Space News Update

— January 23, 2018 —

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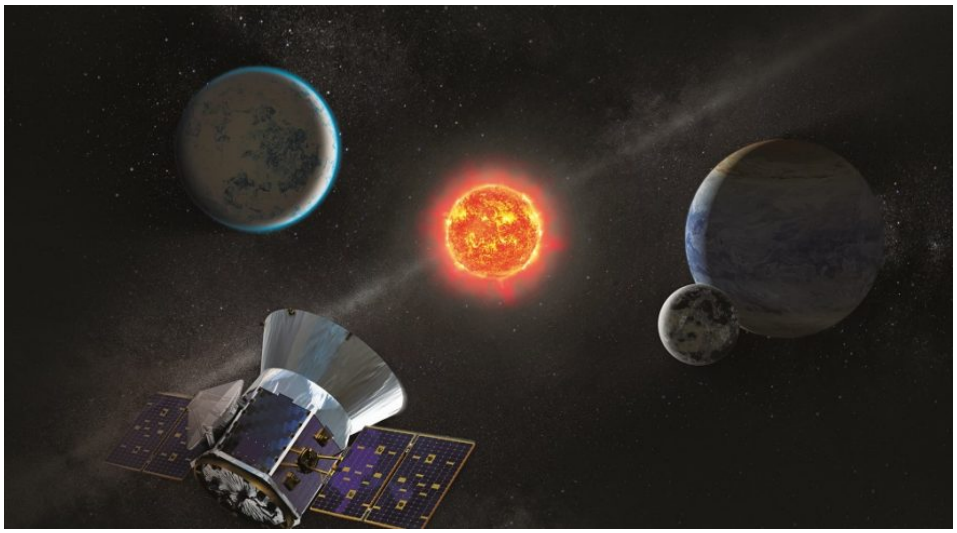
1. A changing of the guard in NASA's hunt for exoplanets



Sometime later this year NASA's Kepler spacecraft, orbiting the sun more than 150 million kilometers from the Earth, will fire its thrusters for the final time. The spacecraft is running out of the hydrazine fuel used by those thrusters to maintain the spacecraft's orientation. Once the thrusters sputter and shut down, their fuel exhausted, Kepler will no longer be able to control its pointing, and the mission will end.

The project isn't quite sure exactly when that will happen, since the calculation depends on rates of fuel usage and the challenges of measuring just how much hydrazine is left in the spacecraft's tanks. "The fuel is expected to last somewhere between the spring and summer of 2018," said Gary Blackwood, manager of NASA's Exoplanet Exploration Program, at a Jan. 7 meeting of a NASA exoplanet advisory group. He added that the spacecraft's manufacturer, Ball Aerospace, "has found very creative ways" to stretch out that remaining fuel.

Kepler is otherwise working well, performing since 2014 an extended mission called K2 that is looking at different parts of the sky for a few months at a time. "The spacecraft is behaving completely nominally," said Jessie Dotson, K2 project scientist at NASA's Ames Research Center, at a town hall meeting about the mission Jan. 9 during the 231st Meeting of the American Astronomical Society (AAS) in suburban Washington.

The K2 mission is currently performing a set of observations called Campaign 16, scheduled to run through late February. Mission scientists have plans for Campaigns 17, 18 and 19 that would run through the end of the year in a best-case scenario.

"I'm cautiously optimistic we'll make it through Campaign 16," she said. "Anything past that is gravy."

Enter TESS

But as Kepler approaches the end of its life, NASA's next mission to search for exoplanets is gearing up for launch. At an Orbital ATK facility near Washington Dulles International Airport, technicians are completing final tests on the Transiting Exoplanet Survey Satellite (TESS), a NASA mission scheduled for launch this spring.

TESS, like Kepler, will look for exoplanets by detecting very small changes in brightness of stars as orbiting plans cross, or transit, their disks. But while Kepler initially examined a single, small area of the sky in an effort to determine the fraction of stars with planets, TESS will instead perform an all-sky survey, focused on the brightest stars nearest to Earth.

That search is intended to find exoplanets well-suited to follow up observations by other telescopes, including the upcoming James Webb Space Telescope, that can help determine their mass and composition, and even study their atmospheres.

“TESS is tiny, but it punches above its weight,” said George Ricker, principal investigator for TESS at the Massachusetts Institute of Technology, during the Kepler town hall. “It’s a finder scope for JWST.”

The spacecraft, 1.5 meters tall and weighing a few hundred kilograms, will ship in early February to Florida’s Kennedy Space Center for launch processing. TESS will launch no earlier than March 20 on a SpaceX Falcon 9 rocket into an elliptical orbit that is in a 2:1 resonance with the moon.

That orbit, Ricker said, is very stable and also allows for high data rates from the spacecraft. However, it limits the days on which TESS can launch in order to phase into the proper trajectory. Ricker said there were about 40 days through June on which TESS could launch.

