Space News Update

— June 28, 2019 —

Contents

1. **NASA's Dragonfly Will Fly Around Titan Looking for Origins, Signs of Life**

NASA has announced that our next destination in the solar system is the unique, richly organic world Titan. Advancing our search for the building blocks of life, the Dragonfly mission will fly multiple sorties to sample and examine sites around Saturn's icy moon.

Dragonfly will launch in 2026 and arrive in 2034. The rotorcraft will fly to dozens of promising locations on Titan looking for prebiotic chemical processes common on both Titan and Earth. Dragonfly marks the first time NASA will fly a multi-rotor vehicle for science on another planet; it has eight rotors and flies like a large drone. It will take advantage of Titan's dense atmosphere – four times denser than Earth's – to become the first vehicle ever to fly its entire science payload to new places for repeatable and targeted access to surface materials.

Titan is an analog to the very early Earth, and can provide clues to how life may have arisen on our planet. During its 2.7-year baseline mission, Dragonfly will explore diverse environments from organic dunes to the floor of an impact crater where liquid water and complex organic materials key to life once existed together for possibly tens of thousands of years. Its instruments will study how far prebiotic chemistry may have progressed. They also will investigate the moon's atmospheric and surface properties and its subsurface ocean and liquid reservoirs. Additionally, instruments will search for chemical evidence of past or extant life.

"With the Dragonfly mission, NASA will once again do what no one else can do," said NASA Administrator Jim Bridenstine. "Visiting this mysterious ocean world could revolutionize what we know about life in the universe. This cutting-edge mission would have been unthinkable even just a few years ago, but we're now ready for Dragonfly's amazing flight."

Dragonfly took advantage of 13 years' worth of Cassini data to choose a calm weather period to land, along with a safe initial landing site and scientifically interesting targets. It will first land at the equatorial "Shangri-La" dune fields, which are terrestrially similar to the linear dunes in Namibia in southern Africa and offer a diverse sampling location. Dragonfly will explore this region in short flights, building up to a series of longer

“leapfrog” flights of up to 5 miles (8 kilometers), stopping along the way to take samples from compelling areas with diverse geography. It will finally reach the Selk impact crater, where there is evidence of past liquid water, organics – the complex molecules that contain carbon, combined with hydrogen, oxygen, and nitrogen – and energy, which together make up the recipe for life. The lander will eventually fly more than 108 miles (175 kilometers) – nearly double the distance traveled to date by all the Mars rovers combined.

“Titan is unlike any other place in the solar system, and Dragonfly is like no other mission,” said Thomas Zurbuchen, NASA’s associate administrator for Science at the agency’s Headquarters in Washington. “It’s remarkable to think of this rotorcraft flying miles and miles across the organic sand dunes of Saturn’s largest moon, exploring the processes that shape this extraordinary environment. Dragonfly will visit a world filled with a wide variety of organic compounds, which are the building blocks of life and could teach us about the origin of life itself.”

Titan has a nitrogen-based atmosphere like Earth. Unlike Earth, Titan has clouds and rain of methane. Other organics are formed in the atmosphere and fall like light snow. The moon’s weather and surface processes have combined complex organics, energy, and water similar to those that may have sparked life on our planet.

Titan is larger than the planet Mercury and is the second largest moon in our solar system. As it orbits Saturn, it is about 886 million miles (1.4 billion kilometers) away from the Sun, about 10 times farther than Earth. Because it is so far from the Sun, its surface temperature is around -290 degrees Fahrenheit (-179 degrees Celsius). Its surface pressure is also 50 percent higher than Earth’s.

