

December 2013

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**Budget battles,
test flights,
lawsuits...**

2013 IN REVIEW

PREMINENCE AT RISK
AIAA President-Elect Jim Albaugh
on the industry's future, **page B5**



Space exploration developments in 2013 included the launch of a new commercial rocket to deliver supplies to the **International Space Station**. Development of NASA's Space Launch System made steady progress, and space station research yielded scientific and technical dividends. NASA also unveiled a new mission to capture and redirect a small asteroid.

Orbital Sciences' **Antares** rocket lifted off from Wallops Island, Virginia, in June on its first flight. In September, Antares launched the Cygnus module, which completed its first cargo delivery mission, carrying supplies to the space station. Another commercial company, **SpaceX**, also provides station resupply missions, having launched its second one in March.

NASA signed an agreement with **ESA** to develop the **Orion** crew vehicle's service module, scheduled to fly on the Space Launch System in 2017. The module design will be based on ESA's Automated Transfer Vehicle.

Orion's first flight on a Delta 4 rocket is scheduled for 2014. Preparations for the flight included assembly of the flight test vehicle at Kennedy Space Center, pressure and structural tests of the capsule, and manufacture of the heat shield. The adapter ring that will attach the spacecraft to the Delta 4 also was fabricated.

In July, NASA completed the Space Launch System's **preliminary design review**, a key milestone for the program. A three-story-tall friction stir welding machine for construction of the launch system's core stage was installed at the Michoud Assembly Facility, and the first barrel section for this stage was built.

Research conducted on the space station yielded important scientific and technical results this year. Its Alpha Magnetic Spectrometer discovered an excess of positrons in the cosmic ray flux, possible signs of **dark matter** annihilation. The station's robotic refueling mission used the Dextre manipulator to test tools and techniques for satellite servicing. Astronauts on the station tele-operated a rover on the ground to simulate a crew in lunar or Mars orbit working with robots on the surface.

As the station's international partners start to consider extending its operations beyond 2020, NASA is ramping up plans to conduct human research and test new technologies for human missions to Mars. In August, the agency announced the selection of eight new astronauts. It is also plan-

ning a year-long mission involving a U.S. astronaut and a Russian cosmonaut, to study the effects of prolonged spaceflight on human **health** and performance. Other on-station activities would include testing of a **3D printer** in 2014 to fabricate replacement parts in space, and testing of an inflatable module from **Bigelow Aerospace** in 2015.

A new portable life-support system for the **Z-2**, an advanced **space suit** now in development, was assembled and tested. Z-2 will be the first new space suit since the Shuttle Extravehicular Mobility Unit, which became operational in 1981.

The Curiosity rover's Radiation Assessment Detector, operating during interplanetary cruise and on the Martian surface, has found that **radiation** doses may exceed allowable exposure limits for future human explorers on a 500-day mission.

NASA announced plans for an **asteroid** redirect mission, which would capture a small near-Earth asteroid and redirect it into a stable lunar orbit where astronauts would explore it and gather samples for return to Earth. A 40-kW solar electric propulsion system would propel the robotic spacecraft that captures the asteroid. The mission would integrate NASA's space science, human exploration, and technology programs. It could also enable technologies needed for exploiting valuable asteroid resources and for defending Earth from potentially catastrophic asteroid strikes. ▲



Exploration hopes ride on new launchers

by Chris Moore

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

On NASA's proposed asteroid redirect mission, astronauts transported on an Orion capsule would explore a captured asteroid and collect samples. Credit: NASA.