

Review of Progress Toward Implementing the Decadal Survey - Solar and Space Physics: A Science for a Technological Society

Committee

Robyn Millan

Co-Chair

ROBYN MILLAN is a professor of physics and astronomy at Dartmouth College; she previously held research appointments at Dartmouth and at the University of California, Berkeley. Dr. Millan's research includes the use of high-altitude scientific balloon experiments and CubeSats to study Earth's radiation belts. She was principal investigator (PI) for the Balloon Array for Radiation-belt Relativistic Electron Losses (BARREL), and is currently the PI for REAL (Relativistic Electron Atmospheric Loss), a Cubesat that will make high time resolution measurements of electron pitch angle and energy distributions in low Earth orbit in order to characterize the mechanisms responsible for scattering radiation belt electrons. Dr. Millan received her Ph.D. in physics at the University of California, Berkeley, in 2002. She has served as Secretary for the Space Physics and Aeronomy section of the American Geophysical Union (2013-2016). Since 2017, she has served as co-chair for the COSPAR Scientific Roadmap on Small Satellites for Space Science. Dr. Millan is a recipient of NASA's Exceptional Public Achievement Medal (2017) and Dartmouth's John M. Manley Huntington Award for Newly Promoted Faculty (2017). She has participated in a number of National Academy's studies, including "Achieving Science Goals with Cubesats" (2015-2016), the 2013 Decadal Survey in Solar and Space Physics (Panel on Solar-Wind Magnetosphere Interactions and the Platforms Working group), and "The Role and Scope of Mission-Enabling Activities in NASA's Space and Earth Science" (2008-2009). In addition, she has served on the Academy's Committee on Solar and Space Physics (2013-2016).

Thomas N. Woods

Co-Chair

THOMAS N. WOODS is associate director of Technical Divisions at the University of Colorado in the Laboratory for Atmospheric and Space Physics (LASP). Dr. Woods joined LASP to work on the UARS SOLSTICE program under the direction of Dr. Gary Rottman. He originally served as the SORCE project scientist, and became the SORCE principal investigator when Gary Rottman retired (Sept. 2005). He continues in the role of SORCE XPS instrument scientist. In addition, he is the principal investigator of the TIMED SEE and SDO EVE satellite instrument programs at LASP. His research is focused primarily on the solar ultraviolet irradiance and its long-term effects on the Earth's atmosphere. He obtained his B.S. in physics from Southwestern at Memphis (now Rhodes College) and his Ph.D. in physics from the Johns Hopkins University. He has served on the Academies' Committee on Achieving Science Goals with CubeSats and the Panel on Solar and Heliospheric Physics.

Timothy S. Bastian

Member

TIMOTHY S. BASTIAN is head of the observatory science operations at the National Radio Astronomy Observatory, where he has been an astronomer since 1990. He is also an adjunct faculty member in the Astronomy Department at the University of Virginia. Dr. Bastian's research interests include solar and stellar radiophysics; planetary/exoplanetary radio emission; radio propagation phenomena as probes of the solar wind; radio interferometry; and the physics of flares and coronal mass ejections. He is currently the principal investigator on the ALMA Development Study to implement solar observing modes with ALMA. He serves as chair of the AAS Publications Board, and is a member of the NASA Living With a Star Steering Committee. Dr. Bastian previously served as scientific editor of the Astrophysical Journal. He earned his Ph.D. in astrophysics from the University of Colorado. He has previously served on the Academies' Panel on Solar and Heliospheric Physics, and the Committee on Solar and Space Physics.

Monica Bobra

Member

MONICA BOBRA is a research scientist at Stanford University in the W. W. Hansen Experimental Physics Laboratory, where she studies the Sun and space weather as a member of the NASA Solar Dynamics Observatory science team. She previously worked at the Harvard-Smithsonian Center for Astrophysics, where she studied solar flares as a member of two NASA Heliophysics missions called TRACE and Hinode. Her research focuses on analyzing large datasets, on the scale of terabytes to petabytes, that describe the Sun and space weather and is the author of a book on the subject. She also serves as Vice-Chair of the Advisory Board for the SunPy Project, a Python-based ecosystem of open-source software for data analysis in solar physics, and the Heliophysics Editor for the Journal of Open Source Software (JOSS). She also is a frequent contributor to popular science magazines such as Sky & Telescope and Scientific American, covering topics related to the Sun and Sun-like stars. She received her MS in Physics from the University of New Hampshire.

