Space News Update

— August 2, 2019 —

Contents

In the News

Story 1:

Hubble Uncovers a 'Heavy Metal' Exoplanet Shaped Like a Football

Story 2:

A 3-D Model of the Milky Way Galaxy Using Data from Cepheids

Story 3:

The Moon Is Older than Scientists Thought

Departments

The Night Sky

ISS Sighting Opportunities

Space Calendar

NASA-TV Highlights

Food for Thought

Space Image of the Week

1. **Hubble Uncovers a ‘Heavy Metal’ Exoplanet Shaped Like a Football**

How can a planet be "hotter than hot?" The answer is when heavy metals are detected escaping from the planet's atmosphere, instead of condensing into clouds.

Observations by NASA's Hubble Space Telescope reveal magnesium and iron gas streaming from the strange world outside our solar system known as WASP-121b. The observations represent the first time that so-called "heavy metals"—elements heavier than hydrogen and helium—have been spotted escaping from a hot Jupiter, a large, gaseous exoplanet very close to its star.

Normally, hot Jupiter-sized planets are still cool enough inside to condense heavier elements such as magnesium and iron into clouds.

But that's not the case with WASP-121b, which is orbiting so dangerously close to its star that its upper atmosphere reaches a blazing 4,600 degrees Fahrenheit. The WASP-121 system resides about 900 light-years from Earth.

"Heavy metals have been seen in other hot Jupiters before, but only in the lower atmosphere," explained lead researcher David Sing of the Johns Hopkins University in Baltimore, Maryland. "So you don't know if they are escaping or not. With WASP-121b, we see magnesium and iron gas so far away from the planet that they're not gravitationally bound."

Ultraviolet light from the host star, which is brighter and hotter than the Sun, heats the upper atmosphere and helps lead to its escape. In addition, the escaping magnesium and iron gas may contribute to the temperature spike, Sing said. "These metals will make the atmosphere more opaque in the ultraviolet, which could be contributing to the heating of the upper atmosphere," he explained.

The sizzling planet is so close to its star that it is on the cusp of being ripped apart by the star's gravity. This hugging distance means that the planet is football shaped due to gravitational tidal forces.

"We picked this planet because it is so extreme," Sing said. "We thought we had a chance of seeing heavier elements escaping. It's so hot and so favorable to observe, it's the best shot at finding the presence of heavy metals. We were mainly looking for magnesium, but there have been hints of iron in the atmospheres of other exoplanets. It was a surprise, though, to see it so clearly in the data and at such great altitudes so far away from the planet. The heavy metals are escaping partly because the planet is so big and puffy that its gravity is relatively weak. This is a planet being actively stripped of its atmosphere."

The researchers used the observatory's Space Telescope Imaging Spectrograph to search in ultraviolet light for the spectral signatures of magnesium and iron imprinted on starlight filtering through WASP-121b's atmosphere as the planet passed in front of, or transited, the face of its home star.

This exoplanet is also a perfect target for NASA's upcoming James Webb Space Telescope to search in infrared light for water and carbon dioxide, which can be detected at longer, redder wavelengths. The combination of Hubble and Webb observations would give astronomers a more complete inventory of the chemical elements that make up the planet's atmosphere.

The WASP-121b study is part of the Panchromatic Comparative Exoplanet Treasury (PanCET) survey, a Hubble program to look at 20 exoplanets, ranging in size from super-Earths (several times Earth's mass) to Jupiters (which are over 100 times Earth's mass), in the first large-scale ultraviolet, visible, and infrared comparative study of distant worlds.

The observations of WASP-121b add to the developing story of how planets lose their primordial atmospheres. When planets form, they gather an atmosphere containing gas from the disk in which the planet and star formed. These atmospheres consist mostly of the primordial, lighter-weight gases hydrogen and helium, the most plentiful elements in the universe. This atmosphere dissipates as a planet moves closer to its star.

