Timothy D. and Schmidt, George R. Glenn Research Center WBS 182603.01.04.02

Grading NASA's Solar System Exploration Program National Academies Press

Nuclear propulsion : an introduction / Claudio Bruno -- Nuclear-thermal-rocket propulsion systems / Timothy J. Lawrence -- Application of ion thrusters to high-thrust, high-specific-impulse nuclear electric missions / D.G. Fearn -- High-power and high-thrust-density electric propulsion for in-space transportation / Monika Auweter-Kurtz and Helmut Kurtz -- Review of reactor configurations for space nuclear electric propulsion and surface power

considerations / Roger X. Lenard -- Nuclear safety : legal aspects and policy recommendations / Roger X. Lenard -- Radioactivity, doses, and risks in nuclear propulsion / Alessio Del Rossi and Claudio Bruno -- The Chernobyl accident : a detailed account / Alessio del Rossi and Claudio Bruno.

High-Power Hall Propulsion Development at NASA Glenn Research Center Createspace Independent Publishing Platform

In certain cases, Radioisotope Electric Propulsion (REP), used in conjunction with other propulsion systems, could be used to reduce the trip times for outer planetary orbiter spacecraft. It also has the potential to improve the maneuverability and power capabilities of the spacecraft when the target body is reached as compared with non-electric propulsion spacecraft. Current missions under study baseline aerocapture systems to capture into a science orbit after a Solar Electric Propulsion (SEP) stage is jettisoned. Other options under study would use all REP transfers with small payloads. Compared to the SEP stage/Aerocapture scenario, adding REP to the science spacecraft as well as a chemical capture system can replace the aerocapture system but with a trip time penalty. Eliminating both the SEP stage and the aerocapture system and utilizing a slightly larger launch vehicle, Star 48 upper stage, and a combined REP/Chemical capture system, the trip time can nearly be matched while providing over a kilowatt of science power reused from the REP maneuver. A Neptune Orbiter mission is examined utilizing single propulsion systems and combinations of SEP, REP, and chemical systems to compare concepts. Fiehler, Douglas I. and Oleson, Steven R. Glenn Research Center NASA/TM-2004-213220, E-14727, AIAA Paper 2004-3978

Effect of Voltage Level on Power System Design for Solar Electric Propulsion Missions National Academies Press

The NASA Solar Electric Propulsion Technology Applications Readiness Program (NSTAR) will provide a single-string primary propulsion system to NASA's New Millennium Deep Space 1 Mission which will perform comet and asteroid flybys in the years 1999 and 2000. The propulsion system includes a 30-cm diameter ion thruster, a xenon feed system, a power processing unit, and a digital control and interface unit. A total of four engineering model ion thrusters, three breadboard power processors, and a controller have been built, integrated, and tested. An extensive set of development tests has been completed along with thruster design verification tests of 2000 h and 1000 h. An 8000 h Life Demonstration Test is ongoing and has successfully demonstrated more than 6000 h of operation. In situ measurements of accelerator grid wear are consistent with grid lifetimes well in excess of the 12,000 h qualification test requirement. Flight hardware is now being assembled in preparation for integration, functional, and acceptance tests. Sovey, James S. and Hamley, John A. and Haag, Thomas W. and Patterson, Michael J. and Pencil, Eric J. and Peterson, Todd T. and Pinero, Luis R. and Power, John L. and Rawlin, Vincent K. and Sarmiento, Charles J. and Anderson, John R. and Bond, Thomas A. and Cardwell, G. I. and Christensen, Jon A. Glenn Research Center; Jet Propulsion Laboratory RTOP 242-70-01...

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