SPACE™
EMPOWERING LIFE

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Galactica

Astronomy and Space Science Magazine

What's Inside?

www.space-global.com

COVER PICTURE FEATURED IN NASA'S APOD
CAPTURED BY MS.SRUTHI SURESH - SPACE EDUCATOR

Galactica is a monthly magazine about astronomy & space science published by SPACE India targeting amateur astronomers. Each monthly issue includes astronomy news, space launches, what's up in the sky every month, events and announcements done by the space team, Astrophotographs and articles on astronomy & astrophysics submitted by the readers for the general audience, and the article about historical missions & events of astronomy and more. All of this comes in an easy-to-understand user-friendly style that's perfect for astronomers at any level.

Team

ABOUT SPACE

SPACE is the pioneer organization working towards the development of science and astronomy in India. It aims to create a scientifically aware society and contribute to the technological and social development of the country, SPACE organization belongs to an astronomical league. diligently working towards development in astronomy and space science through astronomical tutorials, modules, and curriculum for education requirements of schools & students in India. We constantly engage in offering introductory astronomy, science about space, astrophysics, telescopes, and internet astronomy to the masses.

Vision: To popularize hands-on space science & STEM Education through various fun-filled pioneering concepts, services, and programs.

Mission: To develop and popularize space science & STEM Education In India and establish a global association with national & international space science agencies, societies, amateur, and professional organizations, government agencies, and space observatories.

CMD's Message

Dr. Sachin Bahmba, CMD, SPACE

Space and Astronomy are the future for the young generation of our country. This is a great means to inculcate scientific temperament among the masses. Such astronomy sessions will provide a hands-on learning platform for students wherein they explore the real world of science, I wish for young students to let their ambitions soar and think big as they are the future of our country.

CEO's Message

Mr. Shivam Gupta, CEO & MD, SPACE

Education is integral to humankind growth and it strongly contributes towards innovation and developments. Space is transforming India to provide better learning opportunities through Experiential and Hands-on learning in the very niche field of Astronomy and Space Science. Our mission to build from the grassroots level is what drives us stronger and to impart scientific temperament so the next generation can be entrepreneurs, scientists & astronauts!

CONTENTS

SPACE INSIGHTS

ENTREPRENEURSHIP FEST AT JBM GLOBAL SCHOOL

JBM Global School celebrated its Entrepreneurship Festival on July 22nd, engaging students from classes I to XII. The festival showcased a range of business ideas through skits, games, quizzes, and product exhibitions. Notably, Class IX presented a captivating astronomy-themed concept: the "Planisphere." Through dynamic skits and informative PowerPoint presentations, they outlined its target audience, usage, ideal application, and revenue model.

Simultaneously, an "Astronomy Showcase" dazzled the school grounds. Joint efforts of Astronomy educators and students resulted in an interactive exhibition on July 22, 2023. This showcase featured astronomy-based activities appealing to all age groups. Attendees enjoyed virtual reality experiences, weight simulations on other planets, lung capacity tests, planetary ring challenges, and interactive experiments like pop rockets and hydro rocketry. The showcase also offered safe solar observation activities, providing a glimpse into the cosmos.

The Entrepreneurship Festival and Astronomy Showcase demonstrated the school's commitment to fostering creativity, education, and engagement. These events not only highlighted student ingenuity but also encouraged collaborative learning and exploration, inspiring curiosity among participants.

CHANDRAYAAN 3

As the sun shone high in the sky, clouds of people zoomed in to witness the historic moment of the Indian Space Research Organisation(ISRO). On 14th of July 2023 at 2:35 PM IST, the Launch Vehicle Mark III, flew up, up, and away to the Earth's Moon, Luna. The spacecraft blasted off the Satish Dhawan Space Centre in Sriharikota and underwent the necessary Geostationary Transfer Orbit maneuvers.

Chandrayaan 3, is the third lunar exploration mission by ISRO. It is the successor to Chandrayaan 2, which was launched in July 2019. Chandrayaan 2 consisted of an orbiter, a lander called Vikram, and a rover called Pragyan. Unfortunately, the lander lost communication with the mission control during its descent, and the rover was not deployed on the lunar surface as planned.

About Chandrayaan 3

'Fall seven times, rise up eight!' Such was the motto of ISRO when it launched the Chandrayaan-3. Following the partial success of Chandrayaan-2, ISRO announced plans for Chandrayaan-3 to complete the mission's objectives of landing a rover on the lunar surface. The primary goal of Chandrayaan 3 is to demonstrate India's capability to soft-land on the Moon and operate a rover on its surface. The mission aims to further expand our understanding of the Moon's geology, mineralogy, and evolution.

Thousands of people gathered at Pulicat Lake to watch the beast roaring up in the sky. Among them was the SPACE Chennai Team, who were ready to seize the moment with the cameras and telescopes. The team went live both on Youtube and Instagram, where people from around the world joined us and observed the launch virtually. As the countdown began, the fidgeting of fingers stopped and all were ready to freeze the moment using the DSLRs and mobile phone cameras.

LAUNCH !!!

While the SPACE Chennai team handled the on-field queries, the Delhi educators took part in the media discussion and gave interviews to various TV channels including Times New, Mirror Now, ABP News, etc. They explained the mission in detail so even a layman could understand the mission thoroughly.

A deafening experience!

The laws of physics were once again proved as the roar of the rocket was heard only after a few seconds, and by then the rocket was making its way through the snowy clouds. After a few clicks, we were awestruck by the scenic beauty of the rocket, which left a trail as it was getting an inch closer to its destination. It took ua a fraction of a second to realize the significance of the moment and get back to capturing it.

As the rocket fired up, the sound of it was heard kilometers away from the launch. But, the applause of every Indian witnessing the event surpassed the roar of the rocket. The glistening eyes of the people met the curve of their lips and hands were extended to congratulate each other. One of our educators, Sruthi Suresh, was lucky to capture the majestic view of the rocket using the 18- 55mm DSLR and processed the image using Snapseed. The picture was submitted to NASA's Astronomy Picture of the Day (APOD) and the event turned out to be a blessing in disguise as the capture of the rocket got featured in the Astronomy Picture Of The Day commonly known as APOD. The entire Chennai team was fortunate enough to capture enthralling images which were later posted by Sky, a Facebook page for all the notable submissions of APOD.

Hydro Rocketry Launch in UITS Schools

Hydro rocket launch is an exciting and educational experience for UITS students of Class VIII, as SPACE INDIA offers a unique opportunity to learn and explore various scientific concepts while having fun. Here are ways students enjoy and benefit from hydro rocket launches:
Hands-On Learning: Building and launching hydro rockets involve practical applications of physics, chemistry, and engineering principles. Students can actively participate in assembling the rocket components and understanding the importance of stability, thrust, and aerodynamics. This hands-on experience allows them to bridge the gap between theory and real-world applications.

Teamwork and Collaboration: Hydro rocket projects require teamwork, where students work together to design, construct, and launch the rockets. Collaborating on such projects enhances communication skills, teaches the value of cooperation, and fosters a sense of collective achievement when the rocket successfully takes flight.

Problem-Solving Skills: Throughout the process, students may encounter challenges and setbacks. These situations provide excellent opportunities to develop problem-solving skills as they identify issues, brainstorm solutions, and make necessary adjustments to improve the rocket's performance.

STEM Education: Hydro rocket launches align perfectly with STEM (Science, Technology, Engineering, and Mathematics) education. The activity integrates multiple STEM disciplines, making it an engaging way to ignite interest in these subjects among students.

Understanding Pressure and States of Matter: Explaining the transformation of water into high-pressure steam for propulsion involves concepts related to pressure, temperature, and the different states of matter. Witnessing these principles in action during the launch process helps students grasp complex scientific concepts in a tangible and memorable manner.

Excitement and Thrill: Witnessing a hydro rocket soar into the sky is a thrilling experience for students. It can spark curiosity and fascination with space exploration and rocket science, motivating some to pursue careers in aerospace engineering or related fields.

Critical Thinking: Preparing for a hydro rocket launch requires students to think critically about various aspects, such as choosing the right materials, designing efficient nozzles, and calculating the trajectory. This promotes analytical thinking and encourages students to apply their knowledge creatively.

Inspirational Role Models: Students may get the chance to interact with scientists, engineers, or space enthusiasts who are involved in the hydro rocket launch process. Interacting with these role models can inspire students and expose them to potential career paths in aerospace and space exploration.

In conclusion, hydro rocket launches offer a thrilling and educational experience for students, combining hands-on learning, teamwork, problem-solving, and exposure to scientific principles. By engaging in these projects, students enjoy a fun-filled activity and gain valuable knowledge and skills that can shape their academic and professional journey in the future.






SALLY RIDE EARTHKAM JULY 2023

Sally Ride EarthKAM is a NASA-sponsored project. EarthKAM means Earth Knowledge Acquired by Middle school students. It is an educational program that enables students to take pictures of their own planet from a digital camera on board the International Space Station (ISS) via a web interface. International Space Station is an artificial satellite where astronauts reside for various experiments based on micro-gravity. EarthKAM camera is to date a permanent payload on board the ISS and supports approximately four missions annually, one for each season. The recent mission was opened from the 11th to 14th July.

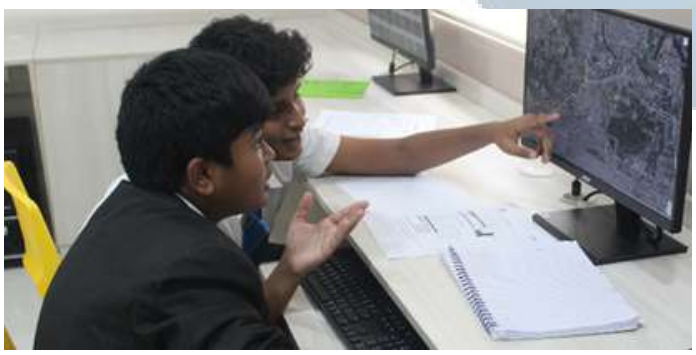
About this year:

We started this year with the third mission cycle of 2023, which is actually the 84th Mission. A Three hour Sally Ride EarthKAM workshop was conducted in the schools of Chennai and Delhi. Students from Class 6 to 8 standard were selected to participate in this workshop. The workshop started with students using Google Earth to find a few locations of interest followed by a presentation about EarthKAM. Students have then demonstrated the use of the EarthKAM interface to request Earth's images by keeping various aspects such as orbital path, weather, location, and day/night preference in mind. After this, the students had an exciting time locating regions of their interest and putting up their requests. The workshop ended with the students writing Messages to Astronauts.

A total of 7 schools, comprising approximately 300 students, participated in the program. The participants were from the schools like - K. R. Mangalam World School, Vaishali, St. Martin Diocesan School, Delhi Cantt., G. D. Goenka Public School, Model Town, K. R. Mangalam World School, Vikaspuri, Delhi Public School, Greater Faridabad, JBM Global School, Noida and Bal Bharti Public School, Pitampura.

A three Sally Ride EarthKAM workshop was conducted in three schools of Chennai Public School, Chennai, on 11th and 12th of July, 2023. Students from Classes 6th & 10th were selected to participate in this workshop. Total three number of schools with 201 number of students participated in this mission



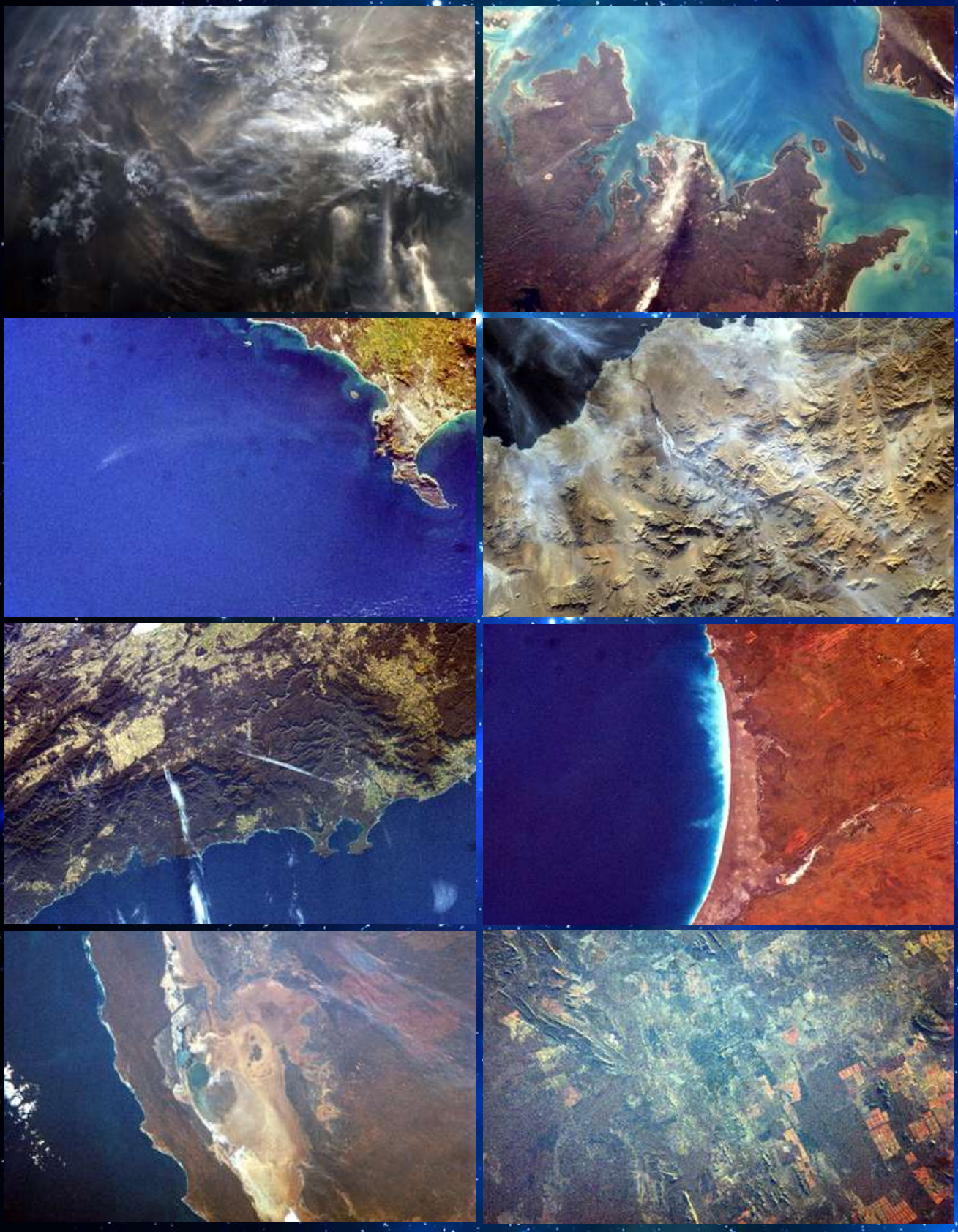

Message for Astronauts:

- I am fascinated by Space, I hope once I will launch or be in a rocket and appreciate the work done by Astronauts – **By Lukesh R S, CPS, CBSE, Thirumazhisai.**
- When you return to Earth bring me some space dust. **By Jatukarnya Arya, CPS, CBSE, Anna nagar.**
- I would like to look at my country from the international space station. "Sare Jahan se accha, yahi hei desh hamara." I'm a proud Indian and aspire to become a space scientist**. - By Pareesa Dudia, CPS, CBSE, Anna Nagar.**

Workshop feedback:

- Thank you for allowing us to select customized locations we'd like to see from the Earth. It was an informative session that allowed us to learn more about the ISS. **By Priyal Lunked, CPS, Global.**
- It was a very interactive and informative session! We all got to know interesting facts about ISS. Thank you for providing me with this wonderful opportunity. **– By Dhoneshwar S, CPS, Global.**
- Thank you for creating a very amazing program. It was really a new outreach program, and it was interesting. **-By Shreenidhi. V, CPS, CBSE, Anna Nagar.**
- It was very useful for me. I saw my favorite place, which I don't think I will see in real. Thank you so much! – **By Raghavi Praba, CPS, CBSE, Thirumazhisai.**

Sally Ride EarthKAM Images captured by the Students:



Images requested by students from top left: Thiruvananthapuram by Sakhsam Swami, Tiwi Island by Kamilus, Madagascar by Anya Achar, Chile by Darshan, Australia by Chaturya, 80 Mile beach by Daniel. Cornovan by Jonah and New South Wales by Priyal Lunked.

INTRODUCING MODULE 2 IN SCHOOLS

As governments worldwide aspire to reach the stars, space exploration has recently transcended national borders and become a global endeavor. Among them, India has distinguished itself as a key participant in the space sector, leading several innovative missions and pushing the limits of human knowledge and technical capabilities. "Space India" refers to the country's exploration, research, and technology development efforts.

Space India has taken its mission to the next milestone by introducing Module 2 in various schools of Chennai and Delhi. One hundred one students enrolled in this program from DAV Public School, Sec. 14 Gurgaon, Prudence School, Sec. 22 Dwarka, Prudence School, Sec 16B Dwarka, Prudence School, Ashok Vihar Phase-2. In Chennai, 110 students of National Public School, Chennai public school (Global, Anna Nagar, and Thirumazhisai) have enrolled for Module 2.

Module-1 of our program opens the gate to the exciting world of astronomy; and Module-2 take students deep into this fascinating world. The beginner level astronomers now need something more. This module is prepared to do just that. The program opens the wonders of the universe to the students and also helps them understand the nature and science better.

Benefits of SPACE Astronomy Club Activities:

- Enhanced Scientific Temperament
- Improved Leadership Skills
- Improved Problem Solving Skills
- Improved Critical thinking
- Effective Peer Group Interaction
- Improved Presentation Skills








HIGHLIGHTS OF JULY 2023

Chandrayaan-3

Chandrayaan-3 was launched on July 14, 2023, from the Satish Dhawan Space Centre in Sriharikota. Since then, it has successfully executed five orbit-raising maneuvers, bringing it closer to its ultimate destination: the moon.

Chandrayaan-3 is a follow-on mission to Chandrayaan-2 to demonstrate end-to-end capability in safe landing and roving on the lunar surface. It consists of Lander and Rover configuration. It will be launched by LVM3 from SDSC SHAR, Sriharikota. The propulsion module will carry the lander and rover configuration till 100 km lunar orbit. The propulsion module has Spectro-polarimetry of Habitable Planet Earth (SHAPE) payload to study the spectral and Polari metric measurements of Earth from the lunar orbit.

July 14, 2023

LVM3 M4 vehicle successfully launched Chandrayaan-3 into orbit. Chandrayaan-3, in its precise orbit, has begun its journey to the Moon. Health of the Spacecraft is normal.

