Space News Update

— September 22, 2017 —

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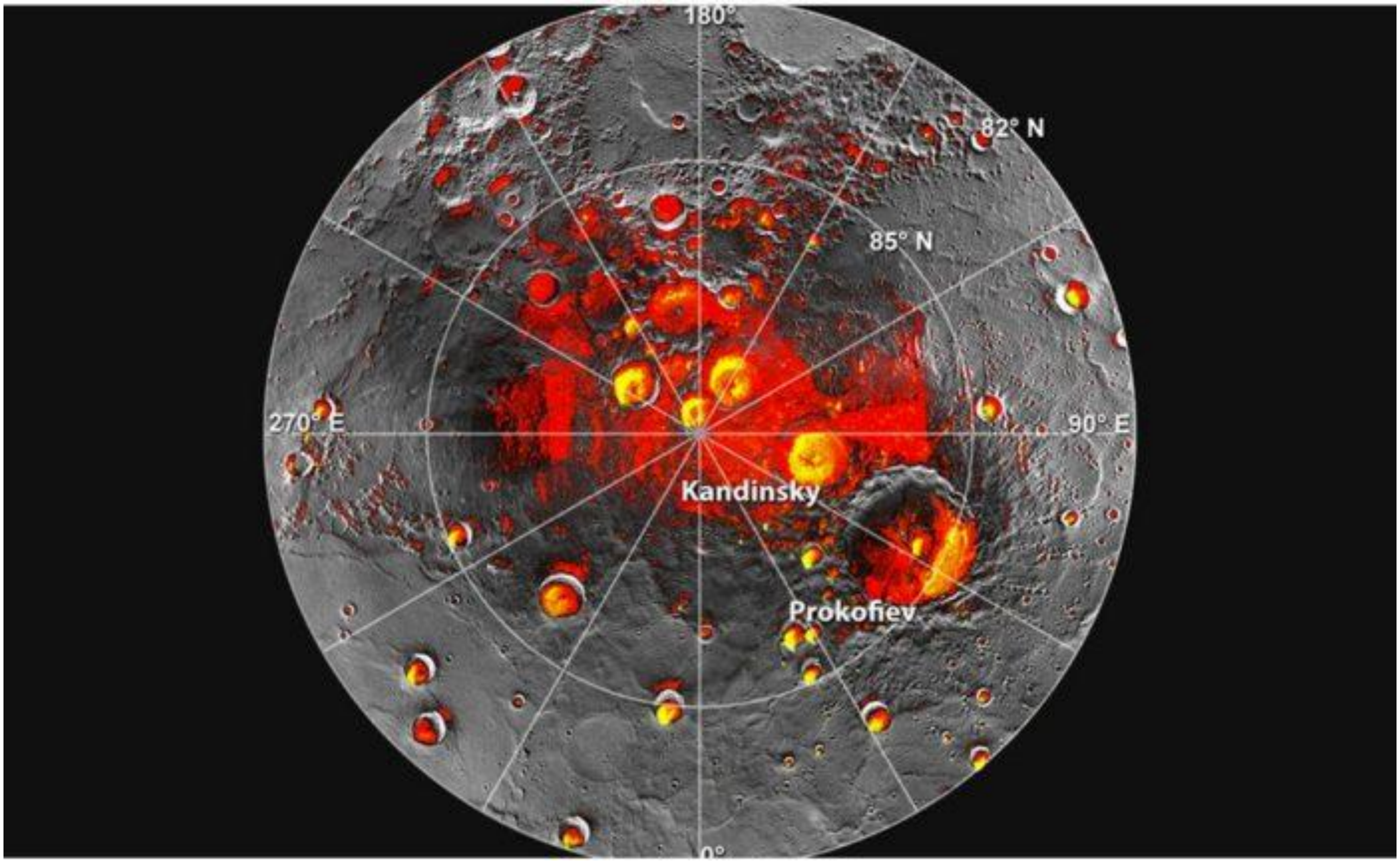
In the News

Departments

1. More Surface Ice on Mercury than Previously Thought



Back in 2012, scientists were delighted to discover that within the polar regions of Mercury, vast amounts of water ice were detected. While the existence of water ice in this permanently-shaded region had been the subject of speculation for about 20 years, it was only after the Mercury Surface, Space Environment, Geochemistry, and Ranging (MESSENGER) spacecraft studied the polar region that this was confirmed.

