Space News Update

— September 26, 2017 —

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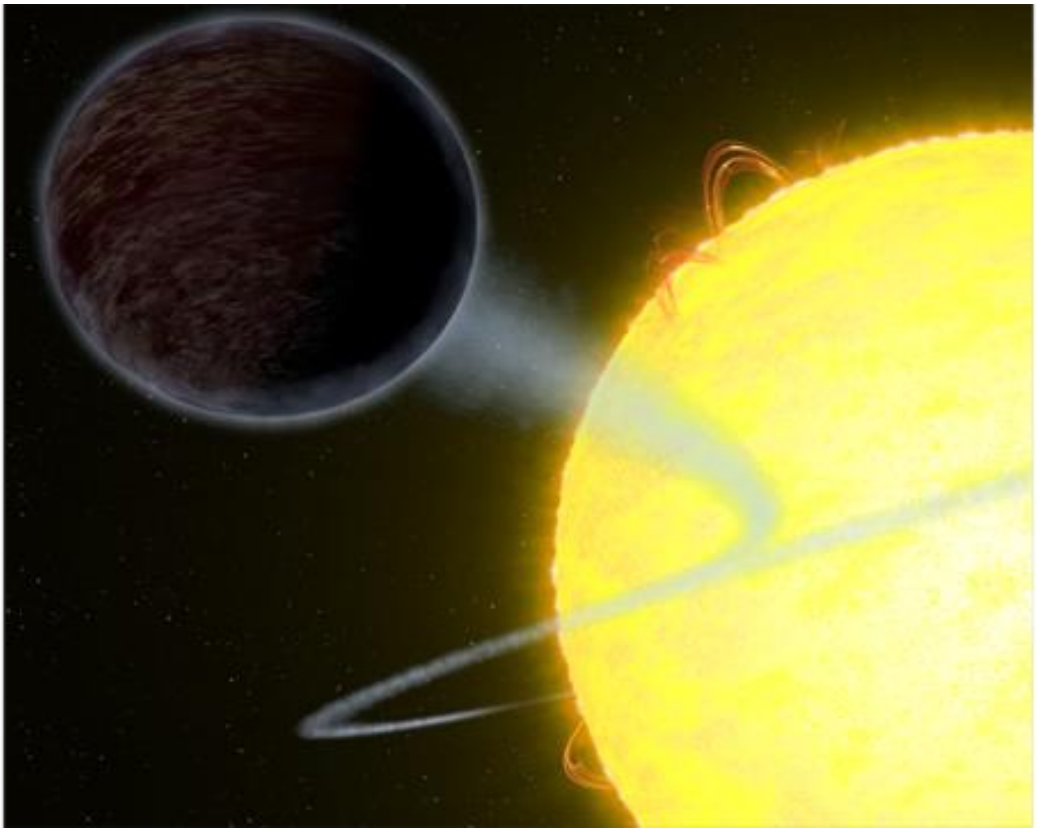
1. Puffed-Up Hot Jupiter Is Surprisingly Dark



This illustration shows the exoplanet WASP-12b — an alien world as black as asphalt orbiting a Sun-like star. They're so close together that the star is pulling gas away from the planet.
Credits: NASA, ESA, and G. Bacon (STScI)

Researchers have found that a football-shaped, ultra-hot gas giant that's being devoured by its host star is also one of the least reflective exoplanets ever found.

Imagine a football-shaped planet covered in a fresh layer of asphalt and you might get close to what WASP-12b, a hot Jupiter 900 light-years away, would look like to a hypothetical space traveler. Add a faint red glow like that of a smoldering iron and you're probably dead on.

A group of astronomers led by Taylor Bell (McGill Space Institute) helped paint that picture. They discovered that WASP-12b is one of the least reflective exoplanets known to date. Bell's team used the Hubble Space Telescope to observe the planet as it passed *behind* its host star, measuring the tiny dip in light due to the disappearance of the planet's reflection of starlight. They found that it absorbs 94% of the visible light it receives, compared to 60% for most hot Jupiters.

WASP-12b is a gaseous giant orbiting a Sun-like star once a day, close enough to be roasted by stellar radiation. The planet has taken the shape of a football due to strong tidal forces. The same forces cause the planet to always face the same side to its star, which makes the dayside temperature rise to a toasting 3100°C. The extreme heat not only prevents the formation of clouds, which could reflect some light back to space, but it also dissociates hydrogen molecules (H_2) into hydrogen atoms (H), which absorb even more light.