The four cameras on TESS will map nearly the entire sky over its two-year primary mission. Astronomers expect that TESS will detect thousands of exoplanets, many of which will be ideal for follow-up observations by other telescopes, including the James Webb Space Telescope, to characterize them. Any extended mission, Ricker said, would allow TESS to fill in gaps in observations from its primary mission or do follow-up studies in other parts of the sky.

Shifting focus

TESS has not been without its problems, though. NASA confirmed last July that engineers discovered that the focus in the four cameras on TESS would drift once the cameras cool to operating temperatures after launch. At the time, the agency said that it believed the issue would not be a major problem for the mission, although other astronomers expressed concern it could affect the spacecraft’s ability to detect exoplanets.

Additional testing and analysis since then has given those involved with the mission greater confidence that they understand the focus issue and that it won’t adversely affect the mission’s science.

“Subsequent testing that we did starting this summer and then into the fall indicated that there is a model” for explaining the focus change, Ricker said at a Jan. 9 briefing about the mission during the AAS conference. “This is a very reproducible crystallization effect for one of the materials used to manufacture the lenses.”

Ricker said the mission did four months of testing on a flight spare camera to understand long-term focus effects. Those tests show that the focus of the camera drifts for about one week, then stops. “There’s essentially no measurable change after that,” he said, calling the issue a one-time “focus shift” rather than a more continuous “focus drift.”

That focus shift, he said, won’t affect the ability of TESS to meet its primary, or “Level One,” science requirements, which call for eventually measuring the mass of at least 50 planets similar in size to the Earth. The mission’s primary focus on photometry — measuring very small changes in brightness of stars — also minimizes the importance of a sharp focus.

“This is a photometry mission, not an imaging mission,” he said. “What this means is that it’s not important to have a sharp focus across the entire field of view. This was never part of the design. But it is important that the focus be stable, and that’s what we’ve been able to establish.”

A wide range of science

TESS has also attracted interest from other astronomers wanting to use spacecraft data for other research. Padi Boyd, director of the guest investigator program for TESS at NASA's Goddard Space Flight Center, said at the briefing that there was a very strong response to a first call for proposals to participate on the mission, with scientists proposing to use TESS data for topics ranging from other exoplanet studies to stellar astrophysics and extragalactic astronomy.

"We were very excited to see how the broader scientific community really responded to this opportunity," she said, adding that the initial set of guest investigations will be announced in about a month.

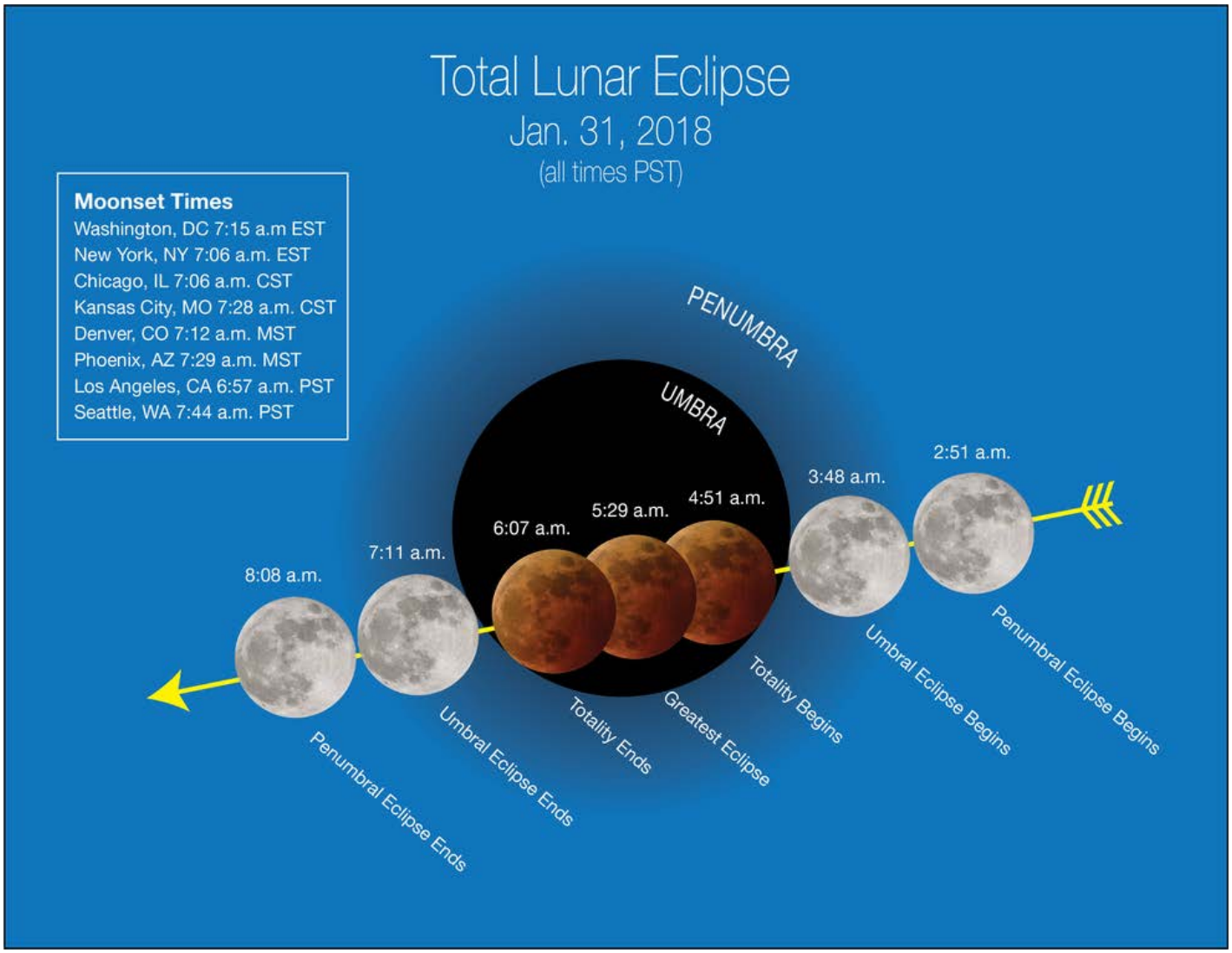
While TESS has a two-year primary mission, Ricker said he believed that the spacecraft could operate for much longer. The stability of its orbit, he said, requires no station-keeping, and hence limits the use of thrusters. "The operational life of the mission could very well extend for more than two decades," he said.

