The Prairie Astronomer

February 2021 Volume 62, Issue #2

February Program:

"A Planet - Not Our Own"

Dr. Elizabeth Tasker, JAXA

The Newsletter of the Prairie Astronomy Club

The Prairie Astronomer

NEXT MEETING AND PROGRAM

February 23, 7:30pm: "A Planet - Not Our Own", via Zoom

Speaker: Dr. Elizabeth Tasker - Associate Professor, Japan Aerospace Exploration Agency (JAXA)

What determines where planet orbits are established, solid vs gas giants? Are planets always within the solar disk? Is the habitable zone the same for every star/planet factor? Do recently identified Exoplanets follow the same "Physics" as our Solar System?

Bob will email the Zoom meeting link to club members on the 23rd.

FUTURE PROGRAMS

To be announced

CONTENTS

Cover: M42 The Great Orion Nebula, taken by Jason O'Flaherty. See page 6.

CALENDAR

PAC Meeting
Tuesday, February 23, 2021, 7:30pm via Zoom

PAC Meeting
Tuesday, March 30, 2021, 7:30pm

PAC Meeting
Tuesday, April 27, 2021, 7:30pm

2021 STAR PARTY DATES

	Date	Date
January	8	**15**
February	5	**12**
March	5	**12**
April	2	**9**
May	7	**14**
June	4	**11**
July	2	**9**
August	Jul 30	**6**
September	Aug 27	**3**
October	1	**8**
November	Oct 29	**5**
December	Nov 26	**3**

Dates in **BOLD** are closest to the New Moon.

CLUB OFFICERS

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Night Sky Network

www.prairieastronomyclub.org

The President's Message

Bob Kacvinsky

Last year at this time we had already had two successful star parties, and there was this weird virus that was popping up in New York and Seattle. We wondered if this might have some minor effects elsewhere. Fast forward to this year we are buried in 20+ inches of snow and temps that make observing "uncomfortable." Oh, and then that virus happened to have an impact on our plans.

I was looking back at our February newsletter that listed our planned meeting programs: March: Comet Observing – Jim Kvasnicka; April: TBD; May: Annual Club Dinner; June: Solar Star Party; July: NSP Review; August: TBD; September: TBD; October: Club Viewing Night; November: How to Buy a Telescope; December: Holiday Gathering. Lot of repeats from previous years. Yet, by the end of February/ early March the Board was deciding to cancel our March meeting and figuring out alternatives moving forward.

As we look back, the circumstances allowed us to "step out of our boxes" and consider alternative meeting programs. We still had the great Comet presentation from Jim in April, and the Solar Observing Party with Dave and James was moved to August, but for our other meetings we had to adapt to a new Zoom norm that could reach speakers that were not possible under previous conditions. Special thanks go out to Jack Dunn who helped us identify several of these programs.

Special programs like Dr. Ken Murphy, SW MN Observatory on Open Space Project; Dr. Tom Fields (Seattle), Sky and Telescope on Spectral Ability to Touch a Star; Dr. Martin Gaskell on Galactic Nuclei; Dr. Raja Couhathakurta on Dark Matter Secrets of the Universe; Dr. Patricia Craig on Roving Mars with Curiosity and Science Lab; Dr. Konstantine Betygin (CalTech) on existence of Planet Nine; Dr. Carter Emmert with high res Open Space images from New Horizon and Pluto; Herb Schwartz on Drake Un Observatory 100th Anniversary; and Dr. Elizabeth Tasker (Japan) on Planet Designs. Five of these presentations were live in person and four were video recordings plus the two live programs from PAC members. Speakers ranged from coast to coast and even Hawaii and Japan. COVID may have shut down our gathering activities, but it also opened a door to new possibilities and allowed PAC members who no longer live in Lincoln to reconnect. While a pile of horse manure may be

unpleasant to some, to those with a childlike imagination it means there is a pony close by. I hope you felt PAC pony-adapted well.

FEBRUARY MEETING PROGRAM. Our Feb meeting program is titled "A Planet – Not Our Own" by Dr. Elizabeth Tasker, Assoc Professor at Japan Aerospace Exploration Agency. Dr. Tasker explains planet formation, how and why they end up in their orbits, positioning, and are newly found exoplanets following the same "physics" as our solar system? Her presentation can relate to all ages while appealing to anyone from 8 to 80. You will not want to miss this one.

The snow and cold has temporarily halted our physical observing but we can look forward to March and April star parties. Several PAC/OAS/ Chicago members are planning a spring "Pre NSP" near Valentine, NE the weekend of April 7-11. There are still a couple rooms available if anyone would like to attend. Let me know if you are interested. No planned program, just very dark sky observing.

As the vaccines are being moved out into the public and we reach herd immunity PAC will monitor options for beginning to host "public" observing events including working with the Hyde Board. In the near term we will maintain our members-only star parties each month. Once the weather warms up, we are planning to resume quarterly Lunar Star parties focused on helping newer members getting use to their telescopes. Watch the newsletter in the coming months for more information.

Please let your PAC Board know if you have any ideas or suggestions on how we can improve your experience within your Prairie Astronomy Club.

Bob Kacvinsky PAC President
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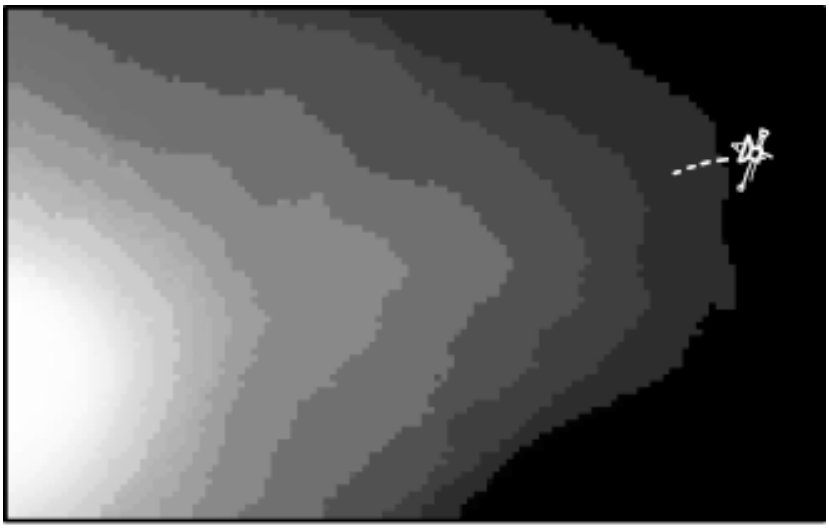


Meeting Minutes

Bill Lohrberg

PAC meeting minutes January 26, 2021 as recorded by Bill Lohrberg

Bob Kacvinsky hosted the Zoom meeting which began at 7:30pm welcoming 20 in attendance.
Due to time limitations started with the program presentation by Herbert "Herb" Schwartz of Drake University Observatory in Des Moines, celebrating the 100 year anniversary of the observatory. Herb shared some very interesting history on how the observatory came to be and how it is still in use today.

Bob Kacvinsky presented the February observing report in Jim Kvasnicka's absence. Details are found in the club newsletter.

Club star party dates were announced for February 5th and 9th, check before going out for locations – either Cortland or Branched Oak and be aware of possible wet, muddy or snowy ground conditions which can be difficult to get into and out of the sites.

Observing made easier topic of the month was an announcement by James Quach of a winter star party in the Florida Keys Feb 8th to 11th, 7pm to 11pm eastern time hosted by the SCAS - Southern Cross Astronomical Society. Virtual access for streamed events will be available during the star party, registration at SCAS.org/winter-star-party.

Some highlights in the News Bob shared that the 34 meter deep space communication dish in Madrid Spain will be critical for the Artemis program and Mars missions. The Perseverance Mars rover's helicopter "ingenuity" will be attempting flight in the thin 1% atmosphere of Mars by way of high speed and relatively large rotors. It flies autonomously and withstands the minus 130 degree Farehnheit night temperatures. If successful will be the first helicopter to fly on another planet.

Schedules and other announcements: Hyde Observatory remains on hold. It is looking like summer time before it may be open. Patience will be rewarded as the observatory will be equipped with updated AV. Also there was mention of the 11" being upgraded. The February 23 PAC meeting will be via Zoom, program will be announced in the newsletter.

Club Treasurer John Reinert gave a summary, no major changes to report. There are still 2 years of club audit needing to be completed.