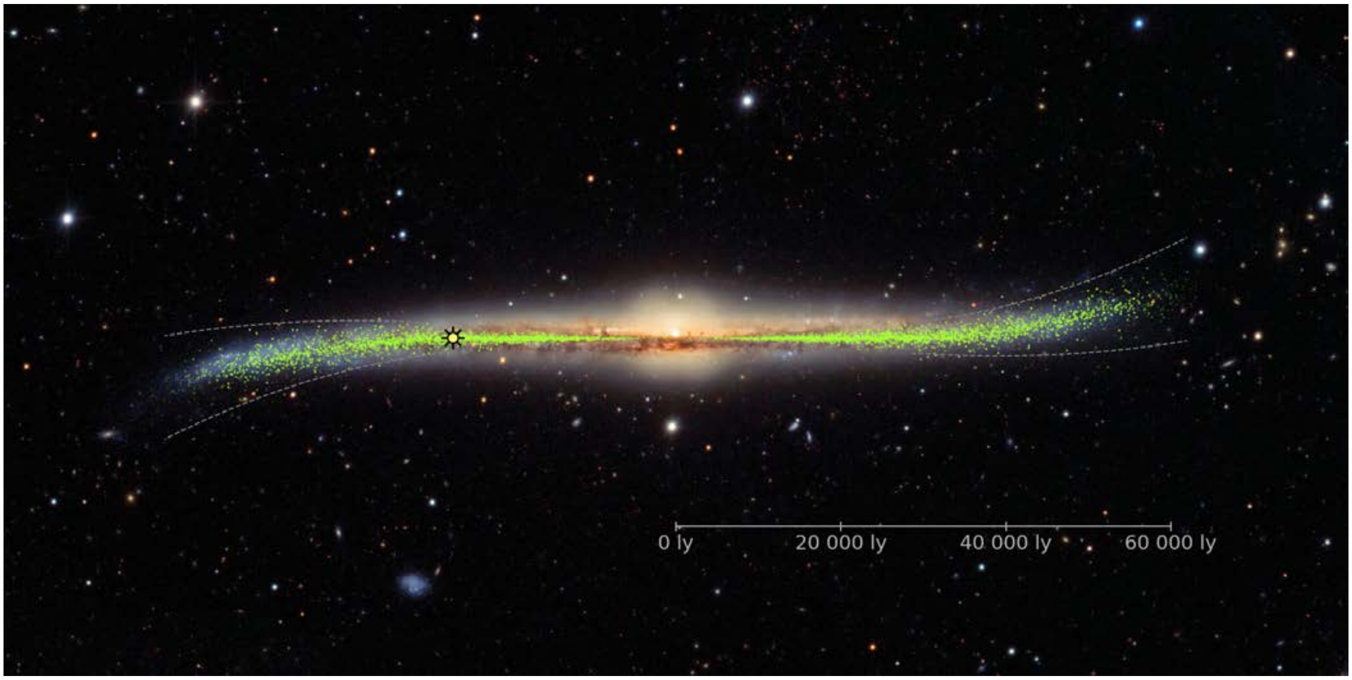
"The hot Jupiters are mostly made of hydrogen, and Hubble is very sensitive to hydrogen, so we know these planets can lose the gas relatively easily," Sing said. "But in the case of WASP-121b, the hydrogen and helium gas is outflowing, almost like a river, and is dragging these metals with them. It's a very efficient mechanism for mass loss."

The results will appear online today in The Astronomical Journal.

The Hubble Space Telescope is a project of international cooperation between NASA and ESA (European Space Agency). NASA's Goddard Space Flight Center in Greenbelt, Maryland, manages the telescope. The Space Telescope Science Institute (STScI) in Baltimore, Maryland, conducts Hubble science operations. STScI is operated for NASA by the Association of Universities for Research in Astronomy in Washington, D.C.

Source: NASA Return to Contents

2. A 3-D Model of the Milky Way Galaxy Using Data from Cepheids



A team of researchers at the University of Warsaw has created the most accurate 3-D model of the Milky Way Galaxy to date. In their paper published in the journal *Science*, the group explains how they used measurements from a special group of pulsating stars to create the map.

Most people imagine the Milky Way as a flat spiral—that is the way it has been shown in school textbooks for years. In more recent times, however, scientists have discovered that our galaxy is not flat at all—it is more like a wobbly uncooked pizza crust that has been tossed into the air. In this new effort, the researchers have found that our galaxy is even more wobbly than has been suspected.

To create their new map, the researchers used data from the Optical Gravitational Lensing Experiment—a long term sky surveying project based at the University of Warsaw. More specifically, the researchers wanted data regarding Cepheids, which are a unique type of pulsating star. They were useful to the researchers because they pulse with regularity and brightness. This means that their true brightness can be calculated and compared to the brightness of them as seen here from Earth—doing so allows for very accurately measuring how far away from us they are.

By amassing data from 2,431 Cepheids (collected over six years) and putting them all on a map together, the researchers were able to produce a 3-D representation of the Milky Way, at least from the perspective of Cepheids. The model they created is the first to be built using direct measurements of star distances, thus it is the most accurate to date.