Based on the MESSENGER data, it was estimated that Mercury could have between 100 billion to 1 trillion tons of water ice at both poles, and that the ice could be up to 20 meters (65.5 ft) deep in places. However, a new study by a team of researchers from Brown University indicates that there could be three additional large craters and many more smaller ones in the northern polar region that also contain ice.

The study, titled "New Evidence for Surface Water Ice in Small-Scale Cold Traps and in Three Large Craters at the North Polar Region of Mercury from the Mercury Laser Altimeter", was recently published in the *Geophysical Research Letters*. Led by Ariel Deutsch, a NASA ASTAR Fellow and a PhD candidate at Brown University, the team considered how small-scale deposits could dramatically increase the overall amount of ice on Mercury.

Despite being the closest planet to the Sun, and experiencing scorching surface temperatures on its Sun-facing side, Mercury's low axial tilt means that its polar regions are permanently shaded and experience average temperatures of about 200 K (-73 °C; -100 °F). The idea that ice might exist in these regions dates back to the 1990s, when Earth-based radar telescopes detected highly reflective spots within the polar craters.

This was confirmed when the MESSENGER spacecraft detected neutron signals from the planet's north pole that were consistent with water ice. Since that time, it has been the general consensus that Mercury's surface ice was confined to seven large craters. But as Ariel Deutsch explained in a Brown University press statement, she and her team sought to look beyond them:

"The assumption has been that surface ice on Mercury exists predominantly in large craters, but we show evidence for these smaller-scale deposits as well. Adding these small-scale deposits to the large deposits within craters adds significantly to the surface ice inventory on Mercury."

For the sake of this new study, Deutsch was joined by Gregory A. Neumann, a research scientist from NASA's Goddard Space Flight Center, and James W. Head. In addition to being a professor the Department of Earth, Environmental and Planetary Sciences at Brown, Head was also a co-investigator for the MESSENGER and the Lunar Reconnaissance Orbiter missions.

Together, they examined data from MESSENGER's Mercury Laser Altimeter (MLA) instrument. This instrument was used by MESSENGER to measure the distance between the spacecraft and Mercury, the resulting data being then used to create detailed topographical maps of the planet's surface. But in this case, the MLA was used to measure surface reflectance, which indicated the presence of ice.

As an instrument specialist with the MESSENGER mission, Neumann was responsible for calibrating the altimeter's reflectance signal. These signals can vary based on whether the measurements are taken from overhead or at an angle (the latter of which is refereed to as "off-nadir" readings). Thanks to Neumann's adjustments, researchers were able to detect high-reflectance deposits in three more large craters that were consistent with water ice.

According to their estimates, these three craters could contain ice sheets that measure about 3,400 square kilometers (1313 mi^2). In addition, the team also looked at the terrain surrounding these three large craters. While these areas were not as reflective as the ice sheets inside the craters, they were brighter than the Mercury's average surface reflectance.

Beyond this, they also looked at altimeter data to seek out evidence of smaller scale deposits. What they found was four smaller craters, each with diameters of less than 5 km (3 mi), which were also more reflective than the surface. From this, they deduced that there were not only more large deposits of ice that were previously undiscovered, but likely many smaller "cold traps" where ice could exist as well.

Between these three newly-discovered large deposits, and what could be hundreds of smaller deposits, the total volume of ice on Mercury could be considerably more than we previously thought. As Deutsch said:

"We suggest that this enhanced reflectance signature is driven by small-scale patches of ice that are spread throughout this terrain. Most of these patches are too small to resolve individually with the altimeter instrument, but collectively they contribute to the overall enhanced reflectance… These four were just the ones we could resolve with the MESSENGER instruments. We think there are probably many, many more of these, ranging in sizes from a kilometer down to a few centimeters."

In the past, studies of the lunar surface also confirmed the presence of water ice in its cratered polar regions. Further research indicated that outside of the larger craters, small "cold traps"could also contain ice. According to some models, accounting for these smaller deposits could effectively double estimates on the total amounts of ice on the Moon. Much the same could be true for Mercury.