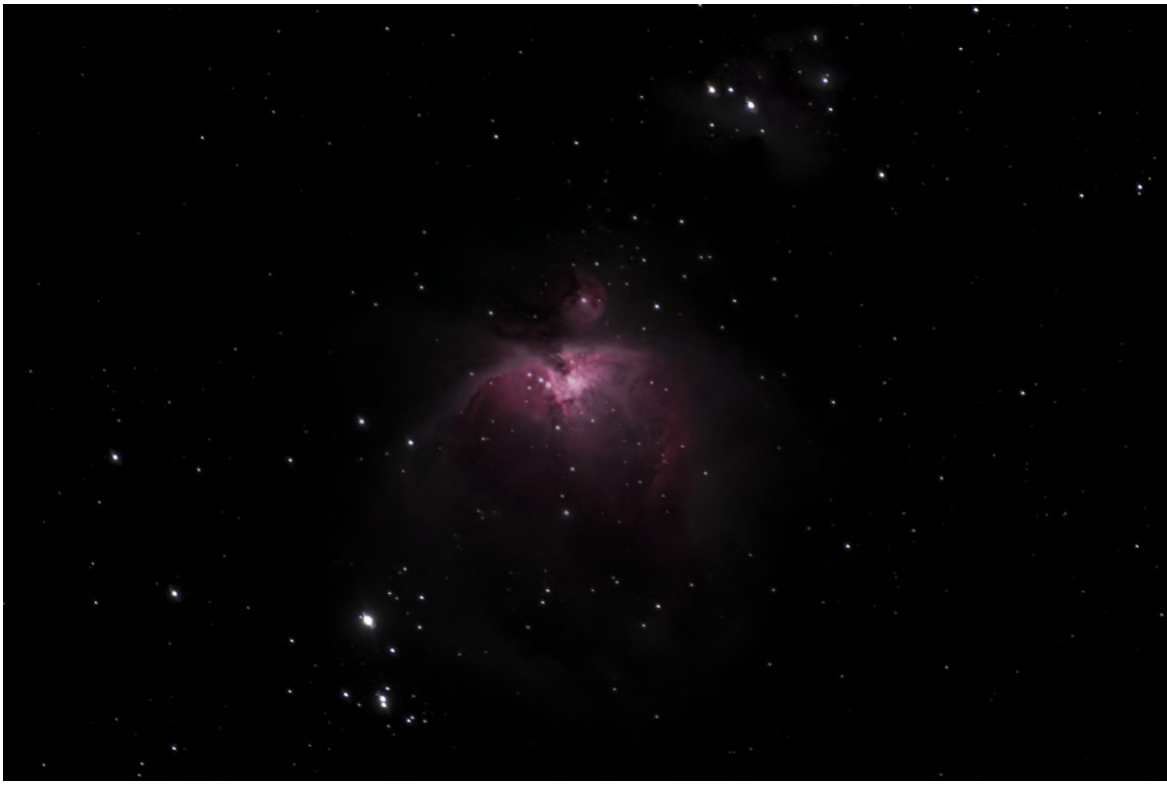
Bob gave a brief summary of the PAC officers board meeting held on January 19th to discuss moving forward in the new year. One topic that was agreed upon is the need to create a nomination committee for the election of officers. Also the idea of a "president elect" position was discussed – the president elect could be then oriented prior to taking over the duties and responsibilities suddenly. This may alleviate the hesitation to take on the role for an incoming club president.

At approximately 7:54pm the meeting was concluded with no further business.

Astrophotos

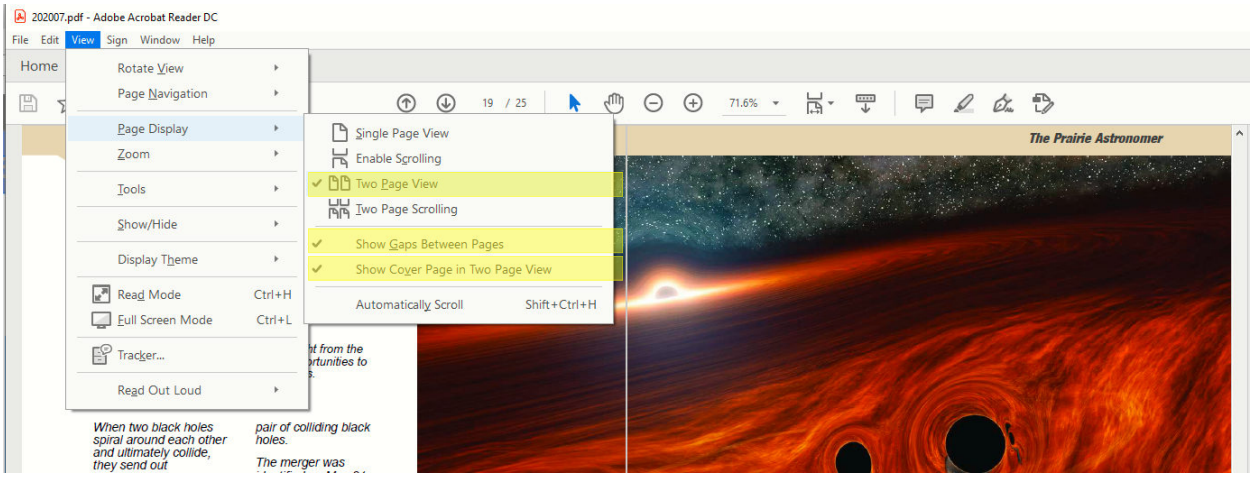
Jason O'Flaherty

This month I have M42 - The Great Orion Nebula captured on January 25th, 2021. It is 6 frames at 120 sec each using a Fujifilm XT-4 at 540mm f/8 ISO-320. My notes on capturing it are on my website at: https://www.jasonoflaherty.com/messier-objects/m42.



New Newsletter Format

How to Adjust Adobe Acrobat Settings for Two Page View



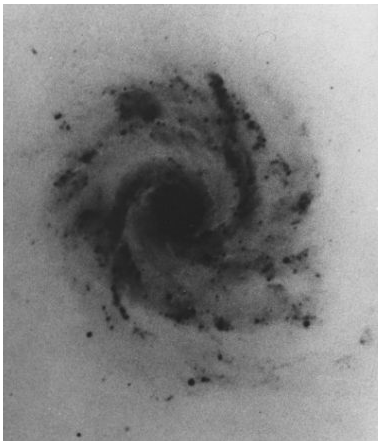
*To view this newsletter in magazine spread format in Acrobat, select **View ->Page Display->Two Page View**. Acrobat will then show two pages side by side. Also make sure the checkboxes "Show Cover Page in Two Page View" and "Show Gaps Between Pages" are checked.*

If you have it setup correctly, the cover page will be displayed by itself and subsequent pages will be side by side with the odd numbered pages on the left.

ARP 27

Rick Johnson

Arp 27/NGC 3631 is a grand design spiral in Ursa Major. Redshift shows it to be about 62 million light-years distant. A Tully-Fisher measurement says 70 million light-years. Pretty good agreement as these things go. Arp puts this one in his category of spiral galaxies with one heavy arm. NED classes it as SA(s)c. At magnitude 10.6 this is a good one for visual observers. Arp's comment on this one reads: "Note straight arm, absorption tube crossing from inside to outside of south arm." The straight arm he refers to is easy to spot. The absorption tube is likely the dark feature from upper left to lower right crossing the narrow arm. A narrow line of star clusters continues on what would be the upper side if it continued further southwest. 3 clouds might be along the lower side of it.



ARP's image

Often I've mentioned "So many galaxies, too few grad students." Finally, I hit one a student (undergraduate) worked on in 2007. She didn't have time to finish her project as it was a summer stipend only but has a web page up on what she did find. So rather than me rattle on I'll refer you to her web page on it.

http://www.astro.wisc.edu/~crystal/index.html

My annotated image has one galaxy listed as an AGN but Sloan lists it as a quasar. It looks like a galaxy in my image, I see no starlike point that would be expected from a quasar. Still, I've listed it as G/Q.

I found some images of the galaxy at the Hubble Legacy Archive. I made a mono image from the best of them. None are all that good and the wrong bands for good color. At Hubble's limited field and higher resolution, the galaxy looks very normal. Even the "straight arm" looks normal along the part that is within its limited field of view. Due to the high noise level in the image, I'm reproducing it at half scale. This is sufficient to show Hubble can resolve the brightest blue stars in this galaxy. Some of the knots in my image are made up of the light of only two or three of them in some cases. If they were standing alone some would be within my reach.

The Sloan survey shows several "galaxies" within the disk of Arp 27. I didn't include these when I made the annotated image as I felt they were just parts of the galaxy and not really

The Mantrap Skies Image Catalog

Rick Johnson, a founding member of the Prairie Astronomy Club, passed away in January, 2019. His legacy lives on through his comprehensive catalog of over 1600 images at www.mantrapskies.com.

ARP27, continued.