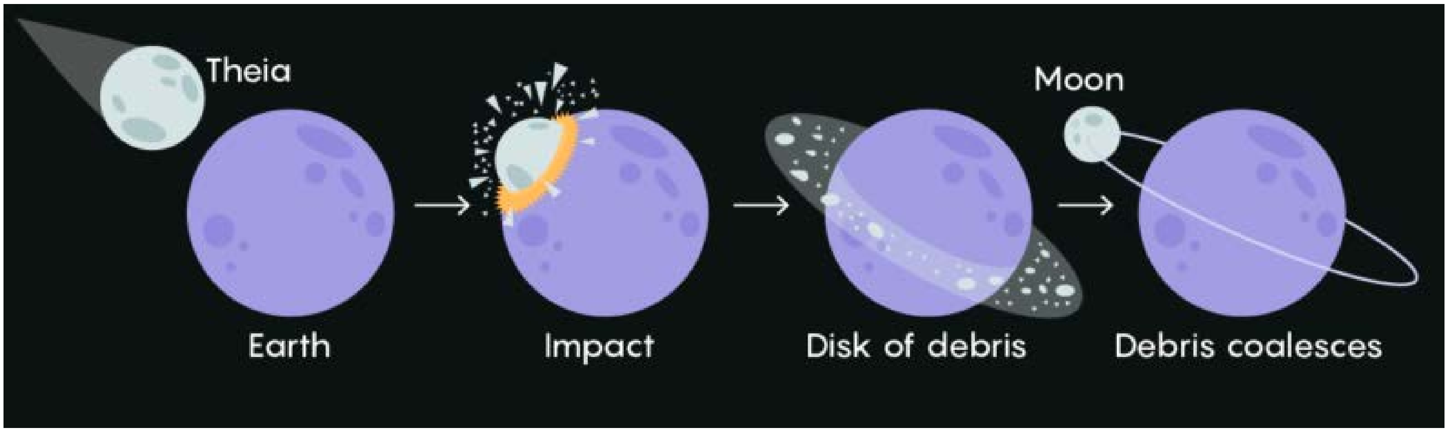
In studying the 3-D model they had created, the researchers were able to see that the Milky Way is far from flat. They could also see that it gets less flat the farther from the sun it goes. They noted also that the Cepheids appeared to be grouped into clusters, suggesting that they may have formed at or near the same time. The researchers also suggest the warping was likely caused by interactions with other galaxies, dark matter or intergalactic gas.

Explore further: The Milky Way is warped

Source: Phys.org

Return to Contents

3. The Moon Is Older than Scientists Thought



The most comprehensive and widely-held theory of how the Moon formed is called the 'giant impact hypothesis.' That hypothesis shows that about 150 million years after the Solar System formed, a roughly Mars-sized planet named Theia collided with Earth. Though the timeline is hotly-debated in the scientific community, we know that this collision melted Theia and some of Earth, and that molten rock orbited around Earth until it coalesced into the Moon.

But now a new study, though not contradicting the giant impact hypothesis, is suggesting a different timeline, and an older Moon.

New research from scientists at the University of Cologne's Institute of Geology and Mineralogy suggests that the Moon is older than the giant impact hypothesis says it is. Their research is based on chemical analyses of Apollo lunar samples and it shows that the Moon formed only 50 million years after the Solar System, rather than 150 million years. This ages the Moon by 100 million years.

This is important work because understanding the age of the Moon helps us understand the age of the Earth. And this type of study can only be done with Moon rocks because they're largely unchanged since the time of formation. Earthly rocks have been subjected to geological processes for billions of years and don't provide the same type of pristine record of formation that Moon rocks do.

The study is titled "Early Moon formation inferred from hafnium-tungsten systematics," and is published in Nature Geoscience.

The evidence stems from the relationships between two rare elements: hafnium (Hf) and tungsten (W; it used to be known as wolfram.) It's focused on the amounts of the different chemical elements that are in rocks of different ages.

"By comparing the relative amounts of different elements in rocks that formed at different times, it is possible to learn how each sample is related to the lunar interior and the solidification of the magma ocean," said Dr. Raul Fonseca, from the University of Cologne. Together with his colleague, and co-author of the study Dr. Felipe Leitzke, they do laboratory experiments to study the geological processes that occurred in the Moon's interior.

After Theia struck Earth and created a swirling cloud of magma, that magma cooled and formed the Moon. After the collision, the newly-born Moon was covered in magma. As the magma cooled, it formed different types of rocks. Those rocks contain a record of that cooling scientists are trying to recover. "These rocks recorded information about the formation of the Moon, and can still be found today on the lunar surface," says Dr. Maxwell Thiemens, former University of Cologne researcher and lead author of the study.

There are black regions on the surface of the Moon called mares, which means ‘seas’ in latin. They’re large formations of basaltic, igneous rock. The scientists behind the study used the relationship between uranium, hafnium, and tungsten to understand the melting that created the Moon’s mares. Because of the precision of their measurements, they identified distinct trends among the different suites of rocks.

Hafnium and tungsten provide scientists with a natural clock contained in the rock itself, because over time the hafnium-182 isotope decays into tungsten 182. But that decay didn’t go on for ever; it only lasted for the first 70 million years of the Solar System’s life. The team compared the Apollo samples with their laboratory experiments and found that the Moon already started solidifying as early as 50 million years after solar system formed.