For Kepler, the science will continue long after the spacecraft exhausts its fuel later this year. As with TESS, Kepler attracted astronomers interested in using the spacecraft for more than just exoplanet science during the K2 mission, particular as the spacecraft looked at different parts of the sky.

Dotson said she expects astronomers to tap into the archive of Kepler data for various research for years to come. "While we're running low on fuel," she said, "the science is just getting going."

Source: Space News Return to Contents

2. ‘Super Blue Blood Moon’ Coming Jan. 31



If you live in the western part of North America, Alaska, and the Hawaiian islands, you might set your alarm early the morning of Wednesday, Jan. 31 for a lunar trifecta: a pre-dawn “super blue blood moon.”

“For the (continental) U.S., the viewing will be best in the West,” said Gordon Johnston, program executive and lunar blogger at NASA Headquarters in Washington. “Set your alarm early and go out and take a look.”

The Jan. 31 full moon is special for three reasons: it’s the third in a series of “supermoons,” when the Moon is closer to Earth in its orbit -- known as perigee -- and about 14 percent brighter than usual. It’s also the second full moon of the month, commonly known as a “blue moon.” The super blue moon will pass through Earth’s shadow to give viewers in the right location a total lunar eclipse. While the Moon is in the Earth’s shadow it will take on a reddish tint, known as a “blood moon.”

If you live in North America, Alaska, or Hawaii, the eclipse will be visible before sunrise on Jan. 31. For those in the Middle East, Asia, eastern Russia, Australia and New Zealand, the “super blue blood moon” can be seen during moonrise in the morning on the 31st.

“Weather permitting, the West Coast, Alaska and Hawaii will have a spectacular view of totality from start to finish,” said Johnston. “Unfortunately, eclipse viewing will be more challenging in the Eastern time zone. The

eclipse begins at 5:51 AM ET, as the Moon is about to set in the western sky, and the sky is getting lighter in the east."

So for viewers in New York or Washington, D.C., the Moon will enter the outer part of Earth's shadow at 5:51 a.m., but Johnston says it won't be all that noticeable. The darker part of Earth's shadow will begin to blanket part of the Moon with a reddish tint at 6:48 a.m. EST, but the Moon will set less than a half-hour later. "So your best opportunity if you live in the East is to head outside about 6:45 a.m. and get to a high place to watch the start of the eclipse—make sure you have a clear line of sight to the horizon in the west-northwest, opposite from where the Sun will rise," said Johnston.

If you live in the Central time zone, viewing will be better, since the action begins when the Moon is higher in the western sky. At 4:51 a.m. CST the penumbra -- or lighter part of Earth's shadow – will touch the Moon. By about 6:15 a.m. CST the Earth's reddish shadow will be clearly noticeable on the Moon. The eclipse will be harder to see in the lightening pre-dawn sky, and the Moon will set after 7:00 a.m. as the Sun rises. "So if you live in Kansas City or Chicago, your best viewing will be from about 6:15-6:30 a.m," said Johnston. "Again, you'll have more success if you can go to a high place with a clear view to the West."

In the Rocky Mountain region, the show begins as the umbra touches the edge of the Moon at 4:48 a.m. MST. The peak of the blood moon eclipse is at about 6:30 a.m. local time, and the Moon will set shortly after 7 a.m.

Californians and viewers in western Canada will be treated to the total eclipse phase from start to finish, though the penumbral shadow will pass after the Moon has set. The umbral eclipse begins at 3:48 a.m. Pacific Time. At 4:51 a.m., totality will begin, with best viewing between about 5:00 and 6:00 a.m. local time. The totality phase ends about 6:05 a.m.

