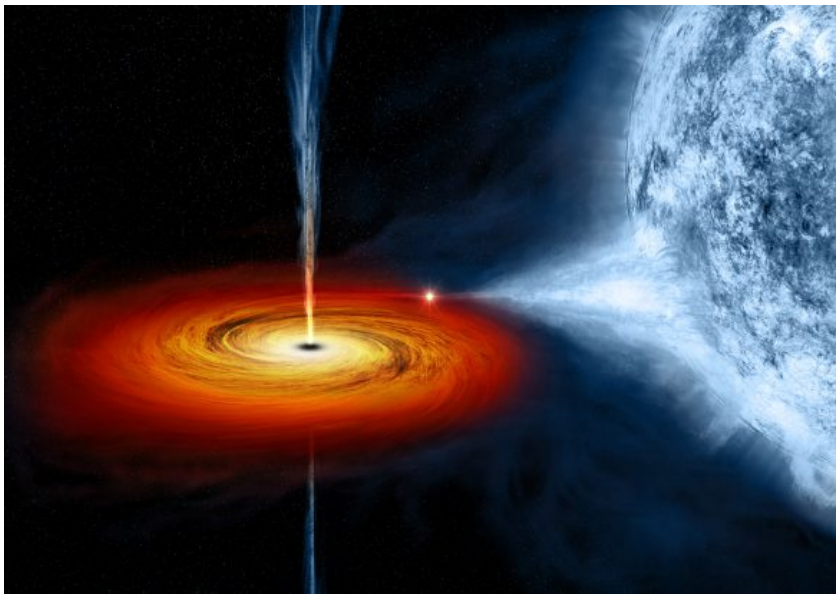
Space News Update

— March 7, 2017 —

Contents

1. Towards a New Understanding of Dark Matter



This artist's drawing shows a stellar black hole as it pulls matter from a blue star beside it. Could the stellar black hole's cousin, the primordial black hole, account for the dark matter in our Universe? Credits: NASA/CXC/M.Weiss

Dark matter remains largely mysterious, but astrophysicists keep trying to crack open that mystery. Last year's discovery of gravity waves by the Laser Interferometer Gravitational Wave Observatory (LIGO) may have opened up a new window into the dark matter mystery. Enter what are known as 'primordial black holes.'

Theorists have predicted the existence of particles called Weakly Interacting Massive Particles (WIMPS). These WIMPs could be what dark matter is made of. But the problem is, there's no experimental evidence to back it up. The mystery of dark matter is still an open case file.

When LIGO detected gravitational waves last year, it renewed interest in another theory attempting to explain dark matter. That theory says that dark matter could actually be in the form of Primordial Black Holes (PBHs), not the aforementioned WIMPS.

Primordial black holes are different than the black holes you're probably thinking of. Those are called stellar black holes, and they form when a large enough star collapses in on itself at the end of its life. The size of these stellar black holes is limited by the size and evolution of the stars that they form from.

Unlike stellar black holes, primordial black holes originated in high density fluctuations of matter during the first moments of the Universe. They can be much larger, or smaller, than stellar black holes. PBHs could be as small as asteroids or as large as 30 solar masses, even larger. They could also be more abundant, because they don't require a large mass star to form.

When two of these PBHs larger than about 30 solar masses merge together, they would create the gravitational waves detected by LIGO. The theory says that these primordial black holes would be found in the halos of galaxies.

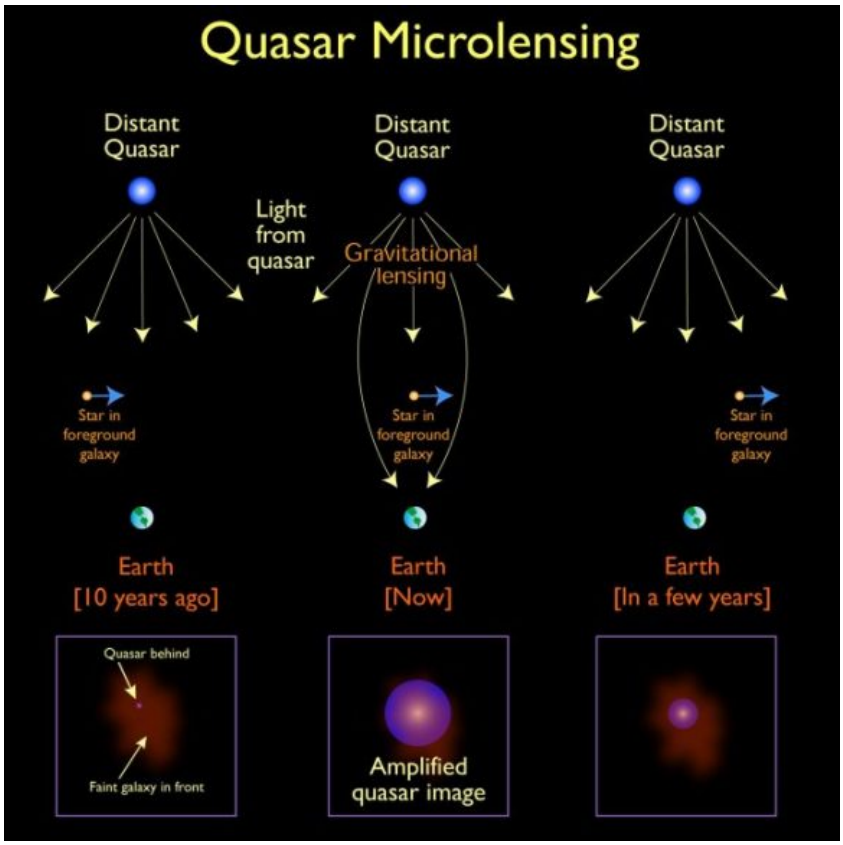
If there are enough of these intermediate sized PBHs in galactic halos, they would have an effect on light from distant quasars as it passes through the halo. This effect is called 'micro-lensing'. The micro-lensing would concentrate the light and make the quasars appear brighter.