“This age information means that any giant impact had to occur before that time, which answers a fiercely debated question among the scientific community regarding when the Moon formed,” adds Professor Dr. Carsten Münker from the UoC’s Institute of Geology and Mineralogy, senior author of the study.

Dr. Peter Sprung, co-author of the study, adds: “Such observations are not possible on Earth anymore, as our planet has been geologically active over time. The Moon thus provides a unique opportunity to study planetary evolution.”

It’s amazing that the rocks collected during Apollo 11 fifty years ago are still yielding evidence like this. The team’s extremely precise measurements are based on inductively coupled plasma mass spectrometry, something that wasn’t possible in Apollo’s time. The astronauts that collected the samples couldn’t have known this, but those rocks are still teaching us not only about the Moon, but about the age of the Earth itself.

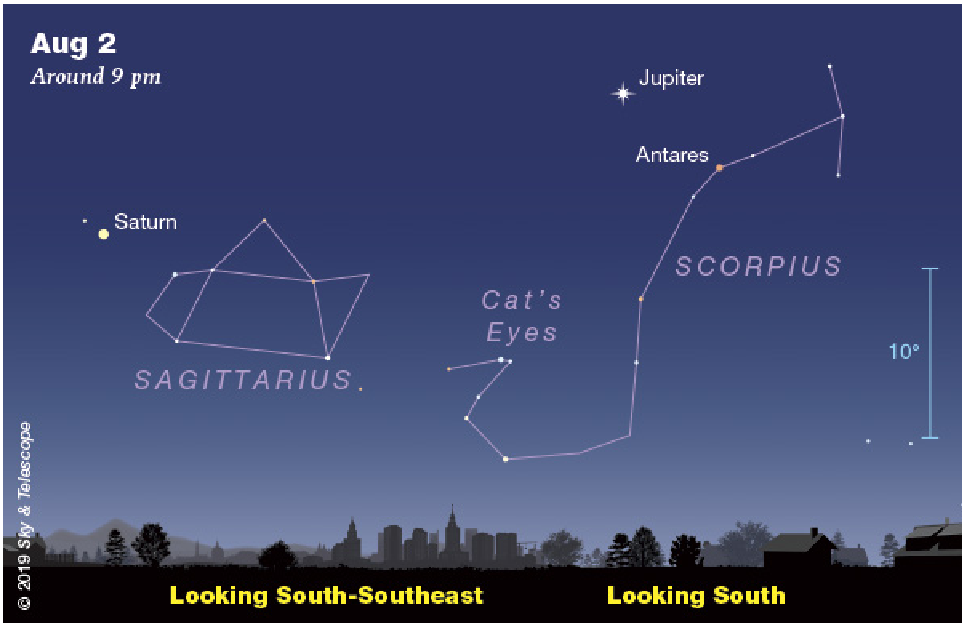
More:

- Press Release: Study shows that the Moon is older than previously believed
- Research Paper: Early Moon formation inferred from hafnium–tungsten systematics
- Wikipedia: Lunar Mare
- NASA: The Moon in Depth

Source: Universe Today Return to Contents

The Night Sky

Friday, August 2



• Bright Vega passes closest to overhead around 11 p.m., depending on how far east or west you live in your time zone. How closely it *misses* your zenith depends on how far north or south you are. It passes right through your zenith if you're at latitude 39° north (Washington DC, Cincinnati, Kansas City, Lake Tahoe). How closely can you judge this just by looking?

Deneb crosses its closest to the zenith almost exactly two hours after Vega.

Saturday, August 3

• The Big Dipper hangs diagonally in the northwest after dark. It's starting to "scoop water," which it will dump from on high to become "spring showers" in the evenings a half year from now.

From the Dipper's midpoint, look three fists to the right to find Polaris (not very bright) glimmering due north as always.

Polaris is the handle-end of the Little Dipper. The only other parts of the Little Dipper that are even modestly bright are the two stars forming the outer end of its bowl. On August evenings you'll find them to Polaris's upper left (by about a fist and a half at arm's length). They're called the Guardians of the Pole, since they circle around Polaris throughout the night and throughout the year.

Sunday, August 4

• After nightfall, Altair shines high in the southeast. Above Altair by a finger-width at arm's length is little orange Tarazed.

A bit more than a fist-width to Altair's left or lower left is little Delphinus, the Dolphin, leaping leftward.

Above the midpoint between Altair and Delphinus is even fainter, smaller Sagitta, the Arrow.

Monday, August 5

• The waxing crescent Moon hangs in the west-southwest as twilight fades. Look for Spica about 7° to its lower left (for North America). Much higher above the Moon is brighter Arcturus.