Weather permitting, eclipse fans in Hawaii will experience the lunar eclipse from start to finish, as will skywatchers in Alaska, Australia and eastern Asia.

If you miss the Jan. 31 lunar eclipse, you'll have to wait almost another year for the next opportunity in North America. Johnston said the Jan. 21, 2019 lunar eclipse will be visible throughout all of the U.S. and will be a supermoon, though it won't be a blue moon.

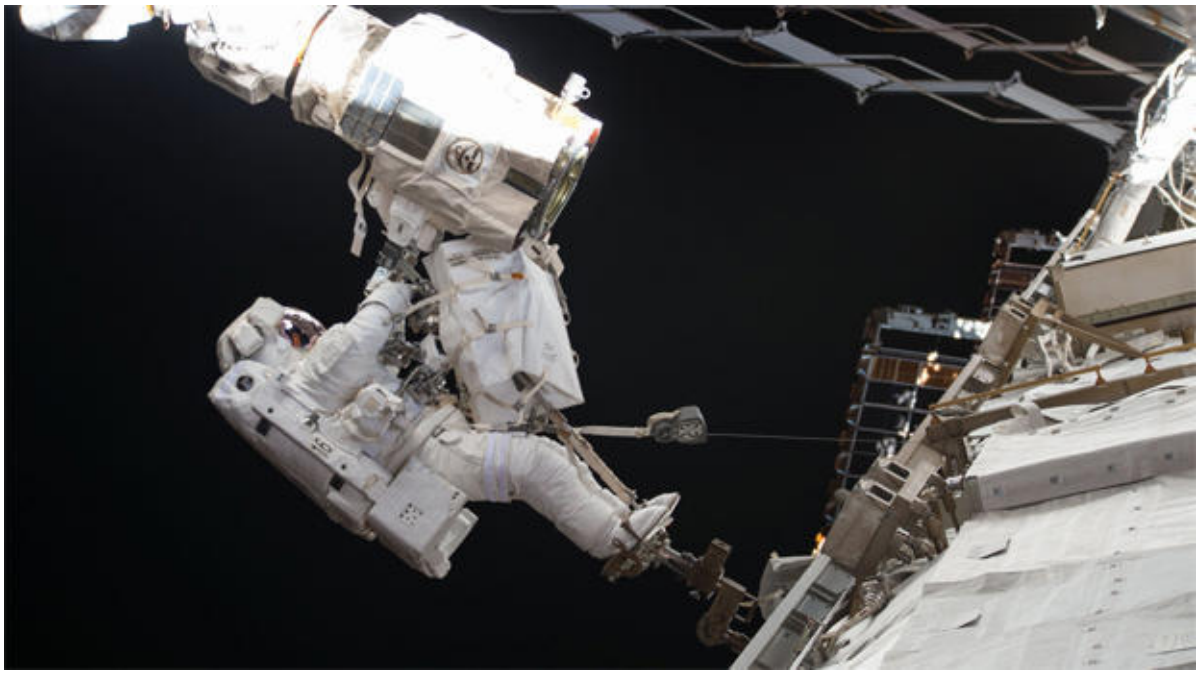
Johnston has been following and writing about the Moon since 2004, when he and about 20 colleagues at NASA Headquarters would get together after work during the full moon in "celebratory attire"—which for Johnston meant his signature bow tie. Long after the socializing fell by the wayside, Johnston's monthly blog lives on, with a dedicated following on NASA's lunar website, moon.nasa.gov.

Said Johnston, "I have always been fascinated by the night sky. Most of what we can see without a telescope are points of light, but the Moon is close enough that we can see it and the features on it, and notice what changes and what stays the same each night."

To watch a NASA ScienceCast video, A Supermoon Trilogy about the Dec. 3, 2017, Jan. 1, 2018, and Jan. 31, 2018 supermoons, click here.

Source: NASA Return to Contents

3. Spacewalkers service station’s robot arm



Two astronauts floated outside the International Space Station early Tuesday to replace one of the grapple fixtures on the end of the lab's robot arm, the first of two excursions over the next week to complete a complex overhaul that began with a pair of spacewalks last October.

Floating in the station's Quest airlock, astronaut Mark Vande Hei and crewmate Scott Tingle switched their spacesuits to battery power at 6:49 a.m. EST (GMT-5) to officially kick off a planned 6.5-hour spacewalk, the first of 2018 and the 206th since station assembly began in 1998.

"Make us proud out there, we'll have hot chow when you get back," astronaut Joe Acaba radioed from inside the station.

For identification, Vande Hei, call sign EV-1, is wearing a spacesuit with red stripes and using helmet camera No. 18. Tingle, EV-2, is wearing an unmarked suit and is using helmetcam 20.

The goal of the spacewalk is to complete repairs on the station's Canadarm 2 space crane, a 50-foot-long robot arm that can move end over end, inchworm fashion, from one mounting fixture to another to reach various work sites along the station's main power truss.