The effect of this micro-lensing would be stronger the more mass a PBH has, or the more abundant the PBHs are in the galactic halo. We can't see the black holes themselves, of course, but we can see the increased brightness of the quasars.

Working with this assumption, a team of astronomers at the Instituto de Astrofísica de Canarias examined the micro-lensing effect on quasars to estimate the numbers of primordial black holes of intermediate mass in galaxies.

"The black holes whose merging was detected by LIGO were probably formed by the collapse of stars, and were not primordial black holes." -Evencio Mediavilla

The study looked at 24 quasars that are gravitationally lensed, and the results show that it is normal stars like our Sun that cause the micro-lensing effect on distant quasars. That rules out the existence of a large population of PBHs in the galactic halo. "This study implies "says Evencio Mediavilla, "that it is not at all probable that black holes with masses between 10 and 100 times the mass of the Sun make up a significant fraction of the dark matter". For that reason the black holes whose merging was detected by LIGO were probably formed by the collapse of stars, and were not primordial black holes".



A depiction of quasar microlensing. The microlensing object in the foreground galaxy could be a star (as depicted), a primordial black hole, or any other compact object. Credit: NASA/Jason Cowan (Astronomy Technology Center)

Depending on you perspective, that either answers some of our questions about dark matter, or only deepens the mystery.

We may have to wait a long time before we know exactly what dark matter is. But the new telescopes being built around the world, like the European Extremely Large Telescope, the Giant Magellan Telescope, and the Large Synoptic Survey Telescope, promise to deepen our understanding of how dark matter behaves, and how it shapes the Universe.

It's only a matter of time before the mystery of dark matter is solved.

Source: Universe Today

Return to Contents

2. Sierra Nevada to resume Dream Chaser flight tests

An atmospheric test model of Sierra Nevada's Dream Chaser space plane is being readied for tow and landing tests at NASA's Armstrong Flight Research Center in California this spring.

The partially-assembled test craft arrived at the California test site, located on Edwards Air Force Base, on Jan. 25. Technicians are adding the ship's V-shaped tail fins and other equipment before kicking off ground and flight tests in the coming months, according to Mark Sirangelo, corporate vice president of Sierra Nevada's space systems division.

"We'll do a series of ground tests," Sirangelo said in a recent interview. "That will include towing the vehicle down the runway, and that allows us to see how it stops and how it moves, but it also allows us to test all the sensors on the vehicle because we can get it up to a high enough speed where that will happen."

The Dream Chaser spacecraft, originally envisioned to fly with astronaut crews, will now fly on space missions with cargo deliveries heading for the International Space Station. That change means the spaceship will return to Earth on autopilot, using navigation aids to descend to a runway, deploy its landing gear and touch down like NASA's space shuttles.

After the ground tests, Sirangelo said the Dream Chaser test article will perform "captive carry" tests suspended under a helicopter, using the exercises to verify the movements of the craft's aerosurfaces and navigation instrumentation.

"When that's done, we'll move into a series of flight tests, where it will be dropped for approach and landing like the shuttle Enterprise," Sirangelo said, referring to the vehicle NASA used for landing demonstrations in the 1970s before the first full-up space shuttle mission.

The Dream Chaser will be dropped from heavy-duty carrier helicopter for an autonomous landing at Runway 22L at Edwards Air Force Base.

The test campaign in California's Mojave Desert comes three-and-a-half years after Sierra Nevada's Dream Chaser last flew on its own. A drop test in October 2013 ended with a crash landing after the ship's left landing gear failed to deploy.

Sierra Nevada says the 2013 flight was successful until that point, and Dream Chaser's autopilot landing system steered the craft toward the runway for a touchdown on the centerline.

Engineers blamed the mishap on a landing gear borrowed from a U.S. Air Force F-5E jet. Future Dream Chaser cargo missions to the space station will fly with a different landing gear, and the spaceship preparing for tests this spring in California features a gear more advanced then the suspect system at fault in 2013.

"We had borrowed that gear for that test, and that was one of the decision we made that didn't work out, obviously," Sirangelo said. "It wasn't the orbital flight design. It's a completely different design system now, so it's very different from what we had before. It's not quite the full orbital design, but it's on that path."

After the crash landing in 2013, Sierra Nevada returned the damaged test craft to the company's facility in Louisville, Colorado, for repairs. While the vehicle set for landing tests in the coming months is the same one that flew in 2013, Sirangelo said it is "substantially upgraded."

"It's much more close to the (configuration) of the orbital vehicle now, with flight software," Sirangelo told Spaceflight Now. "It's fully autonomous, so it will use flight software that we'll go to orbit with. All the control surfaces, and all the data gathering is all electronic.

"The computer systems are now the orbital version of the computer systems that we will manage with, so it's structurally similar, but virtually the whole inside of the vehicle has been updated and changed."

In 2013, Sierra Nevada was competing with Boeing and SpaceX for lucrative contracts with NASA to carry astronauts to and from the International Space Station. The space agency awarded the crew transportation deals to the other two companies in 2014, leaving Dream Chaser's future uncertain.

