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Word from the Editor

Smashing Success

(NASA/JPL) When NASA’s Deep Impact probe collided with Tempel 1, a bright, small flash was created, which rapidly expanded above the surface of the comet. This flash lasted for more than a second. Its overall brightness is close to that predicted by several models.

After the initial flash, there was a pause before a bright plume quickly extended above the comet surface. The debris from the impact eventually cast a long shadow across the surface, indicating a narrow plume of ejected material, rather than a wide cone. The Deep Impact probe appears to have struck deep, before gases were heated and explosively released. The impact crater was observed to grow in size over time.

A preliminary interpretation of these data indicate that the upper surface of the comet may be fluffy, or highly porous. The observed sequence of impact events is similar to laboratory experiments using highly porous targets, especially those that are rich in volatile substances. The duration of the hot, luminous gas phase, as well as the continued growth of the crater over time, all point to a model consistent with a large crater.

This image was taken by Deep Impact’s medium-resolution camera.

It will take over a year to fully analyze the data from this mission. As the analysis becomes available, we will present it here in future issues of onOrbit.

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Editor: Dr. Dale Etheridge, CCSN Planetarium Director • Graphic Design: Denise MacRae
Circulation Manager: Daisy Polidoro
Supernova Remnant N 63A Menagerie

(NASA/STScI) A violent and chaotic-looking mass of gas and dust is seen in this Hubble Space Telescope image of a nearby supernova remnant (cover). Denoted N 63A, the object is the remains of a massive star that exploded, spewing its gaseous layers out into an already turbulent region.

The supernova remnant is a member of N 63, a star-forming region in the Large Magellanic Cloud (LMC). Visible from the southern hemisphere, the LMC is an irregular galaxy lying 160,000 light-years from our own Milky Way galaxy. The LMC provides excellent examples of active star formation and supernova remnants to be studied with Hubble.

Many of the stars in the immediate vicinity of N 63A are extremely massive. It is estimated that the progenitor of the supernova that produced the remnant seen here was about 50 times more massive than our own Sun. Such a massive star has strong stellar winds that can clear away its ambient medium, forming a wind-blown bubble. The supernova that formed N 63A is thought to have exploded inside the central cavity of such a wind-blown bubble, which was itself embedded in a clumpy portion of the LMC’s interstellar medium.

Images in the infrared, X-ray, and radio emission of this supernova remnant show the much more expanded bubble that totally encompasses the optical emission seen by Hubble. Odd-shaped mini-clouds or cloudlets that were too dense for the stellar wind to clear away are now engulfed in the bubble interior. The supernova generated a propagating shock wave, that continues to move rapidly through the low-density bubble interior, and shocks these cloudlets, shredding them fiercely.

Supernova remnants have long been thought to set off episodes of star formation when their expanding shock encounters nearby gas. As the Hubble images have illustrated, N 63A is still young and its ruthless shocks destroy the ambient gas clouds, rather than coercing them to collapse and form stars. Data obtained at various wavelengths from other detectors reveal on-going formation of stars at 10 to 15 light-years from N 63A. In a few million years, the supernova ejecta from N 63A would reach this star-formation site and may be incorporated into the formation of planets around solar-type stars there, much like the early history of the solar system.

The Hubble image of N 63A is a color representation of data taken in 1997 and 2000 with Hubble’s Wide Field Planetary Camera 2. Color filters were used to sample light emitted by sulfur (shown in red), oxygen (shown in blue), and hydrogen (shown in green).
New Director Appointed for Space Telescope

Dr. Mattias (Matt) Mountain has been appointed director of the Space Telescope Science Institute (STScI) in Baltimore, the science operations center for NASA’s Hubble Space Telescope and the planned James Webb Space Telescope (JWST). He will succeed Dr. Steven V. W. Beckwith, who will end his term Sept. 1.

Previously, Dr. Mountain was director of the Gemini Observatory and was based in Hilo, Hawaii. The observatory operates the two 8-meter Gemini Telescopes on Mauna Kea, Hawaii and Cerro Pachón in Chile. Dr. Mountain is also the telescope scientist for the James Webb Space Telescope, a member of the JWST Science Working Group, and a visiting professor at the University of Oxford (UK).

