Celestial Observer

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CCAS Member Scott Beer imaged Comet C/2020 F3 (NEOWISE) on 7/20/2020 using a tracking mount for long exposures.
CCAS Member Dave Majors processed the image slightly with levels and curves that darkened the background and brought out more of the ion tail.

Special Events: ONLINE Tour of the Moon!
CCAS Officer Lee Coombs will be presenting a *One Week Tour of the Moon*.

Connect here:
CentralCoastAstronomy.org/moon

Next Star Gazing: ONLINE!
Saturday, August 22nd at 7pm with Kent Wallace and Aurora Lipper on a virtual tour of the night sky for the month of August.

Connect here:
CentralCoastAstronomy.org/stargaze

ONLINE: Thursday, August 20th at 5pm

Lee Coombs, CCAS Officer

A One Week Tour of the Moon

Join CCAS Officer, Lee Coombs as he presents a tour of the Moon. He will discuss its formation and terrain while diving deep into the features that one can observe starting with the 5 day Moon, and ending with the 11 day Moon. This will include features that one can see with binoculars as well as telescopes.

Anyone is welcome to join! From amateur astronomers learning to identify areas and formations they have been looking at their whole lives, to the more advanced observer, this presentation will give you a seven day-to-day tour of Lunar details which can be performed any month of the year.

CCAS Member Dave Majors took this picture of the moon on Monday, July 27th from Carrizo Plains in the California Valley.

Next Stargazing: ONLINE! Invite friends!!

Saturday, August 22nd at 7pm

CCAS Member Kent Wallace and president Aurora Lipper are hosting an online stargazing event that you don't want to miss!

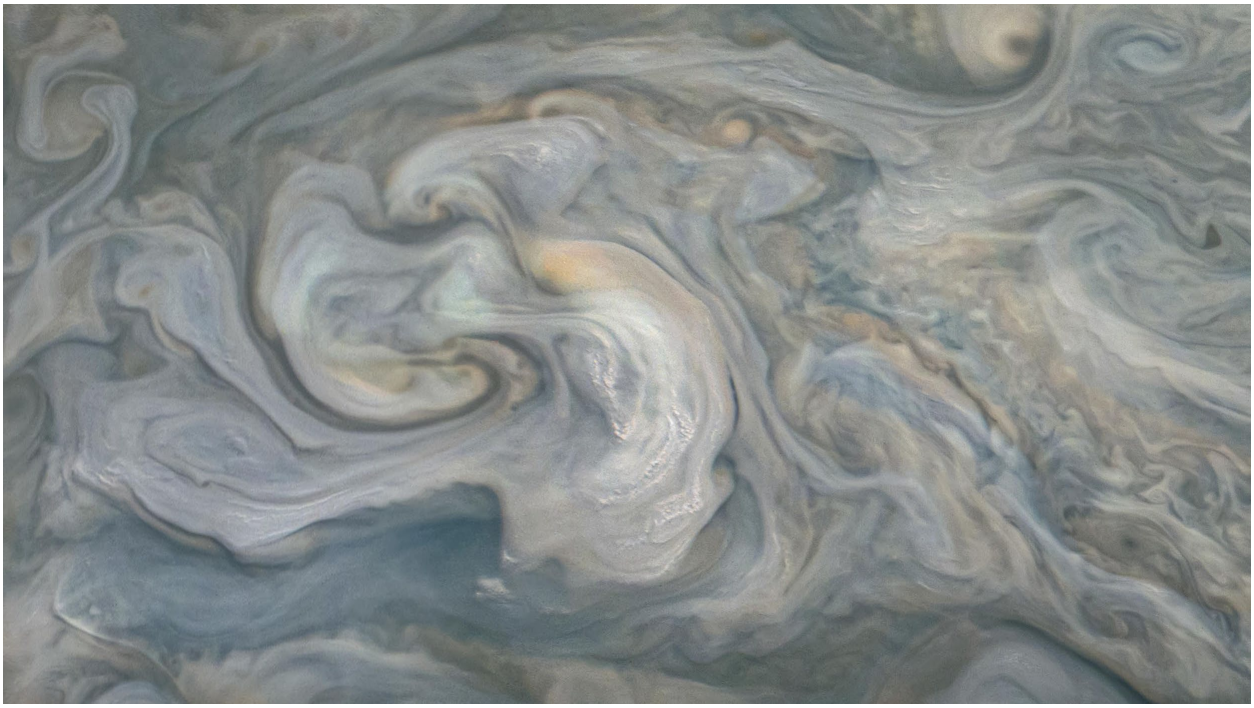
It'll be like going to a planetarium except it's from your computer screen at home. We will focus on how to find naked-eye and binocular objects in the night sky, and you'll be able to interact and ask questions as we go along.

When we're done, go outside and look up, and you'll be able to not only find objects but also understand what you're looking at. Check our website for all the details:

CentralCoastAstronomy.org/stargaze

'Shallow Lightning' and 'Mushballs' Reveal Ammonia to NASA's Juno Scientists

by NASA / JPL



In the center of this JunoCam image, small, bright "pop-up" clouds seen rise above the surrounding features. Clouds like these are thought to be the tops of violent thunderstorms responsible for "shallow lighting." Credit: NASA/JPL-Caltech/SwRI/MSSS/Kevin M. Gill © CC BY

New results from NASA's Juno mission at Jupiter suggest our solar system's largest planet is home to what's called "shallow lightning." An unexpected form of electrical discharge, shallow lightning originates from clouds containing an ammonia-water solution, whereas lightning on Earth originates from water clouds.