But Sierra Nevada found other business for the lifting body space plane, primarily in the space station's cargo resupply program. NASA announced in January 2016 that Sierra Nevada, SpaceX and Orbital ATK will be responsible for hauling up most of the space station's U.S. cargo and experiments from 2019 through 2024, the station's current planned retirement date.

SpaceX and Orbital ATK are the incumbent commercial cargo transportation contractors, and Sierra Nevada will join them in the follow-on contract.

Sierra Nevada also has agreements with the European Space Agency to study the use of Dream Chaser to provide access to space for European research experiments after the end of the space station program in the 2020s. The United Nations agreed last year to purchase a standalone unpiloted Dream Chaser mission to Earth orbit in 2021 to host research payloads from developing nations.

Sirangelo said the long gap between Dream Chaser flight tests was not only driven by technical concerns — like the upgrade and repair of the test craft — but by closing the business case for the program.

"We had to go and win a contract," Sirangelo said. "We needed a path to really make this all worthwhile to take this next step. Once we won the contract a year ago, we were able to accelerate the program and get back into flight tests."

The feeling among Sierra Nevada's team is different this time, he said.

"Not only are we back in flight tests, but now it's different in that we know that we have a contract," Sirangelo said. "We have flights coming up. We've got decades of flights in front of us, so it's a different feeling."

Under the structure of the cargo resupply contract, each partner must pass several programmatic, safety and integration milestones before flying missions. Sierra Nevada has passed two of those milestones so far, Sirangelo said, and a preliminary design review for the full Dream Chaser system is coming up soon.

NASA has not ordered resupply missions from any of the three providers under the new cargo contract — called Commercial Resupply Services-2 — but Sirangelo said the company hopes to get a firm order and a target launch date from the space agency this year. Each of the three CRS-2 contract winners is guaranteed at least six missions.

On space station resupply runs, the Dream Chaser will take off from Florida on top of United Launch Alliance Atlas 5 rockets and return to runway landings at one of several potential sites, such as the Shuttle Landing Facility at the Kennedy Space Center, for unpacking, refurbishment and reuse.

The Dream Chaser is about one-quarter the size of a space shuttle orbiter, allowing it to land on shorter runways.

It is capable of delivering more than 12,000 pounds (5,500 kilograms) of equipment to the space station inside its pressurized compartment and on an external aft-mounted payload carrier. At the end of each flight, the two parts will detach, with the Dream Chaser space plane returning to Earth with research specimens and other gear, and the disposable cargo module burning up in the atmosphere to incinerate trash.

The fully-loaded spacecraft will weigh around 20 tons and will likely require the lift capacity of ULA's most powerful Atlas 5 rocket configuration — the "551" with five strap-on solid rocket boosters and a 5-meter (17-foot) payload fairing, according to Sirangelo.

The first space-rated Dream Chaser is "well under design and development" and on schedule, he said.

"We've now built the full pressure shell and tested it, and now we're building the orbital shell — we call it the external structure — the structure of the vehicle, and all the flight software," Sirangelo said. "A lot of the work has been on the software side because it is a fully autonomous vehicle now, so it's well on the way to being ready on time."

Lockheed Martin built the Dream Chaser's composite structure, and Sierra Nevada will locate the spaceship's launch site processing facility alongside Lockheed Martin's Orion production line inside the Neil Armstrong Operations and Checkout Building at the Kennedy Space Center in Florida.