This is only the second time researchers have used this method to spectrally resolve reflected light from a hot Jupiter. On exoplanet, HD 189733b, Hubble revealed a very different world, one where silicate beads in the atmosphere scatter blue light.

Another hot Jupiter called TrES-2b actually holds the record for the darkest exoplanet — it's so light-hungry that it absorbs more than 99% of its star's light.
But none of that makes WASP-12b any less fascinating — it's a strange world that has found itself the subject of many investigations.

Puffed-Up World

Since it was discovered in 2008, WASP-12b has been observed at many wavelengths, including with NASA's Great Observatories: Hubble (visible/UV), Spitzer (infrared), and Chandra (X-ray). Hubble's Cosmic Origins Spectrograph revealed in 2010 that the planet is slowly being devoured by its host star. They're so close together that the star is pulling gas away from the planet. At the current rate of dissolution, scientists estimate that in roughly 10 million years WASP-12b will be no more.

The weird planet also appears to be bloated: even though it only has 1.4 Jupiter's mass, it's three times Jupiter's size. Some researchers think that electric currents emanating from the star could link to the planet's magnetic field, ionizing particles to puff up the atmosphere.

Probing WASP-12b's Atmospheric Chemistry

Previous observations using transmission spectroscopy, which probes a sliver of atmosphere at the boundary between night and day, have showed hints of a titanium oxide haze — a powerful heat absorber. But it can't contribute to the low reflectivity that Bell's team found. "Our observations firmly reject such a model for the planet's dayside, which is not overly surprising as we would expect the dayside would be far too hot for this haze to exist," Bell says.

But with a difference of 1000°C between the planet's nightside and dayside, each side might exhibit completely different chemistries. "It's entirely possible," Bell adds, "that such haze may form closer to the night side of the planet and affect the transit observations."

WASP-12b will probably continue to surprise us: The planet will almost certainly be observed with the James Webb Space Telescope, scheduled for launch in 2018. Those observations could give additional insights into the strange properties of WASP-12b's atmosphere.

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References: Bell et al. "The Very Low Albedo of WASP-12b from Spectral Eclipse Observations with Hubble." *Astrophysical Journal Letters*, September 14, 2017.

Source: Sky and Telescope

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2. Cloudy with a Chance of Radiation: NASA Studies Simulated Radiation

Earth observation of the space environment taken during a night pass by Dr. Kjell Lindgren of the Expedition 44 crew during Scott Kelly's One-Year Mission aboard the International Space Station (ISS). An aurora with purple and SSRMS arm are visible. Credits: NASA

In each life a little rain must fall, but in space, one of the biggest risks to astronauts' health is radiation "rain". NASA's Human Research Program (HRP) is simulating space radiation on Earth following upgrades to the NASA Space Radiation Laboratory (NSRL) at the U.S. Department of Energy's Brookhaven National Laboratory. These upgrades help researchers on Earth learn more about the effects of ionizing space radiation, to help keep astronauts safe on a journey to Mars.

Radiation is one of the most dangerous risks to humans in space, and one of the most challenging to simulate here on Earth. The risk to human health significantly increases when astronauts travel beyond Lower Earth Orbit (LEO) outside the magnetosphere. The magnetosphere shields Earth from solar particle events (SPEs) and radiation caused by the sun and galactic cosmic rays (GCRs) produced by supernova fragments. Radiation particles like ions can be dangerous to humans because they can pass through skin, depositing energy and damaging cells or DNA along the way. This damage can increase the risk for diseases later in life or cause radiation sickness during the mission.

Radiation may cause damage to the central nervous system, cardiovascular system, and circulatory system of astronauts. There is evidence that humans exposed to large doses of radiation from radiotherapy experience cognitive and behavioral changes, and recent studies suggest these risks may occur at lower doses for GCR creating a possible risk for operating a space vehicle. Space environment variables (Ex. microgravity, CO2, lack of sleep, etc.) which produce stress could interact with radiation in a synergistic fashion exacerbating the impacts.