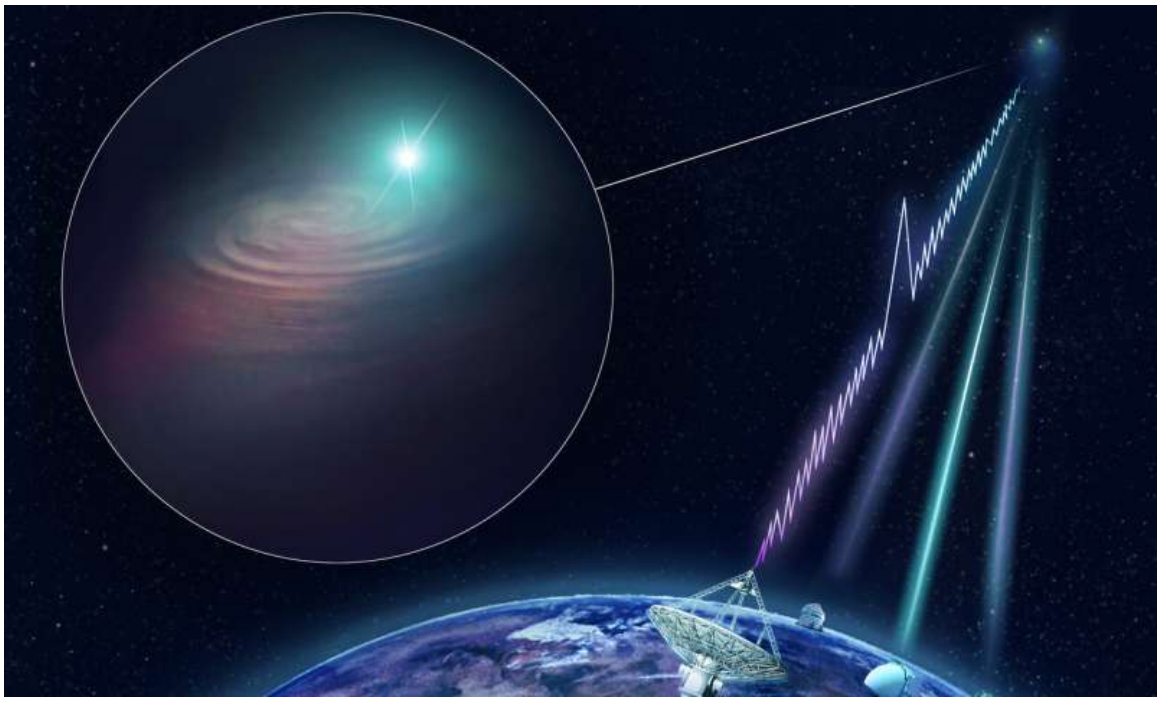
Dragonfly was selected as part of the agency’s New Frontiers program, which includes the New Horizons mission to Pluto and the Kuiper Belt, Juno to Jupiter, and OSIRIS-REx to the asteroid Bennu. Dragonfly is led by Principal Investigator Elizabeth Turtle, who is based at Johns Hopkins University’s Applied Physics Laboratory in Laurel, Maryland. New Frontiers supports missions that have been identified as top solar system exploration priorities by the planetary community. The program is managed by the Planetary Missions Program Office at NASA’s Marshall Space Flight Center in Huntsville, Alabama, for the agency’s Planetary Science Division in Washington.

“The New Frontiers program has transformed our understanding of the solar system, uncovering the inner structure and composition of Jupiter’s turbulent atmosphere, discovering the icy secrets of Pluto’s landscape, revealing mysterious objects in the Kuiper belt, and exploring a near-Earth asteroid for the building blocks of life,” said Lori Glaze, director of NASA’s Planetary Science Division. “Now we can add Titan to the list of enigmatic worlds NASA will explore.”

For more information about Titan, visit https://solarsystem.nasa.gov/moons/saturn-moons/titan/overview. Read more about NASA’s New Frontiers Program and missions at https://planetarymissions.nasa.gov.

Source: NASA Return to Contents

2. Cosmic waves Discovery Could Unlock Mysteries of Intergalactic Space



Scientists were celebrating a groundbreaking astronomical discovery Thursday that they say could pave the way for mapping the outer reaches of the universe.

An Australian-led team of international astronomers have determined for the first time the precise source of a powerful, one-off burst of cosmic radio waves. They have pinpointed it to a massive galaxy billions of light years away, with properties that upend what scientists previously thought they knew about the formation of mysterious fast radio bursts (FRBs). "This result is highly anticipated within the astronomy community," Casey Law, an astronomer at UC Berkeley who was not involved in the study told AFP.