Anthea J. Coster

Member

ANTHEA J. COSTER is assistant director and principal research scientist at the Massachusetts Institute of Technology in the Haystack Observatory in Westford, Massachusetts. Her research interests include physics of the ionosphere, magnetosphere, and thermosphere; space weather and geomagnetic storm time effects; coupling between the lower and upper atmosphere; GPS positioning and measurement accuracy; radio wave propagation effects; and meteor detection and analysis. She is a co-principal investigator on the NSF supported Millstone Hill Geospace facility award and a principal investigator/co-principal investigator on numerous projects involving the use of GPS to probe the atmosphere, including investigations of the plasmaspheric boundary layer, stratospheric warming, and the ionosphere over the Antarctic. Dr. Coster and her co-workers developed the first real-time ionospheric monitoring system based on GPS in 1991. She has been involved with measuring atmospheric disturbances over short baselines (GPS networks smaller than 100 km) for the U.S. Federal Aviation Administration, and has coordinated meteor research using the ALTAIR dual-frequency radar for NASA. She received her Ph.D. in space physics and astronomy from Rice University. Dr. Coster previously served on the Academies' U.S. National Committee for the International Union of Radio Science, and The Role of High-Power, High Frequency-Band Transmitters in Advancing Ionospheric/Thermospheric Research: A Workshop.

Edward E. Deluca

Member

EDWARD E. DELUCA is a senior astrophysicist at the Smithsonian Astrophysical Observatory. His research interests are in the theory of magnetic field generation in the Sun and stars, along with coronal heating via magnetic reconnection and MHD turbulence, and the nature and origin of coronal fine structure. Prior to being appointed as the Senior astrophysicist of the High Energy Astrophysics Division, he served as a Supervisory astrophysicist at the Smithsonian Astrophysical Observatory and an astronomer at the University of Hawaii. Dr. Deluca has served on numerous committees including the Hinode Science Working Group, the LWS Targeted Research and Technology Steering Committee, the Solar-C International Sub-Working Group Co-Chair for NGXT, the NASA Advisory Council for Heliophysics Sub-Committee, and chair of the American Astronomical Society Solar Physics Division. Dr. Deluca received his PhD in Astrophysics from the University of Colorado. He has not previously served on an Academies committee.

Scott L. England

Member

SCOTT L. ENGLAND is an associate professor at Virginia Polytechnic Institute and State University (Virginia Tech) in the Aerospace and Ocean Engineering Department. His research involves studying coupling of energy and momentum between different regions of the atmosphere via atmospheric waves. He spent 12 years at the Space Sciences Laboratory at the University of California, Berkeley, where his studies focused on the interaction between atmospheric waves and charged particles in the near-Earth space environment. At Virginia Tech his research focuses on using remote sensing instruments to study the upper atmosphere and near-earth space environment. He is the project scientist for the upcoming NASA ICON spacecraft, a co-investigator on the upcoming NASA GOLD spaceflight mission, and a participating scientist on the NASA MAVEN mission to Mars. He was the recipient of a 2016 NASA RHG Exceptional Achievement for Science award for achieving exciting science results and making fundamental discoveries about the Mars environment from the MAVEN spacecraft. He received his Ph.D. for radio and plasma physics at the University of Leicester, UK. He has not previously served on an Academies committee.