July 15, 2023
The first orbit-raising maneuver (Earthbound firing-1) is successfully performed at ISTRAC/ISRO, Bengaluru. Spacecraft is now in 41762 km x 173 km orbit.

July 17, 2023
The second orbit-raising maneuver performed. The spacecraft is now in 41603 km x 226 km orbit.

July 22, 2023
The fourth orbit-raising maneuver (Earth-bound perigee firing) is completed. The spacecraft is now in a 71351 km x 233 km orbit.

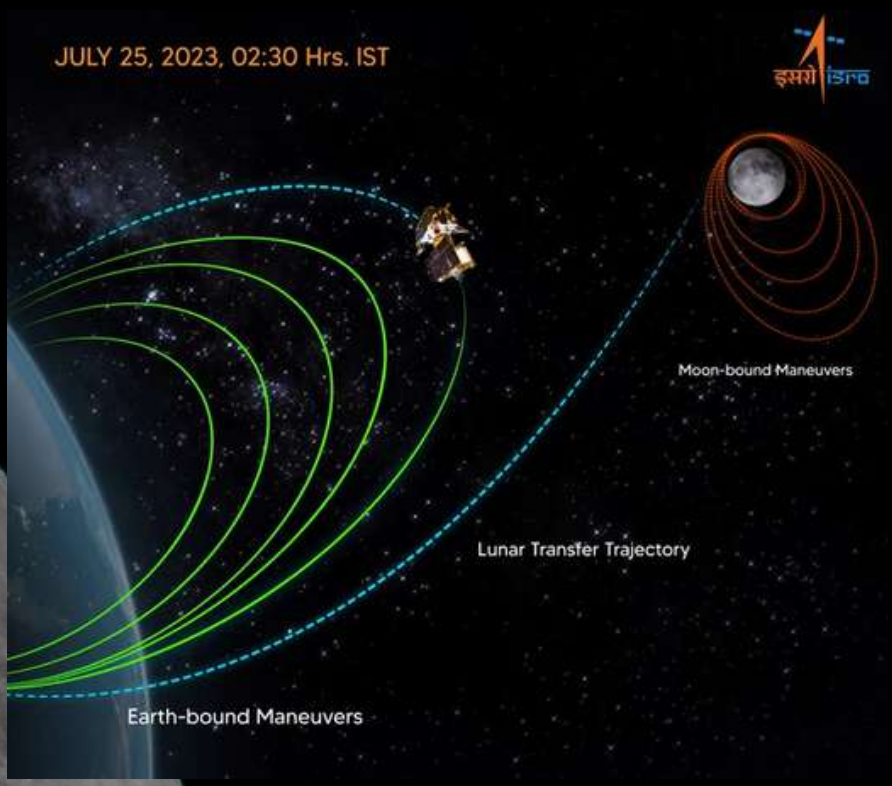
July 25, 2023

Orbit-raising maneuver performed on July 25, 2023. Next firing (TransLunar Injection), is planned for August 1, 2023.

August 01, 2023

The spacecraft is inserted into the translunar orbit. The orbit achieved is 288 km x 369328 km. Lunar-Orbit Insertion (LOI) is planned for Aug 5, 2023.

Chandrayaan-3 will make five orbit manoeuvres around the Earth, each time increasing the distance it swings away from the Earth. Then, after it completes the fifth manoeuvre, it begins to move towards the moon. This phase is the Trans Lunar Injection phase.
Similar to the orbit manoeuvres around the Earth, the module orbits the moon four times, each time coming closer. Eventually, it will reach a circular orbit of 100 km x 100 km. Here, the lander separates from the propulsion module, and alters its orbit so it comes as close as 30 km to the moon. Then, the lander commences soft-landing procedures.



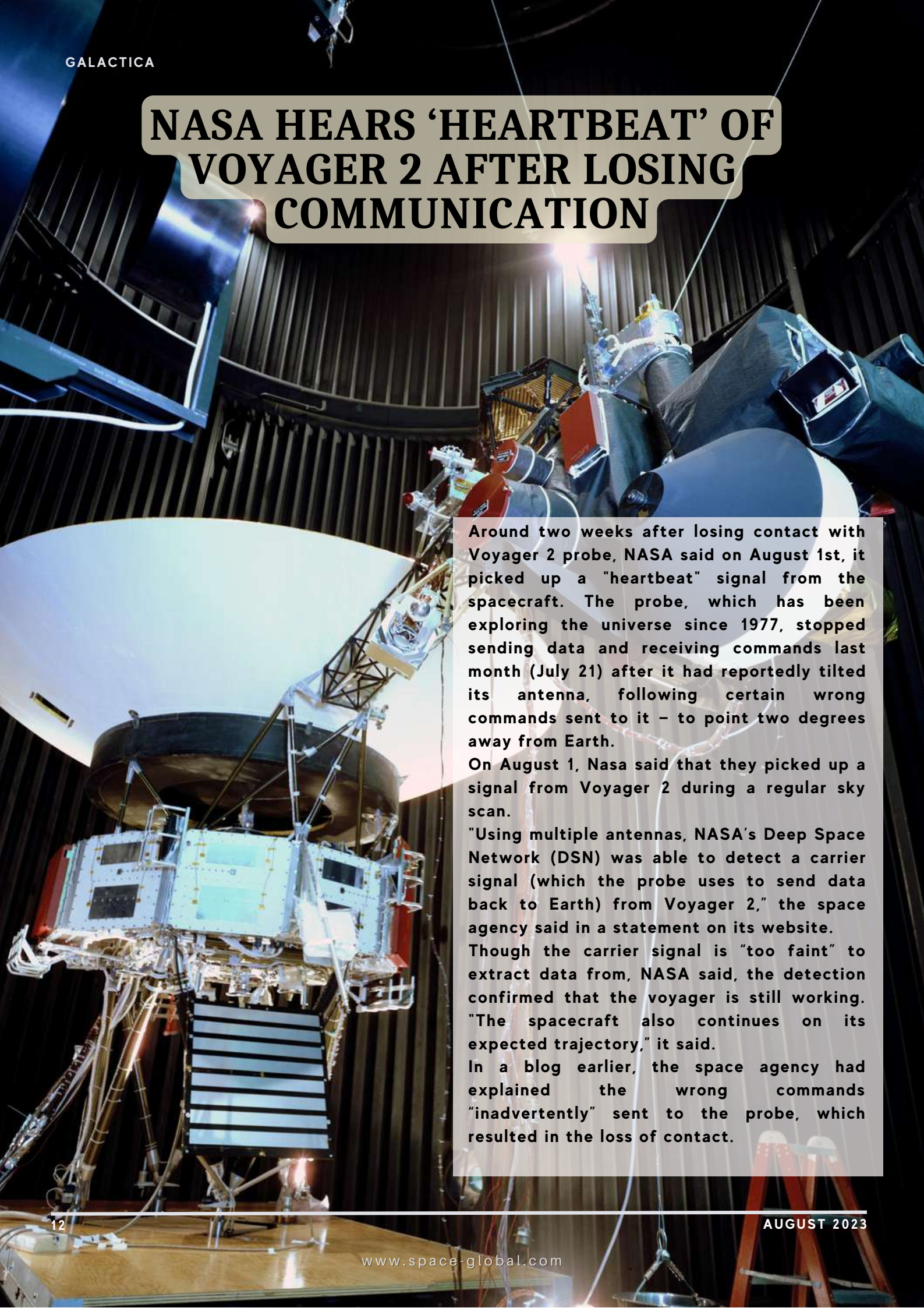
Lander payloads: Chandra's Surface Thermophysical Experiment (ChaSTE) to measure the thermal conductivity and temperature; Instrument for Lunar Seismic Activity (ILSA) for measuring the seismicity around the landing site; Langmuir Probe (LP) to estimate the plasma density and its variations. A passive Laser Retroreflector Array from NASA is accommodated for lunar laser ranging studies.

Rover payloads: Alpha Particle X-ray Spectrometer (APXS) and Laser Induced Breakdown Spectroscope (LIBS) for deriving the elemental composition in the vicinity of landing site.

The Lander will be able to soft land at a specified lunar site and deploy the Rover which will carry out in-situ chemical analysis of the lunar surface during its mobility.
The mission objectives of Chandrayaan-3 are:

1. To demonstrate Safe and Soft Landing on Lunar Surface
2. To demonstrate Rover roving on the moon and
3. To conduct in-situ scientific experiments.

NASA HEARS 'HEARTBEAT' OF VOYAGER 2 AFTER LOSING COMMUNICATION



Around two weeks after losing contact with Voyager 2 probe, NASA said on August 1st, it picked up a "heartbeat" signal from the spacecraft. The probe, which has been exploring the universe since 1977, stopped sending data and receiving commands last month (July 21) after it had reportedly tilted its antenna, following certain wrong commands sent to it – to point two degrees away from Earth.

On August 1, Nasa said that they picked up a signal from Voyager 2 during a regular sky scan.

"Using multiple antennas, NASA's Deep Space Network (DSN) was able to detect a carrier signal (which the probe uses to send data back to Earth) from Voyager 2," the space agency said in a statement on its website.

Though the carrier signal is "too faint" to extract data from, NASA said, the detection confirmed that the voyager is still working. "The spacecraft also continues on its expected trajectory," it said.

In a blog earlier, the space agency had explained the wrong commands "inadvertently" sent to the probe, which resulted in the loss of contact.

"A series of planned commands sent to NASA's Voyager 2 spacecraft on July 21 inadvertently caused the antenna to point 2 degrees away from Earth. As a result, Voyager 2 is currently unable to receive commands or transmit data back to Earth," it wrote on July 28.

The tilt interrupted communication between Voyager 2 and the ground antennas of DSN. As a result, the DSN stopped receiving the data being sent by the spacecraft, and the latter is also not receiving commands from ground controllers.

Where Is The Voyager 2 Now?

Voyager 2 is currently located more than 19.9 billion km away from Earth. The spacecraft was built and is operated by a division of Caltech in Pasadena at NASA's Jet Propulsion Laboratory.

According to NASA, Voyager 2 is programmed in a way that it resets its orientation multiple times every year to keep its antenna pointed towards Earth. The next reset is scheduled for October 15, and the agency has said that should enable the communication between Voyager 2 and DSN to resume. NASA believes Voyager 2 will remain on its planned trajectory during this period.

Meanwhile, Voyager 1 is also operating normally, located almost 24 billion km from Earth.

Sun breaks out with record number of sunspots

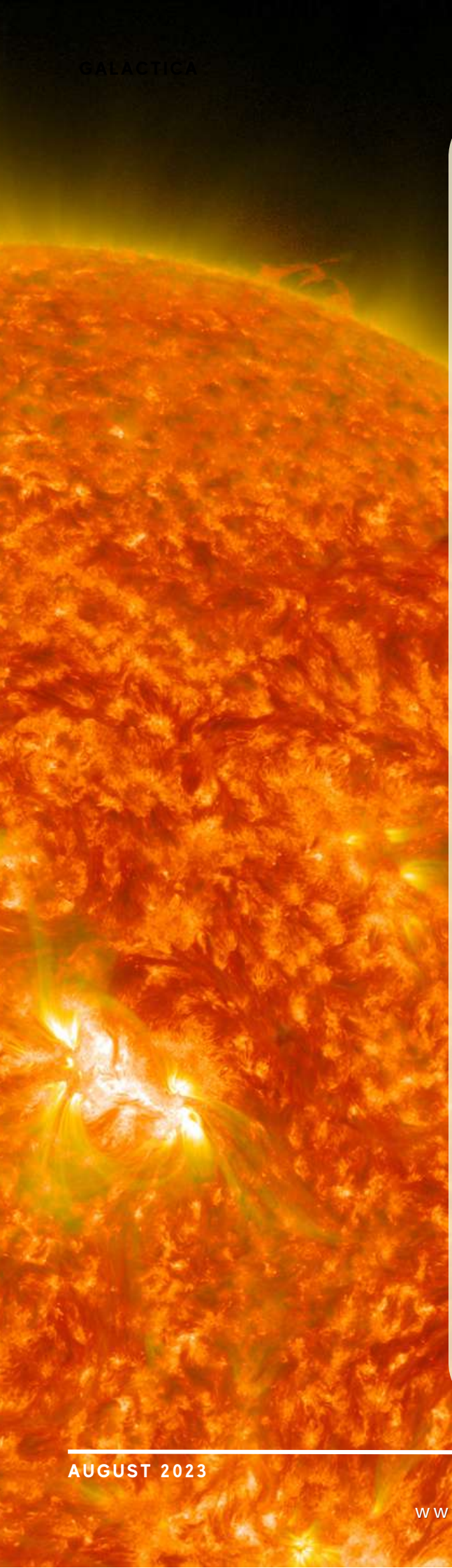
The sun produced over 160 sunspots in June, the highest monthly number in more than two decades. The sun hasn't produced this many sunspots in a single month since 2002.

The data confirm that the current solar cycle, the 25th since records began, is picking up intensity at a much quicker pace than NASA and the U.S. National Oceanic and Atmospheric Administration (NOAA) forecasted, sparking concerns of severe space weather events in the months and years to come.

While the space agencies predicted a maximum monthly number of sunspots during the 25th solar cycle's maximum to reach a modest 125, the star is now on a trajectory to peak at just under 200 monthly sunspots, and some scientists think this peak may arrive in just one year.

On Sunday (July 2), one of these sunspots, the darker, cooler areas on the star's surface that feature dense, strong magnetic fields, produced a powerful solar flare, an energetic flash of light, that caused a temporary radio blackout in the western U.S. and over the Pacific Ocean, according to Spaceweather.com. Such events might become more common in the near future as the solar cycle approaches its maximum.

And contrary to the original NASA and NOAA forecast, this maximum might get rather fiery. More sunspots means not only more solar flares but also more coronal mass ejections, powerful eruptions of charged particles that make up solar wind. And that can mean bad space weather on Earth. Intense bursts of solar wind can penetrate Earth's magnetic field and supercharge particle's in Earth's atmosphere, which triggers mesmerizing aurora displays but also causes serious problems to power grids and satellites in Earth's orbit.



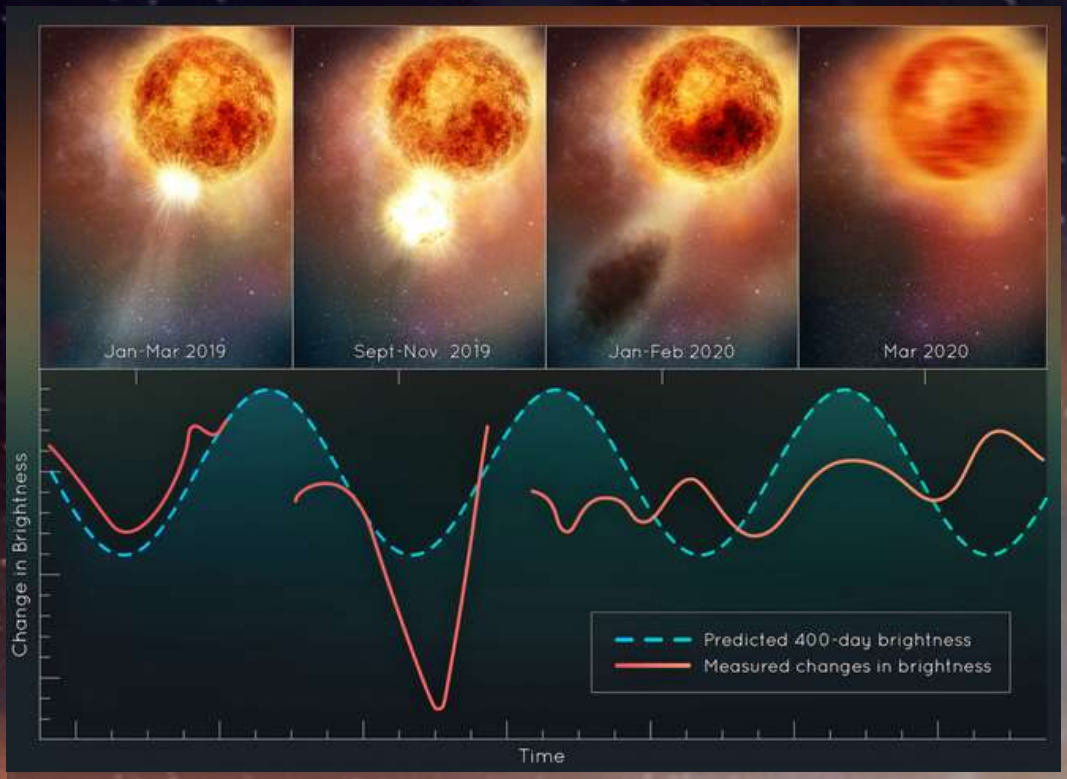
Tom Berger, a solar physicist and director of the Space Weather Technology Center at the University of Colorado, Boulder, told in an earlier interview that after a major solar storm that hit Earth in October 2003, satellite operators lost track of hundreds of spacecraft for several days. This happened due to the increase in gas density in the highest layers of the atmosphere that correspond with the low Earth orbit region where many satellites, as well as the International Space Station, reside.

Experts worry that due to the growth in the number of satellites and space debris fragments that the low Earth orbit experienced since the last serious solar storm, such a situation might result in orbital chaos that could last for weeks. During this period, the risk of dangerous collisions with space debris fragments would be exceptionally high, creating further risk to satellite operators.

Various operators have already experienced early space weather trouble, including SpaceX, which lost a batch of 40 new Starlink satellites after launching them into what they thought was just a mild solar storm. The mishap that took place in February 2022 saw the brand new spacecraft burn-up in Earth's atmosphere when they couldn't raise their orbits after launch due to the unexpected drag. The European Space Agency (ESA) also reported problems last year after its three Swarm satellites, which study the planet's magnetic field, started losing altitude at a rate never seen before. Operators had to use the spacecrafts' thrusters to prevent them from falling to Earth in the denser gas.

"Since Cycle 25 is odd, we might expect the most effective events to happen after the maximum, in 2025 and 2026," Leamon said. "This is because how the poles of the sun flip every 11 years. You want the pole of the sun in the same orientation compared to the poles of Earth so that then causes the most damage and the best coupling from the solar wind through Earth's magnetic field."

WILL THE BETELGEUSE SUPERNOVA EXPLOSION HAPPEN IN OUR LIFETIME?



One of the brightest stars in the sky that is visible from Earth will eventually explode and will appear as a full moon during the daytime.
Betelgeuse, about 640,000 light years away, is one of the closest and brightest stars to Earth, and its violent death will be visible from our planet.

