Space Science & Engineering

- Planetary Science
- Terrestrial & Planetary Magnetospheric Physics
- Solar & Heliospheric Physics
- Spacecraft Instrumentation
- Spacecraft Avionics
- Electromechanical Systems
- Power Systems
- Microsatellite Design, Development & Fabrication
- Spacecraft Management
- Data Analysis & Science Support
- Science & Mission Operations
- Lighter-Than-Air Systems

In 2015, Southwest Research Institute made history with NASA's New Horizons Pluto encounter and the launch of the Magnetospheric Multiscale (MMS) mission. SwRI leads the New Horizons science mission and built two of the instruments aboard the spacecraft. After a 9.5-year, 3-billion-mile journey, New Horizons became the first spacecraft to fly past Pluto, acquiring high-resolution images of the planet's surface and its moons, as well as measuring its atmosphere and space environment. New Horizons is now heading deeper into the Kuiper Belt and, with a mission extension, may encounter another object in this zone of primitive icy bodies, relics of the formation of the solar system.

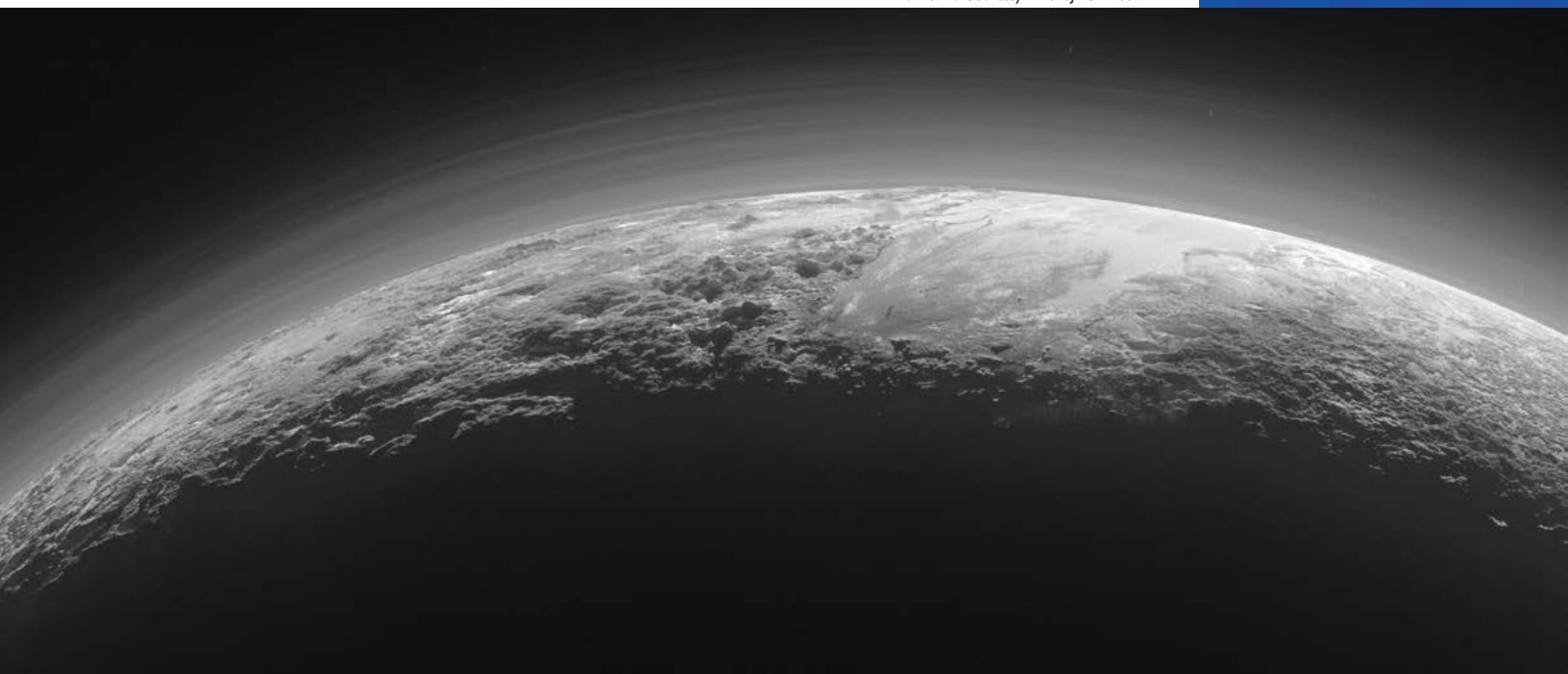
SwRI leads the MMS science investigation and built the plasma composition instruments and payload computers for the four MMS spacecraft. Following a successful launch and on-orbit commissioning, the MMS spacecraft are studying how the Sun's magnetic field, carried by the solar wind, can merge with the Earth's. Using MMS data, scientists will unravel the microphysics of "magnetic reconnection" — a fundamental, but poorly understood, physical process that transforms magnetic energy into kinetic energy and heat. Reconnection is at the heart of the phenomena referred to as "space weather."

