Achieving Science Goals with CubeSats

Committee

Thomas H. Zurbuchen

Chair

THOMAS H. ZURBUCHEN is a professor of space science and aerospace engineering at the University of Michigan. He is also the associate dean of entrepreneurial programs in the college of engineering, founder of the college's center for entrepreneurship, and also senior counselor to the provost. In these roles, he is responsible for educational and research programs focused on innovation, entrepreneurial thought and action, and enhancing research impact. He has been at the University of Michigan for over 19 years. He is a part-time visiting scientist to the International Space Science Institute in Bern. Dr. Zurbuchen has received numerous awards, including the prestigious U.S. Presidential Early Career Award, which represents the highest honor bestowed by the U.S. government on scientists and engineers beginning their independent careers. He has also received the Outstanding Accomplishment Awards at the University of Michigan from his department, college and university focused on service, mentorship and research, as well as multiple NASA Group Achievement Awards, due to his involvement in missions such as Ulysses, MESSENGER, Wind and ACE. Dr. Zurbuchen, a specialist in the robotic exploration of space and expert in space plasmas, is a founder of the Solar and Heliospheric Research group currently responsible for more than 10 instruments in flight and two more under development. He served as team leader for the development of NASA's Fast Imaging Plasma Spectrometer, an instrument that is part of the MESSENGER spacecraft in orbit about Mercury since 2011. He serves on the boards of four companies and non-profits (none of which are CubeSat or space related), including as a governor-appointed trustee of Northern Michigan University. Dr. Zurbuchen holds a Ph.D. in solar and heliospheric physics and an M.S. in physics, mathematics, and astronomy from the University of Bern, Switzerland. He is currently a member of the Space Studies Board and its executive committee at the NRC and has had extensive previous experience as vice chair for the Committee on a Decadal Strategy for Solar and Space Physics, vice chair and a former member of the Committee on Solar and Space Physics, member of the Plasma Science Committee, member of the Workshop Organizing Committee on Solar Systems Radiation Environment and NASA's Vision for Space Exploration, and member of the Panel on the Sun and Heliospheric Physics.

Julie Castillo-Rogez

Member

JULIE CASTILLO-ROGEZ is a planetary scientist at the Jet Propulsion Laboratory, California Institute of Technology. Her research focuses on water-rich objects from modeling and experimental perspectives applied to the formulation, design, and planning of planetary missions. Her current activities focus on Ceres, target of the Dawn mission, Mars' moons in the frame of the human exploration program, as well as other small bodies whose study can help improve understanding of the early Solar system. Dr. Castillo-Rogez serves as the science principal investigator for NASA’s Near Earth Asteroid Scout Mission, is a participating scientist in NASA’s Mars Atmosphere and Volatile Evolution mission (MAVEN), and is the investigation scientist for NASA’s Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) mission to Mars. Dr. Castillo-Rogez also served as the infusion scientist for the INSPIRE CubeSat mission. She co-founded the Ice Physics Laboratory at JPL in 2007, and she previously was a member of the Cassini Mission Radio Science Team. She earned a B.S. in geology from the University of Nantes, France, a M.S. in geophysics from the University of Rennes, France, and a Ph.D. in planetary geophysics from the University of Rennes, France.

Andrew Clegg

Member

ANDREW CLEGG is the spectrum engineering lead at Google, Inc. Prior to Google, he served 11 years as a program manager at the National Science Foundation, where he created the Enhancing Access to the Radio Spectrum (EARS) program, which was focused on funding research in radio spectrum efficiency and access. He also served as NSF's Electromagnetic Spectrum Manager, where, among other tasks, he helped the nascent Cubesat movement gain access to spectrum resources and represented the U.S. at two World Radiocommunication Conferences. Prior to NSF, he was principal member of technical staff at Cingular Wireless (now AT&T Mobility), and a senior engineer for Comsearch. He was also a member of the Remote Sensing Division at the Naval Research Laboratory immediately after graduation. Dr. Clegg earned his M.S. and Ph.D. in radio astronomy and electrical engineering from Cornell University.

