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The first sign of trouble from Europe's Schiaparelli lander came around the time the probe was supposed to jettison its parachute and fire thrusters to brake for touchdown on the vast equatorial plains of Mars, officials said Thursday. The spacecraft is feared lost after mission control lost contact with it less than a minute before landing Wednesday, when Schiaparelli was aiming to become the first European probe to successfully land on Mars.

Built as a technology demonstrator, Schiaparelli was designed to validate a Doppler radar altimeter, sophisticated guidance and control software, and avionics systems that the European Space Agency intends to place on future Mars missions, beginning with a lander and rover scheduled for launch in 2020 developed in partnership with Russia.

After its release Sunday from a carrier aboard Europe's ExoMars Trace Gas Orbiter, which flew to Mars in tandem with the lander, Schiaparelli made an automated approach to the red planet and glided into the Martian atmosphere Wednesday at a velocity of 13,000 mph (21,000 kilometers per hour) for a fast-paced, six-minute descent sequence. The entry profile involved heat protection from cork and resin tiles, a European-built 39-foot-diameter (12 meter) supersonic parachute, and nine rocket thrusters mounted around the circumference of Schiaparelli in clusters of three.

Something unexpected happened near the end of the lander's descent under the parachute, when Schiaparelli's back shell was timed to jettison and the probe's thrusters were programmed to ignite. “All the EDM (Entry, Descent and Landing Demonstrator Module) has behaved according to our expectation up to a certain point,” said Andrea Accomazzo, head of the solar and planetary missions division at the European Space Operations Center in Darmstadt, Germany. “There's a point where the parachute was released, and this is where the data we preliminarily analyzed from the EDM do not match, exactly, our expectations, and this is what we have to understand,” Accomazzo said.

Officials said the separation parachute and back shell apparently occurred earlier than expected, and the lander deviated from the flight plan around the same time. “The parachute phase was nominal up until the
very last point, when the parachute is ejected,” Accomazzo said. “This is there where we are not in a position yet to provide a description (of what happened). The previous phase on the parachute was absolutely nominal. It’s only the end point where we’re not yet in a position to explain.”

The compact space probe was about the size of a Smart car, measuring less than 6 feet (1.8 meters) tall and around 5 feet (1.65 meters) wide after flying free of its heat shield.

The robotic probe sent its last signal around 50 seconds before the expected landing time, Accomazzo said Thursday, and telemetry from Schiaparelli being analyzed by experts on the ground appears to show the spacecraft activated its radar and ignited its landing rockets, at least for three or four seconds. “They did fire,” Accomazzo told reporters in a press briefing Thursday. “Definitely, we saw them fire for a few seconds, for a time much shorter than what we were expecting.” Stressing that engineers are still at a preliminary stage decoding the telemetry from Schiaparelli, Accomazzo said it was not clear whether all nine of the engines ignited or the altitude at which the thrusters cut off.

The thrusters should have fired for 30 seconds to slow the lander’s velocity from more than 120 mph (200 kilometers per hour) to a walking pace around 6 feet (2 meters) above the Martian surface. At that point, the engines were supposed to shut down, and the lander was to fall to the ground cushioned by a crushable carbon-fiber shell.

“It will take some time, of course, to analyze (the data),” Accomazzo said. “We can definitely say that all the hardware of the EDM has been activated successfully. We have data from all the hardware of the EDM, all the sensors and all the actuators.” He said telemetry from all the lander’s systems provided “meaningful data” to engineers to unravel what happened. “Now it’s a matter to analyze why, when we put together this data in the Martian environment, the spacecraft didn’t behave exactly as we had expected,” Accomazzo said.

Accelerometer measurements from Schiaparelli might indicate whether the lander made a hard touchdown before it stopped transmitting, officials said, and engineers will try to determine if the probe was descending much faster than predicted. “There are multiple options,” Accomazzo said. “It could mean that this parachute phase has been terminated too early, then we are far too high, or we have had a behavior during the parachute phase that led the lander to be far too low. From the data we have processed so far, we are not in a position to conclude on this specific point.”

Nevertheless, engineers are confident the answers are buried somewhere in the 600 megabytes of data received from Schiaparelli before it went silent. “The first analysis suggests that most of the steps required for the entry and descent were successfully completed, particularly the deceleration from 21,000 kilometers per hour (13,000 mph) at the top of the atmosphere down to having the probe suspended on its parachute,” said David Parker, director of ESA’s human spaceflight and robotic exploration division.

