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# 2016

## YEAR IN REVIEW



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Shaping the Future of Aerospace

## Mars, Jupiter and the human factor

BY CHRIS MOORE AND SURENDRA SHARMA

The **Space Exploration Program Committee** brings together experts on topics relevant to future human and robotic exploration missions.

**N**ASA's Juno spacecraft entered Jupiter's orbit on July 4 after a journey of almost five years. Juno will orbit Jupiter 37 times to investigate the composition and structure of the deep atmosphere, to map the planet's magnetic and gravitational fields, and to study the auroras. The spacecraft has taken the first pictures of Jupiter's North Pole.

The **Origins, Spectral Interpretation, Resource Identification, Security-Regolith Explorer**, better known as OSIRIS-REx, asteroid sample return mission was launched on Sept. 8. The spacecraft will rendezvous with the near-Earth asteroid Bennu, collect a sample of surface material with its robotic arm and return the sample to Earth via a detachable capsule in 2023. Bennu is a carbon-rich asteroid that may contain organic molecules, volatiles and amino acids that may have been the precursors to life on Earth.

After an extensive review process, NASA is ready to proceed with the final design and construction of the **Mars 2020 rover**. The rover will investigate a region of Mars where the ancient environment may have been favorable for microbial life. It will collect samples of soil and rock and cache them on the surface for possible return to Earth by a future mission. To reduce risk and cost, the 2020 rover will look much like its six-wheeled predecessor, Curiosity, but with an array of new science instruments to explore Mars as never before. The rover will also conduct the first demonstration of oxygen production from the Martian atmosphere in preparation for human missions.

Astronomers at the European Southern Observatory in Chile announced they had discovered a planet slightly larger than Earth orbiting in the habitable zone of the nearest star, **Proxima Centauri**, which is 4.3 light years distant from our solar system.

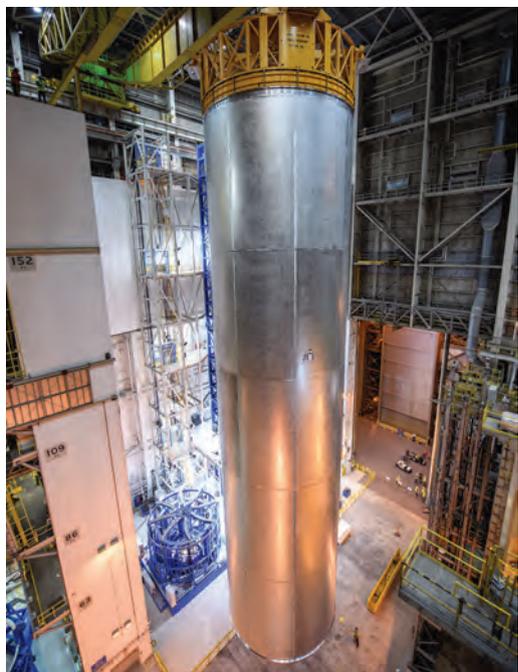
In human space exploration, American astronaut Scott Kelly and Russian cosmonaut Mikhail Kornienko returned to Earth on March 2 after a historic 340-day mission aboard the International Space Station. Their mission investigated the medical and psychological effects of long-duration spaceflight on the crew's health and performance. The knowledge gained from this mission will help NASA develop plans for sending humans to Mars

on missions lasting over 1,000 days.

There are many signs of progress as NASA works toward the first launch of the Space Launch System, or SLS, in 2018. In June, a second qualification firing of the solid rocket booster was conducted at Orbital ATK in Utah. In July, a 650-second test of an RS-25 engine for the core stage was conducted at Stennis Space Center, Mississippi. NASA completed fabrication of a qualification test article for the 130-foot-long SLS liquid hydrogen tank at the **Michoud Assembly Facility**, New Orleans. Construction of a structural test stand for the core stage has been completed at Marshall Space Flight Center, Alabama. New work platforms are also being installed in the Vehicle Assembly Building at Kennedy Space Center, Florida, where SLS will be assembled.

In space exploration technology, the **Bigelow Expandable Activity Module**, or BEAM, was successfully deployed on the ISS. The objective of BEAM's 2-year mission is to demonstrate human-rated inflatable structures technology for a deep space habitat. BEAM is instrumented with sensors to characterize its structural integrity and internal radiation environment. NASA is planning to test a habitat in the proving ground of cislunar space in the mid-2020s before sending humans to Mars.

In August, NASA awarded public-private partnerships to six companies — Bigelow Aerospace, Boeing, Lockheed Martin, Orbital ATK, NanoRacks and Sierra Nevada — to develop prototype cislunar habitats for ground testing in 2018. The companies are contributing 30 percent of the funds to the partnerships and plan to leverage the same technologies for developing commercial habitats in low Earth orbit. ★



NASA

◀ **The 130-foot-long fuel tank test article** for NASA's Space Launch System launch vehicle is removed from the Vertical Assembly Center at Michoud Assembly Facility in New Orleans in July after welding.