Bhavya Lal

Member

BHAVYA LAL is a research staff member at the IDA Science and Technology Policy Institute (STPI) where her research and analysis focuses on space technology and policy and is frequently incorporated in national policy documents. Recent and ongoing projects include supporting the Office of Science and Technology Policy and other federal agencies in developing a national space technology strategy, improving detection of near Earth objects, evaluating a civilian space situational awareness capability, documenting global trends in space, and examining recent commercial activities in space including their legal ramifications related to the Outer Space Treaty. Before joining STPI, Dr. Lal was president of C-STPS, LLC, a science and technology policy research and consulting firm in Waltham, Massachusetts. Prior to that, she was a researcher and the director of the Center for Science and Technology Policy Studies at Abt Associates, Inc., in Cambridge, Massachusetts. Dr. Lal holds B.S. and M.S. degrees in nuclear engineering from the Massachusetts Institute of Technology (MIT), an M.S. from MIT's Technology and Policy Program, and a Ph.D. from the Trachtenberg School of Public Policy and Public Administration (concentration in science and technology policy) at George Washington University. She has previously served on the NRC Committee on Space-Based Additive Manufacturing.

Paulo Lozano

Member

PAULO C. LOZANO is an associate professor and chair of the graduate program in the Department of Aeronautics and Astronautics at the Massachusetts Institute of Technology. He is also the director of MIT's Space Propulsion Laboratory. His main interests are plasma physics, space propulsion, ion beam physics, small satellites and nanotechnology. Part of Prof. Lozano's research topics includes the development of highly efficient and compact ion propulsion systems for pico/nano-satellites. He has published over 80 conference and journal publications on his research. He received the Young Investigator Program Award from the Air Force and the "Future Mind" Award from Quo/The Discovery Channel. Prof. Lozano is an associate fellow of the American Institute of Aeronautics and Astronautics and member of the American Physical Society. He earned his Ph.D. in Space Propulsion from MIT. Previous NRC service includes the panel on Mitigation Strategies for Potentially Hazardous Near Earth Objects and the panel on Priorization of NASA Technology Roadmaps.

Malcolm Macdonald

Member

MALCOLM MACDONALD is the director of the Scottish Centre of Excellence in Satellite Applications, based at the University of Strathclyde. Until 2008, he worked at SciSys (UK) Ltd. on several projects, including ADM-Aeolus and LISA-Pathfinder. His work focuses on the end-to-end development and application of space mission systems to challenge conventional ideas and advance new concepts in the exploration and exploitation of space; the end-to-end philosophy enables new space-derived data product concepts through advances in space technology, including new platforms concepts such as CubeSats. Specific interests are in the use of multiple spacecraft to enable new space science and services through the application of concepts from swarm engineering, combined with astrodynamics and space system design. His outputs are reported in over 110 publications, and have been cited over 820 times. In publication citations since 2009, he has an H-index of 14 and an i10-index of 18. He is currently deputy chair of the UK Space Agency's Space Programme Review Panel, a member of the UK's Space Leadership Council, an associate editor of the AIAA's Journal of Guidance, Control, and Dynamics, and a fellow of the Royal Aeronautical Society. He is also has a Honours degree and a Ph.D. from the University of Glasgow.

Robyn Millan

Member

ROBYN MILLAN is an associate professor of physics and astronomy at Dartmouth College. Her research includes the use of high-altitude scientific balloon experiments to study Earth's radiation belts, specifically the loss of relativistic electrons from the outer radiation belts into Earth's atmosphere. Dr. Millan is principal investigator for the BARREL (Balloon Array for RBSP Relativistic Electron Losses) project, which is being planned for flight in association with the Radiation Belt Storm Probe mission. Her prior positions include research appointments at Dartmouth and at the University of California, Berkeley. She received her Ph.D. in physics at the University of California, Berkeley in 2002. Dr. Millan served on the NRC Committee on the Role and Scope of Mission-Enabling Activities in NASA's Space and Earth Science Missions and on the Panel on Solar Wind-Magnetosphere Interactions for the Committee for a Decadal Strategy for Solar and Space Physics (Heliophysics).

Charles D. Norton

Member

CHARLES D. NORTON is a program manager and principal technologist at the Jet Propulsion Laboratory (JPL) at the California Institute of Technology. He is the engineering and science directorate formulation lead for Small Satellites at JPL. His research interests are small satellites for spaceborne technology validation, high performance computing for Earth and space science modeling, and advanced information systems technologies. He has managed CubeSat flight projects and co-led a Keck Institute study “Small Satellites: A Revolution in Space Science.” He is a recipient of numerous awards for new technology and innovation including the JPL Lew Allen Award and the NASA Exceptional Service Medal, and is a member of IEEE (senior level), AIAA, and AGU, holding a B.S.E from Princeton University in electrical engineering and computer science and M.S and Ph.D. in computer science from Rensselaer Polytechnic Institute. Prior to joining JPL he was an NRC Postdoctoral Fellow.