Source: Sky & Telescope Return to Contents

ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Fri Aug 2, 9:48 PM	2 min	67°	27° above NW	47° above E
Sat Aug 3, 8:59 PM	4 min	38°	25° above NNW	13° above E
Sat Aug 3, 10:34 PM	1 min	18°	10° above W	18° above WSW
Sun Aug 4, 9:46 PM	3 min	40°	20° above WNW	33° above S
Mon Aug 5, 8:58 PM	4 min	78°	44° above WNW	14° above SE

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

NASA-TV Highlights

(all times Eastern Daylight Time)

No Special Programming

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

Return to Contents

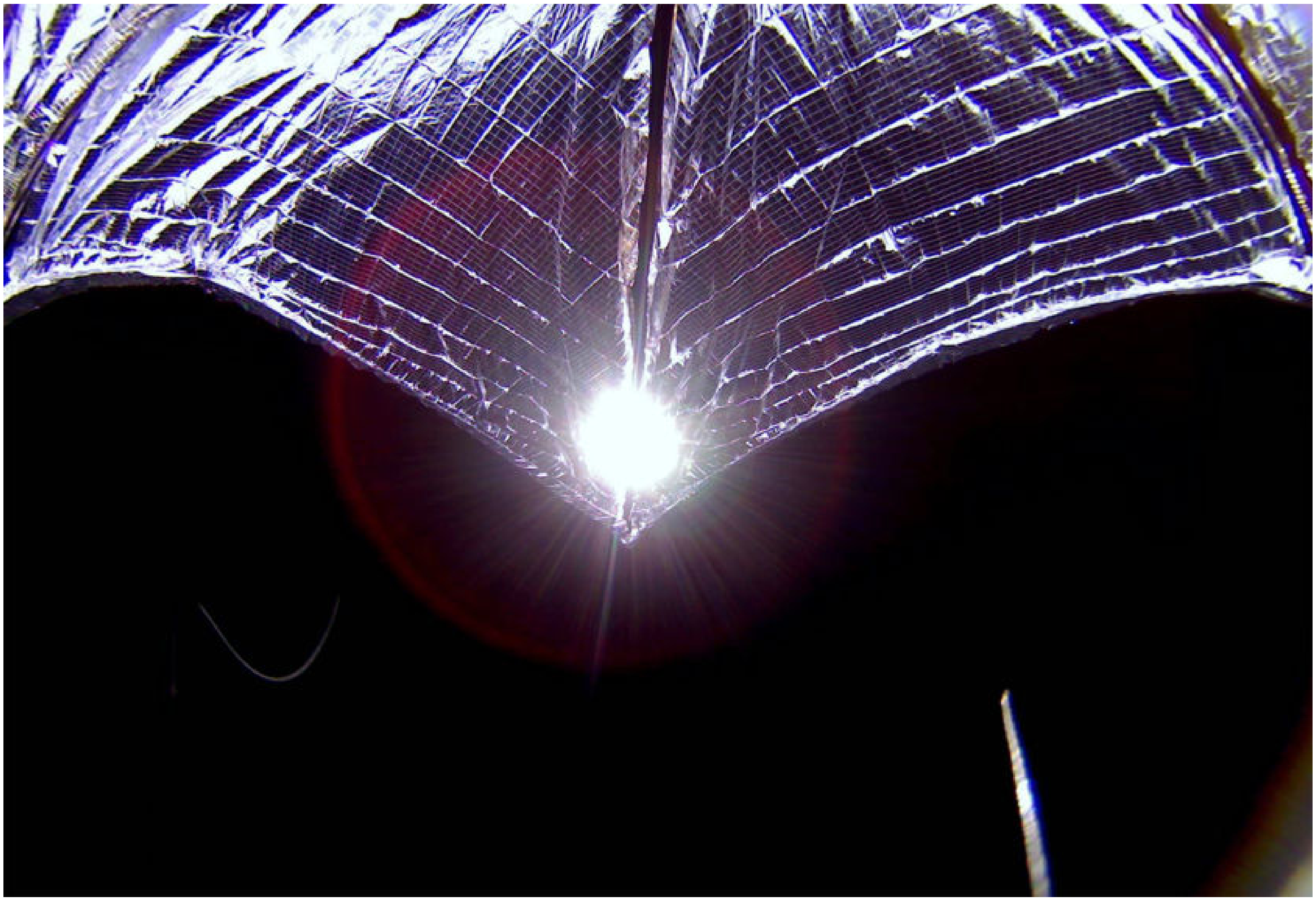
Space Calendar

- Aug 02 - Comet 379P/Spacewatch Perihelion (2.334 AU)
- Aug 02 - Comet C/2017 U7 Closest Approach To Earth (5.493 AU)
- Aug 02 - Asteroid 1877 Marsden Occults TYC 7840-01158-1 (10.5 Magnitude Star)
- Aug 02 - Asteroid 1297 Quadea Occults HIP 65301 (5.0 Magnitude Star)
- Aug 02 - NEW [Aug 01] Apollo Asteroid 2019 OJ3 Near-Earth Flyby (0.029 AU)
- Aug 02 - Asteroid 166614 Zsazsa Closest Approach To Earth (1.653 AU)
- Aug 02 - Asteroid 4763 Ride Closest Approach To Earth (1.780 AU)
- Aug 02 - Asteroid 2791 Paradise Closest Approach To Earth (1.826 AU)
- Aug 02 - Apollo Asteroid 4197 Morpheus Closest Approach To Earth (3.075 AU)
- Aug 03 - Comet 366P/Spacewatch Closest Approach To Earth (2.234 AU)
- Aug 03 - Asteroid 2476 Andersen Closest Approach To Earth (1.743 AU)
- Aug 03 - Asteroid 439 Ohio Closest Approach To Earth (2.335 AU)
- Aug 03 - Asteroid 2197 Shanghai Closest Approach To Earth (2.538 AU)
- Aug 03 - Asteroid 17427 Poe Closest Approach To Earth (2.658 AU)
- Aug 03 - Plutino 2014 JP80 At Opposition (41.147 AU)
- Aug 03 - Kuiper Belt Object 2013 AT183 At Opposition (64.079 AU)
- Aug 03 - Summer on the Hudson: Stargazing, Manhattan, New York
- Aug 03 - Etscorn Star Party, Socorro, New Mexico
- Aug 03 - 15th Anniversary (2004), MESSENGER Delta 2 Launch
- Aug 04 - Comet 110P/Hartley At Opposition (3.330 AU)
- Aug 04 - Comet P/2018 H2 (PANSTARRS) At Opposition (3.414 AU)
- Aug 04 - Apollo Asteroid 5786 Talos Closest Approach To Earth (0.324 AU)
- Aug 04 - Asteroid 16543 Rosetta Closest Approach To Earth (1.374 AU)
- Aug 04 - Asteroid 2104 Toronto Closest Approach To Earth (2.463 AU)
- Aug 05 - HOT [Jul 29] 50th Anniversary (1969), Mariner 7 Mars Flyby
- Aug 05 - UPDATED [Aug 02] Amos 17 Falcon 9 Launch
- Aug 05 - Blagovest-14L Proton-M Launch