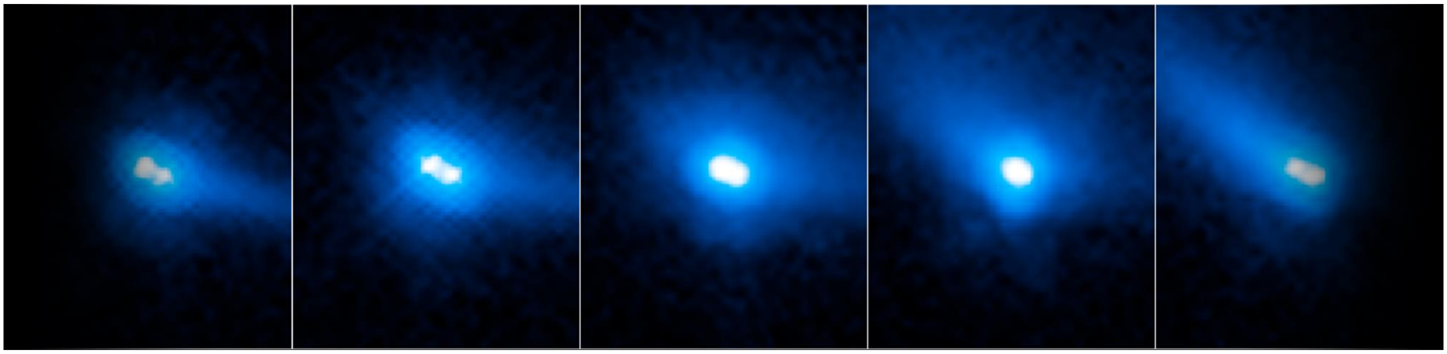
But as Jim Head (who also served as Deutsch Ph.D. advisor for this study) indicated, this work also adds a new take to the critical question of where water in the Solar System came from. "One of the major things we want to understand is how water and other volatiles are distributed through the inner Solar System—including Earth, the Moon and our planetary neighbors," he said. "This study opens our eyes to new places to look for evidence of water, and suggests there's a whole lot more of it on Mercury than we thought."

In addition to indicating the Solar System may be more watery than previously suspected, the presence of abundant ice on Mercury and the Moon has bolstered proposals for building outposts on these bodies. These outposts could be capable of turning local deposits water ice into hydrazine fuel, which would drastically reduce the costs of mounting long-range missions throughout the Solar System.

On the less-speculative side of things, this study also offers new insights into how the Solar System formed and evolved. If water is far more plentiful today than we knew, it would indicate that more was present during the early epochs of planetary formation, presumably when it was being distributed throughout the Solar System by asteroids and comets.

Source: Universe Today Return to Contents

2. Comet or Asteroid? Hubble Discovers that a Unique Object is a Binary



NASA's Hubble Space Telescope helped an international team of astronomers find that an unusual object in the asteroid belt is, in fact, two asteroids orbiting each other that have comet-like features. These include a bright halo of material, called a coma, and a long tail of dust.

Hubble was used to image the asteroid, designated 300163 (2006 VW139), in September 2016 just before the asteroid made its closest approach to the Sun. Hubble's crisp images revealed that it was actually not one, but two asteroids of almost the same mass and size, orbiting each other at a distance of 60 miles.

Asteroid 300163 (2006 VW139) was discovered by Spacewatch in November 2006 and then the possible cometary activity was seen in November 2011 by Pan-STARRS. Both Spacewatch and Pan-STARRS are asteroid survey projects of NASA's Near Earth Object Observations Program. After the Pan-STARRS observations it was also given a comet designation of 288P. This makes the object the first known binary asteroid that is also classified as a main-belt comet.

The more recent Hubble observations revealed ongoing activity in the binary system. "We detected strong indications for the sublimation of water ice due to the increased solar heating — similar to how the tail of a comet is created," explained team leader Jessica Agarwal of the Max Planck Institute for Solar System Research, Germany.

The combined features of the binary asteroid — wide separation, near-equal component size, high eccentricity orbit, and comet-like activity — also make it unique among the few known binary asteroids that have a wide separation. Understanding its origin and evolution may provide new insights into the early days of the solar system. Main-belt comets may help to answer how water came to a bone-dry Earth billions of years ago.