“We will be able to explain what was observed,” Accomazzo said. “I have no doubts.”

“This lander was a test, and as we are always doing when we are doing tests, we put many sensors on-board,” said Jan Woerner, ESA’s director general.

“We can say the experiment test has yielded a huge amount of data, and clearly we are going to have to carry on analyzing this for the days and weeks to come, but it gives us a lot of confidence for the future,” Parker said. “We need to understand what happened in the last few seconds before the planned landing, and that is likely to take some time.”

[Note: Original article edited for length]
NASA’s Juno spacecraft entered safe mode Tuesday, Oct. 18 at about 10:47 p.m. PDT (Oct. 19 at 1:47 a.m. EDT). Early indications are a software performance monitor induced a reboot of the spacecraft's onboard computer. The spacecraft acted as expected during the transition into safe mode, restarted successfully and is healthy. High-rate data has been restored, and the spacecraft is conducting flight software diagnostics. All instruments are off, and the planned science data collection for today's close flyby of Jupiter (perijove 2), did not occur.

“At the time safe mode was entered, the spacecraft was more than 13 hours from its closest approach to Jupiter,” said Rick Nybakken, Juno project manager from NASA’s Jet Propulsion Laboratory in Pasadena, Calif. “We were still quite a ways from the planet’s more intense radiation belts and magnetic fields. The spacecraft is healthy and we are working our standard recovery procedure.”

The spacecraft is designed to enter safe mode if its onboard computer perceives conditions are not as expected. In this case, the safe mode turned off instruments and a few non-critical spacecraft components, and it confirmed the spacecraft was pointed toward the sun to ensure the solar arrays received power.

Mission managers are continuing to study an unrelated issue with the performance of a pair of valves that are part of the spacecraft’s propulsion system. Last week the decision was made to postpone a burn of the spacecraft’s main engine that would have reduced Juno’s orbital period from 53.4 to 14 days.

The next close flyby is scheduled on Dec. 11, with all science instruments on.

The Juno science team continues to analyze returns from the first close flyby on Aug. 27. Revelations from that flyby include that Jupiter’s magnetic fields and aurora are bigger and more powerful than originally thought. Juno’s Microwave Radiometer instrument (MWR) also provided data that give mission scientists their first glimpse below the planet’s swirling cloud deck. The radiometer instrument can peer about 215 to 250 miles (350 to 400 kilometers) below Jupiter’s clouds.

“With the MWR data, it is as if we took an onion and began to peel the layers off to see the structure and processes going on below,” said Bolton. “We are seeing that those beautiful belts and bands of orange and white we see at
Jupiter’s cloud tops extend in some version as far down as our instruments can see, but seem to change with each
layer.”

The JunoCam public outreach camera also was operating during the Aug. 27 flyby. The raw images from that flyby
(and all future flybys) were made available on the JunoCam website (www.missionjuno.swri.edu/junocam) for the
public to not only peruse but to process into final image products. JunoCam is the first outreach camera to venture
beyond the asteroid belt.

“JunoCam has a small operations team and no image processing team, so we took a leap of faith that the public
would step up and help us generate images of Jupiter from the raw data,” said Candy Hansen, JunoCam imaging
scientist from the Planetary Science Institute in Tucson, Arizona. “All sorts of people are coming to the JunoCam
site and providing their own aesthetic. We have volunteers from all over the world, and they are doing beautiful
work. So far all our expectations for JunoCam have not only been met but are being exceeded, and we’re just
getting started.”

The final image products include straightforward images of the solar system’s largest world, but also some with a
certain artistic license, including a variation on Vincent Van Gogh’s Starry Night painting and even a “smiley face”
made from an image of Jupiter’s south pole. These amateur-generated JunoCam images are not only being used to
help interest the media and public in this mission to the most massive planet in the solar system, but are engaging
Juno’s science team as well.

“The amateurs are giving us a different perspective on how to process images,” said Hansen. “They are
experimenting with different color enhancements, different highlights or annotations than we would normally expect.
They are identifying storms tracked from Earth to connect our images to the historical record. This is citizen science
at its best.”