Other new findings suggest the violent thunderstorms for which the gas giant is known may form slushy ammonia-rich hailstones Juno's science team calls "mushballs"; they theorize that mushballs essentially kidnap ammonia and water in the upper atmosphere and carry them into the depths of Jupiter's atmosphere.

The shallow-lightning findings will be published Thursday, Aug. 6,2020 in the journal Nature, while the mushballs research is currently available online in

the Journal of Geophysical Research: Planets.

Since NASA's Voyager mission first saw Jovian lightning flashes in 1979, it has been thought that the planet's lightning is similar to Earth's, occurring only in thunderstorms where water exists in all its phases - ice, liquid, and gas. At Jupiter this would place the storms around 28 to 40 miles (45 to 65 kilometers) below the visible clouds, with temperatures that hover around 32 degrees Fahrenheit (0 degrees Celsius, the temperature at which water freezes). Voyager, and all other missions to the gas giant prior to Juno, saw lightning as bright spots on Jupiter's cloud tops, suggesting that the flashes originated in deep water clouds. But lightning flashes observed on Jupiter's dark side by Juno's Stellar Reference Unit tell a different story.

"Juno's close flybys of the cloud tops allowed us to see something surprising - smaller, shallower flashes - originating at much higher altitudes in Jupiter's atmosphere than previously assumed possible," said Heidi Becker, Juno's Radiation Monitoring Investigation lead at NASA's Jet Propulsion Laboratory in Southern California and the lead author of the Nature paper.

Becker and her team suggest that Jupiter's powerful thunderstorms fling water-ice crystals high up into the planet's atmosphere, over 16 miles (25 kilometers) above Jupiter's water clouds, where they encounter atmospheric ammonia vapor that melts the ice, forming a new ammonia-water solution. At such lofty altitude, temperatures are below minus 126 degrees Fahrenheit (minus 88 degrees Celsius) - too cold for pure liquid water to exist.

"At these altitudes, the ammonia acts like an antifreeze, lowering the melting point of water ice and allowing the formation of a cloud with ammonia-water liquid," said Becker. "In this new state, falling droplets of ammonia-water liquid can collide with the upgoing water-ice crystals and electrify the clouds. This was a big surprise, as ammonia-water clouds do not exist on Earth."

The shallow lightning factors into another puzzle about the inner workings of Jupiter's atmosphere: Juno's Microwave Radiometer instrument discovered that ammonia was depleted - which is to say, missing - from most of Jupiter's atmosphere. Even more puzzling was that the amount of ammonia changes as one moves within Jupiter's atmosphere.

"Previously, scientists realized there were small pockets of missing ammonia, but no one realized how deep these pockets went or that they covered most of Jupiter,"said Scott

Bolton, Juno's principal investigator at the Southwest Research Institute in San Antonio. "We were struggling to explain the ammonia depletion with ammonia-water rain alone, but the rain couldn't go deep enough to match the observations. I realized a solid, like a hailstone, might go deeper and take up more ammonia. When Heidi discovered shallow lightning, we realized we had evidence that ammonia mixes with water high in the atmosphere, and thus the lightning was a key piece of the puzzle."

Jovian Mushballs

A second paper, released yesterday in the Journal of Geophysical Research: Planets, envisions the strange brew of 2/3 water and 1/3 ammonia gas that becomes the seed for Jovian hailstones, known as mushballs. Consisting of layers of water-ammonia slush and ice covered by a thicker water-ice crust, mushballs are generated in a similar manner as hail is on Earth - by growing larger as they move up and down through the atmosphere.

"Eventually, the mushballs get so big, even the updrafts can't hold them, and they fall deeper into the atmosphere, encountering even warmer temperatures, where they eventually evaporate completely," said Tristan Guillot, a Juno co-investigator from the Université Côte d'Azur in Nice, France, and lead author of the second paper. "Their action drags ammonia and water down to deep levels in the planet's atmosphere. That explains why we don't see much of it in these places with Juno's Microwave Radiometer."

"Combining these two results was critical to solving the mystery of Jupiter's missing ammonia," said Bolton. "As it turned out, the ammonia isn't actually missing; it is just transported down while in disguise, having cloaked itself by mixing with water. The solution is very simple and elegant with this theory: When the water and ammonia are in a liquid state, they are invisible to us until they reach a depth where they evaporate - and that is quite deep."

Understanding the meteorology of Jupiter enables us to develop theories of atmospheric dynamics for all the planets in our solar system as well as for the exoplanets being discovered outside our solar system. Comparing how violent storms and atmospheric physics work across the solar system allows planetary scientists to test theories under different conditions.

More About the Mission

The solar-powered Jupiter explorer launched nine years ago today, on Aug. 5, 2011. And last month marked the fourth anniversary of its arrival at Jupiter. Since entering the gas giant's

orbit, Juno has performed 27 science flybys and logged over 300 million miles (483 million kilometers).

JPL, a division of Caltech in Pasadena, California, manages the Juno mission for the principal investigator, Scott Bolton, of the Southwest Research Institute in San Antonio. Juno is part of NASA's New Frontiers Program, which is managed at NASA's Marshall Space Flight Center in Huntsville, Alabama, for the agency's Science Mission Directorate in Washington. Lockheed Martin Space in Denver built and operates the spacecraft.

More information about Juno is available at:

nasa.gov/juno

missionjuno.swri.edu

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CCAS Information

Founded in 1979, the Central Coast Astronomical Society (CCAS) is an association of people who share a common interest in astronomy and related sciences.

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CCAS Member Peter Bresler took this photo of NGC 6979, part of the Veil Nebula, on August 3rd.