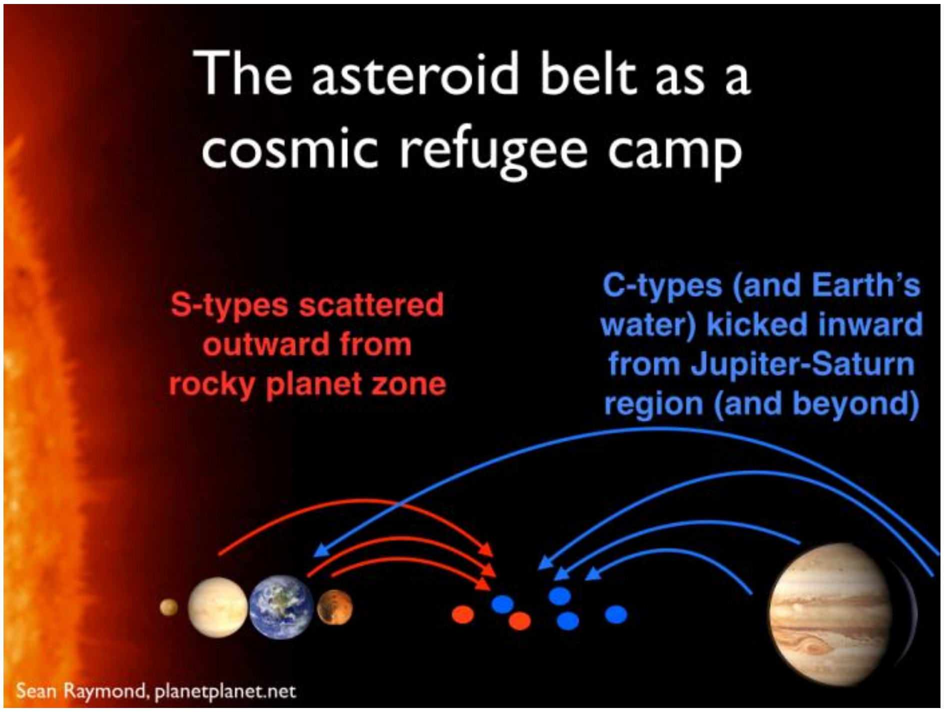
The team estimates that 2006 VW139/288P has existed as a binary system only for about 5,000 years. The most probable formation scenario is a breakup due to fast rotation. After that, the two fragments may have been moved further apart by the effects of ice sublimation, which would give a tiny push to an asteroid in one direction as water molecules are ejected in the other direction.

The fact that 2006 VW139/288P is so different from all other known binary asteroids raises some questions about how common such systems are in the asteroid belt. "We need more theoretical and observational work, as well as more objects similar to this object, to find an answer to this question," concluded Agarwal.

The research is presented in a paper, to be published in the journal Nature this week.

Source: HubbleSite.org Return to Contents

3. New Study Says Primoridal Asteroid Belt Was Empty



Between the orbits of Mars and Jupiter lies a disk of rocks, small bodies and planetoids known as the Main Asteroid Belt. The existence of this Belt was first theorized in the 18th century, based on observations that indicated a regular pattern in the orbits of Solar planets. By the following century, regular discoveries began to be made in the space between Mars and Jupiter, prompting astronomers to theorize where the Belt came from.

For a long time, scientists debated whether the Belt was the remains of a planet that broke up, or remnants left over from the early system that failed to become a planet. But a new study by a pair of astronomers from the University of Bordeaux has offered a different take. According to their theory, the Asteroid Belt began as an empty space which was gradually filled by rocks and debris over time.

For the sake of their study – which recently appeared in the journal *Science Advances* under the title "The Empty Primordial Asteroid Belt" – astronomers Sean N. Raymond and Andre Izidoro of the University of Bordeaux considered the current scientific consensus, which is that the Main Belt was once much more densely packed and became depleted of mass over time.

As Dr. Raymond explained to Universe Today via email:

"The standard picture is that the building blocks of the Solar System — what we call planetesimals, generally thought of as 10-100 km-scale bodies — started off in a smooth distribution across the Sun's planet-forming disk. The problem is, that puts a couple of times Earth's mass in the asteroid belt, where there is now less than a thousandth of an Earth mass. The challenge in this picture is therefore to understand how the belt lost 99.9% of its mass (but not 100%)."

To this, Dr. Raymond and Dr. Izodoro considered the alternate possibility that perhaps the primordial belt started as an empty space. In accordance with this theory, there were no planetesimals – i.e. Ceres, Vesta, Palla, and Hygeia – orbiting between Mars and Jupiter as there are today. This began as a thought experiment which, as Dr. Raymond admits, sounded a bit crazy at first.

However, he and Dr. Izodoro soon realized that several protoplanetary disks like the one they were envisioning had already been discovered in other star systems. For example, in 2014, the Atacama Large Millimeter/submillimeter Array in Chile photographed a planet-forming disk of dust and gas (aka, a protoplanetary disk) in the HL Tauri system, a very young star located about 450 light years away in the Taurus constellation.

As the image (shown below) revealed, the dust in this disk is not smooth, but consists of several broad regions and less dense regions. "The exact explanation for the structure in this disk is still debated but pretty much all models invoke drifting dust," said Raymond. "And planetesimals form when drifting dust piles up into sufficiently-dense rings. So, dust rings should (we think) produce rings of planetesimals."