With the recent upgrades to the NSRL, NASA is improving its ability to understand the effects of radiation on the body. The most notable upgrades were made to the GCR simulator, which was recently highlighted in *ScienceDirect.*

"There is ample research on acute effects of radiation exposure but very little on latent effects, and the latter more closely resembles the health effects expected from long duration space flight," Lisa Carnell, Ph.D., Medical Countermeasure Lead for NASA Space Radiation said. "Imagine ion trajectories to be similar to rain; sometimes there is a downpour (solar particle event) and sometimes there a light drizzle or heavy, sparse droplets (similar to galactic cosmic radiation). With the upgrades we can simulate different types of ion rain with multiple types of ions sequentially versus only one type of ion at a time."

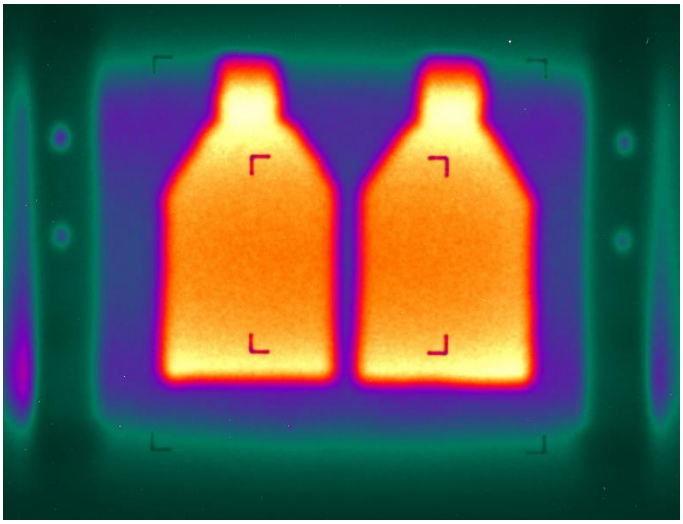
The GCR upgrades enable researchers to rapidly switch ion types and energy intensities. To support these improvements, software controls were added to permit smooth movement from target to target. The cooling system in one of the Electron Beam Ion Source, or EBIS magnets was upgraded to handle higher energy currents. In addition, new probes were installed in two of the beamline's magnets to speed up setting changes.

Before these upgrades, switching radiation beams was not an easy or efficient process in the NSRL. The lab was originally designed to harness ions from Brookhaven's Booster accelerator, which produces all species of ions within a range of energies. Now switching ion species and energies can be done in minutes. More realistic studies and radiation countermeasure tests are conducted because investigators can better simulate the space environment.

The improvements in beam energy enable coverage of a greater part of the GCR spectrum. The larger beam makes it possible to radiate numerous samples at once and increase throughput and efficiency. Precision control also increases the accuracy for dose delivery. Uniformity of the radiation field intensity also reduces uncertainties in dose deliveries.

This results in a more accurate testing environment for NASA researchers who are developing various types of shielding materials to protect astronauts from radiation. HRP investigators can use the technology to test tissue samples leading to health countermeasures to protect against molecular damage. Cancer researchers also can explore various heavy ion therapies to eradicate tumors. The NSRL is one of the few labs in the United States capable of contributing to heavy ion radiotherapy research. Users from NASA, national laboratories, and more than 50 institutions and universities in the U.S., Europe, and Japan test medical, biological, and physical samples using the NSRL ion beam line.

As NASA prepares for sending humans farther and longer than ever before, space radiation research continues to advance our understanding of the risks to the human body. It takes innovative research on the Earth to support innovative research in space. And if the rainy day does come, NASA will be prepared.



Plastic bottles which were shot with ions from the Galactic Cosmic Ray simulator beam at the NASA Space Radiation Laboratory. Credits: U.S. DOE, Brookhaven National Laboratory, NA

Source: NASA

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3. Arecibo Radar Telescope Battered by Hurricane Maria

File photo of Arecibo Observatory. Credit: USRA

Initial reports from the Arecibo Observatory in Puerto Rico indicate powerful winds from Hurricane Maria destroyed an antenna and damaged the radio telescope's huge 300-metre (1,000-foot) dish reflector, but the bulk of the facility remains intact and workers sheltered there were unharmed.

Staff and family members who rode out the storm at the observatory Wednesday are safe, but officials are still trying to contact other employees who sheltered in their homes and other safe places, according to the Universities Space Research Association, or USRA.

USRA is part of a multi-institution team charged with operating Arecibo Observatory by the National Science Foundation.

While electricity and standard communications lines remain out, reports from the observatory were transmitted via shortwave radio, USRA said in a statement.