Scientists have been curious whether the explosion, called supernova, will happen soon because the star has been dimming significantly over the past few years. "They are the largest stars in the universe because they puff up and expand out into space in their old age."
The star is about 10 million years old and is much younger than the Sun in our solar system, which is five billion years old.
However, it is 700 times the size of the Sun and burns through its materials faster, meaning it will have a shorter life than a star like the Sun.
It has a 400-day cycle, as well as a longer cycle that stretches about five years. Our Sun has an 11-year cycle.

A bright, but violent star

This means Betelgeuse has brightness that changes over time, sometimes appearing brighter and then dimmer. Nasa said that the star took a drastic dip in brightness in 2019, which was unusual.
"Within months, the star had dimmed by about 60 per cent in an event now known as the Great Dimming," the US space agency said. "This sudden dimming was so significant that some scientists wondered if Betelgeuse was entering a pre-supernova phase, which precludes a massive star's explosive 'death' in a supernova.

"Talk of a possible explosion sparked intrigue around the world as Betelgeuse would be the closest supernova to be observed and recorded by humans." Data from the Hubble Space Telescope showed that Betelgeuse had ejected surface material into space, which temporarily blocked light from the star.
The Sun also ejects material, but this eruption by Betelgeuse was 400 billion times as much mass that is usually emitted during coronal mass ejections. "The chunk it spewed out into space likely weighed several times as much as our Moon," Nasa said.

What will the explosion look like from Earth?

Dr Stanimir Metchev, Canada research chair in extrasolar planets at Western University, said that when the explosion happens, the star will appear as a full moon on Earth.

"Betelgeuse is already one of the brightest stars in the sky. However, after an initial explosion, and over the course of the first 2 weeks, Betelgeuse will be come as bright as the full moon, and will in fact be visible during daytime," he said.

"The supernova will then gradually fade over months.

"After tens of years the exploded outer shell of the dead star will have been blown away to a sufficiently large distance from the star, that it will appear as a 'planetary nebula': a ring around the remnant faint core of the dead star."

Will it explode in our lifetime?

Nasa said that the supernova is not likely to happen for about another 100,000 years.

It is predicted that by then the star will become either a neutron star or a black hole.

"The star's final fate depends on how much material is left after the supernova event," Nasa said. Dr Stanimir Metchev also said that it was unlikely that it would happen in our lifetime.

He said the last stages of a star's life can last hundreds of thousands of years.

Will the supernova impact Earth?

Dr Stanimir Metchev said the explosion will not have any negative impact on Earth because of its distance from the planet.

Even at its brightest, it would be about 400,000 times fainter than the Sun.

"The most harmful component to Earth from a supernova explosion would be the x-rays and the gamma rays," he said.

"However, a supernova would have to be less than half of Betelgeuse's distance to start having an effect on Earth's atmosphere and life.

"There is no danger of this happening with the nearest stars for hundreds of millions of years.

"Betelgeuse's explosion as a supernova would offer just a spectacular space show for the lucky Earthlings to witness it."

ISRO'S PSLV-C56 PUTS 7 SATELLITES IN ORBIT

The launch of PSLV-C56 carrying DS-SAR satellite, along with 6 co-passengers from the first launch-pad of SDSC-SHAR, Sriharikota is accomplished successfully on July 30, 2023 at 06:30 hours IST. PSLV-C56 is configured in its core-alone mode, similar to that of C55. It would launched DS-SAR, a 360 kg satellite into a Near-equatorial Orbit (NEO) at 5 degrees inclination and 535 km altitude.

DS-SAR

The DS-SAR satellite is developed under a partnership between DSTA (representing the Government of Singapore) and ST Engineering. Once deployed and operational, it will be used to support the satellite imagery requirements of various agencies within the Government of Singapore. ST Engineering will use it for multi-modal and higher responsiveness imagery and geospatial services for their commercial customers.

DS-SAR carries a Synthetic Aperture Radar (SAR) payload developed by Israel Aerospace Industries (IAI). This allows the DS-SAR to provide for all-weather day and night coverage, and capable of imaging at 1m-resolution at full polarimetry.

The co-passengers are:

1. VELOX-AM, a 23 kg technology demonstration microsatellite.
2. ARCADE Atmospheric Coupling and Dynamics Explorer (ARCADE), an experimental satellite.
3. SCOOB-II , a 3U nanosatellite flying a technology demonstrator payload
4. NuLIoN by NuSpace, an advanced 3U nanosatellite enabling seamless IoT connectivity in both urban & remote locations.
5. Galassia-2, a 3U nanosatellite that will be orbiting at low earth orbit.
6. ORB-12 STRIDER , satellite is developed under an International collaboration.

After the launcher placed all the seven satellites into a 535 km circular orbit, PS4 stage was brought back to a lower orbit of 295 km x 300 km orbit.

"The stage is purposefully manoeuvred to a 295 km x 300 km orbit. It now spends significantly less time in space, reducing its duration from over two decades to less than two months, before re-entering the earth's atmosphere. "ISRO and India remain committed to reduced space debris and sustainable use of space for the benefit of all," the space research organisation said after the success of the PS4 stage de-orbiting experiment.

Mr. Somnath said ISRO was set to launch four more missions this year which included another PSLV mission in August or early September, the Gaganyaan test vehicle, third development mission of Small Satellite Launch Vehicle and Geosynchronous Satellite Launch Vehicle mission for launching INSAT-3DS.

NEW SANDWICHED PLANET EXPLAIN HOW SMALLER

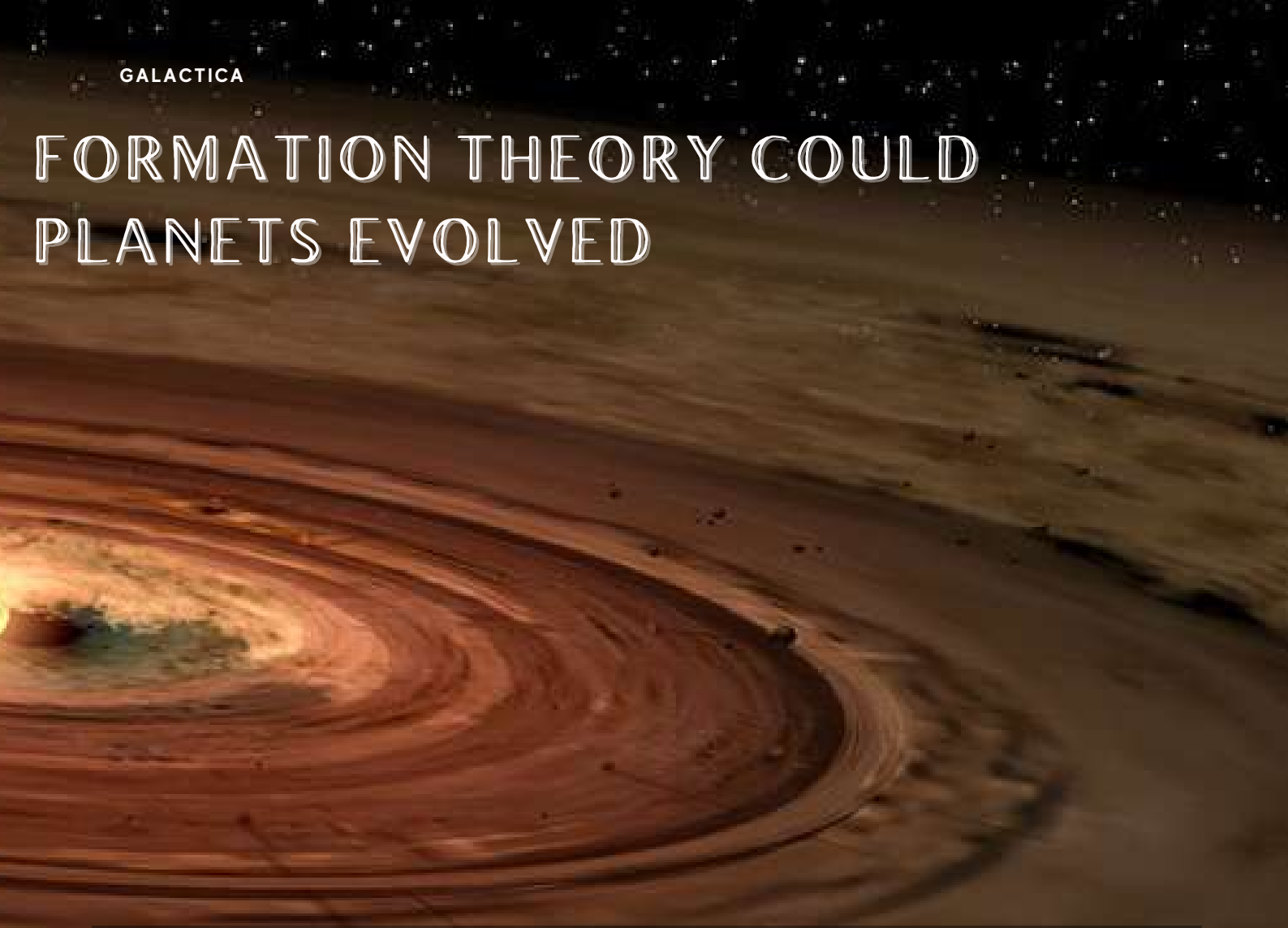
When it comes to explaining how planets are formed, the protoplanetary hypothesis is the most widely accepted explanation. In simple terms, the donut-shaped disc of dust and gas around a star forms the building block of planets. These particles clump together over time, like a snowball, to form larger celestial bodies like planets, a process that can take millions of years.

Now, scientists at the University of Warwick claim to have discovered a new method of planet formation that says two larger planets in the protoplanetary disc of a star can lead to the creation of a smaller planet between them. The team is calling it the "sandwich" theory and their findings have been published in the Monthly Notices of the Royal Astronomical Society journal.

While the mechanics of how exactly sandwich planet formation happens requires further research, it answers one crucial piece of the cosmic puzzle. "This theory could present a possible explanation for the formation of small planets, like Mars and Uranus, which are each surrounded by larger planets," says the team.

The "sandwiched planet formation" theory offers a rather unique perspective on planetary genesis with respect to their size and geological chemistry. But there are a few oddities that evade even the new theory. In 2020, scientists spotted an exoplanet named K2-25b in the Hyades cluster that is unusually dense and defies conventional theories about planet formation.

FORMATION THEORY COULD PLANETS EVOLVED



The protoplanetary theory says larger gas giants like Saturn and Jupiter are formed first due to the availability of gaseous raw material. And they are usually further away from their host star, while smaller and rocky planets like Venus are formed closer to the Sun.
The new theory put forth by University of Warwick scientists says that there are rings and gaps in protoplanetary discs, and it's in these rings where sandwiched planet formation occurs. Between two giant planets in a disc, the flow of dust is restricted. But if that dust somehow manages to escape, it leads to the creation of a smaller, middle planet between the two larger siblings.

"The gaps are where we expect planets to be, and we know from theory work that planets cause dust rings to form just exterior to them," explains Farzana Meru, an associate professor at the University of Warwick's physics department. Notably, the researchers say they have actually found evidence of planetary architecture that supports the sandwiched formation theory.

The team says there are examples out there where a smaller planet sitting between two larger planets in a solar system, and their proportions also check out. More importantly, researchers claim that the sandwich theory could very well explain the formation of Mars and Uranus, both of which are flanked by larger planets on each side. While further research is needed, it's an exciting new breakthrough that could unravel a new cosmic process right in the Earth's own solar backyard.

CHINA'S 'ZHURONG ROVER' FINDS MARTIAN ICE AGE ENDED ABRUPTLY 400,000 YEARS AGO

The rover might not be online anymore, but it's still helping to make discoveries on Mars.

China's Zhurong rover is currently on the surface of Mars—at least, that's where we saw it last. The solar-powered rover did not awaken after the long Martian winter, and it's unclear if it ever will. Nevertheless, the China National Space Administration (CNSA) has a mountain of scientific data from the mission to analyze, which is how the team discovered evidence pointing to a radical change in the Martian climate a few hundred thousand years ago.

The Mars of today is a chilly desert, protected by a wispy atmosphere of carbon dioxide. The average temperature on Mars is about -80 degrees Fahrenheit (-63 Celsius), and it has ice caps of frozen carbon dioxide and water. The planet was even colder before its last climate shift. Zhurong sent back data on the surface morphology of dunes that could indicate Mars' last ice age ended abruptly 400,000 years ago.

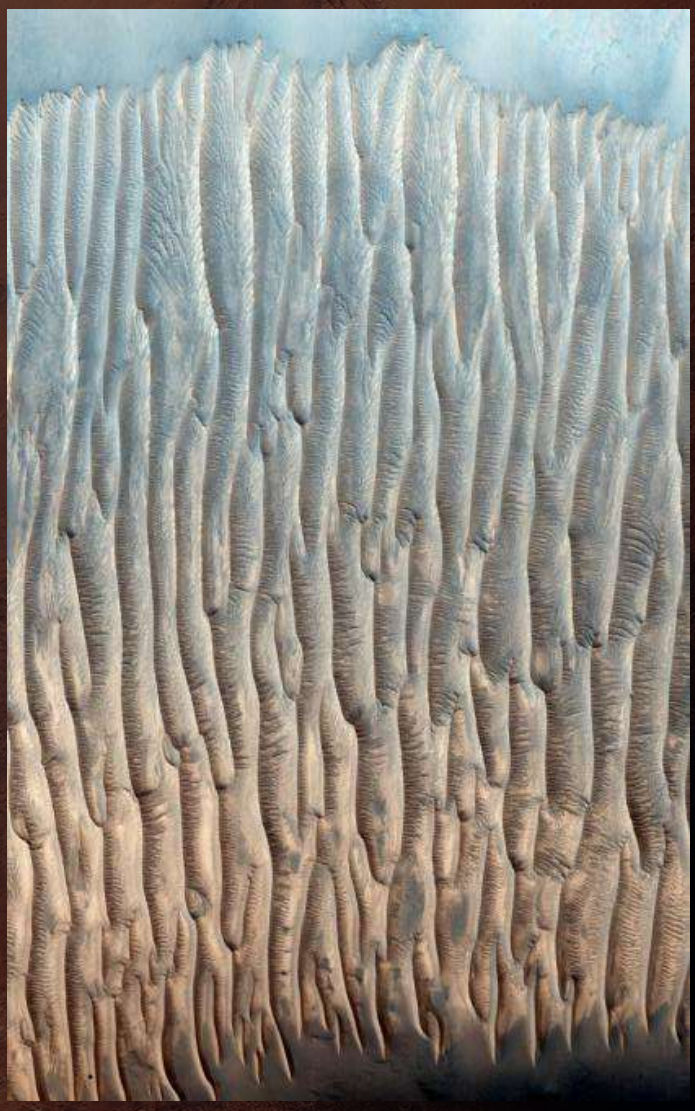
Zhurong was designed to conduct this kind of geological analysis with a wide assortment of instruments for such a small rover. The team used Zhurong's multispectral cameras, spectrophotometers, magnetic sensors, and radar; and then added high-resolution satellite images from the Tianwen-1 orbiter. The team arrived at the 400,000 number by determining how many impact craters were found on top of dunes.

The result, according to the **newly published study**, the result is strong evidence of a climate shift in the dunes of Utopia Planitia. Martian ice ages feature expanded glaciation just like Earth, but the average surface temperature may drop as temperatures at the poles are thought to rise.

For the TARs to have formed at a different angle than the original dunes implies a major change in wind direction for the mid-latitudes. The data shows that prevailing winds shifted by 70 degrees 400,000 years ago. This eroded the crescent-shaped dunes deposited in the ice age. Over time, the planet's wind eroded the dunes into the long, dark ridges (known as transverse aeolian ridges or TARs) we see crisscrossing much of the planet today.

Scientists believe Mars' ice ages are a product of Milankovitch cycles, which cause changes to a planet's axial tilt due to gravitational interactions with the sun and large planets. During the ice age, which is now believed to have run from 2.1 million to 400,000 years ago, the planet's angle of rotation varied between 15 and 35 degrees. Today, Mars sticks around 25 degrees, a little more extreme than Earth's 23.5 degrees. When the tilt changed 400,000 years ago, the climate began shifting immediately.

Scientists have seen TARs all across Mars, but there's never been an explanation for their properties until now. The CNSA team believes that a better understanding of the terrain and history of Mars will help future missions explore more efficiently. Even if Zhurong never wakes up, it's done its part.



TARs as seen by the Mars Reconnaissance Orbiter. Credit: NASA.

AURORAS ACROSS THE SOLAR SYSTEM ARE POWERED IN THE SAME WAY!

It's fascinating to learn that the formation of auroras may occur similarly across the solar system, as suggested by new findings from Mercury. The process you've described is how auroras are formed on Earth and potentially on other planets with magnetospheres and interactions with the solar wind.

Auroras, also known as the northern and southern lights, are beautiful displays of colorful lights in the sky. These displays result from interactions between charged particles from the sun (solar wind) and a planet's magnetosphere. The magnetosphere is a region of space around a planet influenced by its magnetic field. When the solar wind, made up of high-speed charged particles, encounters a planet's magnetosphere, it can lead to various interactions and phenomena, including auroras.

The solar wind interacts with our magnetosphere on Earth, causing the charged particles to follow the planet's magnetic field lines. This interaction leads to the acceleration of particles, especially around the poles. As these charged particles travel along the magnetic field lines towards the polar regions, they collide with gases in the upper atmosphere. These collisions cause the gases to emit light, producing characteristic auroral displays.

Despite having a much smaller and weaker magnetic field than Earth's, Mercury still experiences a similar process. Although diminished in size, its magnetosphere also interacts with the solar wind. When the solar wind enters Mercury's magnetosphere, it can drive the motion of charged particles within it. These particles can then interact with the thin atmosphere of Mercury and potentially create auroras there as well.

The comparison between Earth and Mercury's aurora formation processes helps scientists better understand the fundamental principles governing interactions between solar wind, magnetic fields, and atmospheres across different planets in the solar system. It's a great example of how studying other celestial bodies can illuminate universal physical processes.

The recent evidence from the BepiColombo mission provides valuable insights into the formation of auroras on Mercury and their similarities to those on Earth. This new information adds to our understanding of how auroras are generated on planets with different magnetic field strengths and atmospheres.

By studying the auroras on Mercury through missions like BepiColombo, scientists can gain a better understanding of the underlying physical processes at play in different planetary environments. These findings contribute not only to our knowledge of specific planets but also to the broader understanding of how magnetospheric interactions with solar wind can lead to the generation of auroras across the solar system.