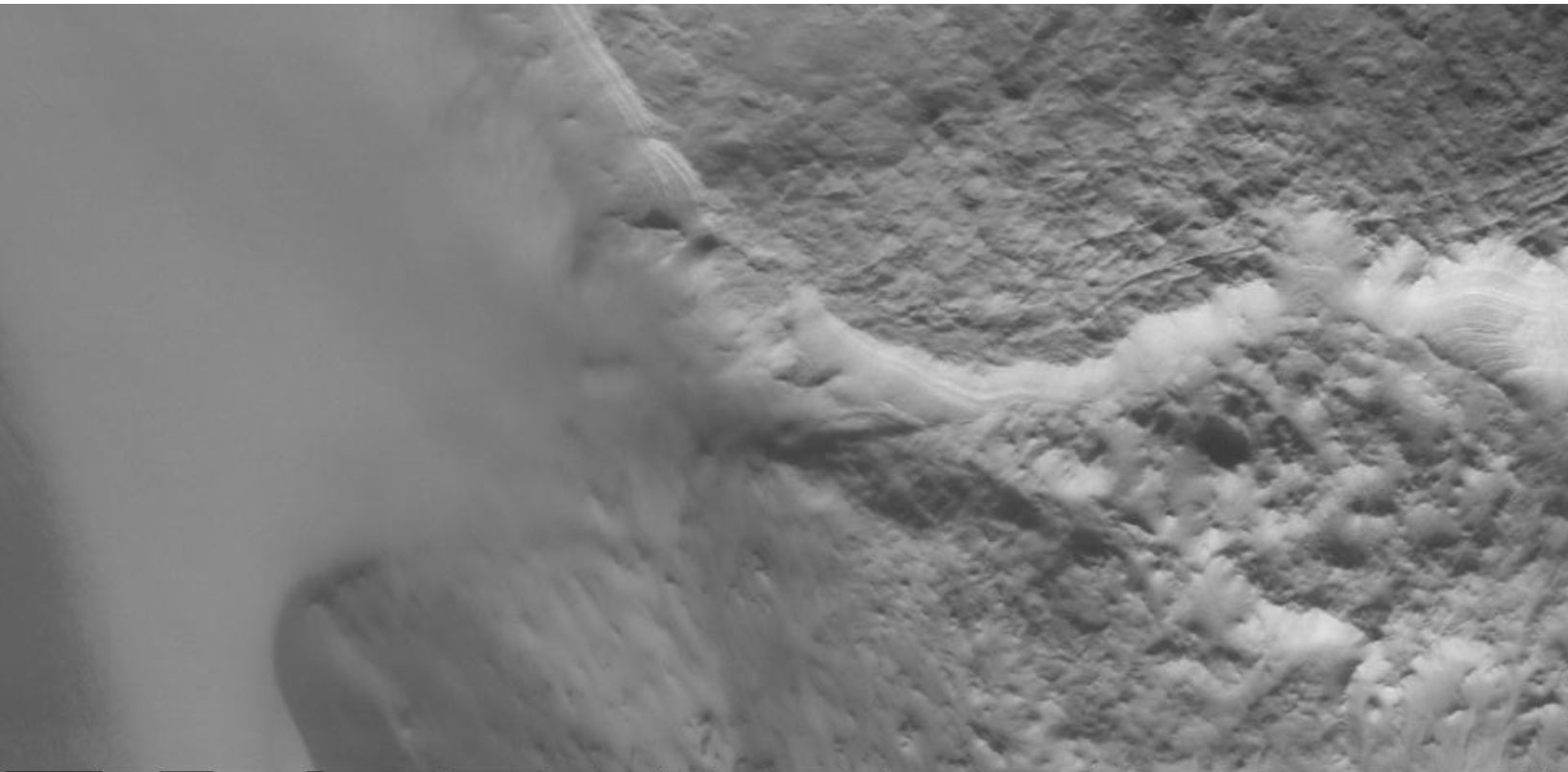
separate galaxies. Some were marked as PoG for this reason but most are shown without that label. Those that are within the Hubble field are seen to be just PoG as I suspected. This pretty well convinces me those outside the field are likely not separate galaxies either.

I found few images of this one taken by amateurs. That surprised me as it is within easy reach of most imagers and is a rather classic galaxy. Just not one you hear of very often.

The image is noisier than I'd like as the night cooled more than I expected. I was imaging at -25C when the temperature suddenly fell to well below that. I was running unregulated for three of the 4 luminance images. The temperature fell about 2C every 10 minutes! I was unable to fully compensate for the dark current because of this. The software records the temperature it was taken at but only at one point in the exposure, the end. This tells the software the wrong temperature and it under compensates for the dark current noise. I had to guess an average temperature to use for each frame and edit the header to that value. I'm sure I didn't always hit it right judging by the resulting noise figure. Still, it will have to do until I can reimage it.

The galaxy was discovered by William Herschel on April 14, 1789 and is in the first Herschel 400 program. My notes from April 16, 1985 with my 10" f/5 with humidity reducing transparency some at up to 150x reads: "Large, nearly face on spiral with a starlike nucleus. Outer halo is quite large and grows even bigger with averted vision."

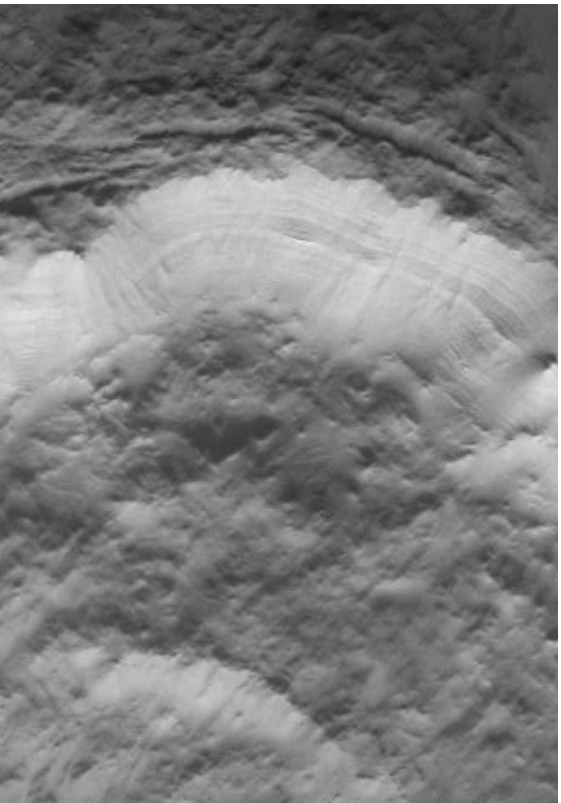
Below: McMurdo Crater, Mars. Located on the margin of the south polar cap, the layering of the ice is visible along the crater rim. McMurdo Crater is name for McMurdo Station in Antarctica. Captured: 2021-01-06 22:46. CREDIT NASA/JPL-Caltech/ASU



A Technicolor Mound near Oxia Planum

An isolated, elongated mound (about 1 mile wide and 3.75 miles long) rises above the smooth, surroundingv plains. Horizontal layers are exposed at the northern end of the mound, and its surface is characterized by a very unusual quasi-circular pattern with varying colors that likely reflect diverse mineral compositions.

A closer view shows that the rock has a range of textures, from massive and fractured on the left, to subtle banding or layering on the right. The origin of this mound is unknown, but its formation may be related to the clay-bearing rocks in the nearby Oxia Planum region.



The map is projected here at a scale of 25 centimeters (9.8 inches) per pixel. (The original image scale is 28.5 centimeters [11.2 inches] per pixel [with 1 x 1 binning]; objects on the order of 85 centimeters [33.5 inches] across are resolved.) North is up.

The University of Arizona, in Tucson, operates HiRISE, which was built by Ball Aerospace & Technologies Corp., in Boulder, Colorado. NASA's Jet Propulsion Laboratory, a division of Caltech in Pasadena, California, manages the Mars Reconnaissance Orbiter Project for NASA's Science Mission Directorate, Washington.

MORE INFO

CREDIT

NASA/JPL-Caltech/ University of Arizona

March Observing

Jim Kvasnicka

This is a partial list of objects visible for the upcoming month.

Planets

Mars: Shines at +0.9 in Taurus. On March 4th it is 2½° from the Pleiades.
Uranus: In Aries.
Jupiter, Saturn, and Mercury: In Capricornus at dawn. On March 5th Mercury is 19' from Jupiter. After March 12th Mercury will not be visible.
Neptune: Not visible.
Venus: In conjunction with the Sun. Venus will appear as an evening star mid-April.

Messier List

M41: Open cluster in Canis Major.
M44: The Beehive Cluster in Cancer.
M46/M47: Open clusters in Puppis.
M48: Open cluster in Hydra.
M50: Open cluster in Monoceros.
M67: Open cluster in Cancer
M81/M82: Galaxy pair in Ursa Major.
M93: Open cluster in Puppis.