Source: Spaceflight Now Return to Contents

3. Seven-Planet Star Hides Age, Might Be Deadly

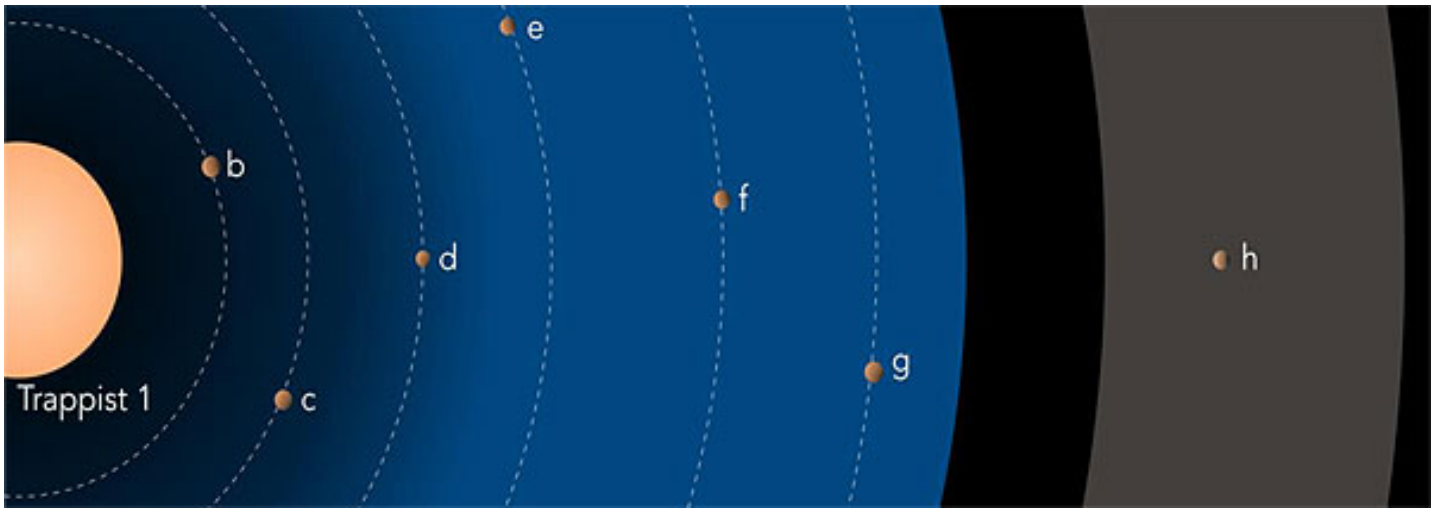


Diagram of the planetary system around TRAPPIST-1. The sizes of the objects are to scale, but the distances have been reduced tenfold. The star's color is realistic. The bluish area indicates the zone where liquid surface water might survive on the planets' surfaces, assuming an Earth-like atmosphere and composition. The greyish area shows the possible range of orbital distances for planet h.

The world is abuzz over the little star TRAPPIST-1, the ultracool *M* dwarf with seven potentially rocky exoplanets. The buzz started in 2016, when astronomers first discovered a couple of small worlds orbiting the star. As part of the ongoing — and now fervent — interest in this pipsqueak sun, Vincent Bourrier (University of Geneva Observatory, Switzerland) and colleagues are putting together a picture of how much high-energy radiation streams out from the star, and what that radiation might mean for the planets.

The team used the Hubble Space Telescope to study the star's ultraviolet output. Specifically, they looked at Lyman-alpha emission, which is a particular wavelength emitted by hydrogen atoms and comes from the star's chromosphere, the layer between the stellar "surface" (the photosphere) and the intensely hot, ionized, wispy corona.

The team found that TRAPPIST-1 emits less than half as much Lyman-alpha radiation as other cool, exoplanet-hosting *M* dwarfs — including Proxima Centauri, which spews forth six times more in ultraviolet as TRAPPIST-1 does. That's to be expected, since TRAPPIST-1 is also cooler than the other *M* dwarfs are.

However, last year the team also found that TRAPPIST-1 emits about as much in X-rays as Proxima Centauri. These X-rays come from the stars' coronas.

The ratio of X-rays to ultraviolet is interesting for a couple of reasons. First, X-ray and ultraviolet output decrease with time for these stars, but X-rays drop off much faster. The fact that TRAPPIST-1 emits roughly a third as much energy in Lyman-alpha as it does in X-ray suggests that the star is "relatively young," the team posits in their March 2017 *Astronomy & Astrophysics* article.

What "relatively young" means is an open question. Astronomers know the star is at least 500 million years old, because it's "settled" into being an adult star. Beyond that, it's anyone's guess. Jeffrey Linsky (University of Colorado, Boulder), who has worked extensively on *M* dwarfs and the trends in Lyman-alpha and X-ray emission for different types of stars, says that TRAPPIST-1 seems both old and young. Stars are born spinning quickly, then slow as they age. TRAPPIST-1 whips around every 1½ days, which at face value would point to it being young, he says — but astronomers don't know how fast these ultracool dwarfs spin down. Furthermore,

the star's fast motion through space usually would indicate it's a member of the old stellar population that comprises the galaxy's halo, but goodness knows if that's a fluke.

Bourrier agrees that the age question is currently unanswerable. The ratio of X-ray to ultraviolet emission seems to indicate that TRAPPIST-1 is "not extremely old," he says, "but I do not think that at this point we can say much more than this."

The second reason the X-ray and ultraviolet levels matter is for habitability, a possibility which has received perhaps more attention than it deserves. Although the ultraviolet level is low, the radiation overall is still high enough that it could strip an Earth-like atmosphere from the inner two planets, b and c, in 1 to 3 billion years; for the planets d, e, f, and g (e, f, and g are in the putative habitable zone), the process would take anywhere from 5 to 22 billion years. The team does see a hint of atmospheric escape from b and c, although the slight drop in starlight that implies it might instead be due to coronal variability.

Due to the worlds' methodical spacing, astronomers conclude the planets likely migrated to their current orbits from farther out. But we don't know how long ago that happened, or whether the orbits are stable long term. "If they migrated within a disk, typical time scales are about 100 million years, but that may not be valid for a system like TRAPPIST-1," Bourrier cautions. "Uncharted territory here!"

Source: Sky & Telescope Return to Contents

The Night Sky

Tuesday, March 7

• At nightfall, look below the Moon for Procyon and above the Moon for fainter Pollux and Castor.

Wednesday, March 8

• Bright Sirius now stands due south on the meridian just as twilight fades away into night. Sirius is the bottom star of the equilateral Winter Triangle. The other two stars of the Tiangle are orange Betelgeuse to Sirius's upper right (Orion's shoulder) and Procyon to Sirius's upper left. The waxing gibbous Moon shines higher to the Triangle's upper left.