FROM THE EYES OF WEBB - JULY 2023

WEBB LOCATES DUST RESERVOIRS IN TWO SUPERNOVAE

Researchers using NASA's James Webb Space Telescope have made major strides in confirming the source of dust in early galaxies. Observations of two Type II supernovae, Supernova 2004et (SN 2004et) and Supernova 2017eaw (SN 2017eaw), have revealed large amounts of dust within the ejecta of each of these objects. The mass found by researchers supports the theory that supernovae played a key role in supplying dust to the early universe.

Dust is a building block for many things in our universe – planets in particular. As dust from dying stars spreads through space, it carries essential elements to help give birth to the next generation of stars and their planets. Where that dust comes from has puzzled astronomers for decades. One significant source of cosmic dust could be supernovae – after the dying star explodes, its leftover gas expands and cools to create dust.

"Direct evidence of this phenomenon has been slim up to this point, with our capabilities only allowing us to study the dust population in one relatively nearby supernova to date – Supernova 1987A, 170,000 light-years away from Earth," said lead author Melissa Shahbandeh of Johns Hopkins University and the Space Telescope Science Institute in Baltimore, Maryland. "When the gas cools enough to form dust, that dust is only detectable at mid-infrared wavelengths provided you have enough sensitivity."

For supernovae more distant than SN 1987A like SN 2004et and SN 2017eaw, both in NGC 6946 about 22 million light-years away, that combination of wavelength coverage and exquisite sensitivity can only be obtained with Webb's MIRI (Mid-Infrared Instrument).

The Webb observations are the first breakthrough in the study of dust production from supernovae since the detection of newly formed dust in SN 1987A with the Atacama Large Millimeter/submillimeter Array (ALMA) telescope nearly a decade ago.
Another particularly intriguing result of their study isn't just the detection of dust, but the amount of dust detected at this early stage in the supernova's life. In SN 2004et, the researchers found more than 5,000 Earth masses of dust.

"When you look at the calculation of how much dust we're seeing in SN 2004et especially, it rivals the measurements in SN 1987A, and it's only a fraction of the age," added program lead Ori Fox of the Space Telescope Science Institute. "It's the highest dust mass detected in supernovae since SN 1987A."

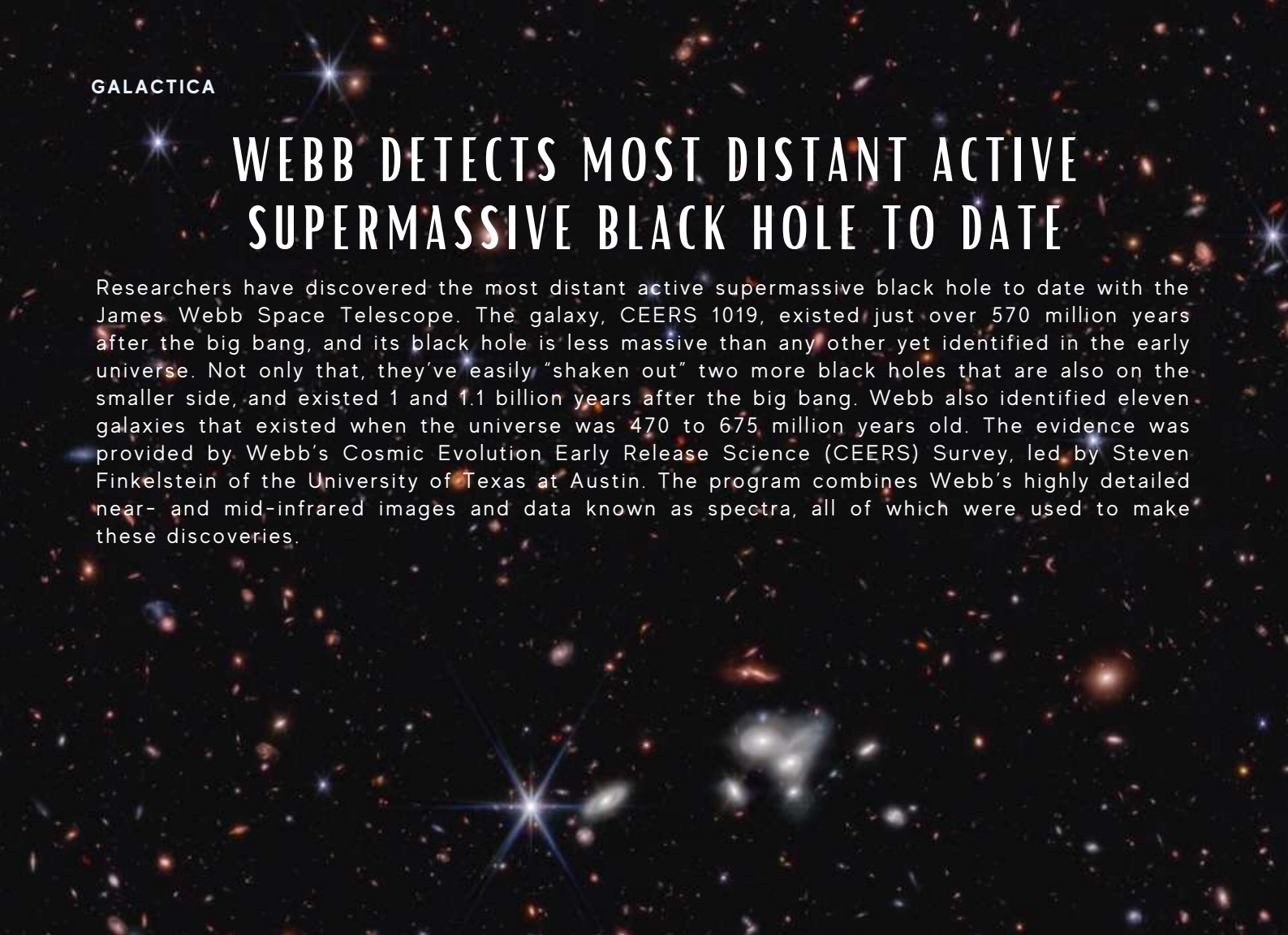
Credits: NASA, ESA, CSA, Ori Fox (STScI), Melissa Shahbandeh (STScI), Alyssa Pagan (STScI)

Observations have shown astronomers that young, distant galaxies are full of dust, but these galaxies are not old enough for intermediate mass stars, like the Sun, to have supplied the dust as they age. More massive, short-lived stars could have died soon enough and in large enough numbers to create that much dust.
While astronomers have confirmed that supernovae produce dust, the question has lingered about how much of that dust can survive the internal shocks reverberating in the aftermath of the explosion. Seeing this amount of dust at this stage in the lifetimes of SN 2004et and SN 2017eaw suggests that dust can survive the shockwave – evidence that supernovae really are important dust factories after all.
Researchers also note that the current estimations of the mass may be the tip of the iceberg. While Webb has allowed researchers to measure dust cooler than ever before, there may be undetected, colder dust radiating even farther into the electromagnetic spectrum that remains obscured by the outermost layers of dust.

The researchers emphasized that the new findings are also just a hint at newfound research capabilities into supernovae and their dust production using Webb, and what that can tell us about the stars from which they came.
"There's a growing excitement to understand what this dust also implies about the core of the star that exploded," Fox said. "After looking at these particular findings, I think our fellow researchers are going to be thinking of innovative ways to work with these dusty supernovae in the future."

WEBB DETECTS MOST DISTANT ACTIVE SUPERMASSIVE BLACK HOLE TO DATE

Researchers have discovered the most distant active supermassive black hole to date with the James Webb Space Telescope. The galaxy, CEERS 1019, existed just over 570 million years after the big bang, and its black hole is less massive than any other yet identified in the early universe. Not only that, they've easily "shaken out" two more black holes that are also on the smaller side, and existed 1 and 1.1 billion years after the big bang. Webb also identified eleven galaxies that existed when the universe was 470 to 675 million years old. The evidence was provided by Webb's Cosmic Evolution Early Release Science (CEERS) Survey, led by Steven Finkelstein of the University of Texas at Austin. The program combines Webb's highly detailed near- and mid-infrared images and data known as spectra, all of which were used to make these discoveries.



CEERS 1019 is not only notable for how long ago it existed, but also how relatively little its black hole weighs. This black hole clocks in at about 9 million solar masses, far less than other black holes that also existed in the early universe and were detected by other telescopes. Those behemoths typically contain more than 1 billion times the mass of the Sun – and they are easier to detect because they are much brighter. (They are actively "eating" matter, which lights up as it swirls toward the black hole.) The black hole within CEERS 1019 is more similar to the black hole at the center of our Milky Way galaxy, which is 4.6 million times the mass of the Sun. This black hole is also not as bright as the more massive behemoths previously detected. Though smaller, this black hole existed so much earlier that it is still difficult to explain how it formed so soon after the universe began. Researchers have long known that smaller black holes must have existed earlier in the universe, but it wasn't until Webb began observing that they were able to make definitive detections. (CEERS 1019 may only hold this record for a few weeks – claims about other, more distant black holes identified by Webb are currently being carefully reviewed by the astronomical community.)

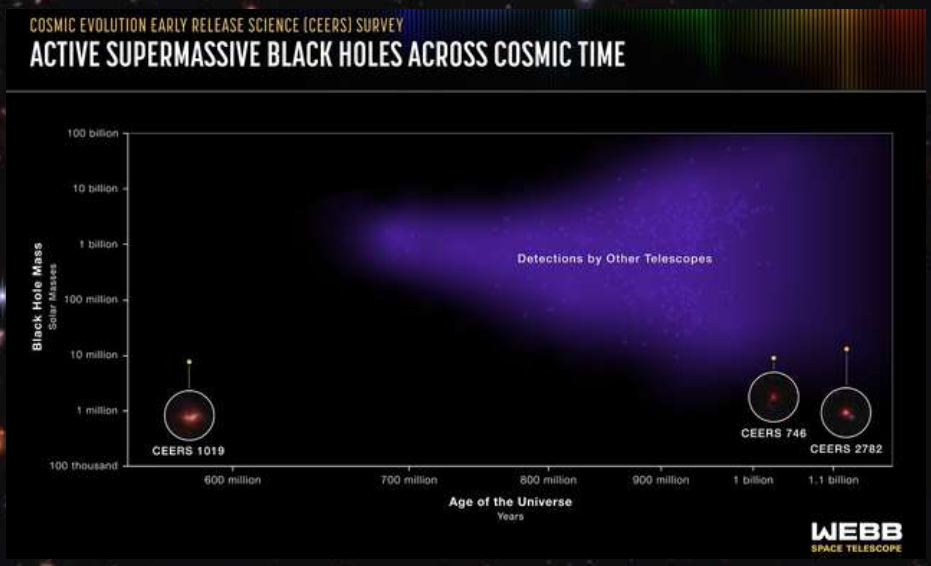
Webb's data is practically overflowing with precise information that makes these confirmations so easy to pull out of the data. "Looking at this distant object with this telescope is a lot like looking at data from black holes that exist in galaxies near our own," said Rebecca Larson of the University of Texas at Austin, who led this discovery. "There are so many spectral lines to analyze!" Not only could the team untangle which emissions in the spectrum are from the black hole and which are from its host galaxy, they could also pinpoint how much gas the black hole is ingesting and determine its galaxy's star-formation rate.

More Extremely Distant Black Holes, Galaxies Hit the Scene

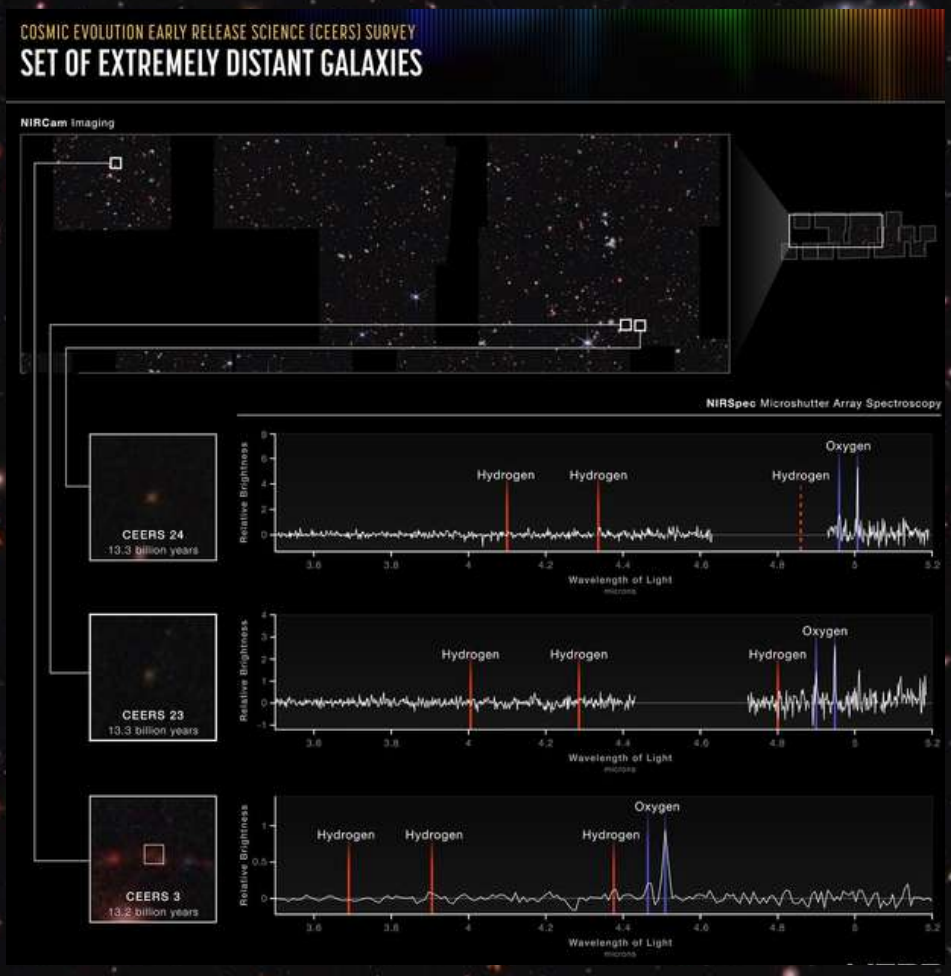
The CEERS Survey is expansive, and there is a lot more to explore. Team member Dale Kocevski of Colby College in Waterville, Maine, and the team quickly spotted another pair of small black holes in the data.The first, within galaxy CEERS 2782, was easiest to pick out. There isn't any dust obscuring Webb's view of it, so researchers could immediately determine when its black hole existed in the history of the universe – only 1.1 billion years after the big bang.

The second black hole, in galaxy CEERS 746, existed slightly earlier, 1 billion years after the big bang. Its bright accretion disk, a ring made up of gas and dust that encircles its supermassive black hole, is still partially clouded by dust. "The central black hole is visible, but the presence of dust suggests it might lie within a galaxy that is also furiously pumping out stars," Kocevski explained.

ike the one in CEERS 1019, these two black holes are also "light weights" – at least when compared to previously known supermassive black holes at these distances. They are only about 10 million times the mass of the Sun.



"Researchers have long known that there must be lower mass black holes in the early universe. Webb is the first observatory that can capture them so clearly," Kocevski added. "Now we think that lower mass black holes might be all over the place, waiting to be discovered." Before Webb, all three black holes were too faint to be detected. "With other telescopes, these targets look like ordinary star-forming galaxies, not active supermassive black holes," Finkelstein added.



Stare deeply at this vast landscape. It was stitched together from multiple images captured by the James Webb Space Telescope in near-infrared light – and it is practically pulsing with activity. To the right of center is a clump of bright white spiral galaxies that seem to be twisting into one another. Threaded throughout the scene are light pink spirals that look like pinwheels twirling in the wind. The bright foreground stars, set off in blue, announce themselves with Webb's prominent eight-pointed diffraction spikes. Don't miss an unconventional sight: In the bottom row, find the square second from far right. At its right edge, a misshapen blue galaxy is outfitted in blue-and-pink sparkling star clusters.

Webb's sensitive spectra also allowed these researchers to measure precise distances to, and therefore the ages of, galaxies in the early universe. Team members Pablo Arrabal Haro of NSF's NOIRLab and Seiji Fujimoto of the University of Texas at Austin identified 11 galaxies that existed 470 to 675 million years after the big bang. Not only are they extremely distant, but the fact that so many bright galaxies were detected is also notable. Researchers theorized that Webb would detect fewer galaxies than are being found at these distances. "I am overwhelmed by the amount of highly detailed spectra of remote galaxies Webb returned," Arrabal Haro said. "These data are absolutely incredible."

These galaxies are rapidly forming stars, but are not yet as chemically enriched as galaxies that are much closer to home. "Webb was the first to detect some of these galaxies," explained Fujimoto. "This set, along with other distant galaxies we may identify in the future, might change our understanding of star formation and galaxy evolution throughout cosmic history," he added.

Credits: NASA, ESA, CSA, Steve Finkelstein (UT Austin), Micaela Bagley (UT Austin), Rebecca Larson (UT Austin)

WEBB DETECTS WATER VAPOR IN ROCKY PLANET-FORMING ZONE

Water is essential for life as we know it. However, scientists debate how it reached the Earth and whether the same processes could seed rocky exoplanets orbiting distant stars. New insights may come from the planetary system PDS 70, located 370 light-years away. The star hosts both an inner disk and outer disk of gas and dust, separated by a 5 billion-mile-wide (8 billion kilometer) gap, and within that gap are two known gas-giant planets.

New measurements by NASA's James Webb Space Telescope's MIRI (Mid-Infrared Instrument) have detected water vapor in the system's inner disk, at distances of less than 100 million miles (160 million kilometers) from the star – the region where rocky, terrestrial planets may be forming. (The Earth orbits 93 million miles from our Sun.) This is the first detection of water in the terrestrial region of a disk already known to host two or more protoplanets.

"We've seen water in other disks, but not so close in and in a system where planets are currently assembling. We couldn't make this type of measurement before Webb," said lead author Giulia Perotti of the Max Planck Institute for Astronomy (MPIA) in Heidelberg, Germany.

"This discovery is extremely exciting, as it probes the region where rocky planets similar to Earth typically form," added MPIA director Thomas Henning, a co-author on the paper. Henning is co-principal investigator of Webb's MIRI (Mid-Infrared Instrument), which made the detection, and the principal investigator of the MINDS (MIRI Mid-Infrared Disk Survey) program that took the data.

A Steamy Environment for Forming Planets

PDS 70 is a K-type star, cooler than our Sun, and is estimated to be 5.4 million years old. This is relatively old in terms of stars with planet-forming disks, which made the discovery of water vapor surprising.