The Juno spacecraft launched on Aug. 5, 2011, from Cape Canaveral, Florida, and arrived at Jupiter on July 4,
2016. During its mission of exploration, Juno soars low over the planet’s cloud tops -- as close as about 2,600 miles
(4,100 kilometers). During these flybys, Juno will probe beneath the obscuring cloud cover of Jupiter and study its
auroras to learn more about the planet’s origins, structure, atmosphere and magnetosphere.

Juno’s name comes from Roman mythology. The mythical god Jupiter drew a veil of clouds around himself to hide
his mischief, and his wife -- the goddess Juno -- was able to peer through the clouds and reveal Jupiter’s true
nature.

JPL manages the Juno mission for the principal investigator, Scott Bolton, of Southwest Research Institute in San
Antonio. Juno is part of NASA’s New Frontiers Program, which is managed at NASA’s Marshall Space Flight Center
in Huntsville, Alabama, for NASA’s Science Mission Directorate. Lockheed Martin Space Systems, Denver, built the
spacecraft. Caltech in Pasadena, California, manages JPL for NASA.

More information on the Juno mission is available at http://www.nasa.gov/juno. The public can follow the mission on

Images and information on how members of the public can participate in JunoCam’s mission, can be found at
www.missionjuno.swri.edu/junocam.

Source: NASA
Ten thousand volunteers viewing images of Martian south polar regions have helped identify targets for closer inspection, yielding new insights about seasonal slabs of frozen carbon dioxide and erosional features known as "spiders."

From the comfort of home, the volunteers have been exploring the surface of Mars by reviewing images from the Context Camera (CTX) on NASA's Mars Reconnaissance Orbiter and identifying certain types of seasonal terrains near Mars' south pole. These efforts by volunteers using the "Planet Four: Terrains" website have aided scientists who plan observations with the same orbiter's High Resolution Imaging Science Experiment (HiRISE) camera. HiRISE photographs much less ground but in much greater detail than CTX.

Volunteers have helped identify more than 20 regions in mid-resolution images to investigate with higher resolution. "It's heartwarming to see so many citizens of planet Earth donate their time to help study Mars," said HiRISE Deputy Principal Investigator Candice Hansen, of the Planetary Science Institute, Tucson, Arizona. "Thanks to the discovery power of so many people, we're using HiRISE to take images of places we might not have studied without this assistance."

Planetary scientist Meg Schwamb, of the Gemini Observatory, Hilo, Hawaii, presented results from the first year of this citizen science project Thursday at the annual meeting of the American Astronomical Society's Division for Planetary Sciences and the European Planetary Science Congress, in Pasadena, California.

The type of terrain called spiders, or "araneiform" (from the Latin word for spiders), is characterized by multiple channels converging at a point, resembling a spider's long legs. Previous studies concluded that this ground texture results from extensive sheets of ice thawing bottom-side first as the ice is warmed by the ground below it. Thawed carbon dioxide gas builds up pressure, and the gas escapes through vents in the overlying sheet of remaining ice, pulling dust with it. This process carves the channels that resemble legs of a spider.
"The trapped carbon dioxide gas that carves the spiders in the ground also breaks through the thawing ice sheet," Schwamb said. "It lofts dust and dirt that local winds then sculpt into hundreds of thousands of dark fans that are observed from orbit. For the past decade, HiRISE has been monitoring this process on other parts of the south pole. The 20 new regions have been added to this seasonal monitoring campaign. Without the efforts of the public, we wouldn't be able to see how these regions evolve over the spring and summer compared with other regions."

Some of the HiRISE observations guided by the volunteers' input confirmed "spider" terrain in areas not previously associated with carbon dioxide slab ice.

"From what we've learned about spider terrain elsewhere, slab ice must be involved at the locations of these new observations, even though we had no previous indication of it there," Hansen said. "Maybe it's related to the erodability of the terrain."

Some of the new observations targeted with information from the volunteers confirm spiders in areas where the ground surface is made of material ejected from impact craters, blanketing an older surface. "Crater ejecta blankets are erodible. Perhaps on surfaces that are more erodable, relative to other surfaces, slab ice would not need to be present as long, or as thick, for spiders to form," Hansen said. "We have new findings, and new questions to answer, thanks to all the help from volunteers."