The main dish of the famed telescope, which spans 305 meters (1,000 feet) across, was reported intact. But the dish suffered several punctures when a 29-metre (96-foot) line feed antenna fell from a catenary more than 100 meters above the reflector, officials said.

The 430 MHz line feed was used to transmit and receive radio waves for atmospheric research. Arecibo uses different equipment for radio astronomy observations, but still relies on the same huge dish reflector.

A 12-metre (39-foot) dish used as a phase reference for Very Long Baseline Interferometry was also lost, according to USRA.

"We will need a full assessment of the damage, repairs that are needed and when the observatory can resume observations," said Nicholas White, senior vice president for science at Universities Space Research Association.

The access road leading to the observatory is still covered in debris and inaccessible, officials said.

A weather station at Arecibo detected sustained winds of 78 mph (126 kilometers per hour) Wednesday morning, with gusts measured up to 108 mph (174 kilometers per hour), according to the National Hurricane Center.

Officials at Arecibo Observatory announced Monday they began hurricane preparations. The staff planned to secure the telescope, facilities and research equipment.

Hurricane Maria's landfall in Puerto Rico marked the second time in two weeks Arecibo prepared for a tropical cyclone. Hurricane Irma passed just north of the island Sept. 6, sparing the observatory significant damage.

Constructed in the early 1960s, the Arecibo Observatory is the world's second-largest radio telescope, with its dish antenna nestled inside a natural karst depression.

Astronomers use Arecibo to investigate asteroids, planets, pulsars, galaxies and dark matter. The giant radio telescope has also sent signals into the Universe to probe for extraterrestrial life, and listened for signs of transmissions coming from other worlds.

One recent target of Arecibo was the triple asteroid Florence, which passed more than 4 million miles (7 million kilometers) from Earth on Sept. 1. Arecibo and other radars observing the asteroid detected it had two unexpected companions, or moons.

The 430 MHz radar line feed is seen extending to the lower right in this image. Credit: USRA

Source: AstronomyNow.com Return to Contents

The Night Sky

Tuesday, September 26

- The "star" below or lower left of the Moon this evening is Saturn, 3,800 times farther away: Saturn is currently 85 light-minutes distant, compared to the Moon's 1.3 light-seconds.

Wednesday, September 27

- First-quarter Moon; exact at 10:54 p.m. EDT. Since we're still close to the equinox date, the almost exactly first-quarter Moon stands due south right at sunset. (Think about why!)
- Then as night comes on, look to the Moon's lower right for Saturn, and to the Moon's lower left for the Sagittarius Teapot. Depending on where you are, a line lower left from the Moon will go right through the Teapot's centerline from the top of the lid through the center of the base.

Thursday, September 28

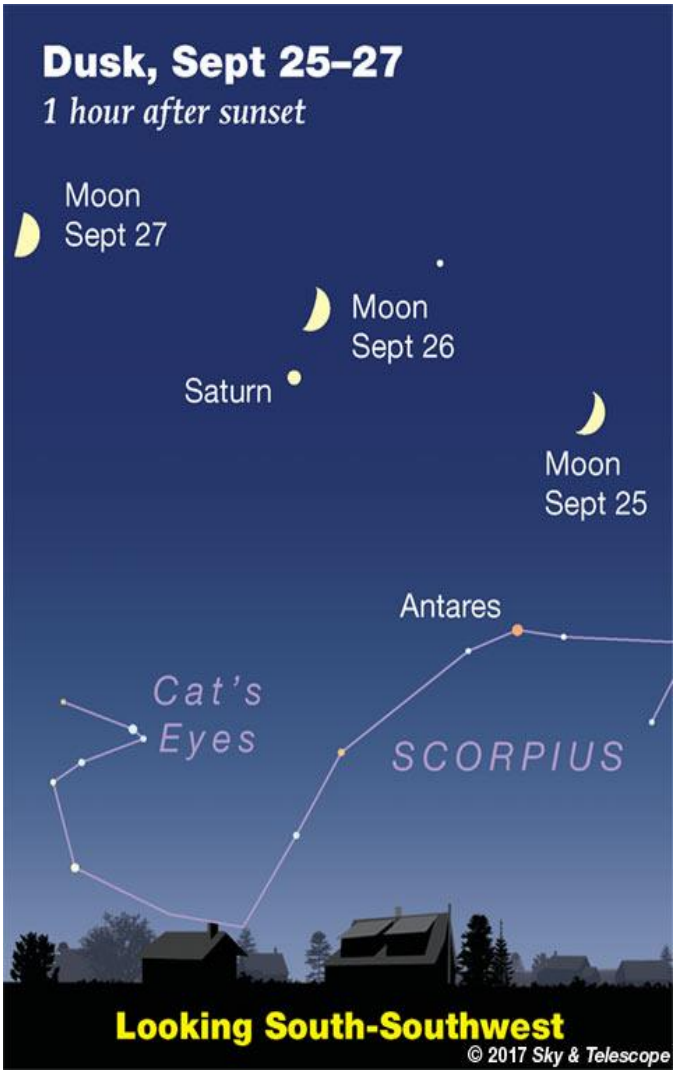
- Now the Moon shines above the Teapot's handle at nightfall.