Stephen A. Fuselier

Member

STEPHEN A. FUSELIER is executive director of the Space Science Directorate at Southwest Research Institute. Previously he served as a researcher and senior manager at Lockheed Martin Advanced Technology Center. He has been involved with the development of the IMAGE (Imager for Magnetopause-to-Aurora Global Exploration) spacecraft since its inception. Dr. Fuselier served as co-investigator on two instruments on-board IMAGE: Far Ultraviolet (FUV) imagers and the Low Energy Neutral Atom (LENA) imager. He also led the U.S. investigation on the Rosetta Orbiter Spectrometer for Ion and Neutral Analysis (ROSINA) on the joint European Space Agency/NASA ROSETTA mission. He is a co-investigator and lead of an instrument on the Interstellar Boundary Explorer (IBEX) and the Magnetospheric Multiscale missions. Dr. Fuselier is the author or co-author of more than 350 scientific publications, a fellow of the AGU, and the 1995 recipient of the AGU James B. Macelwane Award. He is the 2016 recipient of the EGU Hanes Alfven Award. He received his Ph.D. in space plasma physics from the University of Iowa. He has previously served on the Academies Standing Committee on Solar and Space Physics, the Committee on Heliophysics Performance Assessment, and the Committee on Distributed Arrays of Small Instruments for Research and Monitoring in Solar-Terrestrial Physics: A Workshop.

Ramon E. Lopez

Member

RAMON E. LOPEZ is a professor of physics at the University of Texas, Arlington. His research focuses on solar wind-magnetospheric coupling, magnetospheric storms and substorms, and space weather prediction. Dr. Lopez is also working in the areas of teacher education, national science education standards, and physics education research. Dr. Lopez is a fellow of the APS and the AAAS. He received his Ph.D. in space physics from Rice University. He has previously served on the Academies' Committee on NASA Science Mission Extensions, the Committee on Solar and Space Physics, the Committee on a Decadal Strategy for Solar and Space Physics (Heliophysics), and the Committee on Strategic Guidance for NSF's Support of the Atmospheric Sciences.

Janet G. Luhmann

Member

JANET G. LUHMANN is a senior fellow at the University of California, Berkeley at the Space Sciences Laboratory. Her current research includes the use of spacecraft observations and models to investigate the connections between the Sun and heliospheric conditions, and the solar wind interactions with the planets. Dr. Luhmann is the current PI for the IMPACT Investigation on NASA's STEREO mission, and a Deputy PI for the MAVEN mission. She received her Ph.D. from the University of Maryland, College Park. Dr. Luhmann has served on the Academies' Committee on Piled Missions in the Space Sciences: Lessons Learned, Committee on Solar and Space Physics, Panel on Solar Wind-Magnetospheric Interactions, Space Studies Board, and the Committee on Solar-Terrestrial Research.

Katariina Nykyri

Member

KATARIINA (HEIDI) NYKYRI is the associate dean of Research and Graduate Programs at the College of Arts and Sciences and professor of physics at the Embry-Riddle Aeronautical University. Her major research interests involve understanding the physical mechanisms that transport and heat plasma in solar wind-magnetosphere system. Dr. Nykyri was awarded the NSF career award in 2009 and ERAU researcher of the year award in 2010 and 2018. She is a co-director of the ERAU's LASMIR laboratory. Between 2012-2018 she served as a steering committee member of the National Science Foundation's GEM program as a research area coordinator for the Solar Wind Magnetosphere Interactions research area. Since Fall 2017 Dr. Nykyri is the associate director for Embry-Riddle's Centre of Space and Atmospheric Research and director for the Space Weather Division. She received her Ph.D. in physics from the University of Alaska System: Fairbanks. She has not previously served on an Academies' committee.

Jens Oberheide

Member

JENS OBERHEIDE is a professor of physics and astronomy at Clemson University in the Department of Physics and Astronomy. Previously, he was a research professor in atmospheric physics at the University of Wuppertal, Germany. Dr. Oberheide is a specialist in satellite data analysis and conducts empirical modeling of global-scale wave dynamics in earth's upper atmosphere. His research interests include the dynamics of Earth's mesosphere-thermosphere-ionosphere system; the forcing and vertical propagation of tides, planetary waves, and gravity waves, including their effects on chemistry and electrodynamics; geospace environment coupling to the atmosphere below and to solar activity; and utilization of satellite and ground-based remote sensing data to resolve variability and vertical coupling processes in the atmosphere. Dr. Oberheide is a recipient of the NASA Group Achievement Award to the TIMED team. He is an associate editor for the Journal of Geophysical Research-Atmospheres. He received his Ph.D. in physics from the University of Wuppertal. He served on the NASA Senior Review panel of the 2009-2012 Mission Operations and Data Analysis Program for the Heliophysics Operating Missions. Dr. Oberheide served on the Steering Committee of SCOSTEP's Climate and Weather of the Sun-Earth System program and led one of its working groups, investigating the geospace response to variable waves from the lower atmosphere. He served on the Academies' Panel on Atmosphere-Ionosphere-Magnetosphere Interactions.

