SPACE™
EMPOWERING LIFE

DECEMBER 2023
VOLUME 2 | ISSUE XII

Galactica

Astronomy and Space Science Magazine

What's Inside?

www.space-global.com

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

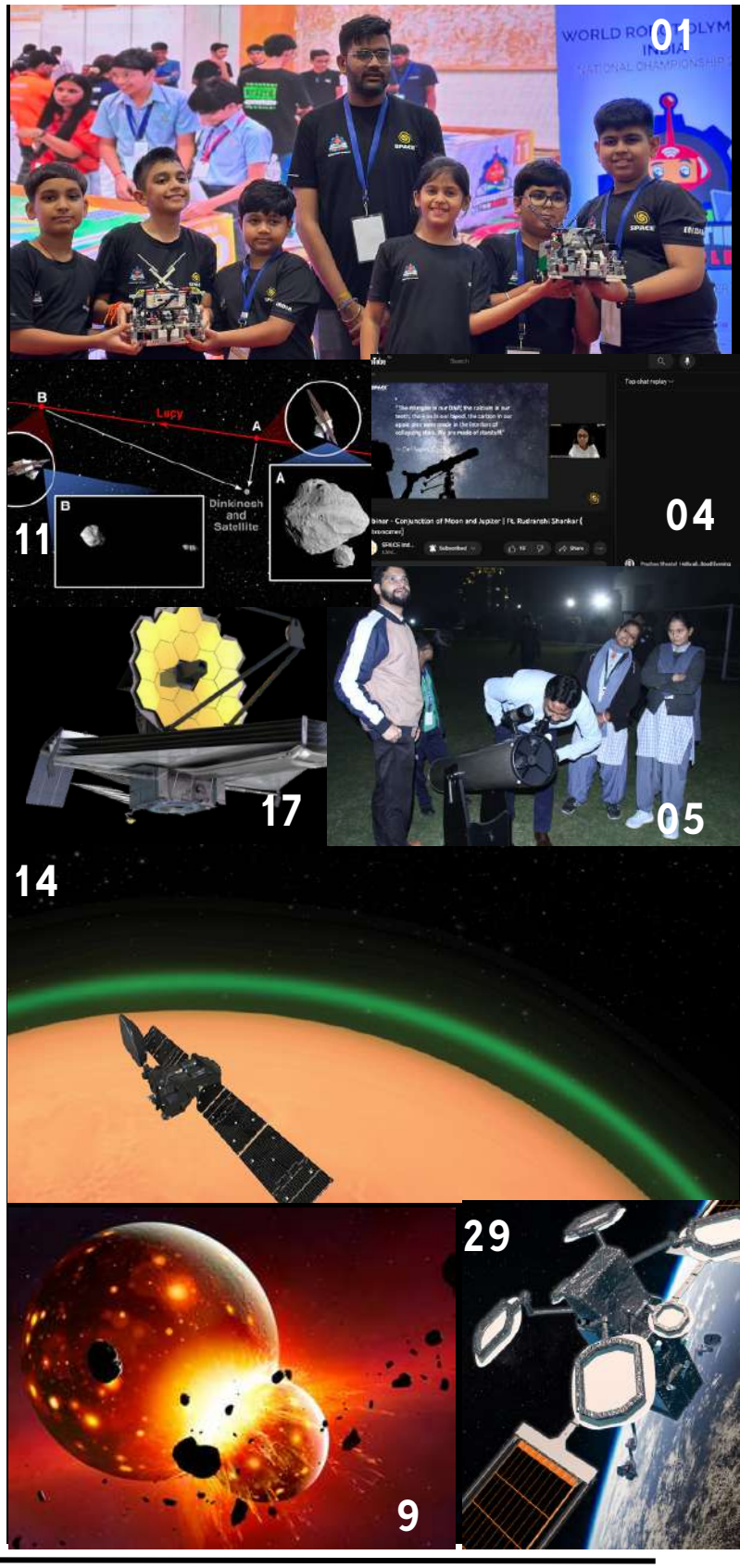
Space and Astronomy are the future for the young generation of our country. This is a great means to inculcate scientific temperament among the masses. Such astronomy sessions will provide a hands-on learning platform for students wherein they explore the real world of science, I wish for young students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