The productive volunteer participation continues, and new CTX images have been added for examining additional areas in Mars' south polar region. Planet Four: Terrains is on a platform released by the Zooniverse, which hosts 48 projects that enlist people worldwide to contribute to discoveries in fields ranging from astronomy to zoology. For information about how to participate, visit http://terrains.planetfour.org.

With CTX, HiRISE and four other instruments, the Mars Reconnaissance Orbiter has been investigating Mars since 2006.

Malin Space Science Systems, San Diego, built and operates CTX. The University of Arizona, Tucson, operates HiRISE, which was built by Ball Aerospace & Technologies Corp. of Boulder, Colorado. NASA's Jet Propulsion Laboratory, a division of Caltech in Pasadena, California, manages the Mars Reconnaissance Orbiter Project NASA's Science Mission Directorate, Washington. Lockheed Martin Space Systems, Denver, built the orbiter and collaborates with JPL to operate it. For additional information about the project, visit http://mars.nasa.gov/mro.

Source: NASA
The Night Sky

Friday, October 21

• Saturn and Antares form a compact right triangle with bright Venus, low in the southwest at dusk as shown above. The triangle will narrow every day as, Venus moves toward the upper left.

• The modest Orionid meteor shower should continue before dawn Saturday, but the light of the last-quarter Moon interferes.

Saturday, October 22

• Capella sparkles low in the northeast these evenings. Look for the Pleiades cluster off to its right, by about three fists at arm’s length. These two heralds of the cold months rise higher as the night grows later... and colder.

• Upper right of Capella, and upper left of the Pleiades, stars of Perseus highlight the winter Milky Way.

Sunday, October 23

• This is the time of year when the Big Dipper lies horizontal low in the north-northwest early in the evening. How low? The farther south you are, the lower. Seen from 40° north latitude (New York, Denver) its bottom stars twinkle nearly ten degrees high. But at Miami (26° N) the entire Dipper skims along out of sight below the north horizon.

Monday, October 24

• Vega is the brightest star high in the west these evenings. Less high in the southwest is Altair, not quite as bright. Just upper right of Altair, by a finger-width at arm’s length, is distant orange Tarazed. Straight down from Tarazed runs the stick-figure backbone of the constellation Aquila, the Eagle.

• In early dawn tomorrow morning the 25th, you’ll find Regulus, the forefoot of Leo, under the waning crescent Moon. Look very far to their lower left for Jupiter. Look even farther to their lower right for Sirius, in the south-southwest.

Source: Sky & Telescope
ISS Sighting Opportunities

For Denver:

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Sighting information for other cities can be found at NASA’s [Satellite Sighting Information](#).

**NASA-TV Highlights**

*(all times Eastern Daylight Time)*

**Friday, October 21**

- 2 p.m., 5 p.m., 8 p.m., Replay of the NASA Television Video File News Feed of ISS Expedition 49-50/Soyuz MS-02 Docking, Hatch Opening and Other Activities (all channels)
- 3 p.m., 7 p.m., 11 p.m., Replay of Space to Ground ISS Weekly Highlights (10/20/16) (all channels)

**Saturday, October 22**

- 1 a.m., 2 a.m., 7 a.m., Replay of Space to Ground ISS Weekly Highlights (10/20/16) (NTV-1 (Public))
- 3 a.m., Replay of Space to Ground ISS Weekly Highlights (10/20/16) (NTV-3 (Media))
- 4 a.m., 2 p.m., 8 p.m., Replay of the Juno News Briefing from the Annual Division for Planetary Sciences (DPS) Meeting in Pasadena (all channels)
- 8 a.m., 4 p.m., Replay of the NASA Television Video File News Feed of ISS Expedition 49-50/Soyuz MS-02 Docking, Hatch Opening and Other Activities (all channels)
- 11 a.m., 3 p.m., 7 p.m., Replay of Space to Ground ISS Weekly Highlights (10/20/16) (all channels)

Watch NASA TV on the Net by going to the [NASA website](#).
Space Calendar

- Oct 21 - Orionids Meteor Shower Peak
- Oct 21 - Asteroid 2022 West Closest Approach To Earth (1.396 AU)
- Oct 21 - Asteroid 48472 Mossbauer Closest Approach To Earth (1.456 AU)
- Oct 21 - Asteroid 8720 Takamizawa Closest Approach To Earth (2.369 AU)
- Oct 21 - 20th Anniversary (1996), Turtle Lake Meteorite Fall (Hit Car in Wisconsin)
- Oct 21 - Ingrid van Houten-Groeneveld's 95th Birthday (1921)