The findings, published in the journal *Science*, are among the most significant since the discovery in 2007 of FRBs, which flash for only a micro-instant but can emit as much energy in a millisecond as the Sun does in 10,000 years. Exactly what creates these high-energy surges of long waves at the far end of the electromagnetic spectrum remains the subject of intense debate, though scientists now agree they originate in far away galaxies.

Since the first FRB was detected a little over a decade ago, a global hunt has found 85 bursts. Most have been "one-offs" but a small fraction have been "repeaters" that recur at the same spot in the sky.

Live replay

In 2017, astronomers were able to trace the source of a repeating burst, but locating a one-off FRB presented a much more difficult challenge. Without the benefit of knowing where to look, a team led by Keith Bannister of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) had to devise a new methodology.

"You can think of it as live action replay mode, where we have a computer that's actually looking for the FRB, so it looked through about a billion measurements every second and I tried to find the one that contains an FRB," Bannister told AFP. Bannister and his team pinpointed the location of FRB 180924 about 3.6 billion light years from Earth.

The discovery was detected on CSIRO's Australian Square Kilometre Array Pathfinder (ASKAP) radio telescope in Western Australia. ASKAP has 36 dish antennas, with the burst reaching each one at a slightly different time, allowing the scientists to calculate its origin. "It's like looking at the Earth from the Moon and not only knowing what house a person lived in, but what chair they were sitting in at the dining room table," Bannister said.

The team then imaged the galaxy with the European Southern Observatory's Very Large Telescope in Chile, and measured its distance with the Keck telescope in Hawaii and the Gemini South telescope in Chile.

While the previously localized FRB 121102 was found to emanate from a dwarf galaxy that was actively forming young stars, the new FRB comes from the outskirts of a massive galaxy with old stars, suggesting a completely different engine is responsible for its creation. "The first localization inspired lots of modeling based on magnetars formed in the deaths of massive stars," said Law, a model which predicted a number of properties confirmed in 121102.

A magnetar is a highly-magnetized type of neutron star, which are formed by the gravitational collapse of a star not quite massive enough to produce a black hole when it explodes.

But the new location is incompatible with the old theory, suggesting there are multiple channels for forming FRBs. "This might suggest that repeating and non-repeating FRBs come from completely different origins," said Shriharsh Tendulkar, an astronomer at McGill University who was not involved in the work.

Weighing space

The new finding is also exciting for another reason: it could help astronomers probe what lies in the vast spaces between galaxies and bring us a step closer to resolving the "missing matter" problem.

Theoretical calculations have suggested there should be twice the number of atoms that can be seen in the stars, which led astronomers to theorize they must be contained in ionized gases in the vast spaces that separate galaxies.

Just as light splits into different colors as it passes through a prism, radio waves disperse as they encounter matter. In the case of FRBs, higher frequencies arrive first, and lower frequencies arrive later. This creates a dispersion pattern, and the pattern observed from FRB 180924 matched what astronomers expected from the theory, meaning the intergalactic space does indeed contain the amount of ionized gas that was expected.

Moving forward, the team would like to localize thousands, if not tens of thousands of more FRBs and look at their dispersions, to generate a detailed map of the far reaches of space. "It's like making a CT scan of this cosmic web," said co-author Ryan Shannon from Swinburne University.