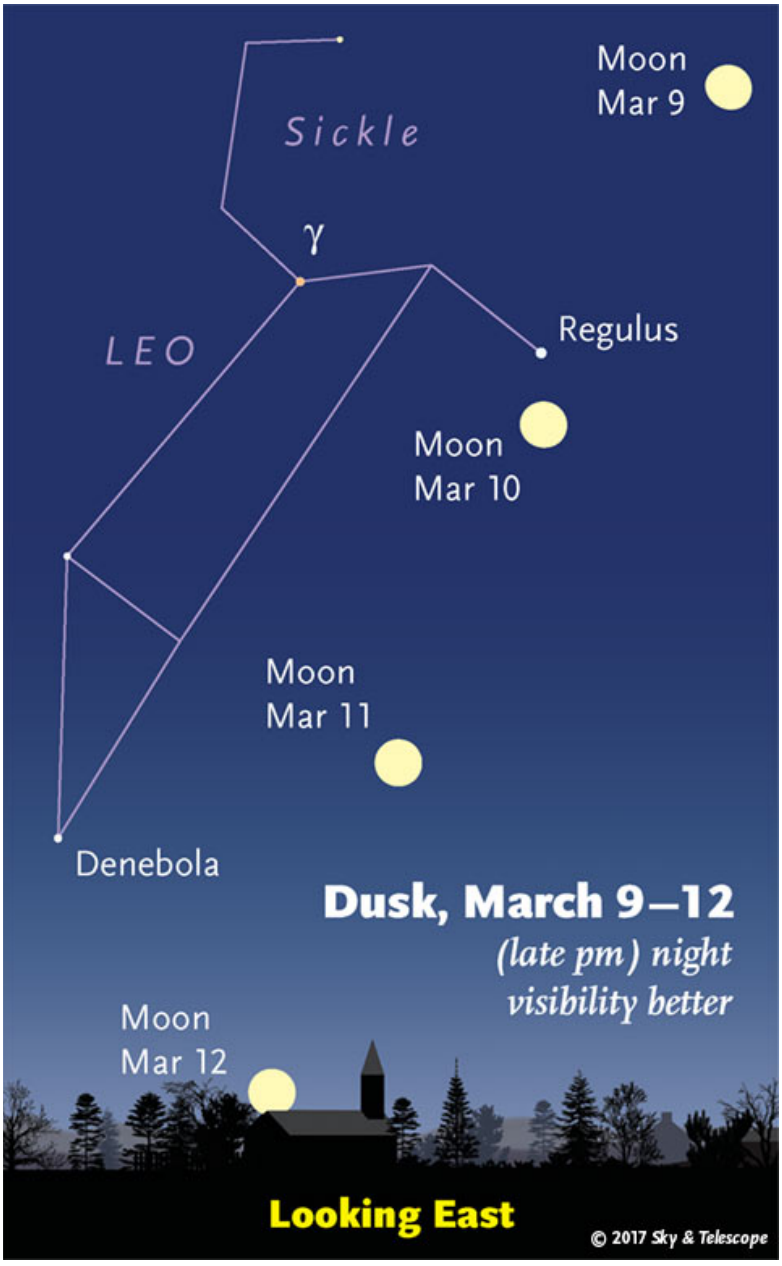
Thursday, March 9

• The waxing gibbous Moon this evening shines to the right of the Sickle of Leo, as shown here.

Friday, March 10

• The bright Moon hangs a few degrees below or lower left of Regulus this evening. The Sickle of Leo extends upper left from Regulus.

• Late tonight comes the second-brightest asteroid occultation predicted this year for North America. A 6.3-magnitude star in Leo's snout, just in front of the Sickle, should snap out of sight for up to 3 seconds for observers along a narrow track running from the Georgia coast to just north of San Francisco. The culprit is the 15th-magnitude asteroid 1343 Nicole, only about 26 km (16 miles) in diameter.



Leo will be very high in the southwest or south. For times, detailed maps, a finder chart for the star (easily spotted less than 1° northeast of Lambda Leonis), and other information, see Steve Preston's prediction page for this event.

Source: Sky & Telescope

Return to Contents

ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Tue Mar 7, 5:14 AM	3 min	23°	20° above NW	11° above NNE
Wed Mar 8, 4:24 AM	2 min	25°	25° above NNE	11° above NE
Wed Mar 8, 5:59 AM	2 min	12°	10° above NW	11° above N
Thu Mar 9, 5:07 AM	3 min	15°	14° above NW	10° above NNE
Fri Mar 10, 4:16 AM	1 min	15°	15° above NNE	10° above NNE
Fri Mar 10, 5:52 AM	1 min	10°	10° above NNW	10° above N

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

NASA-TV Highlights

(all times Eastern Daylight Time)

9 a.m., Wednesday, March 8 - Acting NASA Administrator Robert Lightfoot's Keynote Address on "Future Space: Trends, Technologies and Missions" at the 55th Annual Robert H. Goddard Memorial Symposium (starts at 9:20) (all channels)

11 a.m., Friday, March 10 - JSC Presents "SpaceCast Weekly" (all channels)