MD's Message

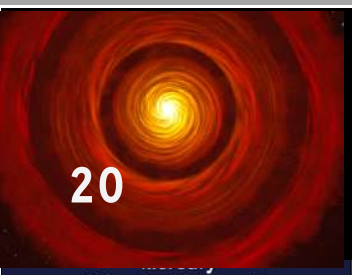
Mr. Shivam Gupta, MD, SPACE

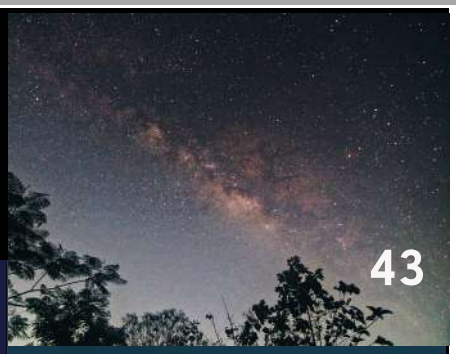
Education is integral to humankind growth and it strongly contributes towards innovation and developments. Space is transforming India to provide better learning opportunities through Experiential and Hands-on learning in the very niche field of Astronomy and Space Science. Our mission to build from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

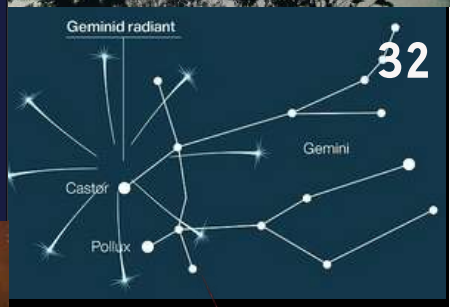
LIST OF

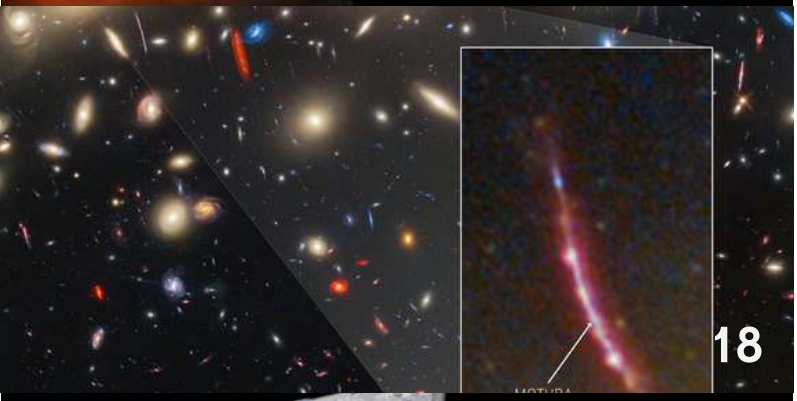


CONTENTS









SPACE INSIGHTS

WORLD ROBOT OLYMPIAD

The World Robot Olympiad (WRO) is an international robotics competition that aims to inspire and engage young people in science, technology, engineering, and mathematics (STEM) education. WRO was founded in 2004 and has since grown to become one of the most significant robotics competitions for students around the world. The competition typically involves students from various age groups and encourages them to design, build, and program robots to complete specific tasks or challenges.

Organiser - India STEM Foundation (ISF) is a leading non-profit organization incorporated under section 25 of the Companies Act, 1956 with a mission to provide access to STEM education and skill development accessible to all, through state-of-the-art STEM programs, tinkering labs, infrastructure, and teachers training. We are committed to nurturing the next generation of innovators, thinkers, and problem solvers. At the forefront of the Science, Technology, Engineering, and Mathematics (STEM) education revolution, our journey began with a simple yet profound vision – to inspire, educate, and empower young minds, equipping them with the skills, resources and knowledge required to thrive in an increasingly complex and technology-driven world.