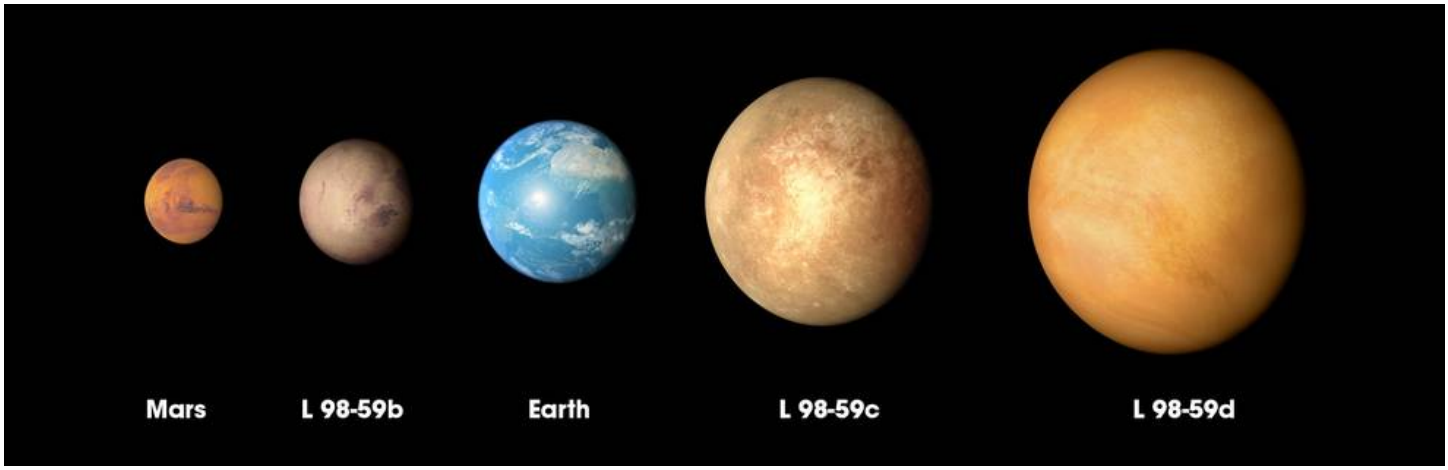
On the missing matter problem, he said: "I think we're on the way to sewing it up. With a few more localized bursts we will be able to nail it."

Explore further

Aussie telescope almost doubles known number of mysterious 'fast radio bursts'

Source: Phys.org Return to Contents

3. NASA's TESS Mission Finds Its Smallest Planet Yet



NASA's Transiting Exoplanet Survey Satellite (TESS) has discovered a world between the sizes of Mars and Earth orbiting a bright, cool, nearby star. The planet, called L 98-59b, marks the tiniest discovered by TESS to date.

Two other worlds orbit the same star. While all three planets' sizes are known, further study with other telescopes will be needed to determine if they have atmospheres and, if so, which gases are present. The L 98-59 worlds nearly double the number of small exoplanets — that is, planets beyond our solar system — that have the best potential for this kind of follow-up.

"The discovery is a great engineering and scientific accomplishment for TESS," said Veselin Kostov, an astrophysicist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, and the SETI Institute in Mountain View, California. "For atmospheric studies of small planets, you need short orbits around bright stars, but such planets are difficult to detect. This system has the potential for fascinating future studies."

A paper on the findings, led by Kostov, was published in the June 27 issue of The Astronomical Journal and is now available online.

L 98-59b is around 80% Earth's size and about 10% smaller than the previous record holder discovered by TESS. Its host star, L 98-59, is an M dwarf about one-third the mass of the Sun and lies about 35 light-years away in the southern constellation Volans. While L 98-59b is a record for TESS, even smaller planets have been discovered in data collected by NASA's Kepler satellite, including Kepler-37b, which is only 20% larger than the Moon.

The two other worlds in the system, L 98-59c and L 98-59d, are respectively around 1.4 and 1.6 times Earth's size. All three were discovered by TESS using transits, periodic dips in the star's brightness caused when each planet passes in front of it.

TESS monitors one 24-by-96-degree region of the sky, called a sector, for 27 days at a time. When the satellite finishes its first year of observations in July, the L 98-59 system will have appeared in seven of the 13 sectors that make up the southern sky. Kostov's team hopes this will allow scientists to refine what's known about the three confirmed planets and search for additional worlds.

"If you have more than one planet orbiting in a system, they can gravitationally interact with each other," said Jonathan Brande, a co-author and astrophysicist at Goddard and the University of Maryland, College Park. "TESS will observe L 98-59 in enough sectors that it may be able to detect planets with orbits around 100

days. But if we get really lucky, we might see the gravitational effects of undiscovered planets on the ones we currently know."