Over time, the gas and dust content of planet-forming disks declines. Either the central star's radiation and winds blow out such material, or the dust grows into larger objects that eventually form planets. As previous studies failed to detect water in the central regions of similarly aged disks, astronomers suspected it might not survive the harsh stellar radiation, leading to a dry environment for the formation of any rocky planets.

Astronomers haven't yet detected any planets forming within the inner disk of PDS 70. However, they do see the raw materials for building rocky worlds in the form of silicates. The detection of water vapor implies that if rocky planets are forming there, they will have water available to them from the beginning.

What is the Water's Origin?

The discovery raises the question of where the water came from. The MINDS team considered two different scenarios to explain their finding.

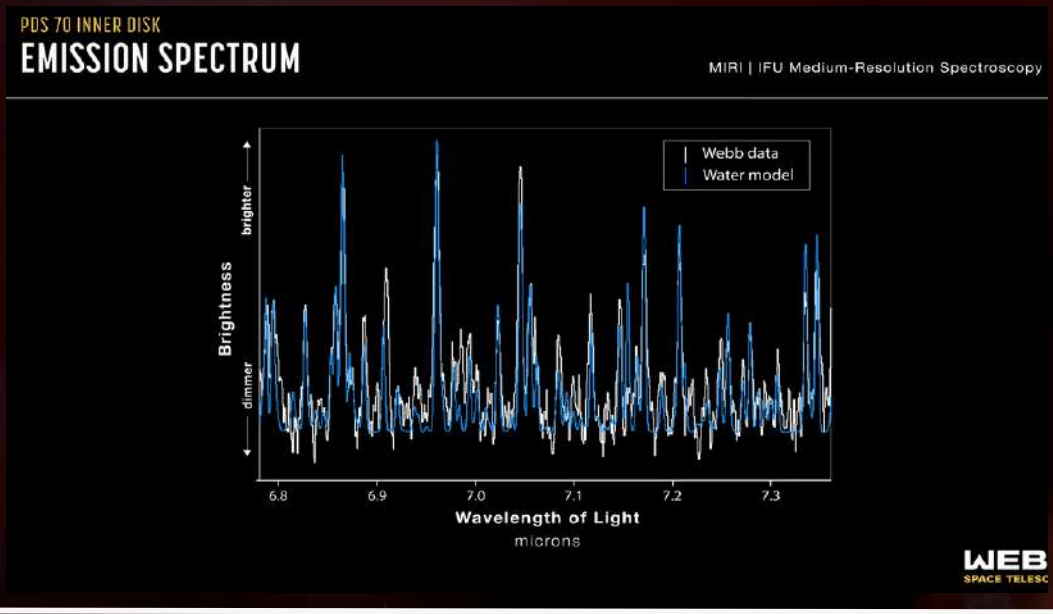
One possibility is that water molecules are forming in place, where we detect them, as hydrogen and oxygen atoms combine. A second possibility is that ice-coated dust particles are being transported from the cool outer disk to the hot inner disk, where the water ice sublimates and turns into vapor. Such a transport system would be surprising, since the dust would have to cross the large gap carved out by the two giant planets.

Another question raised by the discovery is how water could survive so close to the star, when the star's ultraviolet light should break apart any water molecules. Most likely, surrounding material such as dust and other water molecules serves as a protective shield. As a result, the water detected in the inner disk of PDS 70 could survive destruction.

Ultimately, the team will use two more of Webb's instruments, NIRCam (Near-Infrared Camera) and NIRSpec (Near-Infrared Spectrograph) to study the PDS 70 system in an effort to glean an even greater understanding.

"We find a relatively high amount of small dust grains. Combined with our detection of water vapor, the inner disk is a very exciting place," said co-author Rens Waters of Radboud University in The Netherlands.

A spectrum of the protoplanetary disk of PDS 70, obtained with Webb's MIRI (Mid-Infrared Instrument), displays a number of emission lines from water vapor. Scientists determined that the water is in the system's inner disk, at distances of less than 100 million miles from the star – the region where rocky, terrestrial planets may be forming. Download the full-resolution version from the Space Telescope Science Institute.
Credits: NASA, ESA, CSA, J. Olmsted (STScI)



WEBB SNAPS HIGHLY DETAILED INFRARED IMAGE OF ACTIVELY FORMING STARS

Young stars are rambunctious!

NASA's James Webb Space Telescope has captured the "antics" of a pair of actively forming young stars, known as Herbig-Haro 46/47, in high-resolution near-infrared light. To find them, trace the bright pink and red diffraction spikes until you hit the center: The stars are within the orange-white splotch. They are buried deeply in a disk of gas and dust that feeds their growth as they continue to gain mass. The disk is not visible, but its shadow can be seen in the two dark, conical regions surrounding the central stars.

The most striking details are the two-sided lobes that fan out from the actively forming central stars, represented in fiery orange. Much of this material was shot out from those stars as they repeatedly ingest and eject the gas and dust that immediately surround them over thousands of years.

When material from more recent ejections runs into older material, it changes the shape of these lobes. This activity is like a large fountain being turned on and off in rapid, but random succession, leading to billowing patterns in the pool below it. Some jets send out more material and others launch at faster speeds. Why? It's likely related to how much material fell onto the stars at a particular point in time.

The stars' more recent ejections appear in a thread-like blue. They run just below the red horizontal diffraction spike at 2 o'clock. Along the right side, these ejections make clearer wavy patterns. They are disconnected at points, and end in a remarkable uneven light purple circle in the thickest orange area. Lighter blue, curly lines also emerge on the left, near the central stars, but are sometimes overshadowed by the bright red diffraction spike.

All of these jets are crucial to star formation itself. Ejections regulate how much mass the stars ultimately gather. (The disk of gas and dust feeding the stars is small. Imagine a band tightly tied around the stars.)

Now, turn your eye to the second most prominent feature: the effervescent blue cloud. This is a region of dense dust and gas, known both as a nebula and more formally as a Bok globule. When viewed mainly in visible light, it appears almost completely black – only a few background stars peek through. In Webb's crisp near-infrared image, we can see into and through the gauzy layers of this cloud, bringing a lot more of Herbig-Haro 46/47 into focus, while also revealing a deep range of stars and galaxies that lie well beyond it. The nebula's edges appear in a soft orange outline, like a backward L along the right and bottom.

This nebula is significant – its presence influences the shapes of the jets shot out by the central stars. As ejected material rams into the nebula on the lower left, there is more opportunity for the jets to interact with molecules within the nebula, causing them both to light up.

There are two other areas to look at to compare the asymmetry of the two lobes. Glance toward the upper right to pick out a blobby, almost sponge-shaped ejecta that appears separate from the larger lobe. Only a few threads of semi-transparent wisps of material point toward the larger lobe. Almost transparent, tentacle-like shapes also appear to be drifting behind it, like streamers in a cosmic wind. In contrast, at lower left, look beyond the hefty lobe to find an arc. Both are made up of material that was pushed the farthest and possibly by earlier ejections. The arcs appear to be pointed in different directions, and may have originated from different outflows.

Take another long look at this image. Although it appears Webb has snapped Herbig-Haro 46/47 edge-on, one side is angled slightly closer to Earth. Counterintuitively, it's the smaller right half. Though the left side is larger and brighter, it is pointing away from us.

Over millions of years, the stars in Herbig-Haro 46/47 will fully form – clearing the scene of these fantastic, multihued ejections, allowing the binary stars to take center stage against a galaxy-filled background.

Webb can reveal so much detail in Herbig-Haro 46/47 for two reasons. The object is relatively close to Earth, and Webb's image is made up of several exposures, which adds to its depth.

Herbig-Haro 46/47 lies only 1,470 light-years away in the Vela Constellation.

WHAT'S UP IN THE SKY - AUGUST 2023

LUNAR CALENDAR

IMPORTANCE OF MOON PHASES FOR STARGAZERS

One might wonder why it is important to refer to moon phases for star gazing. The reason is that the phases of the Moon reflect a great deal of illumination, and because the Moon is so close to us, it overrides the brightness of other celestial objects.

So, What Moon phase is best for stargazing? "The New Moon and the days immediately before and after the new moon (Crescent phases)" are among the best times for stargazing. Whereas the Remaining phases like Full Moon, waxing or waning gibbous, the first or third quarter Moon offers a time to zoom in and witness the features of the Moon.

PLANETS VISIBILITY

Mercury

Reaches greatest eastern elongation of 27.3 degrees from the Sun at 10th of August. Tricky to see.

Venus

This bright morning planet is best observed at the end of the month, where it will be low in the east before sunrise.

Mars

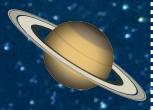
Evening planet, best at the start of August, but hardly visible.

Jupiter

Brilliant morning planet reaching peak altitude under darker skies at the end of August.

Saturn

Morning planet, best Opposition on 27 August when the rings will brighten



Uranus

Morning planet, 50° in altitude at the end of the month, near Jupiter.

Neptune

Morning planet Well placed at the end of the month.

BRIGHT DEEP SKY OBJECTS

Messier 6 also known as The Butterfly Cluster or NGC 6405 is an open cluster of stars in the constellation of Scorpius. Its name derives from the vague resemblance of its shape to a butterfly. Estimates of the Butterfly Cluster's distance have varied over the years, with a mean value of around 1,600 light years, giving it a spatial dimension of some 12 light years.

Lagoon Nebula (M8) was discovered in 1654 by the Italian astronomer Giovanni, sought to catalog nebulous objects in the night sky so they would not be mistaken for comets. This star-forming cloud of interstellar gas is located in the constellation Sagittarius and its apparent magnitude of 6 makes it faintly visible to the naked eye in dark skies.

Messier 10 is a globular cluster of stars in the constellation of Ophiuchus. The object was discovered by the Charles Messier on 1764 and described it as a "Nebula without stars". It is roughly 15,000 light-years from Earth and has an apparent magnitude of 6.4. This cluster can be easily observed during early August.

Messier 19 is a globular cluster in the constellation Ophiuchus. It was discovered by Charles Messier on 1764 and added to his catalogue of comet like objects that same year. It was resolved into individual stars by William Herschel in 1784. The cluster is located 28,500 light-years from Earth and It has an apparent magnitude of 7.7.

ROCKET LAUNCHES IN AUGUST 2023

WE LOVE THE NIGHTLIFE!

The 'We Love the Nightlife' mission is scheduled to launch from Rocket Lab Launch Complex 1 on New Zealand's Mahia Peninsula for American space tech company Capella Space (Capella), a leading provider of commercial Synthetic Aperture Radar (SAR) imagery. It is scheduled to be launched on August 4th, 2023 at 7 UTC.

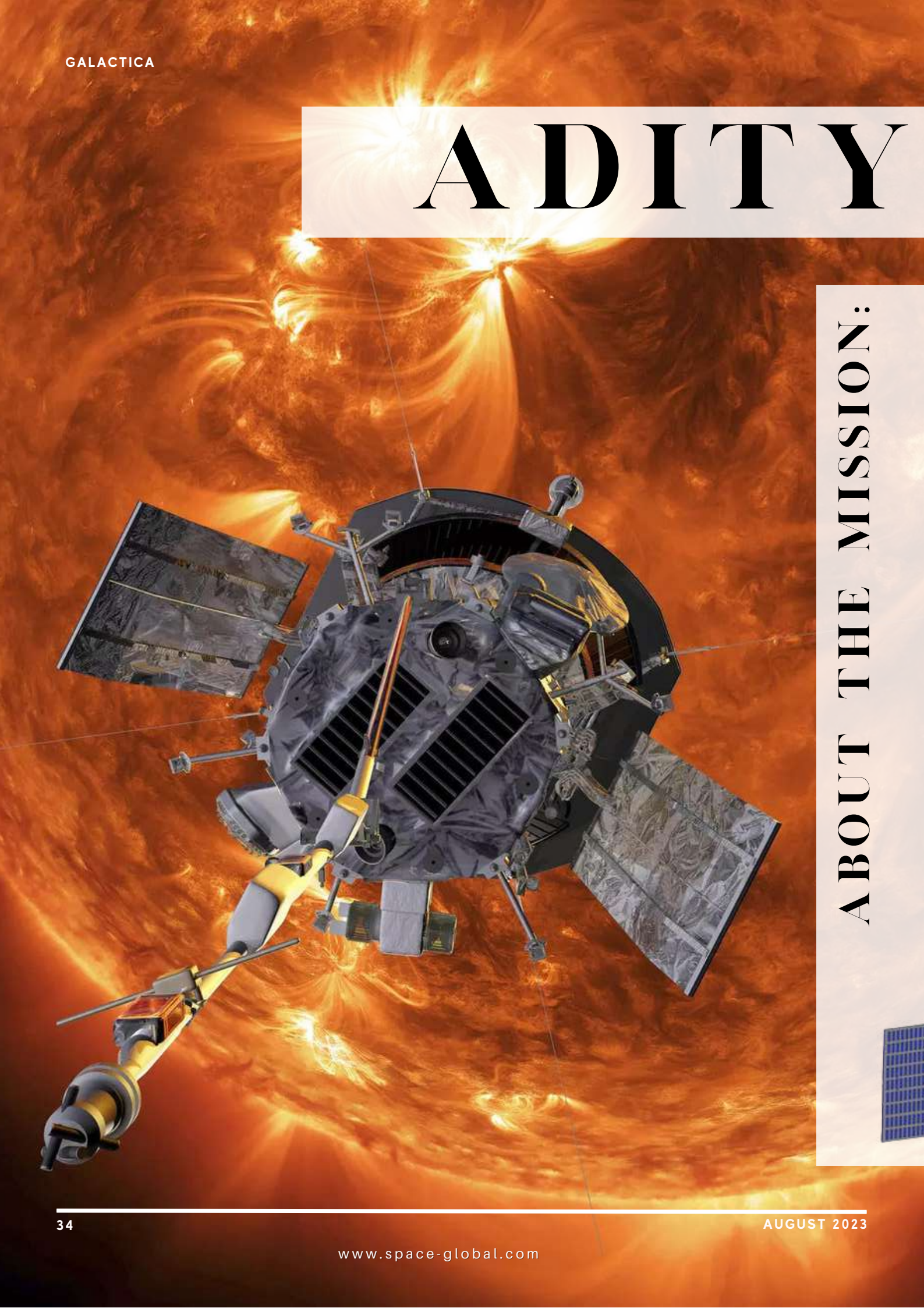
'We Love the Nightlife' will be Rocket Lab's third launch for Capella following the successful "Stronger Together" mission launched in March 2023 from Rocket Lab Launch Complex 2 in Virginia, USA, and the "I Can't Believe It's Not Optical" mission in August 2020 from Launch Complex 1, which deployed the first satellite in Capella's SAR constellation.

'We Love the Nightlife' will be the first of four new dedicated launches on Electron for Capella, announced in February 2023, to deploy Capella's next-generation SAR Earth-imaging satellites called Acadia.

Capella Space's satellites are synthetic radar aperture Earth observation satellites utilizing radar and its reflection from the ground to map the Earth's surface. Using radar has certain advantages over using optical-based methods. Depending on the frequency, radar can observe the surface through clouds, haze, and other obstructions that optical-based systems struggle with. Synthetic aperture radar can also achieve better spatial resolution than similar optical ones with 0.5 m per pixel on Capella Space's second-generation satellites.

ADITY

ABOUT THE MISSION:

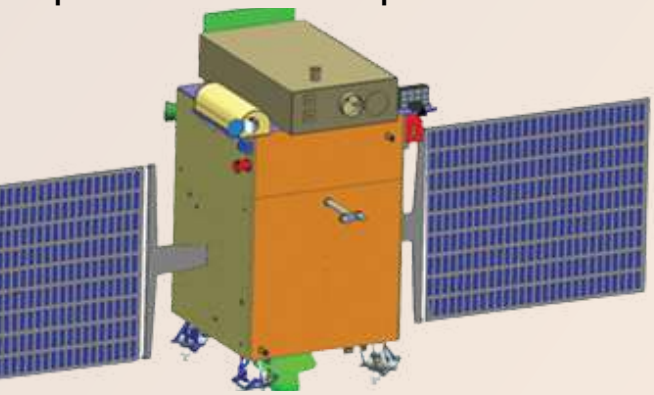


A - L1

The Indian Space and Research Organisation (ISRO), India's national space agency, will launch its first space-based mission to study our parent star on 26 August 2023 from the Sathish Dhawan Space Centre in Sriharikota. The launch of the Aditya-L1 mission takes place a couple of days after the potential lunar landing of Chandrayaan-3.

The Aditya-L1 mission is also known as the Aditya - Lagrange 1. The mission's name gives a succinct description of its focus and its observational position. In Sanskrit, Aditya means Sun, and Lagrange 1 is a mathematical point between Earth and Sun. Aditya-L1 will study the Sun from the Lagrange 1 position.

Conceptualized as Aditya-1 in January 2008, Aditya-1 was to be 400 kg with one payload and observe our Sun in LEO. The mission objectives have expanded since its conceptualization. Thus, the satellite is now a solar and space environment observatory and will be positioned at the L1 point.



Consequentially, the mission was renamed Aditya-L1. The Aditya-L1 satellite is 1500 kg with seven special instruments called payloads onboard. These payloads will provide crucial information that could help us to understand solar weather and the solar magnetic field.

The XL variant of ISRO's Polar Satellite Launch Vehicle (PSLV) will launch the satellite. This launch is the 59th launch of the PSLV class and the 56th commercial launch. Aditya-L1, like the Chandrayaan spacecraft, will initially be placed in the Low Earth Orbit (LEO), before being propelled toward the L1 point, a journey that approximately takes four months.

Aim of Aditya-L1

The primary goal of Aditya-L1 is to study the solar atmosphere (an extremely hot and dynamic region,) and the solar magnetic field. The major objectives of the mission in detail are:

- To study the dynamics of the chromosphere and corona.
- To understand the physics of the partially ionized plasma, the initiation of coronal mass ejection (CME) and flares and study the heating in the chromosphere and corona.
- To observe the particle and plasma environment in situ. This will provide data that we can use to study the particle dynamics of particles from the sun.
- To understand the physics of the solar corona and its heating mechanism.
- To understand the temperature, velocity, and density of coronal loops plasma

GALACTIC 02 SPACESHIP 2

Galactic 02 is a planned crewed sub-orbital spaceflight of the SpaceShipTwo-class VSS Unity, expected to launch on 10 August 2023. It will be the second commercial spaceflight and seventh overall spaceflight for American aerospace company Virgin Galactic. The mission will be the first to carry paying customers, as the previous flight, Galactic 01, carried astronauts from the Italian Air Force and the Italian National Research Council.