Friday, September 29

- As the stars come out in late twilight, look high above the Moon for Altair. After dark, examine the sky about a fist at arm's length upper left of Altair for dim little Delphinus, the Dolphin. A little less far straight above Altair is smaller, dimmer Sagitta, the Arrow. (Binoculars will help.)

Saturday, September 30

- Arcturus shines in the west these evenings, sinking as twilight fades out. Equally-bright Capella is rising lower in the north-northeast, depending on your latitude. (The farther north you are the higher it will be.) They're both magnitude 0, as bright as Vega high overhead.
- By mid- to late evening, Arcturus and Capella shine at identical heights. When will this happen? That depends on both your latitude and longitude.



The waxing Moon steps eastward over Scorpius and Saturn early this week

Source: Sky and Telescope

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ISS Sighting Opportunities (from Denver)

Date	Visible	Max Height	Appears	Disappears
Tue Sep 26, 8:08 PM	5 min	69°	10° above WSW	28° above NE
Wed Sep 27, 7:16 PM	6 min	57°	10° above SW	11° above ENE
Wed Sep 27, 8:55 PM	1 min	21°	18° above NW	21° above NNW
Thu Sep 28, 8:03 PM	3 min	31°	28° above NW	14° above NNE
Fri Sep 29, 7:10 PM	4 min	54°	40° above W	10° above NE
Fri Sep 29, 8:47 PM	2 min	14°	11° above NW	14° above N

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

NASA-TV Highlights (all times Eastern Time Zone)

Wednesday, September 27

- 12 p.m. - ISS Expedition 53 In-Flight Educational Event with the STEM in 30 Program at the National Air and Space Museum and ISS Commander Randy Bresnik of NASA (Starts at 12:15 p.m.) (all channels)
- 3 p.m.,7p.m. and 11p.m. - Replay of ISS Expedition 53 In-Flight Educational Event with the STEM in 30 Program at the National Air and Space Museum and ISS Commander Randy Bresnik of NASA (all channels)
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Friday, September 29

- 9 a.m. - ISS Expedition 53 In-Flight Educational Event for ESA with New Scientist Live and Flight Engineer Paolo Nespoli of the European Space Agency (all channels)

Watch NASA TV online by going to the NASA website.