In 1992 he became project scientist for the Gemini 8-meter Telescopes Project, based in Tucson, Arizona, and went on to become the director of the project in 1994. During his tenure as director, he had direct responsibility for the construction and commissioning of the two Gemini telescopes in Hawaii and Chile. In 1998 he moved to Hawaii and was responsible for the Gemini Observatory, including formulating, implementing, and running the operations and development programs of both Gemini 8-meter Telescopes. As part of the development program, he built up a world-renowned adaptive optics group to keep the Gemini telescopes at the forefront of observational infrared astronomy.

His background is in physics and astronomy, receiving his bachelor of science degree in physics in 1978 and his doctorate in astronomy in 1983, both from the Imperial College of Science and Technology, London University.

In accepting the position, Dr. Mountain said, “It’s an extraordinary privilege to be asked to lead such a fascinating, diverse and challenging organization as the Space Telescope Science Institute. I’m looking forward to working with the superb Institute staff, NASA and the astronomical community; the potential of what we can collectively achieve with HST and the James Webb is tremendously exciting!”

The institute carries out the scientific mission of the Hubble Space Telescope (HST). The Association of Universities for Research in Astronomy, Inc. (AURA) manages STScI for the National Aeronautics and Space Administration (NASA). The European Space Agency (ESA) participates in the HST Project under a long-term arrangement with NASA.

More than 100 candidates were considered for the position. AURA’s Board of Directors made the selection, which was approved by NASA.

William Smith, president of AURA, said, “AURA, NASA and the scientific community have always been extraordinarily fortunate to have had STScI directors of such quality and leadership ability. Matt is inheriting a strong organization poised to take on the responsibility of making the JWST a success.”

AURA is a consortium of 32 U.S. institutions and seven international affiliates. It manages the National Optical Astronomy Observatories, the National Solar Observatory, and the international Gemini Telescope Project in Tucson, Ariz., under separate cooperative agreements with the National Science Foundation; and STScI under contract with NASA.
Looking Back at ‘Purgatory Dune’

(NASA/JPL) The wheels of NASA’s Mars Exploration Rover *Opportunity* dug more than 10 centimeters (4 inches) deep into the soft, sandy material of a wind-shaped ripple in Mars’ Meridiani Planum region during the rover’s 446th martian day, or sol (April 26, 2005). Getting the rover out of the ripple, dubbed “Purgatory Dune,” required more than five weeks of planning, testing, and carefully monitored driving. *Opportunity* used its navigation camera to capture this look back (below) at the ripple during sol 491 (June 11, 2005), a week after the rover drove safely onto firmer ground. The ripple that became a sand trap is about one-third meter (one foot) tall and 2.5 meters (8 feet) wide.  

A mosaic view taken with the navigation camera on the camera boom looking straight down is depicted below left. The other two small images are the left and right front wheels just before the craft was able to work its way out of the sand trap. Based on wheel rotation, *Opportunity* traveled nearly 700 feet while progressing 6 inches just before they were able to extricate it. [NASA/JPL]
Elusive Planet Reshapes a Ring Around Neighboring Star

(NASA/STScI) NASA Hubble Space Telescope’s most detailed visible-light image ever taken of a narrow, dusty ring around the nearby star Fomalhaut (HD 216956), offers the strongest evidence yet that an unruly and unseen planet may be gravitationally tugging on the ring.

Hubble unequivocally shows that the center of the ring is a whopping 1.4 billion miles (15 Astronomical Units) away from the star. This is a distance equal to nearly halfway across our solar system. The most plausible explanation, astronomers said, is that an unseen planet moving in an elliptical orbit is reshaping the ring with its gravitational pull. The geometrically striking ring would not have such a great offset if it were simply being influenced by Fomalhaut’s gravity alone.

An offset of the ring center from the star has been inferred from previous and longer wavelength observations using submillimeter telescopes on Mauna Kea, Hawaii, the Spitzer Space Telescope, Caltech’s Submillimeter Observatory and applying theoretical modeling and physical assumptions. Now Hubble’s sharp images directly reveal the ring’s offset from Fomalhaut.

These new observations provide strong evidence that at least one unseen planetary mass object is orbiting the star. Hubble would have detected an object larger than a planet, such as a brown dwarf. “Our new Hubble images confirm those earlier hypotheses that proposed a planet was perturbing the ring,” said Paul Kalas of the University of California at Berkeley. The ring is similar to our solar system’s Kuiper Belt, a vast reservoir of icy material left over from the formation of our solar system planets.