The crew of Galactic 02 will include three private passengers and three Virgin Galactic employees. Jon Goodwin will become the first Olympian and second person diagnosed with Parkinson's disease to fly to space, while Kiesha Schahaff and Anastasia Mayers will become the first mother-daughter duo and first people from the Caribbean to fly to space, while Mayers will also become the second youngest person to fly to space.

"The dynamic and multinational crew highlights the role the commercial space industry can play in removing barriers that once existed to becoming an astronaut," the company wrote in an update on July 17 that announced the Galactic 02 crew.

(From left) Anastatia Mayers, Jon Goodwin and Keisha Schahaff will fly on the Galactic 02 mission in August.

The former Olympian is 80-year-old British adventurer Jon Goodwin, who competed in canoeing in the 1972 Summer Games in Munich. Goodwin has Parkinson's and will become just the second person diagnosed with the disease to reach space, Virgin Galactic said.

Mayers, 18, will become the second-youngest person to reach space, according to Virgin Galactic. The youngest was Oliver Daemen, who was also 18 when he flew on Blue Origin's New Shepard suborbital vehicle in July 2021.

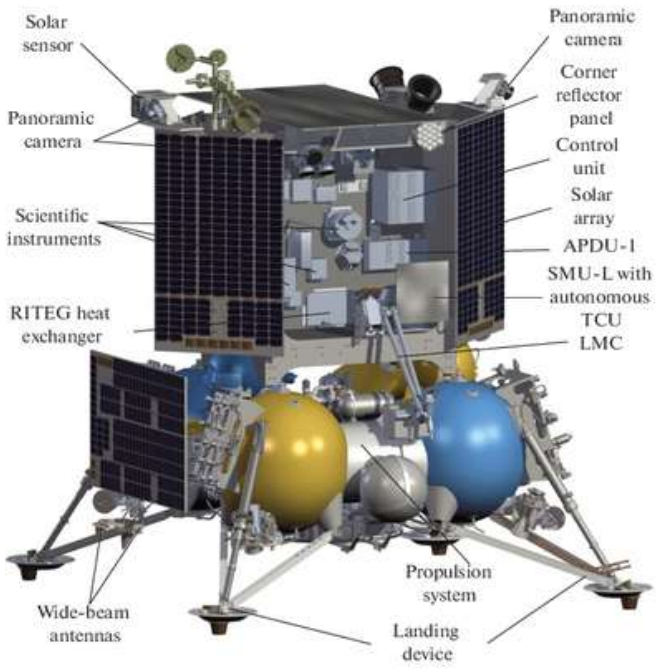
Three other people will fly to space on Galactic 02, all of them Virgin Galactic employees.

The company's chief astronaut instructor, Beth Moses, will be in the cabin of the VSS Unity space plane along with Goodwin, Schahaff, and Mayers. C.J. Sturckow and Kelly Latimer will be in the vehicle's control, as commander and pilot, respectively.

LUNA 25

Russia's long-awaited and delayed robotic re-introduction to moon exploration, Luna-25, is at its launch site! Luna 25 is currently scheduled to launch no earlier than 10 August 2023 at 23:10 UTC. The launch will be on a Soyuz-2 Fregat into Earth orbit. It will fire the Fregat again to go into a lunar transfer orbit and from the lunar orbit it will drop down to the surface.

"It is planned that the device will be the first in the world to carry out a soft landing on the surface of the moon in the south pole region and conduct contact studies of the lunar soil for the presence of ice at the landing site," the statement adds.



The lander has a four-legged base containing the landing rockets and propellant tanks, an upper compartment that holds the solar panels, communication equipment, onboard computers, and most of the science apparatus. The dry mass is about 800 kg, and it is expected to have roughly 950 kg of propellant at launch. The lander has a 1.6 meter-long Lunar Robotic Arm (LRA, or Lunar Manipulator Complex) to remove and collect the surface regolith to depths of 20 to 30 cm. The LRA is equipped with a scoop (175 cubic cm volume) and a sample acquisition tool, a 4.7 cm long tube with an internal diameter of 1.25 cm. (Image Credits: Top image- ROSCOSMOS, Bottom image- Lavochkin)

XRISM

DATE: AUGUST 25, 2023
TIME: 9:34 A.M. (JST)

XRISM (X-ray Imaging and Spectroscopy Mission) is a JAXA/NASA collaborative mission with ESA participation. It will investigate the X-ray sky using high-resolution spectroscopy and imaging.

(Image Credits: JAXA

Location

JYoshinobu Launch Complex at the JAXA Tanegashima Space Center.

Rocket

Family: HII-A

H-IIA (H-2A) is an active expendable launch system operated by Mitsubishi Heavy Industries (MHI) for the Japan Aerospace Exploration Agency. These liquid fuel rockets have been used to launch satellites into geostationary orbit; lunar orbiting spacecraft; Akatsuki, and the Emirates Mars Mission.

(Image Credits: NASA and Mitsubishi)

Agency

The Japan Aerospace Exploration Agency (JAXA) is the Japanese national air and space agency. It is the merger of three previously independent organizations, JAXA is responsible for research, technology development, and launch of satellites into orbit, and is involved in many more advanced missions such as asteroid exploration and possible human exploration of the Moon.

SpaceX Launches - August 2023

GALAXY 37

A SpaceX Falcon 9 is set to launch the Galaxy 37 communications satellite for Intelsat during the midnight hour Thursday. Liftoff from pad 40 at Cape Canaveral Space Force Station is set for 12:15 a.m. EDT (0415 UTC).

It will be the 52nd orbital launch for SpaceX this year and the sixth flight for Falcon 9 booster 1077, which first flew in October 2022 carrying a Crew Dragon to the International Space Station. The booster will land on the drone ship 'Just Read the Instruction about eight and a half minutes after launch.

Inside the rocket's payload fairing is the five-metric-tonne Intelsat Galaxy 37 communications satellite which is equipped with four deployable antenna reflectors for both C-band and Ku-band transmissions. It will serve television and telecommunication networks and the U.S. Government in North America. The Ku-band payload which offers mobile communication services is jointly owned by Intelsat and JSAT International. The spacecraft was built by Maxar. It is the last in a series of satellites to refresh Intelsat's Galaxy fleet of satellites that operate over North America.

The Falcon 9 upper stage will place the Galaxy 37 spacecraft into a so-called super synchronous transfer orbit with a high point above its final planned geostationary orbit. This kind of orbit conserves the satellite's onboard fuel which will be used to circularise and lower the orbit. The second stage will exhaust its remaining propellant supplies to reach the best possible orbit before releasing the satellite about 32 minutes after launch.

It will take about three weeks for the satellite to maneuver itself into a geostationary orbit about 35,500 kilometers above the equator. Testing will take place over Hawaii at about 148 degrees west. Once that checkout is completed it will drift to 127 degrees west, which puts it roughly west of Seattle. The satellite is expected to enter service in early October. It is expected to remain in operation for at least 18 years. Image credits: everdayastronaut

CREW 7

NASA and SpaceX now are targeting 5:23 a.m. EDT Monday, Aug. 21, for the launch of the agency's Crew-7 mission to the International Space Station. The adjusted date allows additional time for launch site processing at Launch Complex 39A at NASA's Kennedy Space Center in Florida. If needed, a backup opportunity is available at 3:49 a.m. on Friday, Aug. 25.

The target date is in coordination with activities aboard the International Space Station, including operations with other crew and cargo spacecraft. A Cygnus cargo spacecraft from Northrop Grumman and Roscosmos Progress cargo spacecraft is due at the station in the coming weeks.

NASA astronaut Jasmin Moghbeli, ESA (European Space Agency) astronaut Andreas Mogensen, JAXA (Japan Aerospace Exploration Agency) astronaut Satoshi Furukawa, and Roscosmos cosmonaut Konstantin Borisov will fly aboard the SpaceX Dragon spacecraft, named Endurance, which previously flew NASA's SpaceX Crew-3 and Crew-5 missions to the space station. This will be the first launch of the Falcon 9 booster SpaceX selected to support this mission.

All hardware for the mission has arrived in Florida for processing. On July 25, the Dragon spacecraft was stacked to its trunk ahead of its upcoming transport to SpaceX's hangar at Launch Complex 39A. Once preflight checkouts of the spacecraft are complete, Dragon will be mated to the rocket ahead of the integrated system's rollout to the launch pad.

The four crew members of NASA's SpaceX Crew-7 mission pose for a photo inside SpaceX Hangar X at NASA's Kennedy Space Center in Florida. From left to right are Konstantin Borisov, Andreas Mogensen, Jasmin Moghbeli, and Satoshi Furukawa. (Photo credit: SpaceX)

STARLINK GROUP 6-9

A Starlink satellite has a lifespan of approximately five years and SpaceX eventually hopes to have as many as 42,000 satellites in this so-called mega constellation.

The current V2 Starlink satellite version weighs approximately 1,760 lbs (800 kilograms) at launch, almost three times heavier than the older generation satellites (weighing in at 573 lbs or 260 kg).

How many Starlink satellites are there?
As of July 2023, there are 4,519 Starlink satellites in orbit, of which 4,487 are operational as per planet4589.org.

Starlink satellites orbit approximately 342 miles (550 kilometers) above Earth and put on a spectacular show for observers as they move across the sky.

A SpaceX Falcon 9 rocket will launch the Starlink (6-9) mission on Thursday, August 10, 2023, at 11:23 PM (UTC).

Starlink satellites are easier to see a day or two after their launch and deployment then become progressively harder to spot as they climb to their final orbital height of around 342 miles (550 km).

SpaceX launched its first two Starlink test craft, named TinTinA and TinTinB, in February 2018. The mission went smoothly. Based on initial data, the company asked regulators for its fleet to be allowed to operate at lower altitudes than originally planned. The first 60 Starlink satellites launched on May 23, 2019, aboard a SpaceX Falcon 9 rocket.

****Note: Launch dates of the missions are scheduled to be launched in August 2023 but may subject to change.**

ASTRONOMICAL EVENTS - AUGUST 2023

PERSEIDS METEOR SHOWER

The Perseids is one of the best meteor showers to observe, producing up to 80 meteors per hour at its peak.

Comet Swift-Tuttle

The Perseids are famous for producing a large number of bright meteors. Made of tiny space debris from the comet Swift-Tuttle, which was discovered in 1862. The Perseids are named after the constellation Perseus. This is because the direction, or radiant, from which the shower seems to come in the sky lies in the same direction as Perseus. The Perseids are widely sought after by astronomers and stargazers because most years at its peak, one can see 60 to 100 meteors in an hour from a dark place. The shower runs annually from July 17 to August 24. It peaks this year on the night of August 12 and the morning of August 13.

How and When to See the Perseids in 2023

The best time to see anything in the night sky is when the sky is darkest and when the target is at its highest position in the sky. For meteor showers, this usually occurs between midnight and the very early hours of the morning.

"2023 will be a good year for the Perseids as the moon will only be 10% illuminated".

(Image credit: Sky and telescope.com)

Myths, legends and associations with the Perseid meteor shower

- Perseus was a hero who beheaded the Gorgon Medusa and later married Andromeda according to Greek Myths. They had nine children together and the word 'Perseids' is derived from the Greek word 'Perseides' which refers to Perseus' descendants.
- In some Catholic traditions, the Perseids is also known as 'the tears of St Lawrence', due to its peak roughly coinciding with the date the Saint achieved martyrdom.
- The Perseids is also associated with the god Priapus, who was believed by the Romans to have fertilized the fields by ejaculating on them once a year on the date the shower peaks.

Viewing Tips for the Perseid Meteor Shower

Watching a meteor shower could not be simpler. Just go outside on the night(s) of the Perseid meteor shower "maximum" and look up! You can maximize your chances of seeing meteors by finding an open area far from man-made lights. Of course, cloud cover can prevent you from seeing the shower.

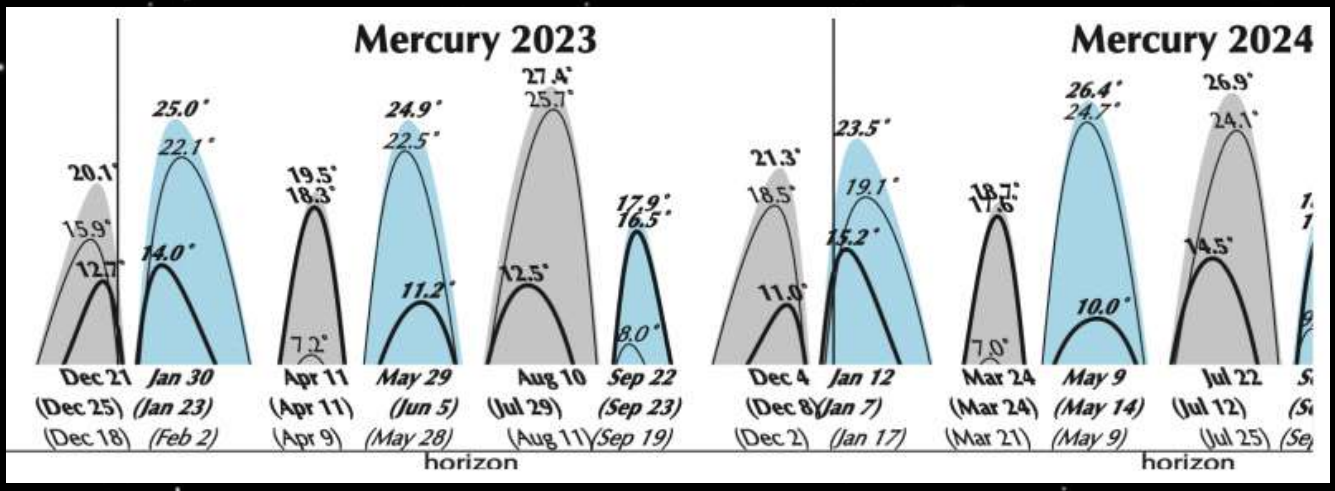
- Get away from light pollution! You'll want to avoid city lights.
- Gaze at whatever part of the sky is darkest at your location.
- You'll need about 15 minutes for your eyes to adapt to the darker skies, so get out earlier and be patient.
- Being comfortable is important. To avoid a stiff neck, bring a chaise lounge or reclining lawn chair.

Don't forget to witness the best Meteor shower of the year.

(An image of the comet Swift-Tuttle Credits - Planetary.org.)

MERCURY AT GREATEST EASTERN ELONGATION

Best day to observe Mercury



(Mercury elongations compared. Here, gray areas represent evening apparitions (eastward elongation). And blue areas represent morning apparitions (westward elongation). The top figures are the maximum elongations, reached at the top dates shown beneath. Image credit: Earthsky.org)

What's Elongation

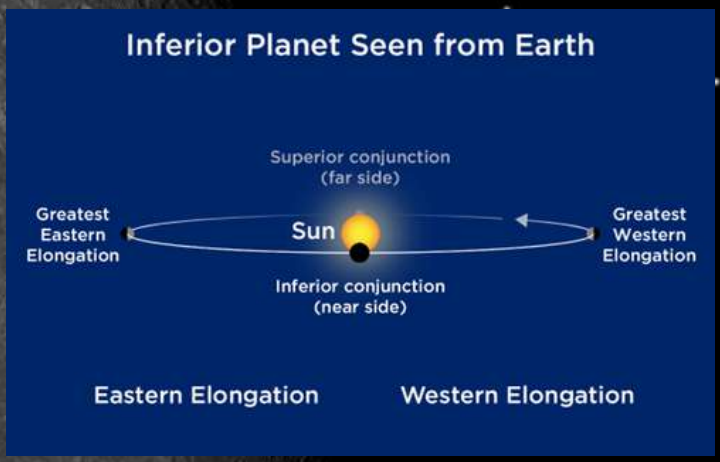
Astronomers use the word elongation to describe the angular distance – the distance on the sky's dome – between the sun and one of the inner planets in our solar system, Mercury or Venus. Elongations are measured in degrees eastward or westward of the sun. Greatest elongations signal the best time to observe one of the inner planets. At greatest elongation, Venus or Mercury is typically farthest from the sun's glare.

Greatest Eastern Elongation

On August 10, 2023 Mercury reaches its greatest distance from the sun. Mercury will shine at magnitude +0.3 when at greatest elongation. So you'll easily see it in the western twilight, if you're in the Southern Hemisphere. But from the Northern Hemisphere it hugs the horizon shortly after sunset.

Where to look: Look in the sunset direction, as the sky is darkening.

When to look: Mercury begins this evening apparition in late July and will disappear again by last week of August.



Through a telescope at greatest elongation: At greatest elongation, Mercury will appear about 49% illuminated, in almost a quarter phase, and 7.55 arcseconds across.

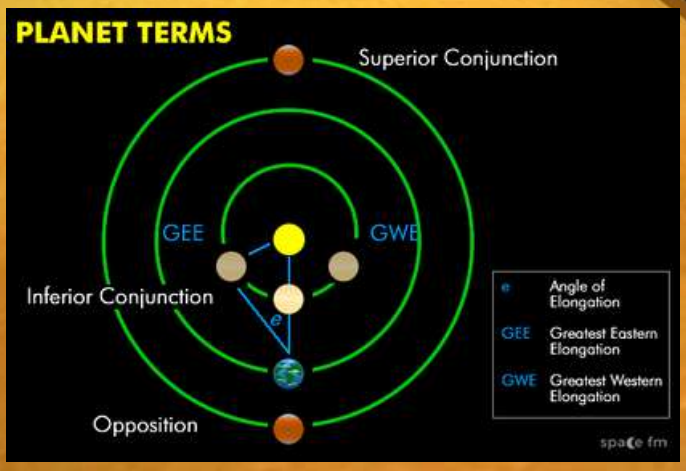
Observing Mercury: Mercury's orbit lies closer to the Sun than the Earth's, meaning it always appears close to the Sun and is lost in the Sun's glare much of the time.

It is observable for only a few weeks each time it reaches greatest separation from the Sun – moments referred to as greatest elongation. These apparitions repeat roughly once every 3-4 months, taking place alternately in the morning and evening skies, depending whether Mercury lies to the east of the Sun or to the west.

"Maximum & Minimum Angular distance of Mercury from the sun (seen from the Earth)at greatest elongation are 28 & 18degrees respectively."

SATURN AT OPPOSITION

Saturn's opposition, when we fly between Saturn and the sun, is at 1:30 pm IST on August 27. So it's in a wonderful place to see now, ascending in the east in the evening, as seen from around the globe. Saturn at opposition is in the dim constellation Aquarius the Water Bearer. In addition, if you have a dark sky, you can see the dim, but pretty constellation Capricornus the Sea-goat. It has the shape of an arrowhead. Indeed, you can see them crossing the sky all night, traveling along the ecliptic, the same path the sun travels during the day.