M dwarfs like L 98-59 account for three-quarters of our Milky Way galaxy's stellar population. But they are no larger than about half the Sun's mass and are much cooler, with surface temperatures less than 70% of the Sun's. Other examples include TRAPPIST-1, which hosts a system of seven Earth-size planets, and Proxima Centauri, our nearest stellar neighbor, which has one confirmed planet. Because these small, cool stars are so common, scientists want to learn more about the planetary systems that form around them.

L 98-59b, the innermost world, orbits every 2.25 days, staying so close to the star it receives as much as 22 times the amount of energy Earth receives from the Sun. The middle planet, L 98-59c, orbits every 3.7 days and experiences about 11 times as much radiation as Earth. L 98-59d, the farthest planet identified in the system so far, orbits every 7.5 days and is blasted with around four times the radiant energy as Earth.

None of the planets lie within the star's "habitable zone," the range of distances from the star where liquid water could exist on their surfaces. However, all of them occupy what scientists call the Venus zone, a range of stellar distances where a planet with an initial Earth-like atmosphere could experience a runaway greenhouse effect that transforms it into a Venus-like atmosphere. Based on its size, the third planet could be either a Venus-like rocky world or one more like Neptune, with a small, rocky core cocooned beneath a deep atmosphere.

One of TESS's goals is to build a catalog of small, rocky planets on short orbits around very bright, nearby stars for atmospheric study by NASA's upcoming James Webb Space Telescope. Four of the TRAPPIST-1 worlds are prime candidates, and Kostov's team suggests the L 98-59 planets are as well.

The TESS mission feeds our desire to understand where we came from and whether we're alone in the universe.

"If we viewed the Sun from L 98-59, transits by Earth and Venus would lead us to think the planets are almost identical, but we know they're not," said Joshua Schlieder, a co-author and an astrophysicist at Goddard. "We still have many questions about why Earth became habitable and Venus did not. If we can find and study similar examples around other stars, like L 98-59, we can potentially unlock some of those secrets."

TESS is a NASA Astrophysics Explorer mission led and operated by MIT in Cambridge, Massachusetts, and managed by NASA's Goddard Space Flight Center. Additional partners include Northrop Grumman, based in Falls Church, Virginia; NASA's Ames Research Center in California's Silicon Valley; the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts; MIT's Lincoln Laboratory; and the Space Telescope Science Institute in Baltimore. More than a dozen universities, research institutes and observatories worldwide are participants in the mission.

Source: NASA Return to Contents

The Night Sky

Friday, June 28

• As evening grows late, even the lowest star of the Summer Triangle shines pretty high in the east now. That's Altair. It's a good three or four fists at arm's length below or lower right of bright Vega.

A marker for Altair is its little 3rd-magnitude buddy Tarazed (Gamma Aquilae), above or upper left of it by about a finger's width at arm's length.

Look left of Altair, by hardly more than one fist, for compact little Delphinus, the Dolphin.

And above the midpoint between Delphinus and Altair look for even smaller, dimmer Sagitta, the Arrow.

Saturday, June 29

• The Milky Way forms a magnificent arch across the eastern sky as evening grows late, if your sky is dark enough! The Milky Way runs all the way from below Cassiopeia in the north-northeast, up and across Cygnus and the Summer Triangle in the east, and down past the spout of the Sagittarius Teapot in the south-southeast, where it's brightest.

Sunday, June 30

• Can you spot the Coma Berenices star cluster with your unaided eyes? It's big but sparse and dim, high in the west after dark. To locate it find brilliant Arcturus high in the southwest, and to the right of that, the end star of the Big Dipper's handle. Take the midpoint between them, and look well down from there. The Coma Star Cluster forms a nearly equilateral triangle with those two stars.

You'll need a dark sky. The cluster is about 4° wide, about the size of a ping-pong ball held at arm's length. Its brightest stars form a tilted, upside-down letter Y.

In binoculars the cluster fills most of the field of view. So if you're expecting to look for something small, you'll miss it by looking right through it!

Monday, July 1

• Low in the north-northeast after dark, the upright W of Cassiopeia is slowly beginning to tilt and climb.