The observations offer insights into our solar system’s formative years, when the planets played a game of demolition derby with the debris left over from the formation of our planets, gravitationally scattering many objects across space. Some icy material may have collided with the inner solar system planets, irrigating them with water formed in the colder outer solar system. Other debris may have traveled outward, forming the Kuiper Belt and the Oort Cloud, a spherical cloud of material surrounding the solar system.

Only Hubble has the exquisite optical resolution to resolve that the ring’s inner edge is sharper than its outer edge, a telltale sign that an object is gravitationally sweeping out material like a plow clearing away snow. Another classic signature of a planet’s influence is the ring’s relatively narrow width, about 2.3 billion miles (25 AU’s). Without an object to gravitationally keep the ring material intact, astronomers said, the particles would spread...
out much wider.

“What we see in this ring is similar to what is seen in the *Cassini* spacecraft images of Saturn’s narrow rings. In those images, Saturn’s moons are ‘shepherding’ the ring material and keeping the ring from spreading out,” Kalas said.

The suspected planet may be orbiting far away from Fomalhaut, inside the dust ring’s inner edge, between 4.7 billion and 6.5 billion miles (50 to 70 AU’s) from the star. The ring is 12 billion miles (133 AU’s) from Fomalhaut, which is much farther away than our outermost planet Pluto is from the Sun. These *Hubble* observations do not detect the putative planet directly, so the astronomers cannot measure its mass. They will, instead, conduct computer simulations of the ring’s dynamics to estimate the planet’s mass.

Kalas and collaborators James R. Graham of the University of California at Berkeley and Mark Clampin of the NASA Goddard Space Flight Center, published their findings in the June 23, 2005 issue of the journal *Nature*.

Fomalhaut, a 200-million-year-old star, is a mere infant compared to our own 4.5-billion-year-old Sun. It resides 25 light-years away from the Sun. Located in the constellation Piscis Austrinus (the Southern Fish), the Fomalhaut ring is ten times as old as debris disks seen previously around the stars AU Microscopii and Beta Pictoris, where planets may still be forming. If our solar system is any example, planets should have formed around Fomalhaut within tens of millions of years after the birth of the star.

The *Hubble* images also provide a glimpse of the outer planetary region surrounding a star other than our Sun. Many of the more than 100 planets detected beyond our solar system are orbiting close to their stars. Most of the current planet-detecting techniques favor finding planets that are close to their stars.

“The size of Fomalhaut’s dust ring suggests that not all planetary systems form and evolve in the same way, planetary architectures can be quite different from star to star,” Kalas explained. “While Fomalhaut’s ring is analogous to the Kuiper Belt, its diameter is four times greater than that of the Kuiper Belt.”

The astronomers used the Advanced Camera for Surveys’ (ACS) coronagraph aboard *Hubble* to block out the light from the bright star so they could see details in the faint ring.

“The ACS’s coronagraph offers high contrast, allowing us to see the ring’s structure against the extremely bright glare from Fomalhaut,” Clampin said. “This observation is currently impossible to do at visible wavelengths without the *Hubble Space Telescope*. The fact that we were able to detect it with *Hubble* was unexpected, but impressive.”

Kalas and his collaborators used *Hubble* over a five-month period in 2004 to map the ring’s structure. One side of the ring has yet to be imaged because it extended beyond the ACS camera’s field of view. The astronomers will use *Hubble* again this summer to map the entire ring. They expect that the additional *Hubble* data will reveal whether or not the ring has any gaps, which could have been carved out by the gravitational influence of an unseen body. The longer, deeper exposures also may show whether the ring has an even wider diameter than currently seen. In addition, the astronomers will measure the ring’s colors to determine its physical properties, including its composition.

Previous thermal emission maps of Fomalhaut showed that one side of the ring is warmer than the other side, implying that the ring is off center by about half the distance measured by *Hubble*. This difference might be explained by the fact that *Hubble’s* ACS images of the ring’s structure are 100 times sharper than the longer wavelength observations, and hence, yield a much more accurate result. Or the discrepancy might imply that the ring’s size looks different at other wavelengths.

