Space News Update — July 28, 2015 —

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1. Rosetta: Preparing for Perihelion

Rosetta’s investigations of its comet are continuing as the mission teams count down the last month to perihelion – the closest point to the Sun along the comet’s orbit – when the comet’s activity is expected to be at its highest.

Rosetta has been studying Comet 67P/Churyumov–Gerasimenko for over a year now, with observations beginning during the approach to the comet in March 2014. This included witnessing an outburst in late April 2014 and the revelation of the comet’s curious shape in early July.

After arriving at a distance of 100 km from the double-lobed comet on 6 August, Rosetta has spent an intense year analysing the properties of this intriguing body – the interior, surface and surrounding dust, gas and plasma.

Comets are known to be made of dust and frozen ices. As these ices are warmed by the Sun, they turn directly to vapour, with the gases dragging the comet’s dust along with it. Together, the gas and dust create a fuzzy atmosphere, or coma, and often-spectacular tails extend tens or hundreds of thousands of kilometres into space.

While ground-based observations can monitor the development of the coma and tail from afar, Rosetta has a ringside seat for studying the source of this activity directly from the nucleus. One important aspect of Rosetta’s long-term study is watching how the activity waxes and wanes along the comet’s orbit.

The comet has a 6.5 year commute around the Sun from just beyond the orbit of Jupiter at its furthest, to between the orbits of Earth and Mars at it closest.

Rosetta rendezvoused with the comet around 540 million km from the Sun. On July 13th, a month from perihelion, this distance is much smaller: 195 million km. Currently travelling at around 120 000 km/h around their orbit, Rosetta and the comet will be 186 million km from the Sun by August 13th.
“Perihelion is an important milestone in any comet’s calendar, and even more so for the Rosetta mission because this will be the first time a spacecraft has been following a comet from close quarters as it moves through this phase of its journey around the Solar System,” notes Matt Taylor, ESA’s Rosetta project scientist.

“We’re looking forward to reaching perihelion, after which we’ll be continuing to monitor how the comet’s nucleus, activity and plasma environment changes in the year after, as part of our long-term studies.”

**Perihelion basics**

**What is perihelion exactly?**

Perihelion is the closest point a Solar System object gets to the Sun along its orbit (aphelion is the term given to the most distant point). The term derives from ancient Greek, where ‘peri’ means near and ‘helios’ means Sun.

**How close to the Sun will the comet be at perihelion?**

 Comet 67P/Churyumov–Gerasimenko is on a 6.5 year elliptical orbit around the Sun which takes it between 850 million km (5.68 AU) from the Sun at its most distant, just beyond the orbit of Jupiter, and 186 million km (1.24 AU) at its nearest, between the orbits of Earth and Mars. As a comparison, Earth orbits the Sun at an average distance of 149 million km (1 Astronomical Unit, or AU).

**At what moment does perihelion occur?**

For this comet, the upcoming perihelion occurs at 02:03 GMT on 13 August 2015. The previous perihelion took place on 28 February 2009.

**What happens to the comet during perihelion? Will there be a big difference in activity in the coming weeks?**

The comet’s activity has been growing over the last year that Rosetta has been at the comet. This is an incremental process brought about by the increase in solar energy incident on the comet, warming up its frozen ices that subsequently sublime. Rosetta has been witnessing this gradual rise, and scientists expect that this activity will reach a peak during August and September. Outbursts are possible, but unpredictable.

**Other comets plunge into the Sun at perihelion, what about this one?**

 Comet 67P/Churyumov–Gerasimenko does not get close enough to the Sun to be destroyed by it; its closest point is actually further than Earth ever gets to the Sun and, furthermore, the comet has survived many previous orbits. It is not, for example, classed as a ‘sungrazer’ like Comet C/2012 S1 ISON, which broke apart during its perihelion passage in November 2013.

**Will Comet 67P/ C-G break apart during perihelion?**

The comet has not broken apart during its many previous orbits, so it is not expected to do so this time, but it cannot be ruled out. Scientists are keen to watch the possible evolution of a 500 m-long fracture that runs along the surface of the neck on the comet during the peak activity.

**Are there any special science observations that will be done at the time of perihelion?**

As with operations, it is also business as usual for science observations – monitoring of the comet and its dust, gas and plasma environment will continue during perihelion. Scientists are particularly keen to study the southern hemisphere of the comet, which has been in full sunlight only since May.