- Aug 05 - Comet 168P/Hergenrother Perihelion (1.359 AU)
- Aug 05 - Comet 163P/NEAT Perihelion (2.067 AU)
- Aug 05 - Comet 264P/Larsen Perihelion (2.438 AU)
- Aug 05 - Apollo Asteroid 2018 AG12 Near-Earth Flyby (0.059 AU)
- Aug 05 - Asteroid 12258 Oscarwilde Closest Approach To Earth (1.452 AU)

Source: JPL Space Calendar Return to Contents

Food for Thought

LightSail Teams Declares Success in Solar Sail Experiment



The gentle push of sunlight is slowly changing the orbit of the Planetary Society's crowd-funded LightSail 2 satellite after it unfurled a thin solar sail the size of a boxing ring last week, officials confirmed Wednesday.

LightSail 2 is the capstone of a decade-long, $7 million effort to advance the science of solar sailing, a technique that could allow small probes to travel across the solar system, or to other stars, at faster speeds and lower cost.

"On behalf of the tens of thousands of people around the world who came together to help the dream of solar sailing move forward, we're thrilled to declare mission success for LightSail 2," said Bruce Betts, the LightSail program manager at the Planetary Society, a non-profit space advocacy group headquartered in Pasadena, California.

LightSail 2 was one of 24 satellites launched June 25 by a SpaceX Falcon Heavy rocket. At the time of launch, LightSail 2 was cocooned inside a larger spacecraft named Prox 1, which released the solar sail craft a week into the mission.

Based on a CubeSat platform, LightSail 2 was about the size of a loaf of bread when folded up for launch. A few days after separating from Prox 1, LightSail deployed solar panels to begin recharging the craft's lithium-ion batteries, then officials sent the command to open the sail July 23, somewhat later than originally planned to allow extra time for engineers to fine-tune the CubeSat's attitude control system.

“Our criterion for mission success was to demonstrate controlled solar sailing in a CubeSat by changing the spacecraft’s orbit using only light pressure of the sun,” Betts said. “This is something that’s never been done before in a small spacecraft.”

In a press teleconference Wednesday, Betts said the high point, or apogee, or LightSail 2’s orbit had increased by a little more than a mile — about 1.7 kilometers — over the preceding four days. LightSail 2 does not carry any other means of propulsion, so engineers have attributed orbit change to solar sailing.