Last Month: M1, M35, M36, M37, M38, M42, M43, M45, M78, M79
Next Month: M40, M65, M66, M95, M96, M105, M106, M108, M109

NGC and other Deep Sky Objects

NGC 2438: Planetary nebula, foreground object in M46.
NGC 2440: Planetary nebula in Puppis.
NGC 2451: Open cluster in Puppis, bright and irregular.
NGC 2452: Planetary nebula in Puppis, just south of open cluster NGC 2452.
NGC 2477: Bright open cluster in Puppis.
NGC 2537: The Bear Paw Galaxy in Lynx.
NGC 2683: Edge on galaxy in Lynx.

Double Star Program List

Epsilon Canis Majoris: White and light blue pair.
Delta Geminorum: Wasat, yellow and pale red stars.
Alpha Geminorum: Castor, white primary with a yellow secondary.
12 Lyncis: Close pair of yellow-white stars.
19 Lyncis: White stars.
38 Lyncis: White primary with a yellow secondary.
Zeta Cancri: Yellow and pale yellow stars.
Iota Cancri: Yellow and pale blue pair.

Challenge Object

NGC 2562/2563/2560: Trio of dim galaxies, part of the Cancer I Galaxy Group.

Focus on Observing

Observing Chair Report

Jim Kvasnicka

In the newsletter the past two years I've been highlighting different observing programs offered by the Astronomical League that PAC members can do. In that period I covered over 24 observing programs. The Astronomical League offers many more observing programs and you can review them all on their web site astroleage.org/observing.

Part of my responsibilities as the club observing chair is to provide a monthly observing report in the newsletter and at our monthly meeting. I also keep PAC members up to date on upcoming star parties and if there are any special observing events happening in the near future. I also feel it is my responsibility to get members out to observe and to start one of the many observing programs. Doing an observing program gives you a goal and direction for your observing. You don't have to go out and wonder what I'm going to look at tonight. It gives you a reason and purpose to go out and observe.

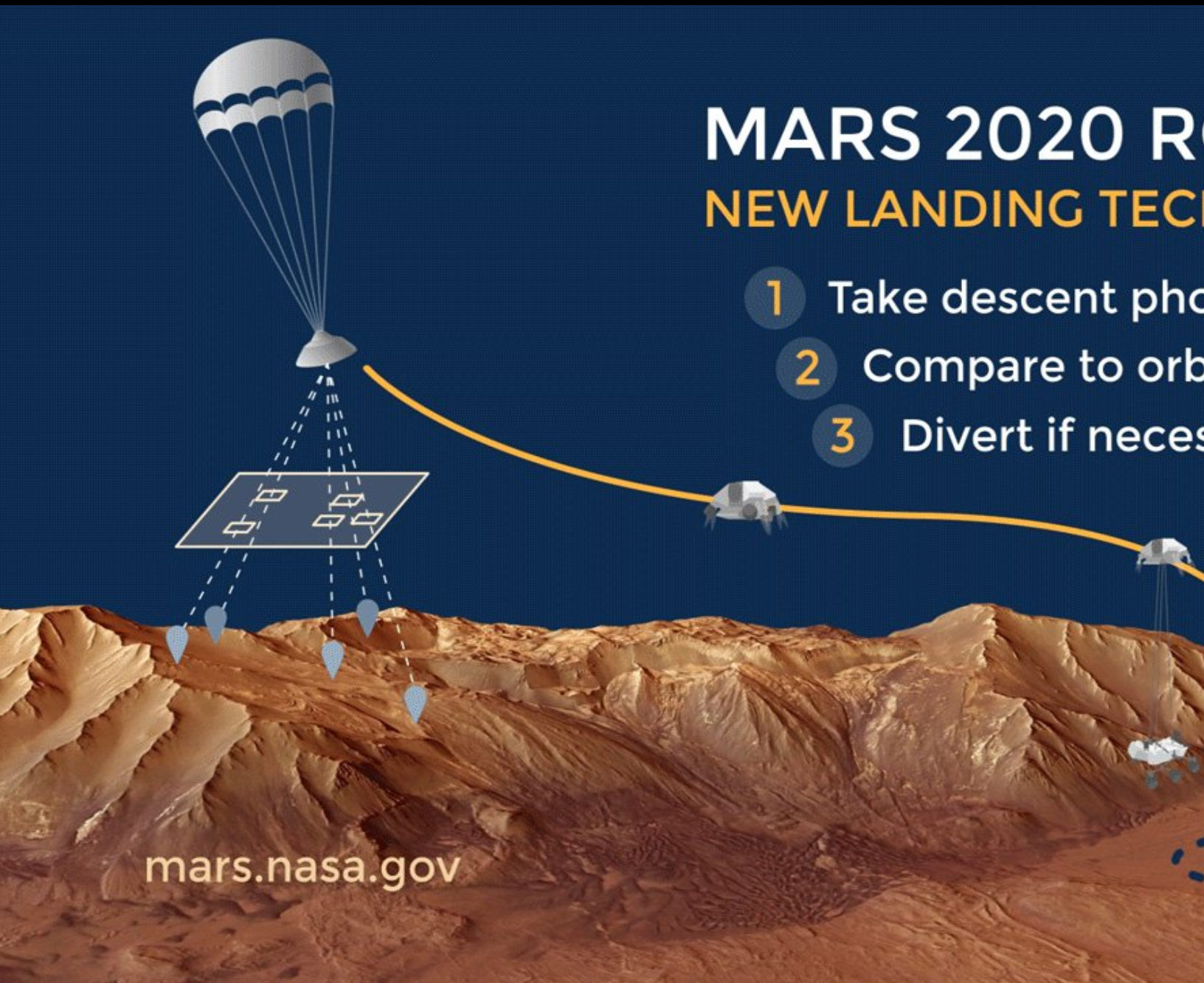
I'm a little concerned regarding our club observing participation. The last observing award we presented was in October of 2018. The Messier Observing Program is usually what new members would do first. Completing the Messier Observing program is somewhat of a milestone. It's an accomplishment that validates you as an amateur astronomer. The last Messier Observing Program award we gave to a club member was in April of 2009, over ten years ago!

I know this winter has been tough to get out and observe. We can only hope for better weather moving forward. When we have better weather my goal is to have better participation at our star parties. If you are a new member and need help the veteran members at the star parties are always willing to help. Once the weather warms up and the snow melts I will plan some Lunar Parties at my house. This is an excellent opportunity for new members to get help using their telescope or finding things in the sky. I was in this situation in 2004 when I joined the club and several members went out of their way to help me for which I'm still grateful.

Let's hope for better weather in the upcoming months and the chance to get out and observe again. Please look at the different observing programs and consider starting one. If you need help getting started or have any questions let me know. I will be changing directions in the newsletter next month and will start to look at the different constellations and what they have to offer.

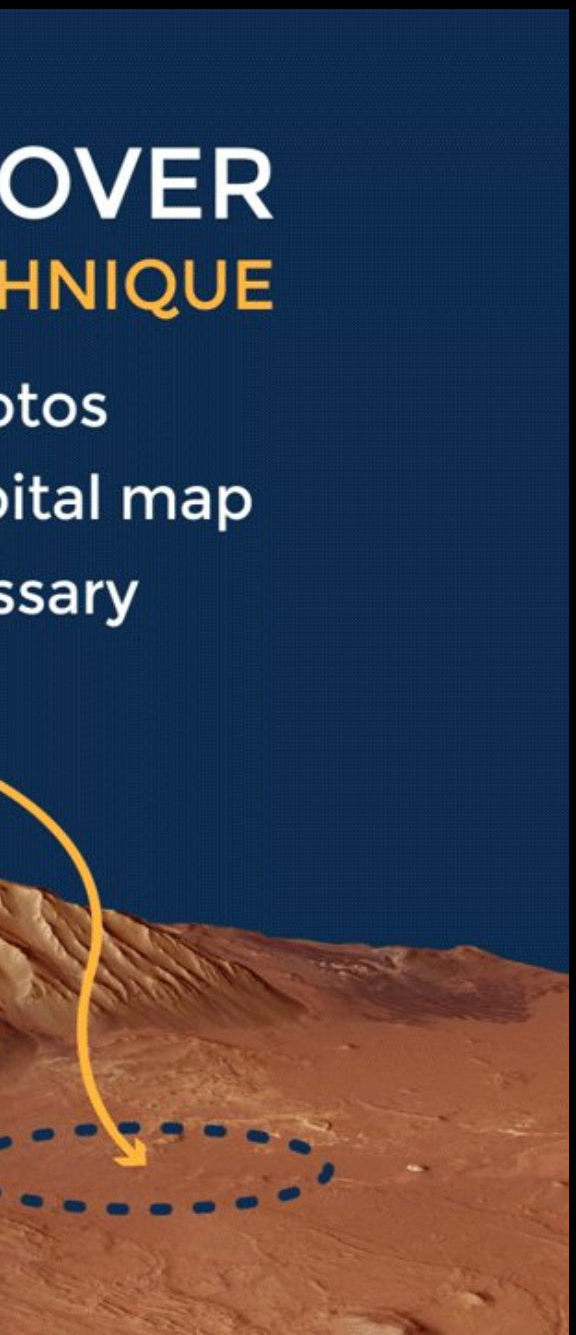
Tricky Terrain: Helping to Assure a Safe Rover Landing

How two new technologies will help Perseverance, NASA's most sophisticated rover yet, touch down onto the surface of Mars this month.