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

Return to Contents

Space Calendar

- Mar 07 - Cassini, Distant Flyby of Mimas & Pan
- Mar 07 - Comet C/2016 VZ18 (PANSTARRS) Perihelion (0.910 AU)
- Mar 07 - Comet 73P-R/Schwassmann-Wachmann Closest Approach To Earth (1.217 AU)
- Mar 07 - Comet 315P/LONEOS At Opposition (1.608 AU)
- Mar 07 - Comet P/2010 J5 (McNaught) At Opposition (2.866 AU)
- Mar 07 - NEW [Mar 05] Apollo Asteroid 2017 EF Near-Earth Flyby (0.019 AU)
- Mar 07 - NEW [Mar 01] Apollo Asteroid 2017 DD38 Near-Earth Flyby (0.038 AU)
- Mar 07 - Apollo Asteroid 2017 DL34 Near-Earth Flyby (0.047 AU)
- Mar 07 - NEW [Mar 05] Aten Asteroid 2017 EL Near-Earth Flyby (0.059 AU)
- Mar 07 - NEW [Mar 05] Amor Asteroid 2017 EO Near-Earth Flyby (0.080 AU)
- Mar 07 - NEW [Mar 01] Apollo Asteroid 2017 DW108 Near-Earth Flyby (0.086 AU)
- Mar 07 - Asteroid 9957 Rafaellosanti Closest Approach To Earth (1.582 AU)
- Mar 07 - Henry Draper's 180th Birthday (1837)
- Mar 07 - John Herschel's 225th Birthday (1792)
- Mar 08 - Wideband Gapfiller Satellite 9 (WGS-9) Delta 4 Launch
- Mar 08 - Comet 73P-AK/Schwassmann-Wachmann Perihelion (0.972 AU)
- Mar 08 - Comet 73P-AU/Schwassmann-Wachmann Perihelion (0.973 AU)
- Mar 08 - Comet 313P/Gibbs Closest Approach To Earth (2.920 AU)
- Mar 08 - Comet 158P/Kowal-LINEAR Closest Approach To Earth (3.872 AU)
- Mar 08 - Comet 158P/Kowal-LINEAR At Opposition (3.872 AU)
- Mar 08 - NEW [Feb 26] Aten Asteroid 2017 DV35 Near-Earth Flyby (0.025 AU)
- Mar 08 - Aten Asteroid 2014 HB124 Near-Earth Flyby (0.092 AU)
- Mar 08 - Arno Wachmann's 115th Birthday (1902)
- Mar 08 - 245th Anniversary (1772), Discovery of Biela's Comet by Jacques Leibax Montaigne & Charles Messier
- Mar 09 - Comet P/2015 X6 (PANSTARRS) Closest Approach To Earth (1.740 AU)
- Mar 09 - Comet 313P/Gibbs At Opposition (2.920 AU)
- Mar 09 - Comet 310P/Hill At Opposition (3.596 AU)
- Mar 09 - Comet 186P/Garradd Closest Approach To Earth (3.881 AU)
- Mar 09 - NEW [Feb 26] Apollo Asteroid 2017 DR35 Near-Earth Flyby (0.030 AU)
- Mar 09 - Asteroid 5959 Shaklan Occults HIP 85365 (4.5 Magnitude Star)
- Mar 09 - Apollo Asteroid 2017 BL30 Near-Earth Flyby (0.063 AU)
- Mar 09 - Asteroid 2577 Litva (2 Moons) Closest Approach To Earth (0.775 AU)
- Mar 09 - Asteroid 3000 Leonardo Closest Approach To Earth (1.732 AU)
- Mar 09 - Asteroid 49272 Bryce Canyon Closest Approach To Earth (1.774 AU)
- Mar 09 - Asteroid 7220 Philnicholson Closest Approach To Earth (1.894 AU)
- Mar 10 - Moon Occults Regulus
- Mar 10 - Comet 2P/Encke Perihelion (0.336 AU)
- Mar 10 - Comet 73P-Z/Schwassmann-Wachmann Closest Approach To Earth (1.166 AU)
- Mar 10 - Comet 73P-AO/Schwassmann-Wachmann Closest Approach To Earth (1.169 AU)
- Mar 10 - Comet 118P/Shoemaker-Levy Closest Approach To Earth (1.821 AU)
- Mar 10 - Comet P/2010 J5 (McNaught) Closest Approach To Earth (2.865 AU)
- Mar 10 - Centaur Object 10199 Chariklo Occults UCAC4-294-210076 (13.0 Magnitude Star)
- Mar 10 - NEW [Feb 26] Apollo Asteroid 2017 DA36 Near-Earth Flyby (0.010 AU)
- Mar 10 - Apollo Asteroid 2015 EF Near-Earth Flyby (0.048 AU)
- Mar 10 - Apollo Asteroid 138404 (2000 HA24) Near-Earth Flyby (0.067 AU)
- Mar 10 - Apollo Asteroid 2008 CA6 Near-Earth Flyby (0.084 AU)
- Mar 10 - Apollo Asteroid 428694 Saule Closest Approach To Earth (0.908 AU)
- Mar 10 - Asteroid 2000 Herschel Closest Approach To Earth (1.658 AU)

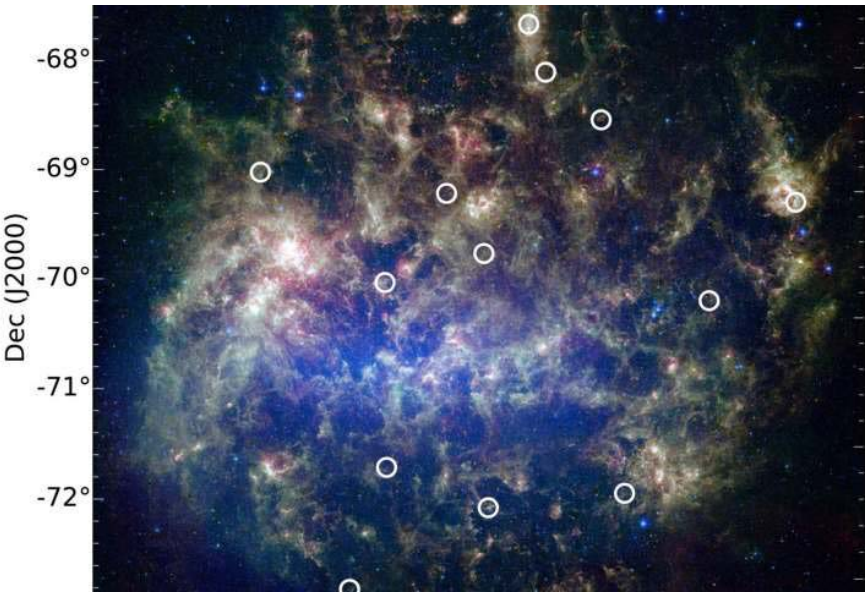
- Mar 10 - 40th Annversary (1977), Discovery of Uranus' Rings
- Mar 10 - George Lewis' 135th Birthday (1882)
- Mar 10 - Jean-Paul Fouchy's 310th Birthday (1707)