LightSail 2’s ultra-thin sail was stowed into the spacecraft’s toaster oven-sized body during launch, but once unfurled, it covers an area comparable to that of a boxing ring, or about 344 square feet (32 square meters). The pressure from solar photons, or units of light, imparts a tiny measure of acceleration on the sail, but it will be enough to change LightSail 2’s orbit.

“This is a very exciting day for us, and for me personally,” said Bill Nye, CEO of the Planetary Society. “This idea that you could fly the spacecraft, that you could get propulsion in space, from nothing but photons is really counterintuitive. It’s surprising. And for me, it’s very romantic that you’ll be sailing on sunbeams.”

Telemetry radioed to the ground by LightSail 2 shows the spacecraft is turning its sail broadside to the as it goes around the Earth. The CubeSat’s orientation allows for pressure from solar photons to push on the sail with a force no more than the weight of a paperclip, according to the Planetary Society.

“Our acceleration divided by mass, or thrust to mass, is the highest of any sail launch so far,” Nye said. “And in order to do this, we have to tack in Earth orbit, which means we have to twist the spacecraft 90 degrees every 50 minutes.”

The LightSail 2 experiment is the second solar sailing CubeSat developed by the Planetary Society, and the group’s third attempt overall at a solar sail experiment in low Earth orbit.

A predecessor mission named LightSail 1 lifted off aboard a United Launch Alliance Atlas 5 rocket in May 2015.

The LightSail 1 CubeSat successfully expanded its solar sail, but the spacecraft’s altitude was too low to demonstrate sailing on sunlight. At LightSail 1’s altitude, aerodynamic drag influenced the craft’s orbit more than the minuscule effect from sunlight.

An earlier solar sail experiment led by the Planetary Society, named Cosmos 1, failed to reach orbit after a launch from a Russian submarine.

The Planetary Society says the LightSail program, comprising both CubeSat missions, cost around $7 million from 2009 through March 2019. Planetary Society members, private citizens, foundations and corporate donors helped pay for the program.

NASA provided the launch of the LightSail 1 mission in 2015 on an Atlas 5 rocket, and the U.S. Air Force Research Laboratory provided LightSail 2 with a ride into orbit on SpaceX’s Falcon Heavy.

LightSail 2’s demonstration comes after the Japanese IKAROS mission became the first spacecraft to rely solely on solar sailing for propulsion. IKAROS launched with Japan’s Akatsuki mission toward Venus in 2010, and opened its 2,110-square-foot (196-square-meter) sail in interplanetary space.

But the IKAROS spacecraft was much larger than LightSail 2. The solar sailing success announced Wednesday proves a relatively low-cost CubeSat-class nanosatellite — within the budget of small space agencies, universities and numerous private companies — can use light pressure to reach far-flung destinations.

A NASA-funded CubeSat mission named NEA Scout will employ a solar sail to travel to a near-Earth asteroid after flying into deep space on the first mission of NASA's Space Launch System heavy-lift rocket.

"This is demonstrating solar sale propulsion in these CubeSats, in small spacecraft," Betts said. "That means it's a possible interplanetary propulsion technique for possible piggyback missions of CubeSats, small missions in the future. And in the fairly near future, NASA's NEA Scout will do this with a spacecraft twice as large. But it's really demonstrating it can be done, and so hopefully opening up a whole new field of spacecraft and spacecraft propulsion between the planets."

Future solar sails could be powered by laser light arrays to accelerate toward other stars, achieving speeds impossible with conventional rocket engines.

Officials expect LightSail 2 to remain in orbit for about a year before atmospheric drag pulls it back to Earth, when it will burn up during re-entry.

"We're going to be, over the next several weeks, continuing to raise the orbit apogee, and we think that we can do that for about a month, probably through the end of August," said Dave Spencer, LightSail 2's project manager.