After a nearly seven-month journey to Mars, NASA's Perseverance rover is slated to land at the Red Planet's Jezero Crater Feb. 18, 2021, a rugged expanse chosen for its scientific research and sample collection possibilities.

But the very features that make the site fascinating to scientists also make it a relatively dangerous place to land – a challenge that has motivated rigorous testing here on Earth for the lander vision system (LVS) that the rover will count on to safely touch down.



"Jezero is 28 miles wide, but within that expanse there are a lot of potential hazards the rover could encounter: hills, rock fields, dunes, the walls of the crater itself, to name just a few," said Andrew Johnson, principal robotics systems engineer at NASA's Jet Propulsion Laboratory in Southern California. "So, if you land on one of those hazards, it could be catastrophic to the whole mission."

Enter Terrain-Relative Navigation (TRN), the mission-critical technology at the heart of the LVS that captures photos of the Mars terrain in real time and compares them with onboard maps of the landing area, autonomously directing the rover to divert around known hazards and obstacles as needed.

"For Mars 2020, LVS will use the position information to figure out where the rover is relative to safe spots between those hazards. And in one of those safe spots is where the rover will touch down," explained Johnson.

If Johnson sounds confident that LVS will work to land Perseverance safely, that's because it allows the rover to determine its position relative to the ground with an accuracy of about 200 feet or less. That low margin of error and high degree of assurance are by design, and the result of extensive testing both in the lab and in the field.

"We have what we call the trifecta of testing," explained JPL's Swati Mohan, guidance, navigation, and control operations lead for Mars 2020.

Mohan said that the first two testing areas – hardware and simulation – were done in a lab.

"That's where we test every condition and variable we can. Vacuum, vibration, temperature, electrical compatibility – we put the hardware through its paces," said Mohan. "Then with simulation, we model various scenarios that the software algorithms may encounter on Mars – a too-sunny day, very dark day, windy day – and we make sure the system behaves as expected regardless of those conditions."

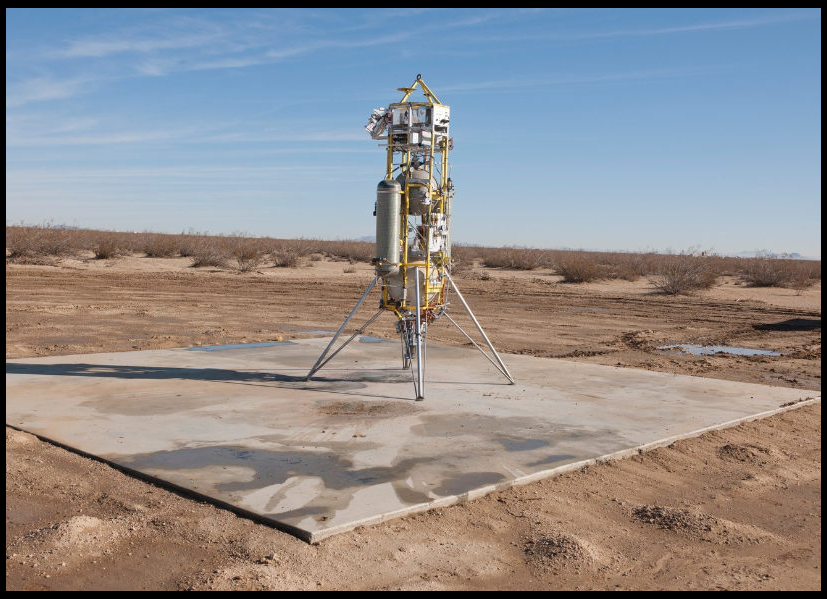
But the third piece of the trifecta – the field tests – require actual flights to put the lab results through further rigor and provide a high level of technical

Rover Landing, continued.

readiness for NASA missions. For LVS's early flight tests, Johnson and team mounted the LVS to a helicopter and used it to estimate the vehicle's position automatically as it was flying.

"That got us to a certain level of technical readiness because the system could monitor a wide range of terrain, but it didn't have the same kind of descent that Perseverance will have," said Johnson. "There was also a need to demonstrate LVS on a rocket."

That need was met by NASA's Flight Opportunities program, which facilitated two 2014 flights in the Mojave Desert on Masten Space Systems' Xombie – a vertical takeoff and vertical landing (VTVL) system that functions similarly to a lander. The flight tests demonstrated LVS's ability to direct Xombie to autonomously change course and avoid hazards on descent by adopting a newly calculated path to a safe landing site. Earlier flights on Masten's VTVL system also helped validate algorithms and software used to calculate fuel-optimal trajectories for planetary landings.



Masten's Xombie VTVL system sits on a launchpad in Mojave, California in December 2014, prepared for a flight test that would help prove lander vision system capabilities for the Mars 2020 Perseverance rover mission. Credit: Masten Space Systems

"Testing on the rocket laid pretty much all remaining doubts to rest and answered a critical question for the LVS operation affirmatively," said JPL's Nikolas Trawny, a payload and pointing control systems engineer who worked closely with Masten on the 2014 field tests. "It was then that we knew LVS would work during the high-speed vertical descent typical of Mars landings."

Johnson added that the suborbital testing in fact increased the technology readiness level to get the final green light of acceptance into the Mars 2020 mission.

"The testing that Flight Opportunities is set up to provide was really unprecedented within NASA at the time," said Johnson. "But it's proven

so valuable that it's now becoming expected to do these types of flight tests. For LVS, those rocket flights were the capstone of our technology development effort."

With the technology accepted for Mars 2020, the mission team began to build the final version of LVS that would fly on Perseverance. In 2019, a copy of that system flew on one more helicopter demonstration in Death Valley, California, facilitated by NASA's Technology Demonstration Missions program. The helicopter flight provided a final check on over six-years of multiple field tests.

But Mohan pointed out that even with these successful demonstrations, there will be more work to do to ensure a safe landing. She'll be at Mission Control for the landing, monitoring the health of the system every step of the way.

"Real life can always throw you curve balls. So, we'll be monitoring everything during the cruise phase, checking power to the camera, making sure the data is flowing as expected," Mohan said. "And once we get that signal from the rover that says, 'I've landed and I'm on stable ground,' then we can celebrate."

About Flight Opportunities

The Flight Opportunities program is funded by NASA's Space Technology Mission Directorate (STMD) and managed at NASA's Armstrong Flight Research Center in Edwards, California. NASA's Ames Research Center in California's Silicon Valley manages the solicitation and evaluation of technologies to be tested and demonstrated on commercial flight vehicles.

About Technology Demonstration Missions

Also under the umbrella of STMD, the program is based at NASA's Marshall Space Flight Center in Huntsville, Alabama. The program bridges the gap between scientific and engineering challenges and the technological innovations needed to overcome them, enabling robust new space missions.

More About the Mission

A key objective for Perseverance's mission on Mars is astrobiology, including the search for signs of ancient microbial life. The rover will characterize the planet's geology and past climate, pave the way for human exploration of the Red Planet, and be the first mission to collect and cache Martian rock and regolith (broken rock and dust).

Subsequent missions, currently under consideration by NASA in cooperation with the European Space Agency, would send spacecraft to Mars to collect these cached samples from the surface and return them to Earth for in-depth analysis.

The Mars 2020 mission is part of a larger program that includes missions to the Moon as a way to prepare for human exploration of the Red Planet. Charged with returning astronauts to the Moon by 2024, NASA will establish a sustained human presence on and around the Moon by 2028 through NASA's Artemis lunar exploration plans.

JPL, which is managed for NASA by Caltech in Pasadena, California, built and manages operations of the Perseverance rover.