Source: ESA
2. NASA's Curiosity Rover Inspects Unusual Bedrock

A rock outcrop dubbed "Missoula," near Marias Pass on Mars, is seen in this image mosaic taken by the Mars Hand Lens Imager on NASA's Curiosity rover. Pale mudstone (bottom of outcrop) meets coarser sandstone (top) in this geological contact zone, which has piqued the interest of Mars scientists. Credits: NASA/JPL-Caltech/MSSS

Approaching the third anniversary of its landing on Mars, NASA's Curiosity Mars rover has found a target unlike anything it has studied before -- bedrock with surprisingly high levels of silica. Silica is a rock-forming compound containing silicon and oxygen, commonly found on Earth as quartz.

This area lies just downhill from a geological contact zone the rover has been studying near "Marias Pass" on lower Mount Sharp.

In fact, the Curiosity team decided to back up the rover 46 meters (151 feet) from the geological contact zone to investigate the high-silica target dubbed "Elk." The decision was made after they analyzed data from two instruments, the laser-firing Chemistry & Camera (ChemCam) and Dynamic Albedo of Neutrons (DAN), which show elevated amounts of silicon and hydrogen, respectively. High levels of silica in the rock could indicate ideal conditions for preserving ancient organic material, if present, so the science team wants to take a closer look.

"One never knows what to expect on Mars, but the Elk target was interesting enough to go back and investigate," said Roger Wiens, the principal investigator of the ChemCam instrument from the Los Alamos National Laboratory in New Mexico. ChemCam is coming up on its 1,000th target, having already fired its laser more than 260,000 times since Curiosity landed on Mars Aug. 6, 2012, Universal Time (evening of Aug. 5, Pacific Time).

In other news, an engineering test on the rover's sample-collecting drill on July 18 is aiding analysis of intermittent short circuits in the drill's percussion mechanism, in preparation for using the drill in the area where the rover has been working for the past two months. The latest test did not result in any short circuits, so the team plans to continue with more tests, performed on the science targets themselves.
Before Curiosity began further investigating the high-silica area, it was busy scrutinizing the geological contact zone near Marias Pass, where a pale mudstone meets darker sandstone.

"We found an outcrop named Missoula where the two rock types came together, but it was quite small and close to the ground. We used the robotic arm to capture a dog's-eye view with the MAHLI camera, getting our nose right in there," said Ashwin Vasavada, the mission's project scientist at NASA's Jet Propulsion Laboratory in Pasadena, California. MAHLI is short for Mars Hand Lens Imager.

The rover had reached this area after a steep climb up a 20-foot (6-meter) hill. Near the top of the climb, the ChemCam instrument fired its laser at the target Elk, and took a spectral reading of its composition.

"ChemCam acts like eyes and ears of the rover for nearby objects," said Wiens.

The rover had moved on before the Elk data were analyzed, so a U-turn was required to obtain more data. Upon its return, the rover was able to study a similar target, "Lamoose," up close with the MAHLI camera and the arm-mounted Alpha Particle X-ray Spectrometer (APXS).

Curiosity has been working on Mars since early August 2012. It reached the base of Mount Sharp last year after fruitfully investigating outcrops closer to its landing site and then trekking to the mountain. The main mission objective now is to examine successively higher layers of Mount Sharp.

A rock fragment dubbed "Lamoose" is shown in this picture taken by the Mars Hand Lens Imager (MAHLI) on NASA's Curiosity rover. Like other nearby rocks in a portion of the "Marias Pass" area of Mt. Sharp, Mars, it has unusually high concentrations of silica. The high silica was first detected in the area by the Chemistry & Camera (ChemCam) laser spectrometer. This rock was targeted for follow-up study by the MAHLI and the arm-mounted Alpha Particle X-ray Spectrometer (APXS). Credits: NASA/JPL-Caltech/MSSS

Source: NASA
3. New Names and Insights at Ceres

This color-coded map from NASA's Dawn mission shows the highs and lows of topography on the surface of dwarf planet Ceres. Image credit: NASA/JPL-Caltech/UCLA/MPS/DFR/IDA

Colorful new maps of Ceres, based on data from NASA's Dawn spacecraft, showcase a diverse topography, with height differences between crater bottoms and mountain peaks as great as 9 miles (15 kilometers).

Scientists continue to analyze the latest data from Dawn as the spacecraft makes its way to its third mapping orbit.