Source: JPL Space Calendar

Return to Contents

Food for Thought

Star clusters discovery could upset the astronomical applecart



This image from NASA's Spitzer Space Telescope features the Large Magellanic Cloud, a satellite galaxy to our own Milky Way galaxy. Overlaying the image are circles showing the locations of 15 star clusters where multiple generations of ...more

The discovery of young stars in old star clusters could send scientists back to the drawing board for one of the Universe's most common objects.

Dr Bi-Qing For, from the International Centre for Radio Astronomy Research in Perth, said our understanding of how stars evolve is a cornerstone of astronomical science.

"There are a billion trillion stars in the Universe and we've been observing and classifying those we can see for more than a century," she said.

"Our models of stellar evolution are based on the assumption that stars within star clusters formed from the same material at roughly the same time."

A star cluster is a group of stars that share a common origin and are held together by gravity for some length of time.

Because star clusters are assumed to contain stars of similar age and composition researchers have used them as an "astronomical laboratory" to understand how mass affects the evolution of stars.

"If this assumption turns out to be incorrect, as our findings suggest, then these important models will need to be revisited and revised," Dr For said.

The discovery, published today in the *Monthly Notices of the Royal Astronomical Society*, involves a study of star clusters located in the Large Magellanic Cloud, a neighbouring galaxy to the Milky Way.

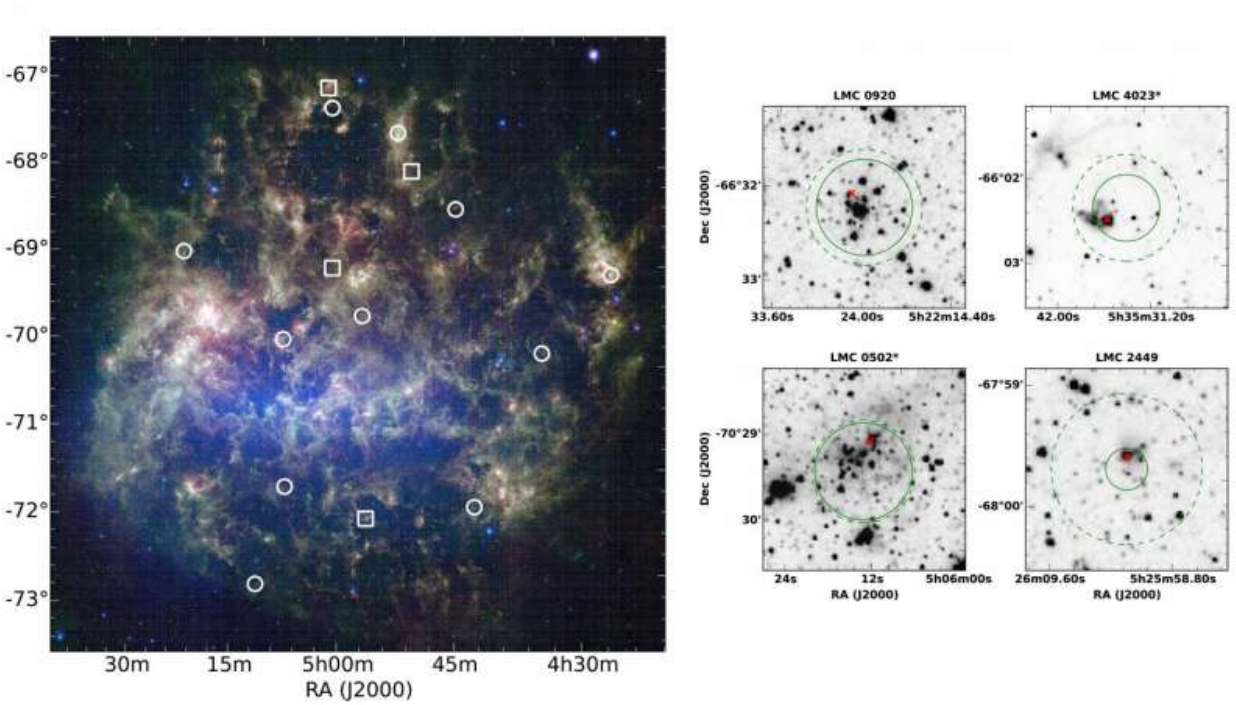
By cross-matching the locations of several thousand young stars with the locations of stellar clusters, the researchers found 15 stellar candidates that were much younger than other stars within the same cluster.

"The formation of these younger stars could have been fuelled by gas entering the clusters from interstellar space," said co-author Dr Kenji Bekki, also from the International Centre for Radio Astronomy Research.

"But we eliminated this possibility using observations made by radio telescopes to show that there was no correlation between interstellar hydrogen gas and the location of the clusters we were studying.

"We believe the younger stars have actually been created out of the matter ejected from older stars as they die, which would mean we have discovered multiple generations of stars belonging to the same cluster."

Dr Bekki said the stars were currently too faint to see using optical telescopes because of the dust that surrounds them.