Saturn at opposition

When and where to watch in 2023: Around its August 26-27 opposition, Saturn is rising in the east at sunset and visible all night. Afterward, for the rest of 2023, Saturn will remain visible in the evening sky. It'll finally disappear in the sunset glare by mid-February 2024.

Date and time of opposition: 1.30 pm IST on August 27, 2023.

Brightness at opposition: At opposition, the ringed planet shines at its brightest for 2023, at magnitude 0.4.

Distance from Earth at opposition: Around opposition, Saturn is at its least distance from Earth for 2023, at 73 light-minutes (about 8.8 astronomical units).

Constellation at opposition: Aquarius the Water Bearer.

Disk size at opposition: Saturn's disk size is the largest around the opposition. At its largest, Saturn will appear 19 arcseconds across.

Ring tilt at opposition: At opposition, Saturn's rings are tilted by 8.1 degrees, relative to earthly viewers. The rings will span 44.2 arcseconds.

(A comparison of the apparent size of Saturn at opposition (August 27, 2023) and when it is most distant from the Earth at solar conjunction (February 29 2024).
Image credit: In-the-Sky.org.)

The opposition surge:

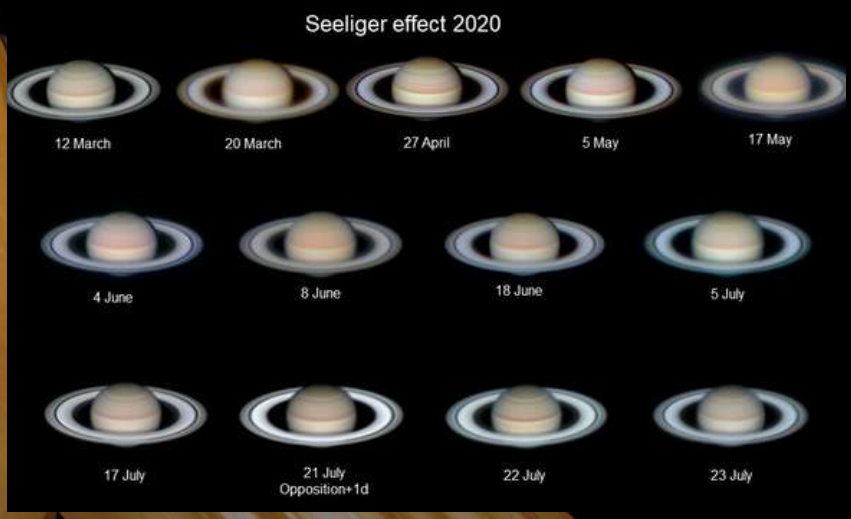
Sometimes known as the opposition effect, opposition spike or Seeliger effect, is the brightening of a rough surface, or an object with many particles, when illuminated from directly behind the observer. The term is most widely used in astronomy, where generally it refers to the sudden noticeable increase in the brightness of a celestial body such as a planet, moon, or comet as its phase angle of observation approaches zero. At zero phase angle, the Sun is directly behind the observer and the object is directly ahead, fully illuminated.

The Seeliger effect:

Generally, when you observe Saturn through a telescope before or after opposition, the rings appear about as bright as the planet's globe. For days around the time of opposition, however, the rings suddenly intensify in apparent brightness, outshining the globe before dimming back to their normal appearance.

German astronomer Hugo von Seeliger (1849–1924) first noticed this change in 1887. Because of his pioneering research into its cause, which led him to conclude that Saturn's rings were composed of tiny particles, the effect was named in this scientist's honor.

Two major physical processes lead to the Seeliger effect: shadow hiding and coherent backscattering. When we see Saturn directly illuminated by the Sun (as it is during opposition), the planet's shadow "hides" behind the globe, placing more ring surface into view. As a result, the rings appear to brighten. The same direct lighting angle also causes the shadows of individual particles in the rings to temporarily vanish, enhancing the result.



(Image credit: Cloudy Night.com)

But that's not all. Observations of the opposition effect on Saturn's rings from the Cassini spacecraft, in orbit around the planet, reveal that "coherent backscattering" also contributes significantly to the phenomenon. This occurs when sunlight interacts with the collective particles in the planet's rings; reflections off the many irregular bits of rock and dust combine to produce a single (coherent) more intense light.

This light scatters back to our eyes and makes the rings seem to brighten.

At opposition, and the days immediately surrounding it, we see the combination of these two mechanisms as a temporary surge in the overall illumination of the rings. The only way to fully appreciate the effect visually, however, is to monitor the planet and its rings for the days near that magic moment – weather permitting.

More than Saturn

We also see the opposition effect each month when we look at the Full Moon. The Sun's direct illumination causes shadows to disappear from our satellite's craters, and the light it reflects at us increases by 40 percent. Based on the irregular particles in Apollo soil samples, scientists have determined that coherent backscatter is the phenomenon's principal cause.

The opposition effect has a terrestrial analog as well. Known as the heiligenschein, this optical phenomenon is a luminous enhancement around the shadow of a person's head. It is most pronounced at low Sun angles when the surface on which the shadow falls is especially dusty or dewy. The enhancement occurs at the antisolar point, or the spot directly opposite the Sun. Immediately around that area, the tiny particles hide their own shadows and scatter back sunlight. The word heiligenschein refers to the halo depicted around saints' heads and literally means "saint's light." Perhaps the painters of old had noticed this optical phenomenon.

SUPER MOON

Super moon captured by Mr. Ranjith Kumar E, Senior Educator, on March 2020 (Super Worm Moon) using a 250mm focal length Camera.

The sturgeon moon, which rises on August 1st and provides a mesmerizing appearance in the night sky, is the first of two supermoons that will occur in August.

Skygazers will experience a celestial joy in August as there are not one, but two full moons–and both of them are supermoons. After a weekend of meteor showers, the first of these brilliant lunar displays, known as the sturgeon moon, will appear on Tuesday, August 1. It is somewhat bigger and brighter than a usual full moon due to the supermoon phenomenon, making it a stunning sight for everyone who looks up at the night sky.

BLUE MOON

A Blue Moon will show brightly in the night sky on August 31st, 2023. It is the second Full Moon in August and a monthly Full Moon. And it won't turn blue, either.

The now-defunct Maine Farmer's Almanack is where the term "seasonal Blue Moon" first appeared, which is defined as the third Full Moon of an astronomical season having four Full Moons. The 13th Full Moon of a year "upset the arrangement of Church festivals," according to the Almanack. The additional Full Moon was dubbed a Blue Moon because of the unfortunate reputation of the number 13 and the challenges associated in predicting the appearance of such a Full Moon.

CONJUNCTIONS FOR THE MONTH

Conjunction - Occasionally two or more objects meet up with each other in our sky. Astronomers use the word conjunction to describe these meetings. Technically speaking, objects are said to be in conjunction in that instant when they have the same right ascension on our sky's dome. Practically speaking, objects in conjunction will likely be visible near each other for some days.

The word conjunction comes from Latin, meaning to join together. Maybe you remember the old Conjunction Junction cartoons from the 1970s. In language, conjunctions relate to clauses brought together in sentences with words like and. In astronomy, conjunctions relate to two or more objects brought together in the sky.

An astronomical conjunction describes a few different types of meetings. The first two types we're describing here – inferior and superior conjunctions – involve the sun and thus can't be seen.

Conjunction of Moon and Jupiter.

On **August 8, 2023. Moon** will appear very close to the planet Jupiter. The pair will be close at midnight. They will be in the Eastern direction. Jupiter is at a magnitude of -2.41 and the Moon has a magnitude of -10.54.

Place: Chennai / Date: 8th August / Time: 2.30AM

Conjunction of Moon and Mars.

On **August 19, 2023**, Moon and planet Mars appear very close to each other in the early evening. They will be in the western direction. Moon is at a magnitude of -7.02, Mars will be at a magnitude of 1.69.

Place: Chennai / Date: 19th August / Time: 7.00PM

Conjunction of Moon and Saturn

On **August 3, 2023**, Moon and the planet Saturn will appear very close to each other in the early night. They will be in the Eastern direction. Moon is at a magnitude of -12.21, and the planet Saturn is at a magnitude of 0.56.

Place: Chennai / Date: 3rd August / Time: 7.30PM

On **August 30, 2023**, Moon and the planet Saturn will appear very close to each other in the early night. They will be in the Eastern direction. Moon is at a magnitude of -12.78, and the planet Saturn is at a magnitude of 0.45.

Place: Chennai / Date: 30th August / Time: 8.30PM

STUDENT'S CORNER

Space Stations

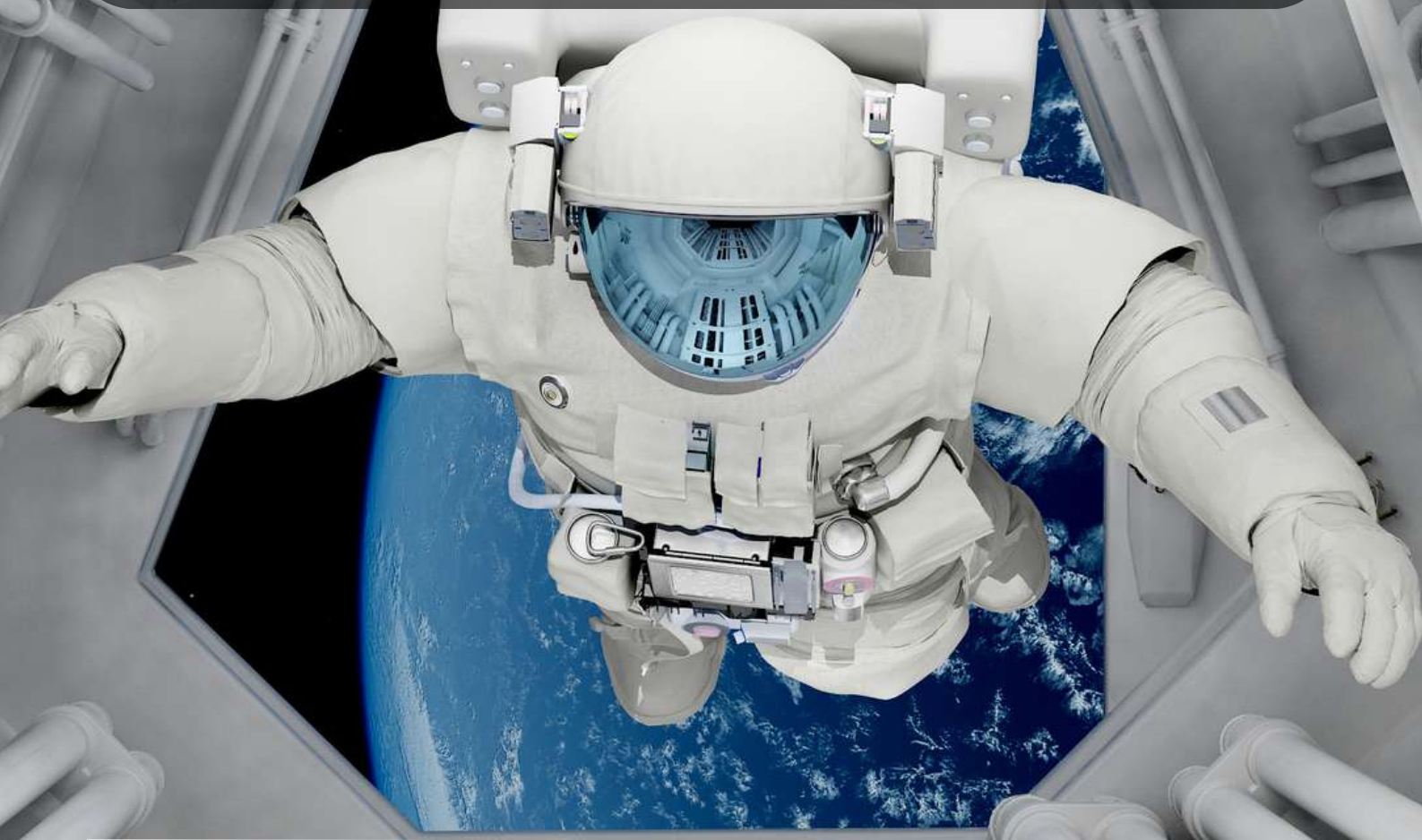
Trishna Bawri
Astronomy Camp Student

Space is an inexhaustible source of knowledge and learning which has driven humans to explore and develop from the fire to present space exploration such as about the celestial bodies like the moon and stars which make up the universe. Hence, it is a magnificent "playground" for scientists. But how is such a big universe explored? Scientists explore space through telescopes, satellites, and also space stations.

Have you ever thought about what space stations are? A space habitat is a space station. It supports a human crew in orbit for an extended period. This orbital space station is an artificial satellite.

As of 2023 two fully operational space stations in Low Earth Body are The International Space Station (ISS) and China's Tiangong Space Station (TSS). The ISS is the largest space station which involves five space agencies: United States's NASA, Russia's ROSCOSMOS, Japan's JAXA, Europe's ESA, and Canada's CSA, which are suited for testing the spacecraft systems and equipment required for future long-duration missions to Moon and Mars. However, in July 2022, Russia announced intentions to withdraw from the ISS after 2024 to build its space station.

Did you know that India is also planning to launch a space station? The ISRO space station is planned to be launched in 2030, but it was postponed to 2035 due to delays led by technical issues related to the Gaganyaan crewed spaceflight mission. The Gaganyaan spacecraft is designed to carry three people. Hence, space stations play a major role in exploring space.



Canis Majoris Dwarf Galaxy: A Tiny Marvel in the Vast Cosmos

Nikhilesh B
IAstronomer Member

The universe is a vast expanse of space, teeming with countless galaxies that vary in size, shape, and characteristics. Among these celestial wonders, the Canis Majoris Dwarf Galaxy is a fascinating and enigmatic gem. Nestled within the constellation of Canis Major, this diminutive galaxy has captivated astronomers and astrophysicists with its unique properties and the mysteries it holds. This essay will explore the key features and significance of the Canis Majoris Dwarf Galaxy, shedding light on its importance in our understanding of the cosmos.

The Canis Majoris Dwarf Galaxy was discovered in 2003 by astronomers from the European Southern Observatory (ESO). As its name suggests, it is a dwarf galaxy, a class of galaxies significantly smaller and less luminous than their larger counterparts. Dwarf galaxies are essential in studying galaxy formation and evolution, as they often act as "building blocks" for more massive galaxies through various interactions, mergers, and accretion processes.

The Canis Majoris Dwarf Galaxy is approximately 25,000 light-years away from Earth, making it relatively close in astronomical terms. Despite its proximity, it has largely eluded detection due to its low surface brightness and the overwhelming glow of the Milky Way. The galaxy's small size and faint appearance have made it a challenging subject of observation, requiring sophisticated telescopes and advanced imaging techniques.

The structure of the Canis Majoris Dwarf Galaxy is intriguing. It possesses an elongated shape characterized by an elliptical or irregular morphology. Unlike spiral galaxies like the Milky Way, dwarf galaxies lack defined spiral arms and have a more disorganized appearance. This peculiarity provides astronomers with valuable insights into the formation and evolution of galaxies with varying structures.

Observations of the Canis Majoris Dwarf Galaxy have revealed a relatively sparse stellar population compared to larger galaxies. Unlike the hundreds of billions found in massive galaxies, it contains only a few million stars. Its stars are old and low-mass, with few young, massive stars actively undergoing nuclear fusion.

The scarcity of new star formation in the Canis Majoris Dwarf Galaxy is of significant interest to astronomers. It challenges existing theories on star formation and the factors influencing it within dwarf galaxies. Studying the conditions and processes that govern star formation in such environments may offer crucial insights into how galaxies evolve.

Dark matter, an elusive form of matter that does not emit light or energy, plays a crucial role in the dynamics of galaxies. The Canis Majoris Dwarf Galaxy is a valuable subject for studying dark matter.

Additionally, the Canis Majoris Dwarf Galaxy has experienced past interactions with the Milky Way, disrupting its original structure. These encounters have left behind observable remnants, such as stellar streams and tidal tails, allowing astronomers to study galactic interactions' gravitational effects.

How to decide a Space Trajectory?

Sourajit Mandal
Club Student

Currently, in the history of space exploration, satellites and space crafts are utilized the most. Some of these travel to other celestial objects. These intricate machines travel at high speeds, for great distances, optimizing fuel usage as much as possible. These are designed to reach their destination most efficiently. They take a path that is curvy and long. But, we have studied in physics that a straight line is the shortest distance between two places. If they travel in a curve for long distances, wouldn't they need more fuel?

No. A spacecraft takes a curve (parabolic) path to use less fuel. 90% of the spacecraft's fuel gets it into Earth's orbit. Then, the spacecraft uses the rest of the fuel for the remaining journey. This technique of optimizing the trajectory of a spacecraft is used so that it attains the desired path and is called a gravity turn or a zero-lift turn. This technique enables the spacecraft to keep a shallow or zero angle. This means that the spacecraft will experience less aerodynamic stress. Moreover, the fuel is not used for changing direction. The gravity of the earth is utilized for the same.

Space trajectories are calculated using a combination of mathematical models and computer simulations. Kepler's laws of motion and Newton's laws of motion are used to calculate these trajectories. The equations involved are quite complex and involve several factors, such as the gravitational forces of the planets and other celestial bodies, the velocity and direction of the spacecraft, and the effects of atmospheric drag and other environmental factors. One of the critical equations used in calculating space trajectories is known as the "two-body problem" equation, which describes the motion of two-point masses under the influence of their mutual gravitational attraction.

Here F is the force of gravity between the two masses, G is the gravitational constant, m1, m2 are the masses of the two objects, and r is the distance between them. To calculate the trajectory of a spacecraft, engineers and scientists use various numerical methods, such as the Runge-Kutta method or the Verlet algorithm, to solve these equations and predict the spacecraft's path through space. These methods involve breaking the trajectory into small time steps and calculating the position and velocity of the spacecraft at each step based on the forces acting on it. These calculations involved in space trajectory planning are complex and require a deep understanding of physics, mathematics, and computer science.

For example, in contrast to the Apollo 11 mission by NASA in 1969, which reached the moon in just four days, the recent Chandrayaan-3 mission by ISRO will take 40 days to reach the moon. This is because Chandrayaan-3 chose to employ a slower, more gradual trajectory than the direct Translunar Injection trajectory used by the Apollo missions. This slower trajectory is purposely chosen to use less fuel.