"The craters we find on Ceres, in terms of their depth and diameter, are very similar to what we see on Dione and Tethys, two icy satellites of Saturn that are about the same size and density as Ceres. The features are pretty consistent with an ice-rich crust," said Dawn science team member Paul Schenk, a geologist at the Lunar and Planetary Institute, Houston.

Some of these craters and other features now have official names, inspired by spirits and deities relating to agriculture from a variety of cultures. The International Astronomical Union recently approved a batch of names for features on Ceres.

The newly labeled features include Occator, the mysterious crater containing Ceres' brightest spots, which has a diameter of about 60 miles (90 kilometers) and a depth of about 2 miles (4 kilometers). Occator is the name of the Roman agriculture deity of harrowing, a method of leveling soil.

A smaller crater with bright material, previously labeled "Spot 1," is now identified as Haulani, after the Hawaiian plant goddess. Haulani has a diameter of about 20 miles (30 kilometers). Temperature data from Dawn's visible and infrared mapping spectrometer show that this crater seems to be colder than most of the territory around it.

Dantu crater, named after the Ghanaian god associated with the planting of corn, is about 75 miles (120 kilometers) across and 3 miles (5 kilometers) deep. A crater called Ezinu, after the Sumerian goddess of grain, is about the same size. Both are less than half the size of Kerwan, named after the Hopi spirit of sprouting maize, and Yalode, a crater named after the African Dahomey goddess worshipped by women at harvest rites.
"The impact craters Dantu and Ezinu are extremely deep, while the much larger impact basins Kerwan and Yalode exhibit much shallower depth, indicating increasing ice mobility with crater size and age," said Ralf Jaumann, a Dawn science team member at the German Aerospace Center (DLR) in Berlin.

Almost directly south of Occator is Urvara, a crater named for the Indian and Iranian deity of plants and fields. Urvara, about 100 miles (160 kilometers) wide and 3 miles (6 kilometers) deep, has a prominent central pointy peak that is 2 miles (3 kilometers) high.

Dawn is currently spiraling toward its third science orbit, 900 miles (less than 1,500 kilometers) above the surface, or three times closer to Ceres than its previous orbit. The spacecraft will reach this orbit in mid-August and begin taking images and other data again.

This image, from Dawn's visible and infrared mapping spectrometer (VIR), highlights a bright region on Ceres known as Haulani, named after the Hawaiian plant goddess.

Each row shows Ceres' surface at different wavelengths. On top is a black-and-white image; in the middle is a true-color image, and the bottom is in thermal infrared, where brighter colors represent higher temperatures and dark colors correspond to colder temperatures. The three images appear slightly flattened in the y-axis and smeared in the upper part due to the motion of the spacecraft.

Source: JPL
The Night Sky

Tuesday, July 28

- After dark, the Big Dipper hangs diagonally in the northwest. Most of its stars are about 80 light-years away. Follow the curve of its handle around by a little more than a Dipper-length and there's bright Arcturus, due west. Arcturus is the nearest orange-giant star, 37 light-years away.

Wednesday, July 29

- We're not quite halfway through summer, but Cassiopeia, a constellation associated with fall and winter, is already climbing up in the north-northeast after dark. And the Great Square of Pegasus, emblem of fall, is up and balancing on one corner on the east-northeast horizon.

Thursday, July 30

- Full Moon tonight and tomorrow (exactly full at 6:43 a.m. Friday morning Eastern Daylight Time). On Thursday evening the Moon rises just before sunset. After dark, can you see through the moonlight that it's in dim Capricornus? This is the second full Moon in the month, sometimes called a "Blue Moon."

Friday, July 31

- This evening, skywatchers in the Americas see the Moon rise about a half day past the moment when it's exactly full. Can you detect the slightest out-of-roundness in the Moon's profile yet?

Saturday, August 1

- The Moon, now between Capricornus and Aquarius, is 1½ days past full when it rises this evening (for the Americas). Now the start of its waning gibbous phase is more definite.

- Today is Lammas Day or Lughnasadh, one of the four traditional "cross-quarter" days midway between the solstices and equinoxes. Sort of. The actual midpoint between the June solstice and the September equinox this year comes at 8:29 a.m. August 7th Eastern Daylight Time (12:29 UT). That's the exact center of astronomical summer.