Merav Opher

Member

MERAV Opher is an associate professor at Boston University in the Department of Astronomy. Her research interests are in how plasma and magnetic effects reveal themselves in astrophysical and space physics environments. In particular, in how stars interact with the surrounding media, how the solar system interacts with the local interstellar medium, and the interaction of extra-solar planets with their host stars. Her other interests are in how magnetic disturbances are driven and propagate from the Sun to Earth. She uses state-of the art 3D computational models to investigate these phenomena. Dr. Opher was awarded the prestigious NSF CAREER award and the Presidential Early Career Award for Scientists and Engineers (PECASE) for studies of shocks in interplanetary space. She also received the Mason Emerging Researcher/Scholar/Creator Award. She is actively involved in several leadership roles in the Space Physics and Astronomy community. Dr. Opher had her postdoctoral training at the Plasma Group of the Physics Dept of UCLA and was a Caltech Scholar at the Jet Propulsion Laboratory and at University of Michigan. Before coming to Boston University, she was an associate professor at George Mason University. She obtained her Ph.D. for physics and astronomy in University in Sao Paulo. She has served on the Academies Panel on Solar and Heliospheric Physics and the Committee on Solar and Space Physics.

Carolus J. Schrijver

Member

CAROLUS J. SCHRIJVER is a senior fellow and director, retired at Lockheed-Martin Advanced Technology Center. He joined Lockheed after postdoctoral appointments at the University of Colorado and the European Space Agency, and a fellowship of the Royal Netherlands Academy of Sciences. His research focused on the magnetic activity of the Sun, the coupling of the Sun's magnetic field into the heliosphere and its solar wind, the manifestations of magnetic activity of other Sun-like stars, and the impact of solar variability on society. In addition to scientific research, he has been actively involved in developing and operating space instrumentation: he was the science lead and later the principal investigator for the Transition Region and Coronal Explorer (TRACE) and for the Atmospheric Imaging Assembly (AIA) of the Solar Dynamics Observatory (SDO), and is co-investigator on the Helioseismic and Magnetic Imager (HMI) on SDO and on the Interface Region Imaging Spectrograph (IRIS) SMEX project. As a Lockheed Martin senior fellow, he was involved in defining and developing instrumentation for future heliophysics missions. He has served in NASA advisory functions, including the NASA Sun-Earth Connection strategic planning (RoadMap) teams, the panel on Theory and Modeling of the NASA Living-With-a-Star (LWS) initiative, the LWS Science Architecture Team, the LWS Mission Operations Working Group, the Solar-Heliospheric MOWG, the LWS TR&T Steering Group, the NASA Heliophysics Subcommittee, and the Science Definition Teams of the Solar Orbiter and Solar Sentinels. . He received his Ph.D. at the University of Utrecht, the Netherlands for astrophysics. He has served on the Academies' Committee on the Effects of Solar Variability on Earth's Climate: A Workshop, the Space Studies Board, and the Task Group on Ground-based Solar Research.

Joshua Semeter

Member

JOSHUA SEMETER is a professor at Boston University (BU) in the Department of Electrical and Computer Engineering, and associate director of the BU Center for Space Physics. He was previously a senior research engineer at SRI International, and a staff scientist at the Max Planck Institute for Extraterrestrial Physics. Dr. Semeter's research concerns physical interactions between the outer atmosphere and space environment that underlie space weather. His laboratory uses optical and radio remote sensing techniques, and physics-based assimilation of observations from ground and space. Dr. Semeter was an associate editor of the Journal of Geophysical Research. He has received the Boston University Faculty Teaching Award in Engineering, and was a recipient of the NSF Faculty Early Career Development (CAREER) award. Dr. Semeter has a Ph.D. in electrical engineering from Boston University. He has served on the Academies Standing Committee on Solar and Space Physics (CSSP) and the Panel on Atmosphere-Ionosphere-Magnetosphere Interactions.