Fomalhaut’s dust ring was discovered in 1983 in observations made by NASA’s *Infrared Astronomical Satellite* (IRAS). The system is a compelling target for future telescopes such as the *James Webb Space Telescope* and the Terrestrial Planet Finder, Kalas said.
Echo of Dead Star’s Rumblings

(NASA/JPL) An enormous light echo etched in the sky by a fitful dead star was spotted by the infrared eyes of NASA’s Spitzer Space Telescope.

The surprising finding indicates Cassiopeia A, the remnant of a star that died in a supernova explosion 325 years ago, is not resting peacefully. Instead, this dead star likely shot out at least one burst of energy as recently as 50 years ago.

“We had thought the stellar remains inside Cassiopeia A were just fading away,” said Dr. Oliver Krause, University of Arizona, Tucson. “Spitzer came along and showed us this exploded star, one of the most intensively studied objects in the sky, is still undergoing death throes before heading to its final grave.”

The Astronomy Store
The CCSN Planetarium
open 5 pm to 9 pm Friday & 3 pm to 9 pm Saturday

The Astronomy Store features items for sale that are of interest to the patrons of The Planetarium. We carry a wide variety of novelties, toys and observing aids with a space or astronomical theme. When patrons obtain their tickets to planetarium shows, they can also purchase a variety of astronomically oriented items. Friends of The Planetarium receive a 10% discount.
Infrared echoes trace the dusty journeys of light waves blasted away from supernova or erupting stars. As the light waves move outward, they heat up clumps of surrounding dust, causing them to glow in infrared light. The echo from Cassiopeia A is the first witnessed around a long-dead star and the largest ever seen. It was discovered by accident during a Spitzer instrument test.

“We had no idea that Spitzer would ever see light echoes,” said Dr. George Rieke of the University of Arizona. “Sometimes you just trip over the biggest discoveries.”

A supernova remnant like Cassiopeia A typically consists of an outer, shimmering shell of expelled material and a core skeleton of a once-massive star, called a neutron star. Neutron stars come in several varieties, ranging from intensely active to silent. Typically, a star that has recently died will continue to act up. Consequently, astronomers were puzzled that the star responsible for Cassiopeia A appeared to be silent so soon after its death.

The new infrared echo indicates the Cassiopeia A neutron star is active and may even be an exotic, spastic type of object called a magnetar. Magnetars are like screaming dead stars, with eruptive surfaces that rupture and...
quake, pouring out tremendous amounts of high-energy gamma rays. Spitzer may have captured the “shriek” of such a star in the form of light zipping away through space and heating up its surroundings.

“Magnetars are very rare and hard to study, especially if they are no longer associated with their place of origin. If we have indeed uncovered one, then it will be just about the only one for which we know what kind of star it came from and when,” Rieke said.

Astronomers first saw hints of the infrared echo in strange, tangled dust features that showed up in the Spitzer test image. When they looked at the same dust features again a few months later using ground-based telescopes, the dust appeared to be moving outward at the speed of light. Follow-up Spitzer observations taken one year later revealed the dust was not moving, but was being lit up by passing light.

A close inspection of the Spitzer pictures revealed a blend of at least two light echoes around Cassiopeia A, one from its supernova explosion, and one from the hiccup of activity that occurred around 1953. Additional Spitzer observations of these light echoes may help pin down their enigmatic source.

Krause was lead author with Rieke of a study about the discovery that appeared in June in the journal Science.

JPL manages the Spitzer Space Telescope mission for NASA’s Science Mission Directorate. Science operations are conducted at the Spitzer Science Center. JPL is a division of Caltech. Spitzer’s multiband imaging photometer was built by Ball Aerospace Corporation. Its development was led by Rieke.

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**The Las Vegas Astronomical Society**

Lake-like Feature on Titan

(NASA/JPL) Scientists are fascinated by a dark, lake-like feature recently observed on Saturn’s moon Titan. NASA’s Cassini spacecraft captured a series of images showing a marking, darker than anything else around it. It is remarkably lake-like, with smooth, shore-like boundaries unlike any seen previously on Titan.

“I’d say this is definitely the best candidate we’ve seen so far for a liquid hydrocarbon lake on Titan,” said Dr. Alfred McEwen, Cassini imaging team member. The suspected lake area measures 145 miles long by 45 miles wide, about the size of Lake Ontario.