Our space engineering program continued growth this year with completion of several new spacecraft control systems. We also realized a 20-fold increase in solid-state recorder performance and established an instrument interface test bed for early evaluation of payload interoperability. Engineers are developing technology to meet challenging thermal and radiation environments, such as required by ESA's Solar Orbiter mission. With our central role in NASA's Cyclone Global Navigation Satellite System (CYGNSS), we are expanding our capabilities in the increasingly important area of microsatellite design, fabrication, and integration.

The Institute's planetary science program is known for developing computer models to simulate and understand the formation of the planets and other solar system bodies. In 2015, new models helped SwRI scientists determine how Jupiter and Saturn likely formed in the solar system's protoplanetary disk. These new calculations show that the cores of these gas giants formed by gradually accumulating a

This image, captured by New Horizons 15 minutes after its closest approach on July 14, shows Pluto's mountains, thought to consist of water ice, and in the upper right, a smooth plain of frozen nitrogen, methane, and carbon monoxide. Also visible in the image are multiple layers of hydrocarbon haze.

D021674 / Courtesy NASA/JHUAPL/SwRI



D021672 / Courtesy ULA

SwRI leads the science investigation for NASA's Magnetospheric Multiscale (MMS) mission. Launched from Cape Canaveral in March, the four MMS spacecraft have achieved the tightest flying formation ever flown in Earth orbit as they probe the boundary of the magnetosphere.

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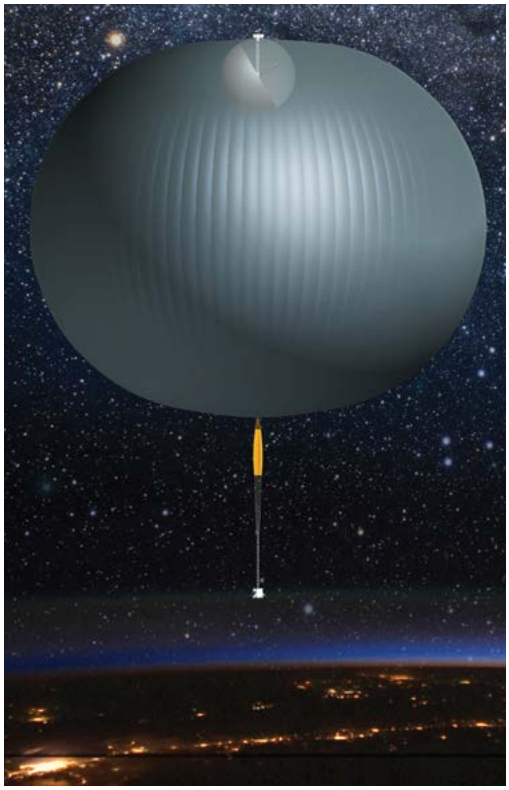
For a future mission to Europa, Jupiter's fourth largest moon, NASA has selected SwRI's MAss Spectrometer for Planetary EXploration (MASPEX™) instrument to measure trace chemicals in the moon's atmosphere. MASPEX will probe Europa's thin atmosphere, especially any plumes venting from an ocean thought to lurk below the moon's icy surface, looking for elements that point to the possibility of life.

population of planetary pebbles — icy objects about a foot in diameter. In another study, SwRI researchers combined numerical simulations with the analysis of stony meteorites to calculate that the giant impact that formed the Moon occurred roughly 4.47 billion years ago.

As we look to the future, two SwRI-developed instruments — MASPEX (MAss Spectrometer for Planetary EXploration) and UVS (Ultraviolet Spectrograph) — have been selected for a NASA mission to probe Jupiter's icy moon Europa. The two instruments will work in tandem to search for specific chemical compounds in Europa's atmosphere to determine if the icy moon could host life. MASPEX, developed with NASA and SwRI funding, is by far the most sensitive, highest resolution mass spectrometer ever flown in space. UVS belongs to a family of UV instruments SwRI developed for various planetary missions, including ESA's JUICE (JUpiter ICy moon Explorer) mission and the Juno mission.

Next year promises more excitement with the launch of CYGNSS' constellation of eight microsatellites and the arrival of the SwRI-led Juno spacecraft at Jupiter. Juno will spend a year in polar orbit studying the origin and evolution of the solar system's largest planet.

*Visit **spacescience.swri.org** for more information or contact Vice President Dr. James L. Burch at (210) 522-2526 or jim.burch@swri.org.*



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Working with the University of Arizona, SwRI developed, built, and is testing a scale-model large balloon reflector (LBR) telescope, which features an inflatable, spherical reflector deployed within a much larger carrier balloon. The LBR telescope will float to the edge of space, well above most of the Earth's atmosphere, which can absorb and distort high-energy electromagnetic signals.