• Explore the double stars and deep-sky sights around the head of Hercules near the zenith, and trace out the little-known asterism Sudor Ophiuchi, using the July *Sky & Telescope*'s Deep-Sky Wonders column and chart (page 54).

Source: Sky & Telescope

Return to Contents

ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Sat Jun 29, 3:59 AM	3 min	14°	12° above SSE	10° above E
Sun Jun 30, 4:44 AM	4 min	80°	13° above SW	37° above ENE
Mon Jul 1, 3:57 AM	3 min	41°	31° above S	18° above ENE
Tue Jul 2, 3:09 AM	2 min	21°	21° above ESE	10° above E

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

- Jun 28 - UPDATED [Jun 28] BlackSky Global 4/ "Make It Rain" Electron Launch
- Jun 28 - Amor Asteroid 2016 NN15 Near-Earth Flyby (0.025 AU)
- Jun 28 - Aten Asteroid 494999 (2010 JU39) Near-Earth Flyby (0.060 AU)
- Jun 28 - Apollo Asteroid 2013 WR45 Near-Earth Flyby (0.092 AU)
- Jun 28 - Asteroid 716 Berkeley Closest Approach To Earth (1.724 AU)
- Jun 28 - Asteroid 1071 Brita Closest Approach To Earth (2.084 AU)
- Jun 28 - 8th Belgian-Dutch Gravitational Waves Meeting, Maastricht, The Netherlands
- Jun 28 - Seminar: A Primer on Axtronomy, Barcelona, Spain
- Jun 28-29 - NEW [Jun 21] StarsUp: The Festival of Science, Aerospace and Innovation, Meudon, France
- Jun 29 - Comet 311P/PANSTARRS Closest Approach To Earth (1.382 AU)
- Jun 29 - Comet 348P/PANSTARRS At Opposition (3.121 AU)
- Jun 29 - Apollo Asteroid 2019 LV1 Near-Earth Flyby (0.013 AU)
- Jun 29 - Apollo Asteroid 2019 LR4 Near-Earth Flyby (0.029 AU)
- Jun 29 - Asteroid 5841 Stone Closest Approach To Earth (1.102 AU)
- Jun 29 - Apollo Asteroid 3361 Orpheus Closest Approach To Earth (1.343 AU)
- Jun 29 - Asteroid 4636 Chile Closest Approach To Earth (1.720 AU)
- Jun 29 - Asteroid 163800 Richardnorton Closest Approach To Earth (1.809 AU)
- Jun 29 - Asteroid 7096 Napier Closest Approach To Earth (2.393 AU)
- Jun 29 - Asteroid 5870 Baltimore Closest Approach To Earth (2.903 AU)
- Jun 29 - Carlyle Beals' 120th Birthday (1899)
- Jun 30 - HOT [Jun 23] Asteroid Day
- Jun 30 - Asteroid 2912 Lapalma Closest Approach To Earth (1.276 AU)
- Jun 30 - Summer on the Hudson: Sun Gaze, Manhattan, New York
- Jun 30 - 15th Anniversary (2004), Cassini, Saturn Orbit Insertion
- Jun 30 - 35th Anniversary (1984), Aomori Meteorite Fall (Hit Building in Japan)
- Jul 01 - Comet P/1999 RO28 (LONEOS) Perihelion (1.123 AU)
- Jul 01 - Comet 84P/Giclas At Opposition (2.181 AU)
- Jul 01 - NEW [Jun 27] Apollo Asteroid 2019 MT Near-Earth Flyby (0.023 AU)
- Jul 01 - Apollo Asteroid 2015 XC352 Near-Earth Flyby (0.031 AU)
- Jul 01 - Asteroid 2200 Pasadena Closest Approach To Earth (1.326 AU)
- Jul 01 - Asteroid 6701 Warhol Closest Approach To Earth (1.462 AU)
- Jul 01 - Asteroid 2068 Dangreen Closest Approach To Earth (1.951 AU)
- Jul 01 - 20th Anniversary (1999), Giotto, Earth Flyby
- Jul 02 - HOT [Jun 25] Total Solar Eclipse (Visible from Central Chile, Central Argentina)
- Jul 02 - NEW [Jun 28] Apollo Asteroid 2019 MD1 Near-Earth Flyby (0.026 AU)
- Jul 02 - Apollo Asteroid 10563 Izhdubar Closest Approach To Earth (0.785 AU)
- Jul 02 - Asteroid 193 Ambrosia Closest Approach To Earth (2.273 AU)
- Jul 02 - 5th Anniversary (2014), Orbiting Carbon Observatory-2 (OCO-2) Launch
- Jul 02 - Pedro Paulet's 145th Birthday (1874)
-