“This feature is unique in our exploration of Titan so far,” said Dr. Elizabeth Turtle, Cassini imaging team associate. “Its perimeter is intriguingly reminiscent of the shorelines of lakes on Earth that are smoothed by water erosion and deposition.”

The feature lies in Titan’s cloudiest region, which is presumably the most likely site of recent methane rainfall. This, coupled with the shore-like smoothness of the feature’s perimeter makes it hard for scientists to resist speculation about what might be filling the lake, if it indeed is one.

“It’s possible that some of the storms in this region are strong enough to make methane rain that reaches the surface,” said Cassini imaging team member Dr. Tony DelGenio.

“Given Titan’s cold temperatures, it could take a long time for any liquid methane collecting on the surface to evaporate. So it might not be surprising for a methane-filled lake to persist for a long time,” DelGenio added. Despite earlier predictions, no definitive evidence for open bodies of liquid has been found on Titan. Cassini has not yet been in a favorable position for using its cameras to check for glints from possible surface liquids in the south polar region.

“Eventually, as the seasons change over a few years, the convective clouds may migrate northward to lower latitudes,” said DelGenio. “If so, it will be interesting to see whether the Cassini cameras record changes in the appearance of the surface as well.”

“An alternate explanation is that this feature was once a lake, but has since dried up, leaving behind dark deposits,” Turtle said. Yet another possibility is that the lake is simply a broad depression filled by dark, solid hydrocarbons falling from the atmosphere onto Titan’s surface. In this case, the smooth outline might be the result of a process unrelated to rainfall, such as a sinkhole or a volcanic caldera.

“It reminds me of the lava lakes seen on Jupiter’s moon, Io,” Dr. Torrence Johnson, an imaging team member.

Thirty-nine more Titan flybys are planned for Cassini’s prime mission. In future flybys the science teams will search for opportunities to observe the lake feature again and to look for mirror-like reflections from smooth surfaces elsewhere on Titan. Such reflections would strongly support the presence of liquids.
Month in History

August

3: Christopher Columbus launched his first voyage of discovery that found the New World in 1492.

4: Apollo 15 was the first manned mission to leave an 80-pound sub-satellite in orbit of the moon in 1971. The small satellite measured magnetic fields, charged particle densities and gravitational anomalies.

5: Neil Armstrong, the first person to walk on the moon, was born in 1930.

7: The first remote image of the earth was returned by a satellite in 1959.

7: A team of scientists announced the discovery of possible fossil micro-organisms in the Martian meteorite ALH84001 in 1997. The meteorite was discovered in the Allen Hills region of Antarctica in 1984.

11: Asaph Hall discovered the outer-most satellite of Mars, Deimos, in 1877.

13: A. J. Ångstrom, the Swedish physicist and spectroscopist, was born in 1814. The Ångstrom Unit, which has a length of one tenth of a nanometer is named for him.

17: Asaph Hall discovered the innermost satellite of Mars, Phobos, in 1877. (Mars Global Surveyor image at right)

19: John Flamsteed, the first Astronomer Royal of Britain, was born on this day in 1646. He is responsible for a numerical method of star designation called Flamsteed numbers.

19: The first flight of an unmanned hot air balloon occurred in France in 1783. This was a test by the Montgolfier brothers prior to their successful manned flight later that year.

19: Orville Wright was born in 1871. Orville and his brother Wilbur built the first successful heavier than air flying machine.

20: Voyager 2 was launched on its journey into the outer solar system in 1977.

21: Gordon Cooper became the first person to fly in space for the second time on Gemini 5 in 1965. His first trip into space was on Mercury 9 in 1963.

23: Lunar Orbiter 7 returned the first image of the earth from the vicinity of the moon in 1966.

24: Voyager 2 returned the first close-up images of Neptune during its flyby of that world in 1989.

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A popular service of The CCSN Planetarium lets you dedicate a star to a loved one. For a donation of $35, we will provide an attractive certificate that proclaims your dedication of the star of your choice to any other person. The certificate will have a chart of the constellation containing the star and complete information about the star. Accompanying the certificate will be The Sky Challenger, which contains a series of adjustable charts of the sky as seen from North America to help you find your star. A donation of $100 will give you an exclusive dedication. Call 651-4138 or 651-4505 for further information.
Sky Calendar

All times are Pacific Daylight Time. Rise and set times are for the astronomical horizon at Las Vegas or Reno as noted.