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Space Calendar

- Sep 26 - Comet 73P-R/Schwassmann-Wachmann Closest Approach To Earth (1.500 AU)
- Sep 26 - Comet 59P/Kearns-Kwee Closest Approach To Earth (2.476 AU)
- Sep 26 - Comet C/2016 Q4 (Kowalski) Closest Approach To Earth (6.117 AU)
- Sep 26 - Comet C/2016 Q4 (Kowalski) At Opposition (6.117 AU)
- **Sep 26 - Apollo Asteroid 2017 RB16 Near-Earth Flyby (0.012 AU)**
- Sep 26 - Amor Asteroid 2004 SS Near-Earth Flyby (0.041 AU)
- Sep 26 - Apollo Asteroid 5189 (1990 UQ) Near-Earth Flyby (0.061 AU)
- Sep 26 - Amor Asteroid 3757 Anagolay Closest Approach To Earth (1.095 AU)
- Sep 26 - Conference: Evidence for Policy in a Post-Fact world (EU4FACTS), Brussels, Belgium
- Sep 26 - Colloquium: Craters and Cryovolcanoes \u2013 Comparisons Across the Outer Solar System, Tucson, Arizona
- Sep 26-29 - Astrochemical Conference (KIDA2017), Bordeaux, France
- Sep 26-29 - DESY Theory Workshop: Fundamental Physics in the Cosmos - The Early, the Large and the Dark Universe, Hamburg, Germany
- Sep 27 - Comet 73P-M/Schwassmann-Wachmann Closest Approach To Earth (1.528 AU)
- Sep 27 - Comet 73P-AD/Schwassmann-Wachmann Closest Approach To Earth (1.535 AU)
- Sep 27 - Comet C/2017 E1 (Borisov) Closest Approach To Earth (2.141 AU)
- Sep 27 - Dwarf Planet Ceres Occults 2UCAC 40015030 (12.2 Magnitude Star)
- Sep 27 - Aten Asteroid 2017 SS10 Near-Earth Flyby (0.025 AU)
- Sep 27 - Amor Asteroid 2017 SQ10 Near-Earth Flyby (0.042 AU)
- Sep 27 - Apollo Asteroid 2017 RE15 Near-Earth Flyby (0.093 AU)
- Sep 27 - Apollo Asteroid 469219 (2016 HO3) Closest Approach To Earth (0.158 AU)
- Sep 27 - Asteroid 90022 Apache Point Closest Approach To Earth (1.574 AU)
- Sep 27 - Kuiper Belt Object 308933 (2006 SQ372) At Opposition (26.842 AU)
- Sep 27 - Lecture: The Solar Energetic Particles - Origin and Consequences, Greenbelt, Maryland
- Sep 27-28 - Astronomy and Astrophysics Advisory Committee (AAAC) Meeting, Washington DC
- Sep 27-29 - International Conference on Space Mission Challenges for Information Technology (SMC-IT), Madrid, Spain
- **Sep 28 - AsiaSat 9 Proton-M/Briz-M P4 Launch**
- **Sep 28 - NROL-52/ Quasar 21 Atlas 5 Launch**
- Sep 28 - Comet 73P-E/Schwassmann-Wachmann Closest Approach To Earth (1.542 AU)
- Sep 28 - Apollo Asteroid 2017 GM6 Near-Earth Flyby (0.080 AU)
- Sep 28 - Asteroid 15783 Briancox Closest Approach To Earth (2.027 AU)
- Sep 28 - Centaur Object 2015 JH1 At Opposition (4.704 AU)
- Sep 28 - Lecture: Cassini's Grand Finale & Final Plunge, Ithaca, New York
- Sep 28 - Seminar: The Curiously Warped Mean Plane of the Kuiper Belt, Houston, Texas
- Sep 28 - Lecture: OSIRIS-REx - Earth Gravity Assist - New Photos of Earth, Tucson, Arizona
- **Sep 29 - Intelsat 37E/ BSAT 4A Ariane 5 Launch**

Source: JPL Space Calendar Return to Contents

Food for Thought

Scientists Urge Europe to Stick with "Armageddon"-style Asteroid Mission

A computer generated handout image released by the European Space Agency shows the impact of the DART (Double Asteroid Redirection Test) projectile on the binary asteroid system (65803) Didymos. Credit: ESA/AFP

For decades, scientists have known that in near-Earth space there are thousands of comets and asteroids that periodically cross Earth's orbit. These Near-Earth Objects (NEOs) are routinely tracked by NASA's Center for Near Earth Object Studies (CNEOS) to make sure that none pose a risk of collision with our planet. Various programs and missions have also been proposed to divert or destroy any asteroids that might pass too closely to Earth in the future.

One such mission is the Asteroid Impact & Deflection Assessment (AIDA), a collaborative effort between NASA and the European Space Agency (ESA). Recently, the ESA announced that it would be withdrawing from this mission due to budget constraints. But this past Wednesday (Sept. 20th), during the European Planetary Science Conference in Riga, a group of international scientists urged them to reconsider.

In addition to NASA and the ESA, AIDA was designed with assistance from the Observatoire de la Côte d´Azur (OCA), and the Johns Hopkins University Applied Physics Laboratory (JHUAPL). To test possible asteroid deflection techniques, the mission intends to send a spacecraft to crash into the tiny moon of the distant asteroid named Didymos (nicknamed "Didymoon") by 2022 to alter its trajectory.

This mission would be a first for scientists, and would test the capabilities of space agencies to divert rocks away from Earth's orbit. NASA's contribution to this mission is known as the Double Asteroid Redirection Test (DART), the spacecraft which would be responsible for crashing into Didymoon. Plans for this spacecraft recently entered Phase B, having met with approval, but still in need of further development.