- Oct 22 - 50th Anniversary (1966), Luna 12 Launch (USSR Moon Orbiter)
- Oct 22 - Comet 136P/Mueller Closest Approach To Earth (2.103 AU)
- Oct 22 - Comet 128P-A/Shoemaker-Holt Closest Approach To Earth (2.239 AU)
- Oct 22 - Comet 238P/Read Perihelion (2.364 AU)
- Oct 22 - Comet 218P/LINEAR At Opposition (3.270 AU)
- Oct 22 - Comet P/2015 J3 (NEOWISE) At Opposition (3.375 AU)
- Oct 22 - Comet 282P/2003 BM80 At Opposition (4.005 AU)
- Oct 22 - Asteroid 18 Melpomene At Opposition (7.4 Magnitude)
- Oct 22 - Erasmus Reinhold's 505th Birthday (1511)
- Oct 23 - Cassini, Distant Flyby of Telesto
- Oct 23 - Comet 22P/Kopff Closest Approach To Earth (2.419 AU)
- Oct 23 - Apollo Asteroid 2005 CE41 Near-Earth Flyby (0.054 AU)
- Oct 23 - Apollo Asteroid 2015 HE10 Near-Earth Flyby (0.076 AU)
- Oct 23 - Apollo Asteroid 2013 UD1 Near-Earth Flyby (0.090 AU)
- Oct 23 - Dwarf Planet Ceres Closest Approach To Earth (1.900 AU)
- Oct 24 - Comet 73P-BD/Schwassmann-Wachmann Perihelion (1.001 AU)
- Oct 24 - Comet 80P/Peters-Hartley At Opposition (4.252 AU)
- Oct 24 - Asteroid 1831 Nicholson Closest Approach To Earth (1.446 AU)
- Oct 24 - Asteroid 35350 Lespaul Closest Approach To Earth (2.346 AU)
- Oct 24 - Neptune Trojan 2001 QR322 At Opposition (29.066 AU)
- Oct 24 - Kuiper Belt Object 55636 (2002 TX300) At Opposition (41.446 AU)
- Oct 24 - Lecture: How to Make a Spaceship! (without NASA), San Francisco, California
- Oct 24 - Colloquium: Geophysics of Pluto and Charon, Tucson, Arizona
- Oct 24 - 10th Anniversary (2006), MESSENGER, 1st Venus Flyby
- Oct 24 - 15th Anniversary (2001), Mars Odyssey, Mars Orbit Insertion
- Oct 24 - 165th Anniversary (1851), William Lassell's Discovery of Uranus Moons Umbriel and Ariel

Source: JPL Space Calendar
A NASA analysis of a 2015 Texas flood is the first to document the full life cycle and impacts of a flood on both land and ocean. Using data from NASA’s Soil Moisture Active Passive (SMAP) satellite and other satellite instruments, the study traced the event’s chronology -- starting with rains that fell weeks before the flood and ending with an unusually shaped plume of freshwater that lingered in the Gulf of Mexico months later, with a potential for significant impacts on the gulf’s marine life.

The analysis was published in the journal Geophysical Research Letters. Séverine Fournier, an oceanographer at NASA’s Jet Propulsion Laboratory, Pasadena, California, is the first author.

The flood occurred in southeastern Texas on May 23-24, 2015, when record rainstorms topped off weeks of sustained rainfall. According to the National Weather Service, 37.3 trillion gallons of water fell on Texas in May 2015 -- enough to cover the entire state 8 inches deep in water. "The sheer amount of water was shocking," said coauthor JT Reager of NASA’s Jet Propulsion Laboratory, Pasadena, California. "Of course it had an impact on land -- 11 people died, and property was lost. We thought, this has to have an impact on the ocean as well."

The research team used measurements from SMAP with observations from five other NASA satellites to create a comprehensive timeline and map of the flood and its regional effects. SMAP measures both soil moisture (water retained in the top few inches of the ground) and sea surface salinity, which allows scientists to calculate how much freshwater is mingled with the saltwater of the ocean.