The Planets

Mercury. The month begins with Mercury between the earth and sun at Inferior Conjunction on August 5. Mercury is low in the east before sunrise for last half of the month. Greatest Western Elongation (18°) occurs on August 23.

Venus. Venus is visible in the evening sky setting about two hours after the sun. It is brighter than every other object in the sky other than the sun and moon. It will remain in the evening sky for the rest of the year. The rapidly moving Venus travels from Leo into Virgo on August 11. Look for the waxing crescent moon to the right of Venus on the evening of August 7. After they set as seen from Nevada, the moon will pass in front of Venus for observers in Alaska and NW Canada. The month will end with Jupiter just 1½° above Venus as they set.

Mars. Mars is moving through Aries for the month. It is primarily in the morning sky rising a bit before midnight. Look for the waning gibbous moon to rise shortly before Mars near 11:00 pm on the night of August 24.

Jupiter. Jupiter, in Virgo, is low in the southwest after sunset setting in the west less than two hours after the sun by the end of the month. Look for the waxing crescent moon below Jupiter on the evening of August 9 and the very bright Venus just below Jupiter on August 31.

Saturn. Saturn, in Cancer, is low in the east at sunrise. It rises about an hour and a half before the sun at mid-month.

Uranus. Uranus, in Aquarius, rises in the early evening at mid-month. Uranus will be directly opposite the sun on August 31 when it will rise at sunset. Uranus is visible only through a telescope.

Neptune. Neptune, in Capricornus, is rising an hour before Uranus at mid-month. Neptune was in opposition to the sun on August 8. Neptune is visible only through a telescope.

Pluto. Pluto is in the constellation of Serpens Cauda. It is high in the south during the mid-evening at mid-month. A telescope of at least 12” diameter from a dark sky environment is usually required to see this faint planet.

The Moon

Each day the moon rises about one hour later than the day before. The New Moon (not visible) is in the direction of the sun and rises and sets with the sun. The first quarter moon rises at about noon and sets near midnight. The full moon is opposite the sun in the sky and rises at sunset and sets at sunrise. The last quarter moon rises near midnight and sets near noon. Perigee is when the moon is closest to the earth and apogee is when it is farthest. The distance varies by ±6% from the average.

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Meteor Shower

The month of August is noted as one of the best meteor showers of the year. It is called the Perseid shower because the meteors seem to radiate out from the constellation of Perseus. The particles that cause the meteors are from Comet Swift-Tuttle of 1862. Since this comet travels on a very elongated orbit, the debris from this comet strikes the earth’s atmosphere at very high velocities. This produces bright meteors that travel rapidly across the sky. Some meteors of this shower are seen to fragment or explode.

The peak of activity for the Perseids occurs on the morning of August 12 (after midnight August 11). The best time for viewing will be 1:00 am to 4:00 am. Since the stream of material that causes the shower is fairly broad, Perseid meteors can actually be seen for about one week on either side of this date. About four days before and after the peak, you can see about one quarter as many Perseid meteors as you can on the night of the peak.

Normally it is possible to see anywhere from 75 to 200 meteors per hour on the night of the maximum under good conditions. Since the moon will be setting before midnight on the night of the peak, it will not be a factor. This will be one of the better years for observing this potentially rich meteor shower.

Perseid meteors are very fast. The average meteor enters the earth’s atmosphere at a speed of 20 to 25 miles per second. Perseid meteors typically travel at 40 miles per second. This can also help you distinguish Perseids from any other sporadic meteors that might occur on the same night.

To see the maximum number of meteors during a shower, you must find a dark location. You want to be away from city lights. From Las Vegas, try Valley of Fire, Echo Bay or Red Rock Canyon. Reno observers will have the best opportunity near Pyramid Lake.

As the earth travels around the sun, more meteors are encountered on the leading side of the earth. As a meteor observer, you are on the leading side of the earth after midnight. Meteors will be visible starting at about midnight.

Since meteors typically last for less than a second and can appear anywhere in the sky, optical aid (telescopes and binoculars) are not useful for general meteor observing. Binoculars can be useful for the occasional bright meteor that leaves a glowing trail in the sky. These trails can be observed for several seconds to a couple of minutes.
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