Each end of the arm is equipped with a complex grapple fixture, known as a latching end effector, or LEE, that uses motorized snares to lock onto anchor fittings and plug into power, data and video connectors. Arm anchor points are mounted on station modules and on a mobile base rail car that can carry the arm to work sites along the truss.

With one latching end effector locked onto station structure or the mobile base, the LEE on the far end can be used to move astronauts, station components and even visiting cargo ships from point to point.

The arm was launched to the station aboard a space shuttle in 2001. Last October, astronauts replaced one aging grapple mechanism -- LEE-A -- and during Tuesday's outing, Vande Hei and Tingle plan to replace LEE-B with a spare that was launched in 2009.

The LEE mechanism is roughly cylindrical, about three fee long and weighs, on Earth, about 450 pounds.

"This is a complex mechanical package," said Tim Braithwaite, a Canadian Space Agency liaison officer at NASA. "This does all the hard work of grasping physical interfaces as the arm is reaching out, whether the arm is walking end-over-end around the space station or picking up DEXTRE, our two-armed robot, to do space station maintenance or catching free-flying cargo vehicles. This is where all of that work is taking place."

Vande Hei and Tingle will first set up the spare LEE for removal from External Stowage Platform No. 2 and then astronaut Joseph Acaba, operating the robot arm from inside the station, will move the LEE-B end of the arm down to the spacewalkers. The degraded LEE-B mechanism will be unbolted and temporarily stowed. The spare unit then will be installed.

During a spacewalk next Monday, Vande Hei and Japanese astronaut Norishige Kanai will conduct a second spacewalk to mount the degraded LEE-B mechanism on a spare anchor fitting on the mobile base rail car. If all goes well, it will remain there for the life of the space station, used sparingly to hold components in place as required.

With the completion of Tuesday's spacewalk, "Canadarm 2 will have fresh hands and be ready to get about the business of the rest of the program," Braithwaite said. "Worth noting, these original Canadarm 2 LEEs both comfortably exceeded their design expectation, lasted years longer than we thought they were going to. So we're really pleased with that."

Tuesday's spacewalk is the 206th devoted to station assembly and maintenance since 1998, the first of up to 12 U.S. and Russian EVAs planned for 2018, the third for Vande Hei and the first for Tingle.

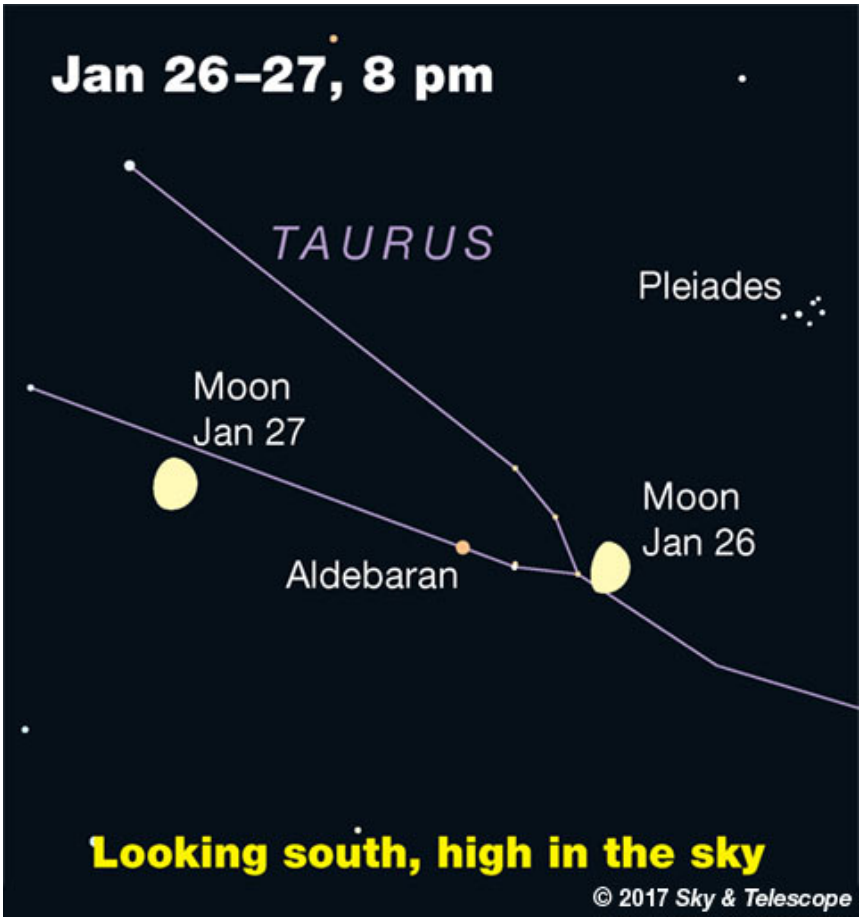
Source: CBS News Return to Contents

The Night Sky

Tuesday, January 23

• Face east after dark and look very high for brilliant Capella, the Goat Star. To the right of it, by a couple of finger-widths at arm's length, is a small, narrow triangle of 3rd and 4th magnitude stars known as "the Kids." Though they're not exactly eye-grabbing, they form a never-forgotten asterism with Capella.