The plan was to mount DART on an already planned commercial or military launch, and would then be placed in geosynchronous orbit between December 2020 and May 2021. It would then rely on a NEXT-C ion engine to push

itself beyond the Moon and reach an escape point to depart the Earth-Moon system, eventually making its way to Didymos and Didymoon.

Europe's contribution to the mission was known as the Asteroid Impact Mission (AIM), which would involve sending a small craft close to Didymos to observe the crash and conduct research on the asteroid's moon. Unfortunately, this aspect of the mission suffered a setback when space ministers from the ESA's 22 member states rejected a €250 million ($300 million USD) request for funding last December.

However, during the European Planetary Science Congress – which will be taking place from September 17th to 22nd in the Latvian capital of Riga – scientists took the opportunity to advise the mission's European partners to get back on board. As they emphasized, this mission – which is a dry-run for future asteroid redirect missions – is crucial if space agencies hope to develop the capacity to protect Earth from hazardous NEOs.

Andrew Cheng from JHUAPL is the project scientist for the DART mission. As he told the AFP at the European Planetary Science Congress, "This is the kind of disaster that could be a tremendous catastrophe." He also stressed that unlike other natural disasters, an asteroid strike "is something that the world is able to defend. We can do something."

But before that can happen, the methods need to be further developed, tested and refined. Hence why Didymoon was selected as the target for the AIDA mission. Whereas the meteor that exploded over the Russian town of Chelyabinsk in 2013 was just 20 meters across (65 feet), but still injured 1600 people, Didymoon measures about 160 meters (525 feet) in diameter.

It is estimated that if this asteroid struck Earth, the resulting impact would be as powerful as a 400 megatonne blast. To put that in perspective, the most powerful thermonuclear device ever built – the Soviet Tsar Bomba – had a yield of 50 megatonnes. Hence, the smaller companion of this binary asteroid, if it struck Earth, would have an impact 80 times greater than the most powerful bomb ever built by humans.

In addition to advocating that the ESA remain committed to the mission, European scientists at the conference also proposed an altered, more cost-effective alternative for AIM. This alternative called for a miniaturized version of the AIM craft that would be equipped with just a camera, forgoing a lander and radars designed to probe Didymoon's internal structure.

According to Patrick Michel, the science lead for the AIM mission, this revised mission would cost about €210 million ($250 million USD). But as he also noted, this would require that the AIM part of the mission be delayed. While it would still conduct crucial measurements of Didymoon, it would not be part of the AIDA mission if NASA decides to stick with its original timeline.

"The main point of the mission was to measure the mass of the object, because this is how you really measure the deflection," he said. "Two or three years (after impact), these things won't change. Of course it's better… that we have the two at the same time. But we found something I think that still works and allows to relax the very tight schedule."

In the meantime, Jan Woerner – the head of the European Space Agency – indicated that the ESA would be moving forward with the new proposal when the next ministerial meeting takes place in 2019. As he told the AFP via email:

"It is important for humanity, as a species we have the means today to deflect an asteroid. We know it will happen, one day sooner or later. It's not a question of if, but when. We have never tested asteroid deflection and there is no way we can test in (the) laboratory. We need to know if our models are correct, (whether) our simulations work as expected."

Source: Universe Today Return to Contents

Space Image of the Week

Veil Nebula: Wisps of an Exploded Star

Image Credit: NASA, ESA, and the Hubble Heritage Team (STScI/AURA)

Explanation: Wisps like this are all that remain visible of a Milky Way star. About 7,000 years ago that star exploded in a supernova leaving the Veil Nebula. At the time, the expanding cloud was likely as bright as a crescent Moon, remaining visible for weeks to people living at the dawn of recorded history. Today, the resulting supernova remnant, also known as the Cygnus Loop, has faded and is now visible only through a small telescope directed toward the constellation of the Swan (Cygnus). The remaining Veil Nebula is physically huge, however, and even though it lies about 1,400 light-years distant, it covers over five times the size of the full Moon. The featured picture is a Hubble Space Telescope mosaic of six images together covering a span of only about two light years, a small part of the expansive supernova remnant. In images of the complete Veil Nebula, even studious readers might not be able to identify the featured filaments.

Source: NASA APOD

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