To test this hypothesis, they constructed a model of the early Solar System which included an empty Main Belt region. As they moved the simulation forward, they found that the formation of the disk was related to the formation of the rocky planets, and would gradually become what we see today. As Raymond indicated:

"What we found is that the growth of the rocky planets is not 100% efficient. A fraction of planetesimals is gravitationally kicked outward and stranded in the asteroid belt. The orbits of captured bodies matches closely those of S-type asteroids. The efficiency of implanting S-types in the belt is quite low, only about 1 in 1000. However, recall that the belt is almost empty. There is a total of about 4 hundred-thousandths of an Earth-mass in S-types in the present-day belt. Our simulations typically implanted a few times that amount. Given that some are lost during later evolution of the Solar System, this matches both the distribution and amount of S-type asteroids in the belt.

They then combined this model with previous work which looked at the growth of Jupiter and Saturn and how this would effect the Solar System. In this study, they showed the C-type asteroids would be deposited in the Belt over time, and that these asteroids would also be responsible for delivering water to Earth. When they combined the distribution of implanted C-type and S-type asteroids with their current work, they found that it matched the present-day distribution of asteroids.

Interestingly enough, this is not the first theory Raymond and Izodoro have come up with to address the Asteroid Belt's missing mass. Back in 2011, Raymond was a co-author on the study that proposed the Grand Tack model, in which he and his colleagues proposed that Jupiter migrated from its original orbit after it formed. At first, the planet moved closer to Mars' current orbit, then back out towards where it is today.

In the process, the asteroid belt would have been cleared, and Mars would have been deprived of mass, thus leading to its diminutive size – relative to Earth and Venus. This resolved a key problem with classical theories of Asteroid Belt formation, which was known as the "small Mars problem". In short, all previous simulations of Solar planet formation tended to produce Mars analogs that were far more massive than Mars is today.

However, the Grand Tack hypothesis still contained theoretical uncertainties, which prompted Raymond and Izodoro to consider the the Empty Primordial Belt theory. "Our new result lends credence to an alternate model in which planetesimals never formed in the asteroid belt at all," he said. "Different pieces of this new alternative model have been developed in recent years, and I think they add up to make a solid alternative to the Grand Tack model."

Looking ahead, Raymond says that he and Izodoro hope to conduct further studies and simulations to see if either theory can be confirmed or falsified. "That's the next step," he said. "Until the next (seemingly-)crazy idea!"

Source: Universe Today Return to Contents

The Night Sky

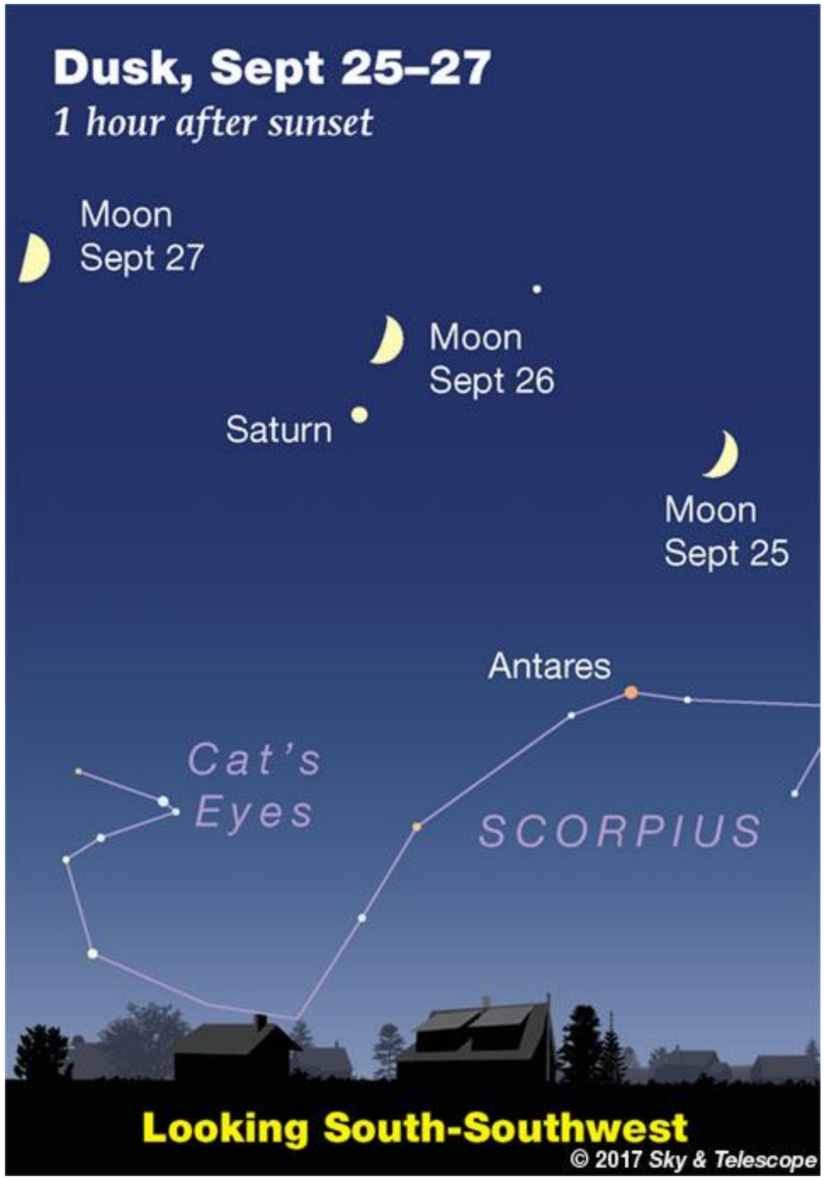
Friday, September 22
• Low in the west-southwest during twilight, spot the thin waxing crescent Moon. Can you see Jupiter to the lower right of it, by about 7°? (for North America.)