Around 9 p.m. they all pass straight overhead (for skywatchers at mid-northern latitudes).



Wednesday, January 24

• First-quarter Moon (exact at 5:20 p.m. EST). The Moon shines next to the dim Head of Cetus; look for Alpha Ceti (Menkar), magnitude 2.5 and tinted orange, about 10° to the Moon's left soon after dark (for North America).

A similar distance below the Moon, and a bit left, is Mira, Omicron Ceti, the prototype red long-period variable star. Mira is at its peak brightness this week, about magnitude 3.5. See Bob King's article Mira Makes January Nights "Wonderful", with sky chart.

Thursday, January 25

• Now Menkar shines about 10° *below* the Moon by mid-evening. And you'll find the Pleiades about half again that far above the Moon.

Friday, January 26

• The Moon, two days past first quarter, shines to the right of Aldebaran and lower left of the Pleiades this evening, as shown here (for the middle of North America).

• Later, the Moon's dark limb *occults* Aldebaran as seen from far northwestern North America during the early-morning hours of Saturday. Map and timetables.

Source: Sky & Telescope

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ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Tue Jan 23, 7:36 PM	< 1 min	13°	10° above SW	13° above SW
Wed Jan 24, 6:44 PM	3 min	43°	11° above SSW	43° above SSE
Thu Jan 25, 5:52 PM	4 min	22°	11° above S	13° above E
Thu Jan 25, 7:29 PM	< 1 min	20°	20° above W	20° above W
Fri Jan 26, 6:37 PM	2 min	69°	28° above WSW	44° above NNE

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

NASA-TV Highlights

(all times Eastern Daylight Time)

11:30 a.m., Thursday, January 25 - ISS Expedition 54 Educational In-Flight Event with West Virginia Wesleyan College in Buckhannon, West Virginia and NASA Flight Engineer Joe Acaba (starts at 11:35 a.m.) (all channels)

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

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Space Calendar

- Jan 23 - Comet C/2018 A1 (PANSTARRS) Closest Approach To Earth (2.074 AU)
- Jan 23 - Comet 249P/LINEAR At Opposition (4.041 AU)
- Jan 23 - Apollo Asteroid 2018 AJ Near-Earth Flyby (0.012 AU)
- Jan 23 - NEW [Jan 18] Apollo Asteroid 2018 AK12 Near-Earth Flyby (0.018 AU)
- Jan 23 - NEW [Jan 17] Apollo Asteroid 2018 AV11 Near-Earth Flyby (0.029 AU)
- Jan 23 - NEW [Jan 21] Aten Asteroid 2018 BT1 Near-Earth Flyby (0.039 AU)
- Jan 23 - Asteroid 495181 Rogerwaters Closest Approach To Earth (1.800 AU)
- Jan 24 - Comet P/1999 XN120 (Catalina) Closest Approach To Earth (2.454 AU)
- Jan 24 - NEW [Jan 22] Apollo Asteroid 2018 BA3 Near-Earth Flyby (0.008 AU)
- Jan 24 - NEW [Jan 21] Apollo Asteroid 2018 BG1 Near-Earth Flyby (0.028 AU)
- Jan 24 - NEW [Jan 21] Aten Asteroid 2018 BP1 Near-Earth Flyby (0.049 AU)
- Jan 24 - NEW [Jan 22] Amor Asteroid 2018 AM12 Near-Earth Flyby (0.081 AU)
- Jan 24 - Asteroid 9879 Mammuthus Closest Approach To Earth (1.846 AU)
- Jan 24 - Centaur Object 32532 Thereus At Opposition (11.761 AU)
- Jan 24 - Plutino 208996 (2003 AZ84) At Opposition (43.607 AU)
- Jan 24 - Ernst Heinkel's 130th Birthday (1888)
- Jan 25 - Telsa Roadster Falcon 9 Heavy Maiden Launch
- Jan 25 - SES-14/ Al Yah-3 Ariane 5 Launch
- Jan 25 - Asteroid 7850 Buenos Aires Closest Approach To Earth (1.505 AU)
- Jan 25 - Asteroid 25000 Astrometria Closest Approach To Earth (1.921 AU)
- Jan 25 - Asteroid 184784 Bettiepage Closest Approach To Earth (2.122 AU)
- Jan 25 - 35th Anniversary (1983), IRAS Launch
- Jan 26 - Comet 238P/Read At Opposition (2.250 AU)
- Jan 26 - Comet 343P/NEAT-LONEOS At Opposition (2.685 AU)
- Jan 26 - NEW [Jan 18] Apollo Asteroid 2018 AL12 Near-Earth Flyby (0.021 AU)
- Jan 26 - Aten Asteroid 2011 CD66 Near-Earth Flyby (0.079 AU)
- Jan 26 - Asteroid 19019 Sunflower Closest Approach To Earth (1.637 AU)
- Jan 26 - Asteroid 1140 Crimea Closest Approach To Earth (1.883 AU)
- Jan 26 - Asteroid 1913 Sekanina Closest Approach To Earth (1.890 AU)
- Jan 26 - 40th Anniversary (1978), IUE Launch
- Jan 26 - Leo Goldberg's 105th Birthday (1913)