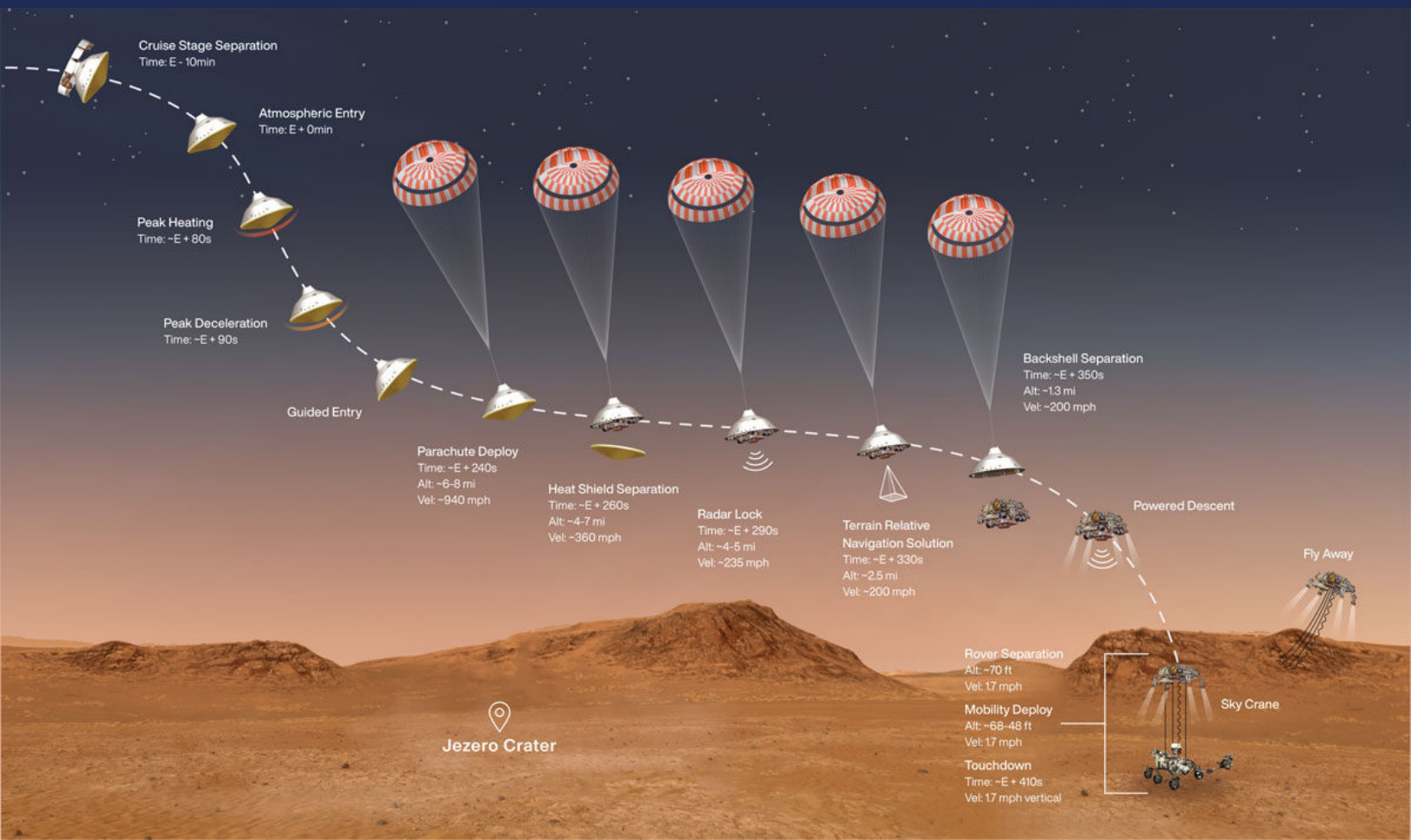
Perseverance EDL Timeline

The NASA TV broadcast from Mission Control starts at 1:15 p.m. CST

Perseverance will touch down on Mars on Thursday, Feb. 18, 2021, at approximately 2:55 p.m. CST). Entry, Descent, and Landing – often referred to as "EDL" – is the shortest and most intense phase of the Mars 2020 mission. It begins when the spacecraft reaches the top of the Martian atmosphere, travelling nearly 12,500 miles per hour (20,000 kilometers per hour). It ends about seven minutes later, with Perseverance stationary on the Martian surface. To safely go from those speeds down to zero, in that short amount of time, while hitting a narrow target on the surface, requires “slamming on the brakes” in a very careful, creative and challenging way.

Ten minutes before entering the atmosphere, the spacecraft sheds its cruise stage, which houses solar panels, radios, and fuel tanks used during its flight to Mars. Only the protective aeroshell – with rover and descent stage inside – makes the trip to the surface. Before entering the atmosphere, the vehicle fires small thrusters on the backshell to reorient itself and make sure the heat shield is facing forward for what comes next.

As the spacecraft enters the Martian atmosphere, the drag produced drastically slows it down – but these forces also heat it up dramatically. Peak heating occurs about 80 seconds after atmospheric entry, when the temperature at the external surface of the heat shield reaches about 2,370 degrees Fahrenheit (about 1,300 degrees Celsius). Safe in the aeroshell, however, the rover gets up to only about room temperature.



From the Archives

February, 2002

Our friend, and GPPA member Tom Gehringer passed away peacefully Saturday, January 12 [2002] following his lengthy battle with cancer. An Omaha native, Tom had been interested in space since hearing Sputnik on his dad's Ham radio. He bought his first telescope while in the seventh grade. Tom received his B.S. in Architectural Studies. University of Nebraska, Lincoln, 1977. Later he found the way to combine his love of astronomy with an interest in teaching as he received his B.S. Secondary Education University of Nebraska, Omaha in 992. He began teaching in the Omaha Public Schools and took over the planetarium at Burke High School to make it nationally recognized. An active member of the Omaha Astronomical Society, he was currently the vice-president of the club. As an avid amateur astronomer, he observed the night sky whenever he could, often taking his wife and boys out to see something spectacular in the heavens. Seeking to further challenge his students, Tom participated in the first Research Based Science Education program, a program sponsored by the National Optical Astronomy Observatories and the National Science Foundation. The project allows students to use real astronomical data on active galactic nuclei and novae to do research - leading his students to national recognition and a trip to the annual meeting of the American Astronomical Society. Tom also created an honors astronomy program at Burke High and was most recently engaged in upgrading the school's planetarium facilities and planning for an observatory. Tom leaves behind wife Pat and his two sons Eric and Brian. Memorials to St. Bernards Renovation Campaign or Burke High Scholarship Fund.

We have been notified by sources at the International Astronomical Union that amateur astronomer and NSO/GONG engineer Roy Tucker has donated an asteroid from his discovery list and the IAU Committee is unanimous in voting to have the asteroid named for Tom.

--Jack Dunn

Asteroid Named in Honor of Tom Gehringer

Asteroid 1997 AT17 is now officially called (31086) Gehringer.

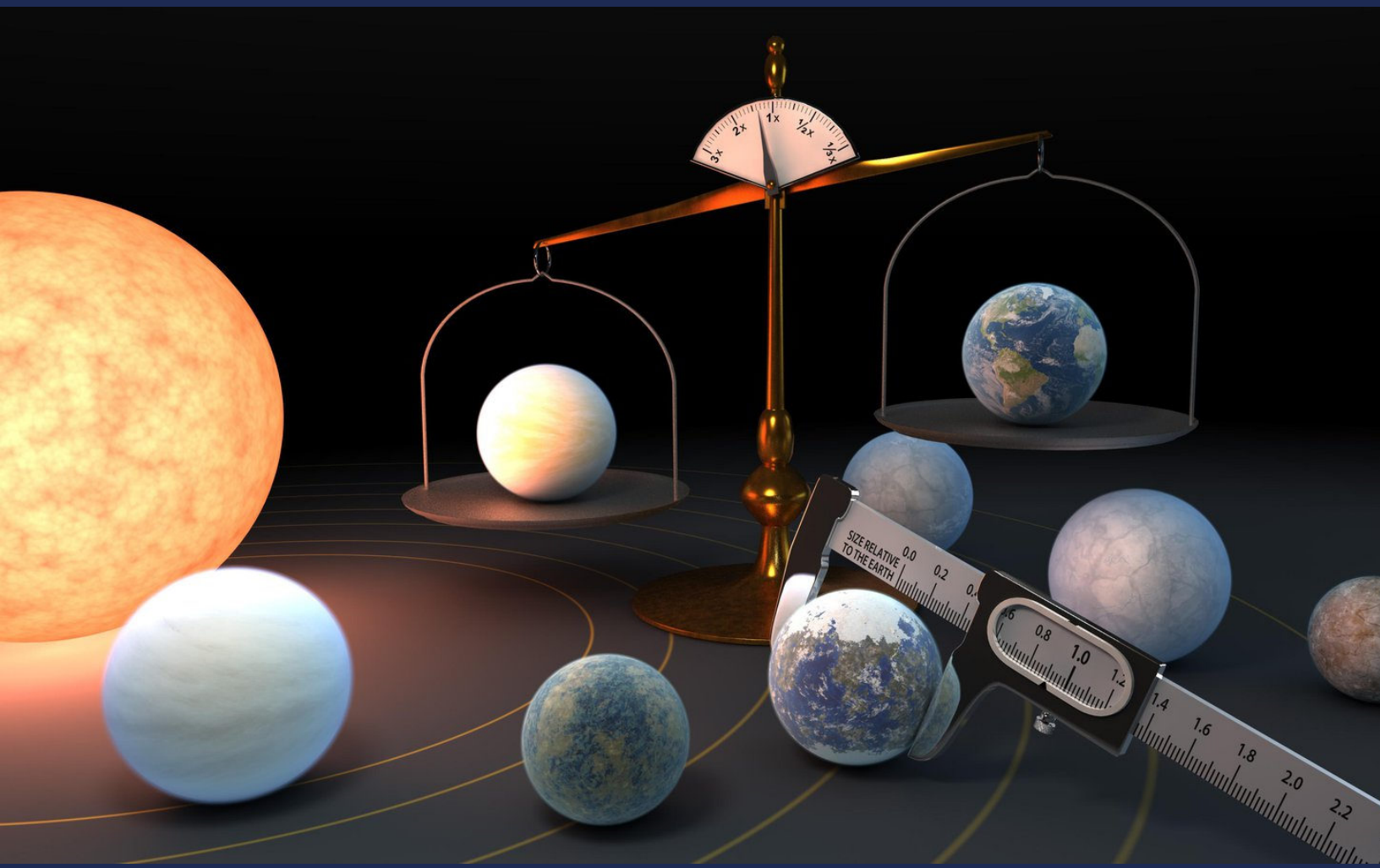
Tom Gehringer taught at Burke High School in Omaha. He participated in an NOAO Teacher Enhancement program called RBSE in 1998, and so had access to images of M31 from Kitt Peak telescopes. His students analyzed the images and contributed to the discovery of 73 novae. They reported their findings at the January 2000 AAS Meeting in Atlanta, a story which was picked up by Sky & Telescope and more. Tom Gehringer was a source of inspiration to the teaching profession for his dedication to students and colleagues while dealing with incredible health obstacles. For more information see: http://www.noao.edu/outreach/press/pr00/pr0001.html, http://www.skypub.com/news/000120.html and http://www.noao.edu/outreach/rbse/nova.html.