• *Equinox:* Autumn begins in the Northern Hemisphere, and spring in the Southern Hemisphere, at 4:02 p.m. EDT. This is when the Sun crosses the equator (both Earth's equator and the celestial equator) heading south for the season.

• Coincidentally, every year around when summer turns to autumn, Deneb takes over from brighter Vega as the zenith star after nightfall (for skywatchers at mid-northern latitudes).

Saturday, September 23
• The starry W of Cassiopeia stands high in the northeast after dark. The right-hand side of the W (the brightest side) is tilted up. Down below it, Perseus is climbing up from the horizon.

• Saturn's brightest moon, Titan, stands about four ring-lengths to Saturn's west this evening. A small telescope will show it; look just after dark while Saturn is still fairly high. Titan circles Saturn every 16 days, so it takes 8 days to move east-west from one elongation to the other.



Sunday, September 24
• This is the time of year when the rich Cygnus Milky Way crosses the zenith in the hour after nightfall is complete (for skywatchers at mid-northern latitudes). The Milky Way now rises straight up from the southwest horizon, passed overhead, and runs straight down to the northeast.

Monday, September 25
• As twilight fades and the stars come out, the crescent Moon shines in the southwest. Look below or lower left of it, by about a fist-width at arm's length, for twinkly Antares. A similar distance or a bit more to the Moon's left, Saturn glows steadily.

Tuesday, September 26
• The "star" below or lower left of the Moon this evening is Saturn, 3,800 times farther away: Saturn is currently 85 light-minutes distant, compared to the Moon's 1.3 light-seconds.

Source: Sky & Telescope Return to Contents

ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Fri Sep 22, 5:27 AM	< 1 min	14°	14° above S	11° above S
Sat Sep 23, 9:09 PM	< 1 min	10°	10° above SW	10° above SW
Sun Sep 24, 8:17 PM	3 min	43°	11° above SSW	43° above SSE
Mon Sep 25, 7:25 PM	5 min	22°	11° above S	11° above E
Mon Sep 25, 9:01 PM	2 min	28°	10° above WSW	28° above WNW
Tue Sep 26, 8:08 PM	5 min	69°	10° above WSW	28° above NE

Sighting information for other cities can be found at NASA's Satellite Sighting Information

NASA-TV Highlights

(all times Eastern Daylight Time)