Source: Sky and Telescope

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### ISS Sighting Opportunities (from Denver)

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Sighting information for other cities can be found at [NASA’s Satellite Sighting Information](https://www.nasa.gov/audience/for students/00-middle-school/iss_sighting.html)

### NASA-TV Highlights  (all times Eastern Time Zone)

**Thursday, July 30**

1:30 p.m. - ISS Expedition 44 Interviews with Fox News Channel’s “America’s News Headquarters" and Reuters TV with NASA Flight Engineer Scott Kelly and Flight Engineer Mikhail Kornienko of the Russian Federal Space Agency (all channels)

**Friday, July 31**

12:30 p.m., - ISS Expedition 44 In-Flight Educational Event with the Great Lakes Science Center in Cleveland and NASA Flight Engineers Scott Kelly and Kjell Lindgren (starts at 12:35 p.m.) (all channels)

Watch NASA TV online by going to the [NASA website](https://www.nasa.gov/).
Space Calendar

- Jul 28 - Asteroid 3167 Babcock Occults HIP 81198 (6.4 Magnitude Star)
- Jul 28 - Asteroid 2013 ND15 (Venus Trojan) Closest Approach To Earth (0.541 AU)
- Jul 28-Aug 04 - Heliophysics Summer School: Seasons In Space - Cycles of Variability of Sun-Planet Systems, Boulder, Colorado
- Jul 29 - South Delta-Aquarids Meteor Shower Peak
- Jul 29 - Comet C/2015 M3 (PANSTARRS) Closest Approach To Earth (3.115 AU)
- Jul 29 - Asteroid 6594 Tasman Closest Approach To Earth (1.341 AU)
- Jul 29 - Asteroid 4252 Godwin Closest Approach To Earth (1.577 AU)
- Jul 29 - Asteroid 16857 Goodall Closest Approach To Earth (1.755 AU)
- Jul 29 - Asteroid 8889 Mockturtle Closest Approach To Earth (1.907 AU)
- Jul 29 - Asteroid 184784 Bettiepage Closest Approach To Earth (2.053 AU)
- Jul 29 - Asteroid 433 Eros Closest Approach To Earth (2.149 AU)
- Jul 29 - Asteroid 6594 Tasman Closest Approach To Earth (0.753 AU)
- Jul 29 - Asteroid 6594 Tasman Closest Approach To Earth (0.769 AU)
- Jul 29 - Asteroid 8837 London Closest Approach To Earth (1.194 AU)
- Jul 29 - Asteroid 11246 Orvillewright Closest Approach To Earth (1.226 AU)
- Jul 29 - Asteroid 301 Bavaria Closest Approach To Earth (1.568 AU)
- Jul 29 - Asteroid 1031 Arctica Closest Approach To Earth (2.235 AU)
- Jul 30 - Dennis di Cicco's 65th Birthday (1950)
- Jul 30 - 405th Anniversary (1610), Galileo Observes Saturn's Rings
- Jul 31 - Venus Passes 6.5 Degrees From Jupiter
- Jul 31 - Comet 297P/Beshore Closest Approach To Earth (2.059 AU)
- Jul 31 - Comet 56P/Slaughter-Burnham At Opposition (2.555 AU)
- Jul 31 - Asteroid 2015 NA14 Near-Earth Flyby (0.061 AU)
- Jul 31 - Asteroid 249519 Whitneyclavin Closest Approach To Earth (1.576 AU)
- Jul 31 - Asteroid 8720 Takamizawa Closest Approach To Earth (1.850 AU)
- Jul 31 - David Tholen's 60th Birthday (1955)
- Aug 01 - Alpha Capricornids Meteor Shower Peak
- Aug 01 - Comet 205P-B/Giacobini Closest Approach To Earth (0.839 AU)
- Aug 01 - Comet 136P/Mueller Closest Approach To Earth (2.363 AU)
- Aug 01 - Asteroid 12759 Joule Closest Approach To Earth (2.422 AU)

Source: JPL Space Calendar

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Traveling to other star systems is a big dream, but achieving it may require going ultrasmall.

Blasting tiny, waferlike sailing spacecraft with powerful lasers could slash interstellar flight times from thousands of years to mere decades, one researcher says.

Human excursions to the stars are cursed by math. To get there in any reasonable amount of time, spacecraft must go incredibly fast — but fast travel requires carrying more propellant. That required amount of propellant, whether rocket fuel, a source for nuclear fusion or even antimatter, would make it more and more difficult for the ship to accelerate.

Some researchers have found a loophole in this dilemma by imagining a solar, laser or microwave sail. An interstellar craft that surfed on the sun's photons or on a beam shot from Earth orbit wouldn't have to carry a propulsion source with it. But to propel a large probe, humanity would need an extraordinarily large orbiting laser, and possibly a sail the size of Texas.