Jeffrey P. Thayer

Member

JEFFREY P. THAYER is the Negler professor of Aerospace Engineering Sciences and the director of the Colorado Center for Astrodynamics Research at the University of Colorado, Boulder. He has recently become the University principal investigator of the newly established Space Weather Technology, Research, and Education Center (SWx TREC) within the College of Engineering and Applied Sciences. His research spans the spectrum, from studies of the Sun's chromosphere to Earth's surface, bridging both science and engineering to understand the fundamental processes that govern our solar-terrestrial system. He specializes in geophysical fluid dynamics, gas and plasma interactions, thermodynamics and electrodynamics, and radar and lidar remote sensing of the near-space environment. His research has impacted topics in atmospheric electricity, satellite drag, solar-terrestrial coupling, solar chromosphere plasma-neutral interactions, geospace plasma physics, stratosphere polar vortex dynamics, cloud physics, and water bathymetry. Dr. Thayer is a recipient of several awards including the Negler Professorship, CU Boulder Faculty Assembly Award for Excellence in Research (emphasis on space environment), NASA Group Achievement Award, and SRI Presidential Achievement Award. He has served on many NASA and National Science Foundation committees and panels, such as, the NASA Geospace Mission and Operations Working Group, the NASA Sun-Earth Connections Roadmap Team, and the NSF CEDAR Science Steering Committee. He received his Ph.D. for atmospheric and space structure from the University of Michigan. He has served on the Academies' Panel on Atmosphere-Ionosphere-Magnetosphere Interactions.

Alan M. Title

Member

ALAN M. TITLE (NAS/NAE) is a senior fellow at the Lockheed Martin Advanced Technology Center (ATC) in Palo Alto, CA. His primary scientific research interest is the generation, distribution, and effects of the solar magnetic field throughout the Sun's interior and outer atmosphere. At present, he has 201 articles in refereed journals. He was the principal investigator for NASA's solar mission called the Interface Region Imaging Spectrograph (IRIS). Dr. Title was the principal investigator responsible for the Atmospheric Imaging Assembly on NASA's Solar Dynamics Observatory (SDO) launched in 2010, and is a co-investigator for another instrument on SDO, the Helioseismic Magnetic Imager. He was also the principal investigator for NASA's solar telescope on the Transition Region and Coronal Explorer (TRACE) mission, launched in 1998, and the Focal Plane Package on the JAXA/ISAS Hinode mission launched in 2006. Additionally, Dr. Title serves as a co-investigator responsible for the Michelson-Doppler Imager (MDI) science instrument on the NASA-European Space Agency Solar and Heliospheric Observatory (SOHO), launched in 1995. All of these instruments were built under his direction at the ATC. As an engineer, Dr. Title designs, develops, builds, and flies new instruments that will gather the data necessary to inform his solar research interests. He led the development of tunable bandpass filters for space-based solar observations, a version of which is currently operating on the JAXA/ISAS Hinode spacecraft. He also invented a tunable variation of the Michelson Interferometer that has been employed on the SOHO spacecraft, the Solar Dynamics Observatory (SDO), the Global Oscillations Network Group of the National Solar Observatory as well as other ground-based systems. Outside of his research, Dr. Title has supported activities at the Tech Museum, Chabot Observatory, Boston Museum of Science, the National Air and Space Museum, and the Hayden Planetarium. In addition, his educational outreach funding has supported a yearly summer program for Stanford undergraduates, and the Stanford Hass Center activities that develop science programs for K-12 classrooms. And for two decades, promising students from the Palo Alto High School District have come to work in his laboratory. Among his honors and awards are the 2011 John Adam Fleming Medal, awarded not more than once annually to an individual "for original research and technical leadership in geomagnetism, atmospheric electricity, aeronomy, space physics, and related sciences." He received his Ph.D. in physics from the California Institute of Technology. He has served on the Academies' Aeronautics and Space Engineering Board, the Committee on Achieving Science Goals with CubeSats, the NASA Technology Roadmap: Instruments and Computing Panel, the Committee on PI-led Missions in the Space Sciences: Lessons Learned, and the Panel on the Sun and Heliospheric Physics.