- **1 p.m., 6 p.m., 9 p.m., Friday, September 22 -** NASA Television Special -- Langley Research Center's Dedication Ceremony of The Katherine G. Johnson Computational Research Facility (all channels)
- **5 p.m., 8 p.m., Friday, September 22 -** Replay of SpaceCast Weekly (all channels)
- **1 a.m., Saturday, September 23 -** Replay of the ISS Expedition 53 In-flight Interviews with KSTP-TV, Minneapolis and the Associated Press with Flight Engineers Joe Acaba and Mark Vande Hei of NASA (NTV-1 (Public))
- **2 a.m., 7 a.m., 11 a.m., 7 p.m., 11 p.m., Saturday, September 23 -** Replay of the ISS Expedition 53 In-flight Interviews with KSTP-TV, Minneapolis and the Associated Press with Flight Engineers Joe Acaba and Mark Vande Hei of NASA (NTV-1 (Public))
- **8 a.m., 1 p.m., 4 p.m., 8 p.m., Saturday, September 23 -** Replay of SpaceCast Weekly (all channels)
- **9 a.m., 2 p.m., 9 p.m., Saturday, September 23 -** Replay of the NASA Television Special -- Langley Research Center's Dedication Ceremony of The Katherine G. Johnson Computational Research Facility (all channels)
- **1 a.m., 2 a.m., 7 a.m., 11 a.m., 3 p.m., 7 p.m., 11 p.m., Sunday, September 24 -** Replay of the ISS Expedition 53 In-flight Interviews with KSTP-TV, Minneapolis and the Associated Press with Flight Engineers Joe Acaba and Mark Vande Hei of NASA (NTV-1 (Public))
- **8 a.m., 6 p.m., 10 p.m., Sunday, September 24 -** Replay of SpaceCast Weekly (all channels)

- **9 a.m., 1 p.m., 4 p.m., 8 p.m., Sunday, September 24 -** Replay of the NASA Television Special -- Langley Research Center's Dedication Ceremony of The Katherine G. Johnson Computational Research Facility (all channels)

Watch NASA TV on the Net by going to the NASA website. Return to Contents

Space Calendar

- Sep 22 - Autumnal Equinox, 20:02 UT
- Sep 22 - HOT [Sep 15] OSIRIS-REx, Earth Flyby
- Sep 22 - Glonass 752/Uragan-M N46 Soyuz 2-1b Launch
- Sep 22 - NEW [Sep 19] Apollo Asteroid 2017 RB15 Near-Earth Flyby (0.015 AU)
- Sep 22 - NEW [Sep 19] Apollo Asteroid 2017 RQ15 Near-Earth Flyby (0.025 AU)
- Sep 22 - Apollo Asteroid 2015 TC24 Near-Earth Flyby (0.070 AU)
- Sep 22 - Asteroid 3749 Balam (2 Moons) Closest Approach To Earth (1.310 AU)
- Sep 22 - Asteroid 52422 LPL Closest Approach To Earth (2.631 AU)
- Sep 22 - UPDATED [Sep 19] Lecture: A Volcanologist's Paradise, Pasadena, California
- Sep 23 - Comet C/2015 ER61 (PANSTARRS) Closest Approach To Earth (1.663 AU)
- Sep 23 - Comet 352P/Skiff Closest Approach To Earth (1.678 AU)
- Sep 23 - Comet P/2001 T3 (NEAT) Closest Approach To Earth (2.387 AU)
- Sep 23 - Apollo Asteroid 2017 PR25 Near-Earth Flyby (0.046 AU)
- Sep 23 - NEW [Sep 21] Amor Asteroid 2017 SN2 Near-Earth Flyby (0.056 AU)
- Sep 23 - Asteroid 85185 Lederman Closest Approach To Earth (0.893 AU)
- Sep 23 - Kuiper Belt Object 2010 RE64 At Opposition (51.282 AU)
- Sep 23 - 55th Anniversary (1962), "The Jetsons" TV Debut
- Sep 24 - Comet 73P-Z/Schwassmann-Wachmann Closest Approach To Earth (1.459 AU)
- Sep 24 - Comet 73P-AO/Schwassmann-Wachmann Closest Approach To Earth (1.463 AU)
- Sep 24 - Comet 213P/Van Ness Perihelion (1.983 AU)
- Sep 24 - Comet 237P/LINEAR Closest Approach To Earth (2.208 AU)
- Sep 24 - Comet 25D/Neujmin At Opposition (3.564 AU)
- Sep 24 - Asteroid 3174 Alcock Closest Approach To Earth (1.956 AU)
- Sep 24 - Kuiper Belt Object 120347 Salacia At Opposition (43.818 AU)
- Sep 24 - 165th Anniversary (1852), Henri Giffard Makes 1st Powered and Controlled Flight
- Sep 25 - Spektr-RG Zenit-3F Launch
- Sep 25 - Comet 213P-B/Van Ness Perihelion (1.983 AU)
- Sep 25 - Comet 89P/Russell Closest Approach To Earth (1.988 AU)
- Sep 25 - Comet P/2015 M2 (PANSTARRS) Closest Approach To Earth (5.308 AU)
- Sep 25 - NEW [Sep 21] Apollo Asteroid 2017 RO16 Near-Earth Flyby (0.011 AU)
- Sep 25 - NEW [Sep 15] Apollo Asteroid 2017 RW1 Near-Earth Flyby (0.028 AU)
- Sep 25 - NEW [Sep 18] Apollo Asteroid 2017 RW2 Near-Earth Flyby (0.039 AU)
- Sep 25 - NEW [Sep 21] Apollo Asteroid 2017 SF2 Near-Earth Flyby (0.058 AU)
- Sep 25 - Asteroid 13752 Grantstokes Closest Approach To Earth (1.086 AU)
- Sep 25 - Asteroid 10797 Guatemala Closest Approach To Earth (1.538 AU)
- Sep 25 - Asteroid 2266 Tchaikovsky Closest Approach To Earth (2.196 AU)
- Sep 25 - 20th Anniversary (1997), STS-86 Launch (Space Shuttle, Atlantis, Mir Space Station)
- Sep 25 - 25th Anniversary (1992), Mars Observer Launch
- Sep 26 - Comet 73P-R/Schwassmann-Wachmann Closest Approach To Earth (1.500 AU)
- Sep 26 - Comet 59P/Kearns-Kwee Closest Approach To Earth (2.476 AU)
- Sep 26 - Comet C/2016 Q4 (Kowalski) Closest Approach To Earth (6.117 AU)
- Sep 26 - Comet C/2016 Q4 (Kowalski) At Opposition (6.117 AU)
- Sep 26 - NEW [Sep 19] Apollo Asteroid 2017 RB16 Near-Earth Flyby (0.012 AU)
- Sep 26 - Apollo Asteroid 5189 (1990 UQ) Near-Earth Flyby (0.061 AU)
- Sep 26 - Amor Asteroid 3757 Anagolay Closest Approach To Earth (1.095 AU)
- Sep 26 - Harrison Brown's 100th Birthday (1917)

