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2018

YEAR IN REVIEW

Spitzer telescope endures, while Opportunity's fate is pending

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



▲ **The Mercury Planetary Orbiter**, part of the BepiColombo mission, during launch preparations at Europe's Spaceport in Kourou, French Guiana. European Space Agency

This year, Spitzer Space Telescope, one of NASA's four Great Observatories, marked 15 years of operation since its August 2003 launch. Spitzer's contributions include exoplanet detections such as TRAPPIST-1's planetary system of seven Earth-sized planets; "direct light measurement" of exoplanets and their atmospheres triggering new methods in exoplanet science; and the development of an "exoplanet weather map" tracking surface temperature variations of certain classes of exoplanets. Spitzer's other contributions include updates to the universe's evolving star catalog; high-resolution spectral images of Saturn's rings relative to its moons; and the earliest detection of buckyballs in space. Spitzer was designed for a 2½-year primary mission, but the telescope has lasted well beyond its expected lifespan.

NASA's 15-year-old Mars exploration rover, Opportunity, has been silent since June after a dust storm encircled the planet, cutting off solar power to the rover and its ability to charge its batteries. Scientists are waiting to see if the rover will return to life from its low-power safe mode when the dust abates. Opportunity and its mate, Spirit, arrived on Mars in 2004 with a planned mission life of 90 Martian days. Opportunity has traveled more than 25 miles on the Martian surface. In February, it descended into Perseverance Valley, sending home pictures of rock stripes that suggest the one-time presence of water or ice. The InSight mission to Mars was launched in May.

The probe was expected to land in late November and then go on to measure surface heat flow and seismic activity from Mars' deep interior to understand how the rocky planet formed.

In June, Japan Aerospace Exploration Agency's Hayabusa2 spacecraft rendezvoused with the asteroid Ryugu. Its mission was to collect a sample of asteroid material for return to Earth and to deploy four small rovers. In August, NASA's asteroid-sample-return spacecraft, OSIRIS-REx, arrived within sighting distance — 2.2 million kilometers — of its target asteroid, Bennu, and commenced approach operations. Part of the New Frontiers program, OSIRIS-REx is NASA's first mission to a near-Earth asteroid. The spacecraft will perform rendezvous maneuvers, including multiplanar flybys of Bennu, to build a mass and microgravity model and survey the asteroid's surface. Eventually, OSIRIS-REx will descend to collect soil samples and return to Earth. For its survey operations, OSIRIS-REx is richly equipped with a multicamera suite, multispectrometer suite and laser altimeters. The spacecraft, launched in September 2016, was scheduled to arrive at Bennu in December.

NASA's Parker Solar Probe launched in August to investigate the sun's outer corona and solar wind. The spacecraft, which will approach within 4 million miles of the surface, will be protected by a carbon-carbon heat shield from external temperatures approaching 1,377 degrees Celsius.

Meanwhile, the Mercury mission, Bepi-Colombo, launched in October as a joint project of the European Space Agency and Japan Aerospace Exploration Agency. The spacecraft triad, a transfer module carrying two science orbiters, will travel together using a combination of solar and electric propulsion, or SEP, aided by nine gravity-assist planetary flybys. Once in their target orbits, the two science spacecraft will make complementary measurements of the planet and its environment, from its interior to its interaction with solar wind. The results will provide insight into how a solar system's innermost planets form and evolve close to the parent star.

NASA made important first steps this year to realize its gateway in lunar orbit with formal calls to commercial partners for proposals to build the gateway's power and propulsion element — a 50-kilowatt SEP system — for first flight demonstration in 2022. NASA's Exploration Campaign plans to establish the gateway to serve as a stepping off point to define a sustainable and viable architecture for cislunar operations, lunar access and missions to Mars and beyond. Together with the Space Launch System and Orion, gateway is central to advancing and sustaining human space exploration goals. ★