Philip Lubin, a researcher at the University of California, Santa Barbara's Experimental Cosmology Group, hopes to get around such problems with tiny waferlike spacecraft. His idea is one of 15 that won a Phase 1 grant from NASA's Innovative Advanced Concepts (NIAC) program in May.

While manned interstellar flight might not be possible for a long time, Lubin doesn't see why that should stop us from sending robotic emissaries to the stars. "Robotic missions, which have really done the bulk of exploration in our solar system, have become the extension of the human mind into far-distant places," Lubin told Space.com. "We don't have a way to send humans to the nearest star, but we do possibly have a way to send our ingenuity to the nearest stars in the form of a very small robotic probe."
NIAC Phase I grants are comparatively small — up to $100,000 — and they encourage researchers to build detailed plans of attack for ambitious, potentially transformative space travel technologies. Lubin's concept is a "Roadmap to the Stars" detailing step-by-step development and testing of the tiny, laser-propelled probes.

Les Johnson, a NASA technologist and science fiction author, described Lubin's NIAC proposal to Space.com: "Instead of making your propulsion systems gargantuan, and all this energy, why don't you just make what you're sending really, really small? Here's how."

The probes, each weighing a single gram, would ride on a laser beam shot from orbit around Earth and would carry tiny sensors to take measurements and transmitters to report back what they found. The system could be built up gradually, because even slightly larger probes or weaker laser beams would be useful for exploring nearer targets within the solar system, Lubin said.

Lubin said that there has been dramatic improvement in directed-energy technology, especially by the United States' Defense Advanced Research Projects Agency (DARPA). Propulsion that would have once required one prohibitively giant laser can now be generated by a much smaller source tied to many amplifiers in orbit around Earth, which could provide enough power to propel a meters-long sail pulling a little probe.

A full-sized laser array would be about 6 miles (10 km) across, but it would be scaled up over time from smaller, usable components. Lubin described the laser setup in earlier research that proposed using the lasers to heat up and knock incoming asteroids off course.

Once small versions of this system are established, in ground-based tests and otherwise, they'd begin to scale up. The largest-scale laser system would employ 50 to 70 gigawatts of power to propel the craft forward, about as much as is used to launch current spacecraft to Earth orbit. That laser setup, which Lubin described in a proposal paper, could propel a tiny spacecraft with a 3.3-foot (1 meter) sail up to 26 percent the speed of light in 10 minutes.

Such a craft could reach Mars in 30 minutes, catch up with Voyager 1 — humanity's farthest spacecraft from Earth — in less than three days and hit the star system Alpha Centauri in 15 years. Larger craft would take longer to accelerate but would still vastly outpace our current options, Lubin said.

"What we're proposing is extremely difficult, extraordinarily difficult — but so far we don't see the fundamental showstopper," Lubin said. "What prevents you from executing it except the hard work to do it and the technological evolution to get there?"

To make the system work, researchers will have to determine how to focus the laser beams precisely enough to direct the tiny spacecraft — as well as how spacecraft that small will be able to transmit back to Earth. It would also require constructing a large orbiting laser, which would become cost-effective after several launches.

Johnson also sees Lubin's road map as an incremental step to interstellar travel that makes a lot of sense.

"There are ways you can do it with laser sails, antimatter propulsion, a fusion drive, but they're all going to depend on traditional-sized spacecraft and really, really big infrastructures that we just don't have or won't have until the next century," Johnson told Space.com. "This is one that could potentially be done with an infrastructure only a little bit bigger than ours, which means it may not be as far out."

Source: Space.com  

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Ultraviolet Rings of M31

Image Credit: GALEX, JPL-Caltech, NASA

Explanation: A mere 2.5 million light-years away the Andromeda Galaxy, also known as M31, really is just next door as large galaxies go. So close and spanning some 260,000 light-years, it took 11 different image fields from the Galaxy Evolution Explorer (GALEX) satellite's telescope to produce this gorgeous portrait of the spiral galaxy in ultraviolet light.

While its spiral arms stand out in visible light images of Andromeda, the arms look more like rings in the GALEX ultraviolet view, a view dominated by the energetic light from hot, young, massive stars. As sites of intense star formation, the rings have been interpreted as evidence Andromeda collided with its smaller neighboring elliptical galaxy M32 more than 200 million years ago. The large Andromeda galaxy and our own Milky Way are the most massive members of the local galaxy group.

Source: NASA APOD