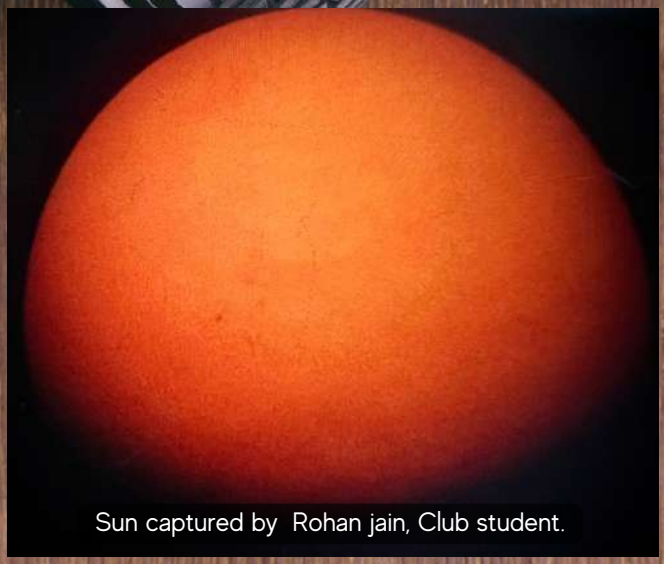
Chandrayaan 3 mission is still ongoing. It is a dangerous mission to the south pole of the moon. Let us wish the mission good luck and hope for the best.

VISUAL ARTS FROM SPACE ASSOCIATED ASTRONOMERS

Moon captured by Rohan jain, Club student.

Moon captured by Maria Vinita, iastronomer

Moon captured by Daksh Rathi, iastronomer.



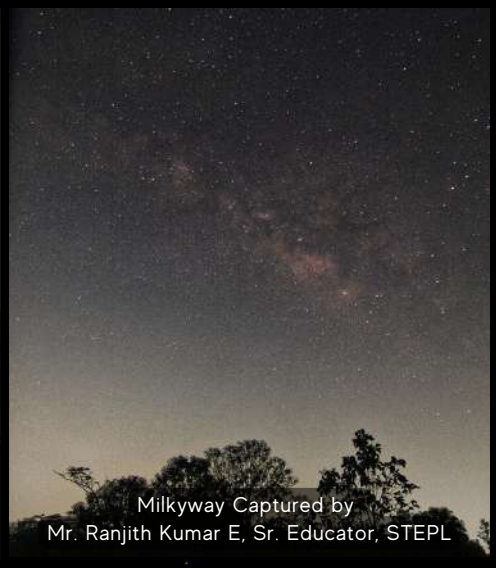
Sun captured by Rohan jain, Club student.

Save Environment drawing by Tanishk Raj, iastronomer

Moon captured by Vetrivel, iastronomer

ASTROPHOTOGRAPHS BY SPACE

Super Moon Trail Captured by
Ms. Sruthi Suresh, Educator, STEPL



Milkyway Captured by
Mr. Ranjith Kumar E, Sr. Educator, STEPL

Sun at Aphelion captured by
Mr. Shirilmon S, Esecutive, GAPL

Chandrayaan 3 rocket launch captured by SPACE Chennai Team

Image credits (Top from left): Mr. Neeraj Ladia, Mr. Ranjith Kumar E, Ms. Priyadharshini D.
(Bottom from left): Mr. Shirilmon S, Mr. Neeraj Ladia, Mr. Ranjith Kumar E, Ms. Sruthi Suresh.

Maria Mitchell

Maria Mitchell (1 August 1818 – 28 June 1889) was an astronomer, librarian, naturalist, and educator. In 1847 she discovered a telescopic comet which thrust her into the international spotlight. She was America's first female professional astronomer and professor of astronomy. She was also the first woman elected as a Fellow of the American Academy of Arts and Sciences and the American Association for the Advancement of Science. Her discovery of the comet, later nicknamed "Miss Mitchell's Comet," got her a gold medal award from the King of Denmark.

HAPPY BIRTHDAY

Eleanor Margaret Burbidge

Eleanor Margaret Burbidge née Peachey; (12 August 1919 – 5 April 2020) was a British-born American observational astronomer and astrophysicist. In the 1950s, she led the team that published the influential Synthesis of the Elements in Stars, a 100-page paper. This paper outlined how elements were synthesized in stars, the astronomical observations which supported the idea, and the hypothetical chain of events that would cause the stellar explosions that distributed elements across space. The work led some to nickname Burbidge "Lady Stardust."

HISTORICAL EVENTS HAPPENED IN AUGUST

JUNO'S LAUNCH

Background image shows cyclones up to 1000 km wide found on Jupiter's south pole.

NASA's Juno spacecraft was launched on August 5th 2011 with the primary objective to peer through Jupiter's thick atmosphere and enhance our understanding of the giant planet. Jupiter is believed to be the oldest planet in the solar system. Thus, understanding its origins and internal processes could help us learn more about our cosmic neighbourhood.

Almost 5 years later, after travelling billions of kilometres, on July 4th 2016, Juno arrived at Jupiter and settles into a 53-day polar orbit. Its orbital path is from just above the Jovian's cloud tops to the outer reaches of Jupiter's magnetosphere.

Juno's sensitive instruments have shed new light on our system's largest planet and sometimes, these discoveries have changed our views of the planet. One such discovery is the fact that the storms on the planet are more chaotic and violent than we previously thought. Additionally, Juno has found several "Earth-size storms" on both of Jupiter's poles.

Juno has made other discoveries such as the possibility that Jupiter's core is larger and 'fuzzier' than anticipated. This has led to a hypothesis of Jupiter having a diluted core instead of a solid compact centre. Another finding made by the spacecraft led to the suggestion that the weather on Jupiter is radically different from Earth's.

There are two phases to Juno's mission: prime mission and extended mission. The prime mission lasted till July 2021 having started from Juno's arrival to Jupiter. During the prime mission, the primary focus was on Jupiter and 3 TB of data was collected. Near the end, as the spacecraft's orbit evolved, flybys of the moon Ganymede took place.

Juno's extended mission started at the end of July 2021. It will continue to investigate the Jovian planetary system through September 2025 or until the spacecraft's end of life. This extension tasks Juno with becoming an explorer of the full Jovian system – Jupiter and its rings and moons – with additional rendezvous planned for two of Jupiter's most intriguing moons: Europa and Io. In fact, on July 30th 2023, Juno made its closest flyby of Io, Jupiter's volcano moon.

Discovery of Phobos and Deimos

The year 1877 was a good year to observe Mars. After several nights of fruitless gazing, X nearly gave up on his search for the Martian Moons. He was encouraged to do so by his wife, Angeline Stickney Hill. The next night, on 11th August 1877, he discovered Deimos. 6 nights later, after the bad weather cleared, on 17th August 1877, he discovered Phobos. Both moons were discovered at the U.S. Naval Observatory.

Like Earth's Moon, the Martian moons always show the same side to their planet. Both moons are lumpy, heavily cratered, and covered in dust and loose rocks. They appear to be made up of carbon-rich rocks that are mixed with ice. The presence of these rocks has given them a darker appearance among the objects of the solar system.

The origins of the Martian moons are unknown though they are thought to be asteroids captured by Mars. They are among the smallest moons found in the solar system. Phobos, the larger Martian moon, has an average diameter of 22 km while Deimos, the smaller of the two, has an average diameter of 13km.

The future of the Martian Moons is bleak. Deimos steal rotational energy from their planet and is slowly moving away. In contrast, Phobos is falling towards the Martian surface. The actual fate of Phobos is unknown. It may get ripped apart by Mars' gravity or may crash onto the planet's surface.

Asaph Hall III - The discovery of the Martian Moons - Phobos and Deimos,

Viking-1's Launch

The First photo Viking-1 Lander took upon landing

Launched on August 29th 1976, the landing of NASA's Viking-1 on Mars in the early summer of 1976 marked the first successful landing on the Martian surface. The Russian Mars 3 probe could claim this title on a technicality but transmissions from the probe stopped almost 15 seconds later.

Viking-1 was part of a two-part mission that aimed to investigate the Red Planet's surface and search for signs of life. Made up of a lander and an orbiter, the initial mission lifetime was projected to be 90 days. Viking-1 lasted for 6 years on the Martian surface, all while collecting valuable data that helped to characterize our neighbouring planet. Until Opportunity broke its record in 2010, the Viking-1 lander was the longest-operating spacecraft on the Martian surface.

Viking-1 helped to characterize Mars as a cold planet with volcanic soil, a thin, dry carbon dioxide atmosphere and evidence of ancient riverbeds and vast flooding. Additionally, data provided has suggested that early Mars was very different from its present day.

This has been backed up by the Viking orbiters who took photos of extinct volcanoes and ancient channels where floods may have taken place. These images and data have defined our view of Mars.

Unfortunately, the Viking-1 mission did not find any definite signs of life on the Red Planet but did find potential hints.

Sunrise on Mars - taken by Viking-1

DISCOVERY OF ENCELADUS

On August 28th 1789, William Herschel pointed the, at the time, world's largest telescope to the sky and spotted Enceladus, a moon of Saturn. He was part of the duo who, along with his sister Caroline Herschel, discovered Uranus in 1781.

Enceladus is the 6th largest moon of the Saturnian system. Even though it is the brightest world in the solar system, scientists did not pay much attention to it. Thus it remained an enigma until Cassini began orbiting Saturn.

Before Cassini's orbit, Enceladus was believed to be a dead icy moon. Cassini quickly changed that perspective proving that Enceladus is a thriving ocean moon. Liquid salty water is hidden beneath the ice crust that is smooth in some places. Data collected by the spacecraft suggests a 10 km deep sea at the south pole and under a 30-40 km thick ice shell.

What makes Enceladus even more impressive is that jets of icy particles from the global ocean gushes out into space continuously. The material shoots out at remarkable speeds. Some of these materials fall back onto Enceladus. Some of the material escapes and form Saturn's E ring, the largest planetary ring of the solar system.

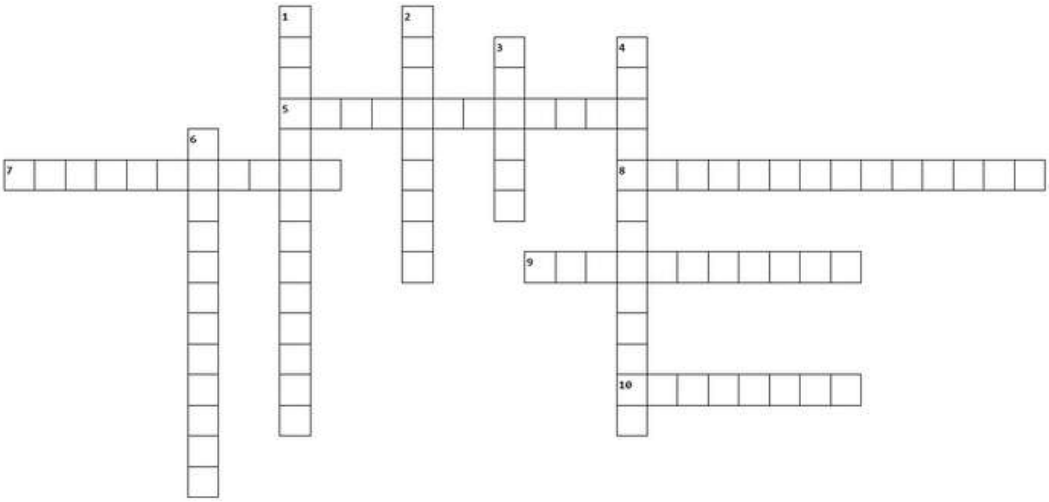
Additionally, Enceladus' active south pole has a cracked terrain which indicates constant motion. The icy terrain stretches in some places while buckling in others. This hints at the possibility that the source of Enceladus' liquid water is via heating by a tidal mechanism.

Other data from Cassini has pointed to the possibility of hydrothermal vents deep beneath Enceladus' icy shell. Something that is not unlike the hydrothermal vents that we find at the bottom of the ocean floor here on Earth.

This, though, was not the most interesting discovery that the Cassini spacecraft made. During a close flyby, Cassini's instruments got a sample of the eruption where the following was detected: volatile gases, water vapour, carbon dioxide, carbon monoxide, and organic materials. All these point to potential signs of life.

TRAIN YOUR BRAIN

CROSSWORD



ACROSS

5. A boundary around a black hole beyond which no light or other radiation can escape is called?
7. What is the center of a black hole called?
8. Who proposed that black holes can evaporate?
9. Who coined the word Blackhole?
10. Which is the first black hole ever discovered?

DOWN

1. Who rejected the existence of black holes?
2. What is the theoretical opposite of a black hole called?
3. First image of a black hole is of which galaxy?
4. In which constellation, is the largest supermassive Blackhole, TON618 located?
6. What is the name of the black hole at the center of our Milky Way galaxy?

ASTRONOMY WORD PUZZLE

Find the names of the famous Moon Craters from the mixed letters and mark them.

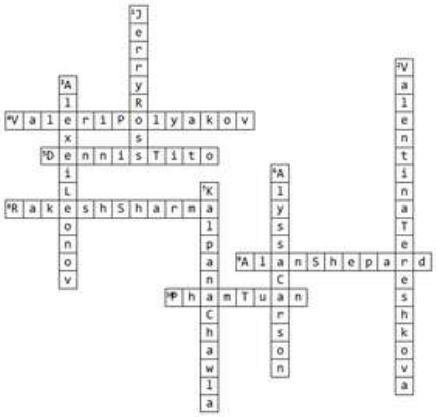
Nebula

E	L	G	A	E	C	B	H	L	H	A	R	S	M
H	A	S	E	R	A	C	B	A	A	G	I	R	H
Y	E	I	R	R	R	R	N	A	L	O	B	A	O
A	D	L	G	E	I	A	L	A	G	O	O	N	R
B	E	B	O	T	N	B	R	A	T	D	S	L	S
A	I	L	R	T	A	R	A	N	T	U	L	A	E
C	H	E	I	E	N	G	E	O	E	M	A	E	H
V	L	H	O	S	O	B	E	Y	L	B	B	D	E
E	D	E	N	O	L	T	E	T	C	B	U	E	A
I	U	L	S	R	G	S	L	O	O	E	B	I	D
L	H	I	D	B	T	N	E	U	T	L	B	L	A
E	R	X	S	A	B	D	I	H	L	L	L	A	E
I	L	V	C	O	B	A	R	R	U	A	E	R	E
I	C	A	B	H	I	D	I	F	I	R	T	E	I

CARINA
LAGOON
RING
TRIFID
CRAB
TARANTULA
ORION
HELIX
CATSEYE
HORSEHEAD
EAGLE
VEIL
DUMBBELL
BUBBLE
ROSETTE

**Answers for this month puzzles will be shared in next magazine.

Answers for last month puzzles.



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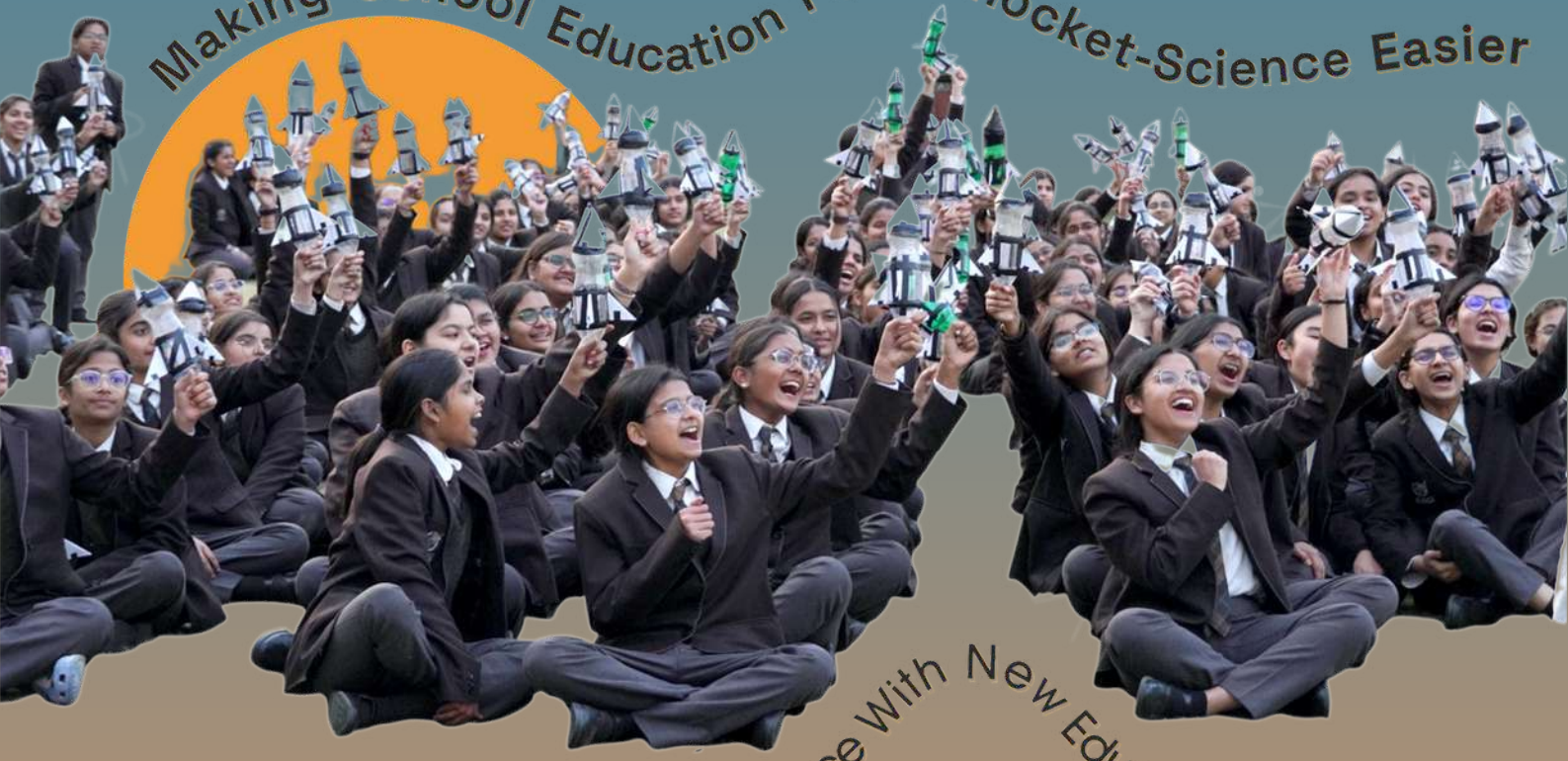

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