When so much rain fell on waterlogged soils, there was nowhere for it to go but downstream. South Texas is one of the parts of the country most in need of stream gauges, according to the U.S. Geological Survey, so ground-level
streamflow data are limited. The new analysis found that eight Texas rivers drained huge volumes of water into the Gulf of Mexico, with peak discharge rates as high as 60,000 cubic feet of water (1,700 cubic meters) per second.

Ocean currents carried this large plume of freshwater eastward along the Louisiana coastline during June 2015. In July, it merged with the Mississippi River's outflow, the downstream product of spring precipitation and snowmelt high water from 40 percent of the contiguous United States.

The combined Texas and Mississippi plumes formed what Reager calls "a huge, very weird, horseshoe shape" with legs extending southward into the central gulf. "We had never seen a plume shaped like this in six years of observations of sea surface salinity," Fournier said, referring to the European Surface Moisture and Ocean Salinity satellite data. "Looking at the circulation in the gulf, you can say the unusual features of this plume are not due to the Mississippi River. They're due to the Texas flood."

A strong ocean current in the east of the gulf and a warm eddy in the west played roles in forming the horseshoe and pulling its legs southward toward the central gulf.

Although river water is called freshwater, that doesn't mean it's pure H2O and nothing else. Rivers carry pollutants to the sea, and that's what makes the location and size of the freshwater plume important. "Riverine waters bring lots of nutrients to the ocean, and that can have impacts," Fournier explained. Ocean algae use nitrogen and phosphorus in the runoff -- mainly the product of fertilizers -- to grow and multiply, and the algae concentrations can become much larger than normal. When these overabundant algae die, they sink and decompose in a process that uses up the oxygen in seawater, sometimes creating dead zones that are so oxygen-starved no fish or plants can live there.

The Gulf of Mexico has a variable but huge dead zone, usually ranked largest or second largest in the world. Its average area is about the same as the state of Connecticut. The gulf is also one of the world's largest seafood providers. When its dead zone expands, there are impacts to both fish and the regional economy; for example, fishing boats have to travel farther offshore to find fish, leading to higher fuel costs and a less profitable industry.

After the Texas flood, the gulf's dead zone was about 28 percent larger than average: the size of Connecticut and Rhode Island combined. Fournier will delve deeper into the biogeochemical impacts of the flood on the gulf waters in a follow-up study. This type of research could lead to predictive models for the influences of the high levels of pollution on gulf fisheries.

Reager noted that the complementary land and ocean measurements of SMAP greatly facilitated the team's analysis. "With the existing suite of NASA satellites, we have the opportunity to see the full extent of regional water cycle extremes and the impacts of heavy rains, saturation flooding and intense runoff on both land and ocean," he said. "SMAP really provides a new and important complement to the tools in the NASA Earth science tool belt."

Besides SMAP's measurements, the study used a wide array of other NASA observations: precipitation data from the Tropical Rainfall Measuring Mission and Global Precipitation Measurement mission, water storage observations from the Gravity Recovery And Climate Experiment, ocean color observations from the Moderate Resolution Imaging Spectrometer, and altimetric satellite measurements of ocean currents from the Jason series of satellites.

NASA uses the vantage point of space to increase our understanding of our home planet, improve lives and safeguard our future. NASA develops new ways to observe and study Earth's interconnected natural systems with long-term data records. The agency freely shares this unique knowledge and works with institutions around the world to gain new insights into how our planet is changing.

For more information about NASA's Earth science activities, visit http://www.nasa.gov/earth.

Source: NASA
The Tulip in the Swan

**Explanation:** Framing a bright emission region this telescopic view looks out along the plane of our Milky Way Galaxy toward the nebula rich constellation Cygnus the Swan. Popularly called the Tulip Nebula, the glowing cloud of interstellar gas and dust is also found in the 1959 catalog by astronomer Stewart Sharpless as Sh2-101. About 8,000 light-years distant and 70 light-years across the complex and beautiful nebula blossoms at the center of the composite image. Red, green, and blue hues map emission from ionized sulfur, hydrogen, and oxygen atoms. Ultraviolet radiation from young, energetic stars at the edge of the Cygnus OB3 association, including O star HDE 227018, ionizes the atoms and powers the visible light emission from the Tulip Nebula. HDE 227018 is the bright star very near the blue arc at the center of the cosmic tulip.

**Image Credit & Copyright:** Martin Pugh