Source: JPL Space Calendar

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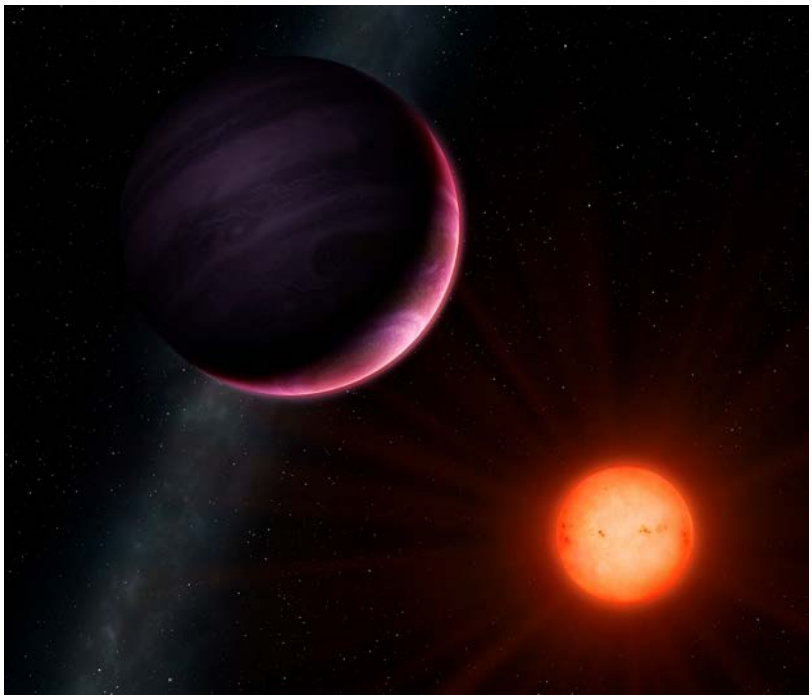
Food for Thought

Scientist proposes new definition of a planet



Pluto hogs the spotlight in the continuing scientific debate over what is and what is not a planet, but a less conspicuous argument rages on about the planetary status of massive objects outside our solar system. The dispute is not just about semantics, as it is closely related to how giant planets like Jupiter form.

Johns Hopkins University astrophysicist Kevin Schlaufman aims to settle the dispute.

In a paper just published in the *Astrophysical Journal*, Schlaufman has set the upper boundary of planet mass between four and 10 times the mass of the planet Jupiter.

Schlaufman, an assistant professor in the university's Department of Physics & Astronomy, says setting a limit is possible now mainly due to improvements in the technology and techniques of astronomical observation. The advancements have made it possible to discover many more planetary systems outside our solar system and therefore possible to see robust patterns that lead to new revelations.

"While we think we know how planets form in a big picture sense, there's still a lot of detail we need to fill in," Schlaufman said. "An upper boundary on the masses of planets is one of the most prominent details that was missing."

The conclusions in the new paper are based on observations of 146 solar systems, systems, Schlaufman said, is the fact that almost all the data he used was measured in a uniform way. The data are more consistent from one solar system to the next, and so more reliable.

Defining a planet, distinguishing it from other celestial objects, is a bit like narrowing down a list of criminal suspects. It's one thing to know you're looking for someone who is taller than 5-foot-8, it's another to know your suspect is between 5-foot-8 and 5-foot-10.

In this instance, investigators want to distinguish between two suspects: a giant planet and a celestial object called a brown dwarf. Brown dwarfs are more massive than planets, but less massive than the smallest stars. They are thought to form as stars do.

For decades brown dwarfs have posed a problem for scientists: how to distinguish low-mass brown dwarfs from especially massive planets? Mass alone isn't enough to tell the difference bzween the two, Schlaufman said. Some other property was needed to draw the line.

In Schlaufman's new argument, the missing property is the chemical makeup of a solar system's own sun. He says you can know your suspect, a planet, not just by his size, but also by the company he keeps. Giant planets such as Jupiter are almost always found orbiting stars that have more iron than our sun. Brown dwarfs are not so discriminating.

That's where his argument engages the idea of planet formation. Planets like Jupiter are formed from the bottom-up by first building-up a rocky core that is subsequently enshrouded in a massive gaseous envelope. It stands to reason that they would be found near stars heavy with elements that make rocks, as those elements provide the seed material for planet formation. Not so with brown dwarfs.