Source: JPL Space Calendar

Return to Contents

Food for Thought

Spaceship Concordia

Science for the benefit of space exploration does not only happen off planet.

While some studies require the weightless isolation of the International Space Station, another location provides the right conditions for investigating the consequences of spaceflight, and it is right here on Earth.

The 2018 crew of Concordia research station in Antarctica recently returned to the European Astronaut Centre in Cologne to wrap up their time as researchers and subjects at Earth's most remote outpost.

Earth's white whale

Antarctica has all the wonder and appeal of space. It is harsh, vast and mysterious. But it also has one thing extra going for it: it is a little easier to access.

Peppered throughout the peninsula are research stations like Concordia, a collaboration between the French Polar Institute and the Italian Antarctic programme. Concordia is one of only three bases that is inhabited all year long, and is located at the mountain plateau called Dome C.

As well as offering around nine months of complete isolation, Concordia's location at 3233 m altitude means the crew experience chronic hypobaric hypoxia - lack of oxygen in the brain.

During the Antarctic winter, the crew of up to 15 people also endure four months of complete darkness: the sun disappears from May and is not seen again until late August.

Temperatures can drop to -80°C in the winter, with a yearly average of -50°C.

As a station set in Earth's harshest space, Concordia is an ideal stand-in for studying the human psychological and physiological effects of extreme cold, isolation and darkness.

Terrestrionauts

To research how these conditions affect humans, ESA sponsors a medical doctor every year to run experiments coordinated by ESA and Concordia partners.

Carmen Possnig, the 2018 medical doctor, followed the effects of lack of sunlight and a less oxygen on herself and her fellow subjects for researchers developing countermeasures to altered motor skills, memory, sleep patterns and moods.

Experiments included playing simple memory games and more complex sessions in simulators requiring subjects to pilot and dock a spacecraft as well as routinely providing blood and urine samples.

Experiments are already years in the running, meaning researchers can test effective countermeasures such as light therapy to improve sleep, awareness and mood.

Social cohesion is also vital to the crew at Concordia, as it is on the International Space Station or any other spacecraft that will be heading for space. While addressing physical discomforts from lack of sleep and oxygen deprivation greatly improves mood and morale, the crew must also bond and work as a team in shared isolation. Building a climbing wall and planning festivities helped the 2018 crew.

Safety procedures and training given months before the crew departs set the tone for crew bonding, much like astronauts training for a mission to the Space Station.

The 2018 Concordia crew got to share another memorable event: meeting ESA astronaut Alexander Gerst during their debriefing in Cologne.

Read more about the research and life at the station on the Chronicles of Concordia blog , written by ESA-sponsored medical doctors. Calls for medical doctor sponsorships can also be found on the Concordia site.

Concordia research is not limited to the human body and mind alone. Meteorology and glaciology studies are a mainstay here that provide valuable data on ice composition and loss and climate change.

Source: Spaceref.com Return to Contents

Space Image of the Week

A Solstice Night in Paris

Explanation The night of June 21 was the shortest night for planet Earth's northern latitudes, so at latitude 48.9 degrees north, Paris was no exception. Still, the City of Light had an exceptionally luminous evening. Its skies were flooded with silvery night shining or noctilucent clouds after the solstice sunset. Hovering at the edge of space, the icy condensations on meteoric dust or volcanic ash are still in full sunlight at the extreme altitudes of the mesophere. Seen at high latitudes in summer months, stunning, wide spread displays of northern noctilucent clouds are now being reported.

Image Credit & Copyright: Loic Michel

Source: APOD

Return to Contents