R. A. Tucker at Goodricke-Pigott Observatory discovered the asteroid on Jan. 12, 1997. Roy Tucker is an engineer with the National Solar Observatory's GONG project, and an amateur astronomer. He began making astrometric observations of asteroids in October of 1996. After only about a month, he began making his own asteroid discoveries. He found 1997 AT17 as a relatively bright object in the constellation Gemini in early January 1997. 1997 AT17 or (31086) Gehringer is a Main Belt asteroid about 2 to 4 miles across and takes 5.4 years to orbit the sun once.

The International Astronomical Union (IAU) is the only recognized organization with the authority to officially name astronomical objects. The discoverer of a particular object has the privilege of suggesting a name to an IAU committee of professional astronomers that judges its suitability. The Minor Planet Center (MPC) operates at the Smithsonian Astrophysical Observatory, under the auspices of the IAU and is a nonprofit organization. The MPC is responsible for the efficient collection, (computation,) checking and dissemination of astrometric observations and orbits for minor planets and comets. It is a significant honor for the IAU to name a minor planet (asteroid) after someone. It requires that you discover, or know someone who has discovered, a suitable object. Second, you have to propose and justify the naming, and third, the IAU committee has to agree with you! It's not a rubber stamp procedure. There are more than 30,000 numbered asteroids, but only a small fraction of these have been named. It is not something that can be purchased.

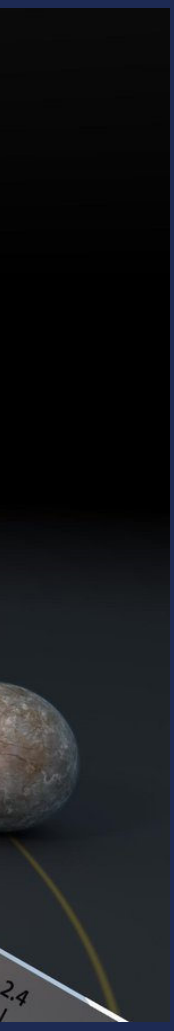
The 7 Rocky TRAPPIST-1 Planets Ma

Precise measurements reveal that the exoplanets have remarkably similar densities, which provides clues about their composition.



Measuring the mass and diameter of a planet reveals its density, which can give scientists clues about its composition. Scientists now know the density of the seven TRAPPIST-1 planets with a higher precision than any other planets in the universe, other than those in our own solar system. Credit: NASA/JPL-Caltech

y Be Made of Similar Stuff



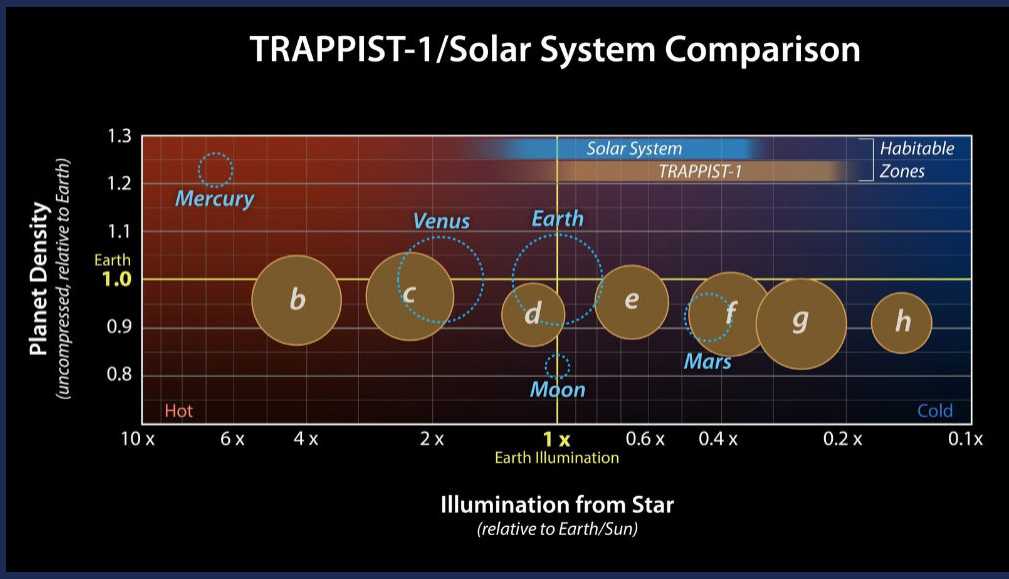
The red dwarf star TRAPPIST-1 is home to the largest group of roughly Earth-size planets ever found in a single stellar system. Located about 40 light-years away, these seven rocky siblings provide an example of the tremendous variety of planetary systems that likely fill the universe.

A new study published today in the Planetary Science Journal shows that the TRAPPIST-1 planets have remarkably similar densities. That could mean they all contain about the same ratio of materials thought to compose most rocky planets, like iron, oxygen, magnesium, and silicon. But if this is the case, that ratio must be notably different than Earth's: The TRAPPIST-1 planets are about 8% less dense than they would be if they had the same makeup as our home planet. Based on that conclusion, the paper authors hypothesized a few different mixtures of ingredients could give the TRAPPIST-1 planets the measured density.

Some of these planets have been known since 2016, when scientists announced that they'd found three planets around the TRAPPIST-1 star using the Transiting Planets and Planetesimals Small Telescope (TRAPPIST) in Chile. Subsequent observations by NASA's now-retired Spitzer Space Telescope, in collaboration with ground-based telescopes, confirmed two of the original planets and discovered five more. Managed by NASA's Jet Propulsion Laboratory in Southern California, Spitzer observed the system for over 1,000 hours before being decommissioned in January 2020. NASA's Hubble and now-retired Kepler space telescopes have also studied the system.

All seven TRAPPIST-1 planets, which are so close to their star that they would fit within the orbit of Mercury, were found via the transit method: Scientists can't see the planets directly (they're too small and faint relative to the star), so they look for dips in the star's brightness created when the planets cross in front of it.

Repeated observations of the starlight dips combined with measurements of the timing of the planets' orbits enabled astronomers to estimate the planets' masses and



A planet's density is determined by its composition as well as its size: Gravity compresses the material a planet is made of, increasing the planet's density. Uncompressed density adjusts for the effect of gravity and can reveal how the composition of various planets compare. Credit: NASA/JPL-Caltech

TRAPPIST-1, continued.

diameters, which were in turn used to calculate their densities. Previous calculations determined that the planets are roughly the size and mass of Earth and thus must also be rocky, or terrestrial – as opposed to gas-dominated, like Jupiter and Saturn. The new paper offers the most precise density measurements yet for any group of exoplanets – planets beyond our solar system.