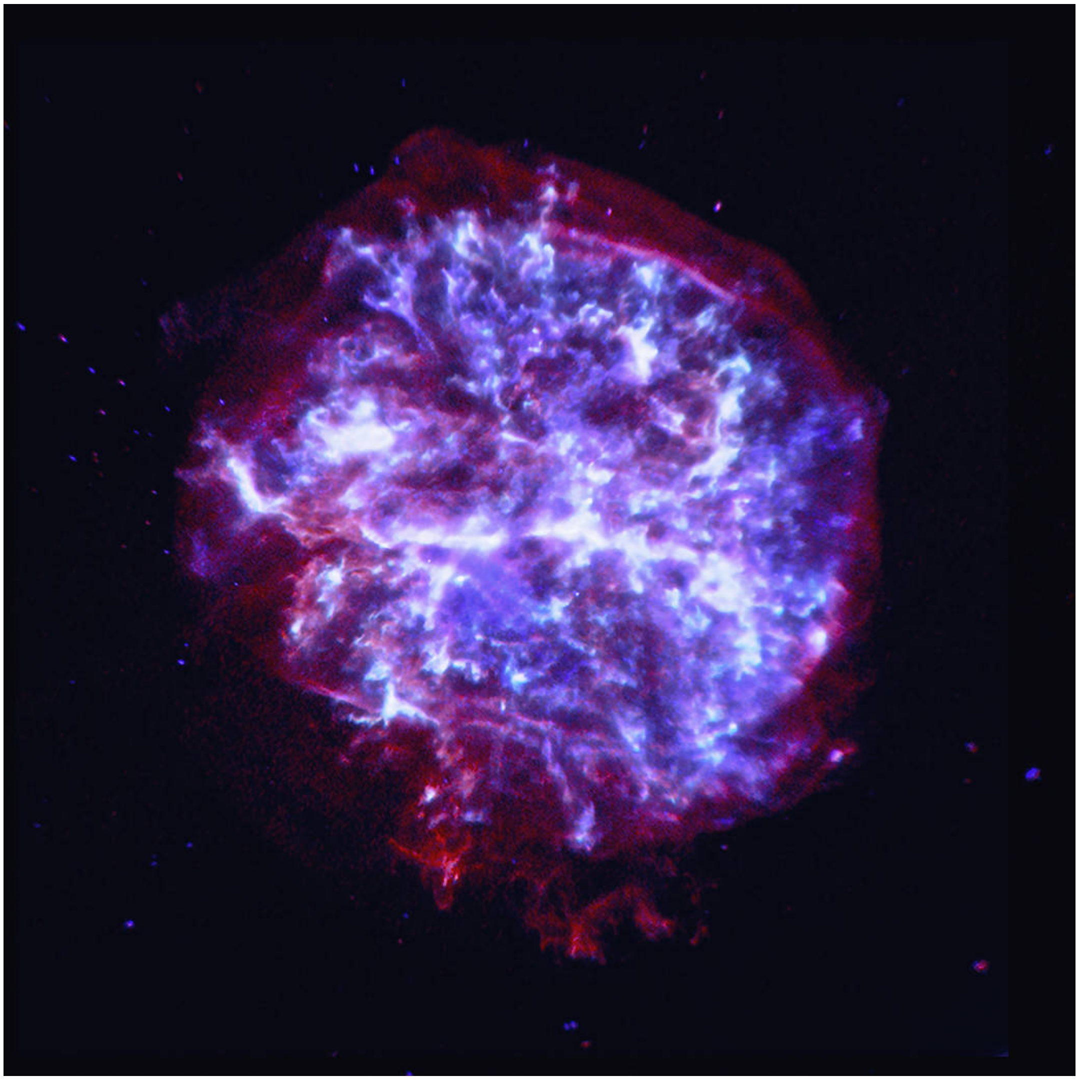
"As we're doing that, our perigee, or the close point in the orbit, is going to move slightly lower over time," Spencer said. "And as it moves lower, the atmosphere is going to cause more drag, to the point where it's going to be impossible for us to overcome that atmospheric drag through the use of solar pressure."

LightSail 2's attitude control system does not have the ability to point the solar sail to circularize its orbit. Future missions will have that capability.

"There's one experiment that I really am looking forward to, Spencer said. "If the spacecraft is still functional, once we get down to the point of re-entry, I'd like to see if we can actually control the re-entry point somewhat by changing the orientation of the solar sail. That's an experiment that to my knowledge, hasn't been done before, and that's called targeted re-entry. That would be a really fascinating experiment."

Source: Spaceflight Now Return to Contents

Space Image of the Week



Elements in the Aftermath

Explanation Massive stars spend their brief lives furiously burning nuclear fuel. Through fusion at extreme temperatures and densities surrounding the stellar core, nuclei of light elements like Hydrogen and Helium are combined to heavier elements like Carbon, Oxygen, etc. in a progression which ends with Iron. So a supernova explosion, a massive star's inevitable and spectacular demise, blasts back into space debris enriched in heavier elements to be incorporated into other stars and planets and people. This detailed false-color x-ray image from the orbiting Chandra Observatory shows such a hot, expanding stellar debris cloud about 36 light-years across. Cataloged as G292.0+1.8, this young supernova remnant is about 20,000 light-years distant toward the southern constellation Centaurus. Light from the inital supernova explosion reached Earth an estimated 1,600 years ago. Bluish colors highlight filaments of the mulitmillion degree gas which are exceptionally rich in Oxygen, Neon, and Magnesium. This enriching supernova also produced a pulsar in its aftermath, a rotating neutron star remnant of the collapsed stellar core. The stunning image was released as part of the 20th anniversary celebration of the Chandra X-ray Observatory.

Image Credit: NASA/CXC/SAO

Source: APOD

Return to Contents