Left: This image from NASA's Spitzer Space Telescope shows the Large Magellanic Cloud, a satellite galaxy to our own Milky Way galaxy. Overlaying the image are the locations of 15 star clusters where multiple generations of stars have been ...more

"They have been observed using infrared wavelengths by orbiting space telescopes Spitzer and Herschel, operated by NASA and the European Space Agency," he said.

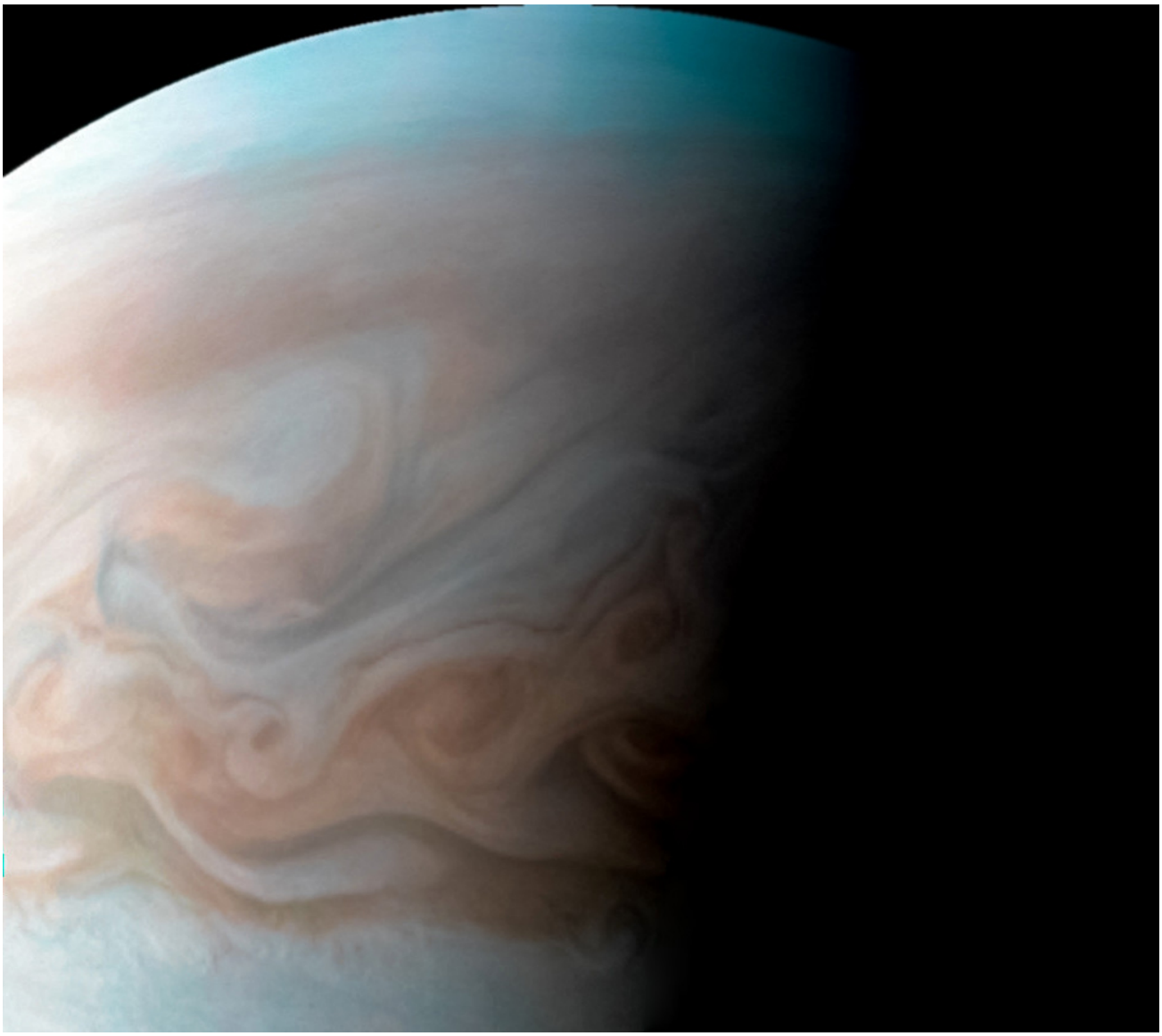
"An envelope of gas and dust surrounds these young stars but as they become more massive and this shroud blows away, they will become visible at optical wavelengths for powerful instruments like the Hubble Space Telescope."

"If we point Hubble at the clusters we've been studying, we should be able to see both young and old stars and confirm once and for all that star clusters can contain several generations of stars."

Source: Phys.org

Return to Contents

Space Image of the Week



Juno Captures Jupiter Cloudscape in High Resolution

This close-up view of Jupiter captures the turbulent region just west of the Great Red Spot in the South Equatorial Belt, with resolution better than any previous pictures from Earth or other spacecraft.

NASA's Juno spacecraft captured this image with its JunoCam citizen science instrument when the spacecraft was a mere 5,400 miles (8,700 kilometers) above Jupiter's cloudtops on Dec. 11, 2016 at 9:14 a.m. PT (12:14 p.m. ET). Citizen scientist Sergey Dushkin produced the sublime color processing and cropped the image to draw viewers' eyes to the dynamic clouds.

JunoCam's raw images are available at www.missionjuno.swri.edu/junocam for the public to peruse and process into image products.

More information about Juno is at http://www.nasa.gov/juno and http://missionjuno.swri.edu.
Credits: NASA/JPL-Caltech/SwRI/MSSS/Sergey Dushkin

Source: NASA

Return to Contents