William H. Swartz

Member

WILLIAM H. SWARTZ is a senior research scientist at the Johns Hopkins University Applied Physics Laboratory (JHU/APL). He is also assistant research professor at Johns Hopkins University. As a member of JHU/APL’s space sector, Dr. Swartz works to advance the use of small satellites for addressing pressing science questions and to enable novel observation systems. He is the Principal Investigator of a NASA-funded CubeSat mission to develop technologies and measurement techniques that could significantly advance space observation of Earth’s radiation budget. He also conducts research into the response of the atmosphere’s chemistry and temperature to solar variability, using both Earth system modeling and observations. Dr. Swartz holds a PhD in atmospheric chemistry from the University of Maryland, College Park and has previously briefed the NAS’s Committee on Earth Science and Applications from Space.

Alan M. Title

Member

ALAN TITLE (NAS/NAE) is a senior fellow at the Lockheed Martin Space Systems 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 200 articles in refereed journals. He is currently the principal investigator for NASA’s solar mission called the Interface Region Imaging Spectrograph (IRIS). 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, 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 Alan Title’s direction at the ATC. As an engineer, Alan 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 Hay- den 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. Most recently, he has served on the NRC’s Board on Research Data and Information and the NASA Technology Roadmap: Instruments and Computing Panel, and he currently serves on the Aeronautics and Space Engineering Board.

Thomas N. Woods

Member

THOMAS WOODS is the associate director of technical divisions of the Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado in Boulder. His research is focused primarily on solar irradiance variability and its effects on Earth's atmosphere, climate change, and space weather. Dr. Woods is involved with several NASA and NOAA satellite programs. He is the Principal Investigator (PI) of the TIMED SEE and SDO EVE satellite instrument programs at LASP and is also the PI of the SORCE and MinXSS CubeSat missions. He is first author on 49 papers and co-author on 143 other papers. 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 previously served on the Panel on Solar and Heliospheric physics for the decadal survey for Solar and Space Physics (Heliophysics).

Edward L. Wright

Member

EDWARD L. WRIGHT (NAS) is a David Saxon Presidential Chair in Physics Professor at the University of California, Los Angeles (UCLA). At UCLA, Dr. Wright has been the data team leader on the Cosmic Background Explorer (COBE), a co-investigator on the Wilkinson Microwave Anisotropy Probe (WMAP), an interdisciplinary scientist on the Spitzer Space Telescope, and the principal investigator on the Wide-field Infrared Survey Explorer (WISE). Dr. Wright is well-known for his Cosmology Tutorial website for the informed public, and his web-based cosmology calculator for professional astronomers. He has served on the NRC’s Beyond Einstein Program Assessment Committee, the committee to study Autonomy Research in Civil Aviation, and the committee to study NASA’s planned Wide Field InfraRed Survey Telescope – Astrophysics Focused Telescope Assets program (WFIRST-AFTA). Dr. Wright currently serves on the committee for Review of the Federal Aviation Administration Research Plan on Certification of New Technologies into the National Airspace System. He earned his Ph.D. in astronomy from Harvard University.

A. Thomas Young

Member

A. THOMAS YOUNG (NAE) is executive vice president, retired, at Lockheed Martin Corporation and former chair of the board of SAIC. Mr. Young was previously the president and chief operating officer of Martin Marietta Corporation. Prior to joining industry, Mr. Young worked for 21 years at NASA where he directed the Goddard Space Flight Center, was deputy director of the Ames Research Center, and directed the Planetary Program in the Office of Space Science at NASA Headquarters. Mr. Young received high acclaim for his technical leadership in organizing and directing national space and defense programs, especially the Viking program. He is currently an honorary fellow of the American Institute of Aeronautics and Astronautics and a fellow of the American Astronautical Society. Mr. Young is a member of the NASA Advisory Council. He earned his engineering degree from the University of Virginia and M.S. in management from the Massachusetts Institute of Technology. Mr. Young's NRC service includes current membership on the Committee on Astronomy and Astrophysics and the Committee on Survey of Surveys: Lessons Learned from the Decadal Survey Process. His prior NRC membership includes the Committee on the Assessment of the Astrophysics Focused Telescope Assets (AFTA) Mission Concepts, the Planning Committee on Lessons Learned in Decadal Planning in space: A Workshop, the Committee on the Planetary Science Decadal Survey: 2013-2022, the Panel on Implementing Recommendations from New Worlds, New Horizons Decadal Survey, the Committee on the Decadal Survey on Astronomy and Astrophysics 2010, and the Space Studies Board (vice chair).