Source: JPL Space Calendar

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Food for Thought

New Horizons Probe Wakes from 5-Month Slumber

NASA's New Horizons spacecraft is zooming through the outer solar system with its eyes open once again.

New Horizons woke from a five-month hibernation period — its first stretch of rest since before its epic Pluto flyby in July 2015 — last week, right on schedule, mission team members said.

The probe is in good health and ready to resume studying the dark, frigid depths of the Kuiper Belt, the ring of bodies beyond Neptune's orbit, they added.

"It's another working science cruise through the Kuiper Belt for New Horizons," mission operations manager Alice Bowman, of the Johns Hopkins Applied Physics Lab in Laurel, Maryland, said in a statement.

From now until mid-December, New Horizons will take the Kuiper Belt's measure, studying the region's radiation environment, gas and dust concentrations, and other characteristics. The spacecraft will also observe a number of Kuiper Belt objects (KBOs) from afar, using its telescopic camera, mission team members said.

In addition, New Horizons' handlers will test the probe's scientific instruments, making sure everything is working ahead of a planned Jan. 1, 2019, flyby of a small KBO called 2014 MU69. This flyby — which will take New Horizons about three times closer to 2014 MU69 than it got to Pluto back in 2015 — is the centerpiece of the spacecraft's extended mission, which NASA approved last year.

On Dec. 9, New Horizons will fire its engines to refine its course toward 2014 MU69. Then, on Dec. 22, the probe will go into hibernation again; it will wake on June 4, 2018, to prep for the upcoming flyby, mission team members said.

The $700 million New Horizons mission, which launched in January 2006, got the first-ever good looks at Pluto during the spacecraft's historic flyby, revealing the dwarf planet to be a stunningly complex world with vast nitrogen-ice plains, towering mountains of water ice and a diversity of other landscapes.

New Horizons is currently about 3.62 billion miles (5.83 billion kilometers) from Earth — so far away that it takes commands more than 5 hours to reach the probe at the speed of light.

Source: Space.com Return to Contents

Space Image of the Week

The Big Corona
Image Credit & Copyright: Alson Wong

Explanation: Most photographs don't adequately portray the magnificence of the Sun's corona. Seeing the corona first-hand during a total solar eclipse is unparalleled. The human eye can adapt to see coronal features and extent that average cameras usually cannot. Welcome, however, to thedigital age. The featured picture is a combination of forty exposures from one thousandth of a second to two seconds that, together, were digitally combined and processed to highlight faint features of the total solar eclipse that occurred in August of 2017. Clearly visible are intricate layers and glowing caustics of an ever changing mixture of hot gas and magnetic fields in the Sun's corona. Looping prominences appear bright pink just past the Sun's limb. Faint details on the night side of the New Moon can even be made out, illuminated by sunlight reflected from the dayside of theFull Earth.

Source: APOD Return to Contents