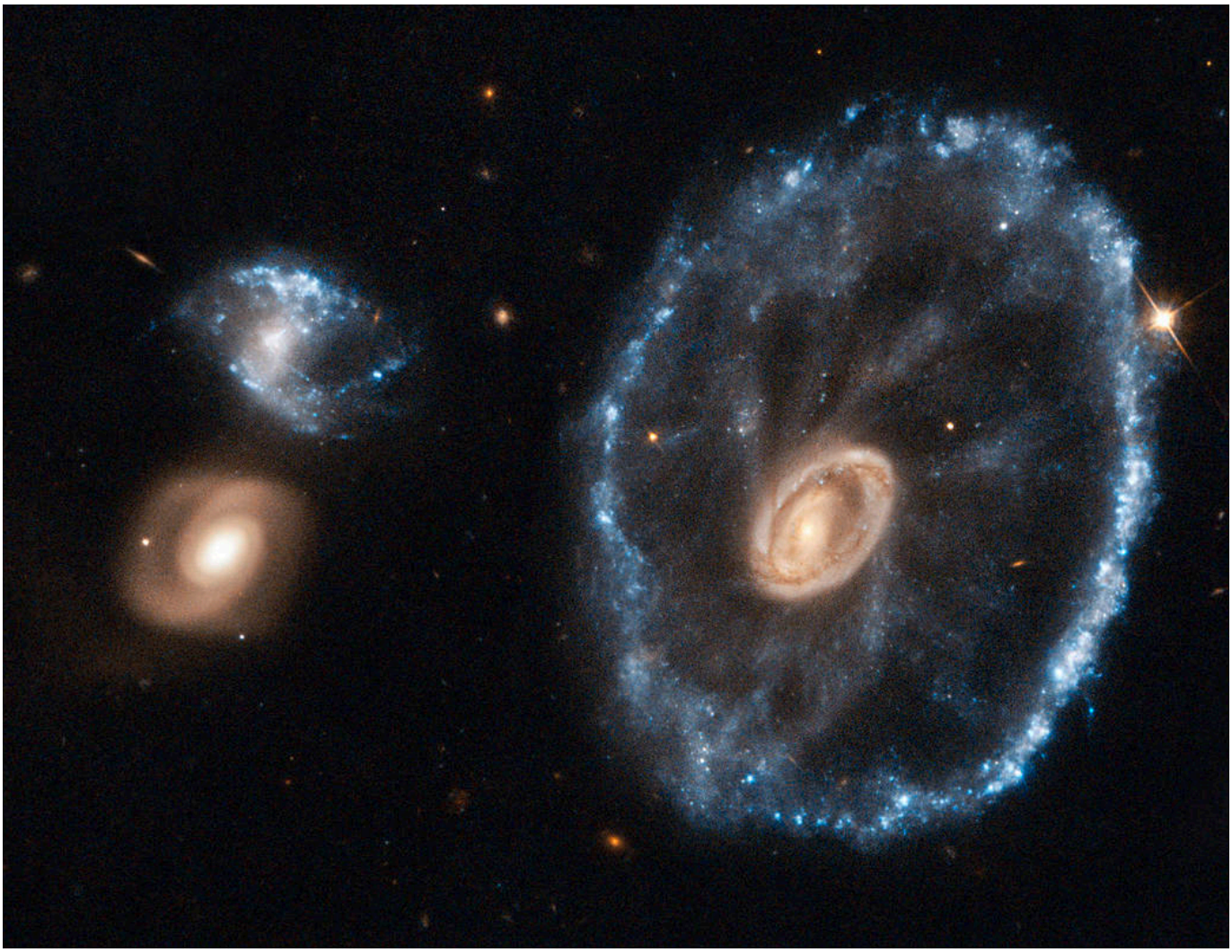
Brown dwarfs and stars form from the top-down as clouds of gas collapse under their own weight.

Schlaufman's idea was to find the mass at which point objects stop caring about the composition of the star they orbit. He found that objects more massive than about 10 times the mass of Jupiter do not prefer stars with lots of elements that make rocks and therefore are unlikely to form like planets.

For that reason, and while it's possible that new data could change things, he has proposed that objects in excess of 10 Jupiter mass should be considered brown dwarfs, not planets.

Source: Phys.org Return to Contents

Space Image of the Week



Hubble's Cartwheel

This is an image of the Cartwheel Galaxy taken with the NASA/ESA (European Space Agency) Hubble Space Telescope.

The object was first spotted on wide-field images from the U.K. Schmidt telescope and then studied in detail using the Anglo-Australian Telescope.

Lying about 500 million light-years away in the constellation of Sculptor, the cartwheel shape of this galaxy is the result of a violent galactic collision. A smaller galaxy has passed right through a large disk galaxy and produced shock waves that swept up gas and dust — much like the ripples produced when a stone is dropped into a lake — and sparked regions of intense star formation (appearing blue). The outermost ring of the galaxy, which is 1.5 times the size of our Milky Way, marks the shock wave's leading edge. This object is one of the most dramatic examples of the small class of ring galaxies.

This image is based on earlier Hubble data of the Cartwheel Galaxy that was reprocessed in 2010, bringing out more detail in the image than seen before.

Source: NASA

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