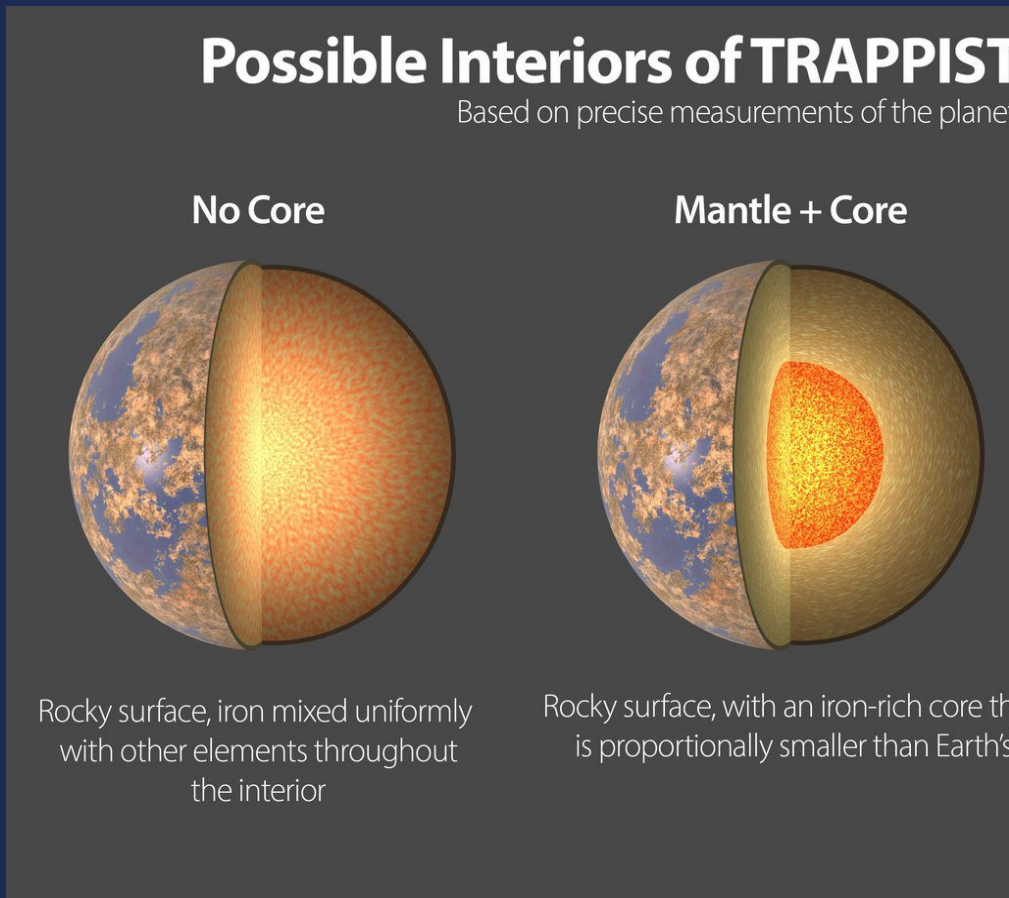
Iron's Reign

The more precisely scientists know a planet's density, the more limits they can place on its composition. Consider that a paperweight might be about the same size as a baseball yet is usually much heavier. Together, width and weight reveal each object's density, and from there it is possible to infer that the baseball is made of something lighter (string and leather) and the paperweight is made of something heavier (usually glass or metal).

The densities of the eight planets in our own solar system vary widely. The puffy, gas-dominated giants – Jupiter, Saturn, Uranus, and Neptune – are larger but much less dense than the four terrestrial worlds because they're composed mostly of lighter elements like hydrogen and helium. Even the four terrestrial worlds show some variety in their densities, which are determined by both a planet's composition and compression due to the gravity of the planet itself. By subtracting the effect of gravity, scientists can calculate what's known as a planet's uncompressed density and potentially learn more about a planet's composition.

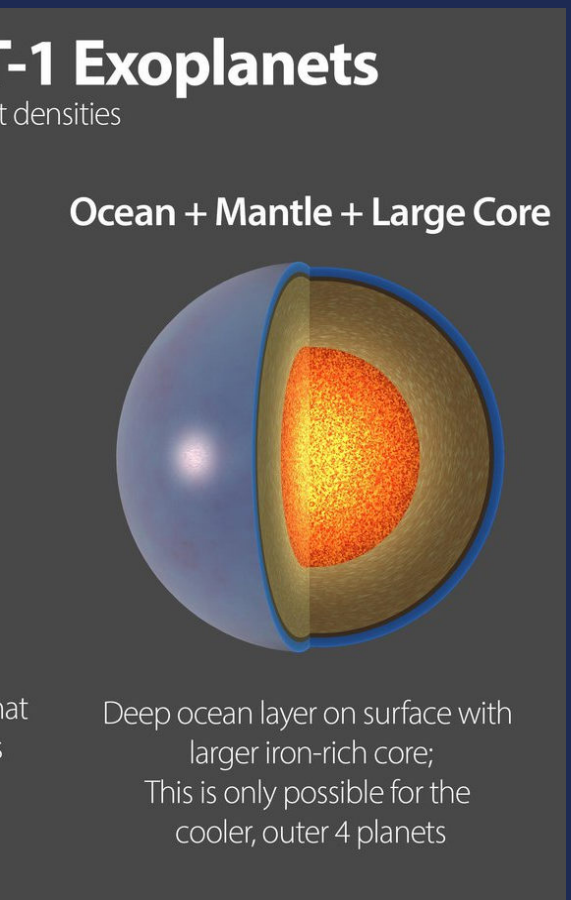
The seven TRAPPIST-1 planets possess similar densities – the values differ by no more than 3%. This makes the system quite different from our own. The difference in density between the TRAPPIST-1 planets and Earth and Venus may seem small – about 8% – but it is significant on a planetary scale. For example, one way to explain why the TRAPPIST-1 planets are less dense is that they have a similar composition to Earth, but with a lower percentage of iron – about 21% compared to Earth's 32%, according to the study.

Alternatively, the iron in the TRAPPIST-1 planets might be infused with high levels of oxygen, forming iron oxide, or rust. The additional oxygen would decrease the planets'



densities. The surface of Mars gets its red tint from iron oxide, but like its three terrestrial siblings, it has a core composed of non-oxidized iron. By contrast, if the lower density of the TRAPPIST-1 planets were caused entirely by oxidized iron, the planets would have to be rusty throughout and could not have solid iron cores.

Eric Agol, an astrophysicist at the University of Washington and lead author of the new study, said the answer might be a combination of the two scenarios – less iron overall and some oxidized iron.



The team also looked into whether the surface of each planet could be covered with water, which is even lighter than rust and which would change the planet's overall density. If that were the case, water would have to account for about 5% of the total mass of the outer four planets. By comparison, water makes up less than one-tenth of 1% of Earth's total mass.

Because they're positioned too close to their star for water to remain a liquid under most circumstances, the three inner TRAPPIST-1 planets would require hot, dense atmospheres like Venus', such that water could remain bound to the planet as steam. But Agol says this explanation seems less likely because it would be a coincidence for all seven planets to have just enough water present to have such similar densities.

"The night sky is full of planets, and it's only been within the last 30 years that we've been able to start unraveling their mysteries," said Caroline Dorn, an astrophysicist at the University of Zurich and a co-author of the paper. "The TRAPPIST-1 system is fascinating because around this one star we can learn about the diversity of rocky planets within a single system. And we can actually learn more about a planet by studying its neighbors as well, so this system is perfect for that."

JPL, a division of Caltech in Pasadena, California, managed the Spitzer mission for NASA's Science Mission Directorate in Washington. Science operations were conducted at the Spitzer Science Center at IPAC at Caltech. Spitzer's entire science catalogue is available via the Spitzer data archive, housed at the Infrared Science Archive at IPAC. Spacecraft operations were based at Lockheed Martin Space in Littleton, Colorado.

Three possible interiors of the TRAPPIST-1 exoplanets. All seven planets have very similar densities, so they likely have a similar compositions. Credit: NASA/JPL-Caltech

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STUDENT MEMBER - $10.00 per year with volunteer requirement.

If you renew your membership prior to your annual renewal date, you will receive a 10% discount.

Club members are also eligible for special subscription discounts on Sky & Telescope Magazine.

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To check out one of the club telescopes, please contact a club officer. Scopes can be checked out at a regular club meeting and kept for one month. Checkout can be extended for another month if there are no other requests for the telescope, but you must notify a club officer in advance.

100mm Orion refractor: Available
10 inch Meade Starfinder Dobsonian: Available
13 inch Truss Dobsonian: Needs repair
10 inch Zhumell: Needs mount

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