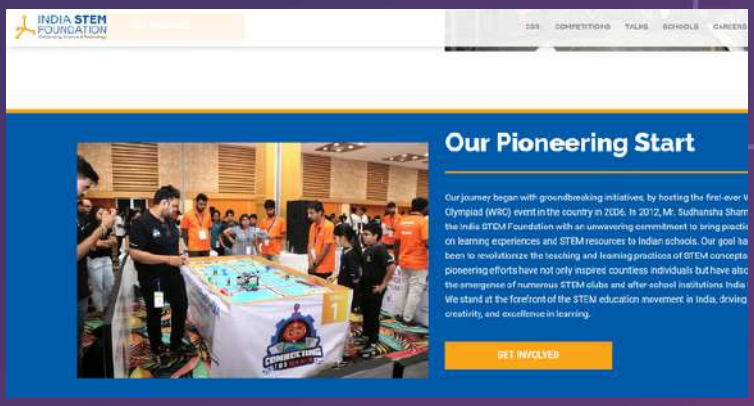
The India STEM Foundation has announced that the National Championship Finals of the World Robot Olympiad (WRO) India is taking place on 28th and 29th of September at the Expo Centre and Mart, Greater Noida. As one of the most awaited events in the field of STEM (Science, Technology, Engineering, and Mathematics) education and robotics, the championship will bring together young innovators, robotics enthusiasts, and problem-solvers from across India. The winners will compete in the international championship later in November.

WORLD ROBOT OLYMPIAD™ WRO®

CONNECTING THE WORLD

The theme for this year is "**Connecting the World**," and an impressive registration of 4000 students for the Level-1 NET, the best of them progressing through WRO India Virtual Regionals and in-person regionals to the National Championship with sustainable and innovative robotic solutions to enhance connectivity, over waterways or through digital technology solutions in three distinct game types – RoboMission, Future Innovators and Future Engineers. The WRO India Season 2023 final promises to be exceptional, featuring a diverse range of challenges and theme that reflect real-world issues. Dr. Sarvjeet Herald (Director, India STEM Foundation), on WRO, said, "Our goal with WRO India Season 2023 is to inspire and empower the next generation of STEM leaders and problem solvers. We are thrilled to see the enthusiasm and innovation displayed by our young participants. This event showcases the limitless possibilities of STEM and underscores its vital role in shaping a brighter future for India."

Participating in the World Robot Olympiad (WRO) offers numerous advantages for school kids. Here are some of the key benefits such as **STEM Education,, Problem-Solving Skills , Creativity and Innovation , Teamwork, Technical Skills , Coding Skills, Competition and Sportsmanship, Global Perspective, Presentation Skills, Recognition and Awards, Motivation for Learning, Networking Opportunities, Preparation for Future Careers**
In summary, the World Robot Olympiad provides a platform for school kids to develop a wide range of skills, from technical and problem-solving skills to teamwork and presentation skills. It offers a holistic educational experience that can have a lasting impact on a student's academic and personal development.



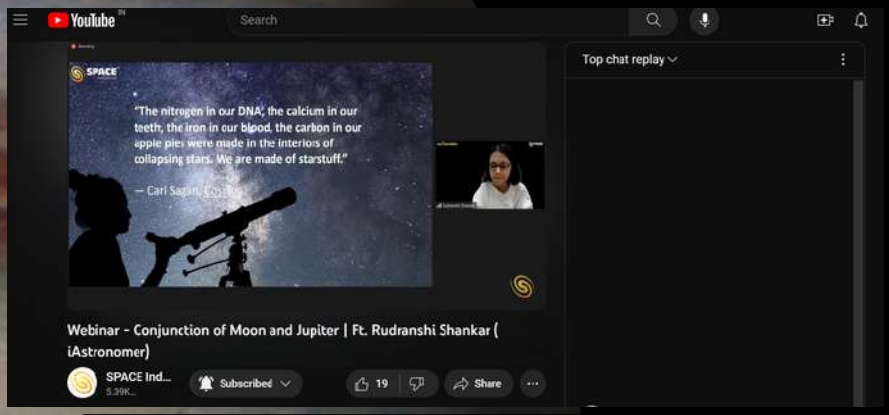
Webinar: Conjunction of the Moon & Jupiter

iASTRONOMER

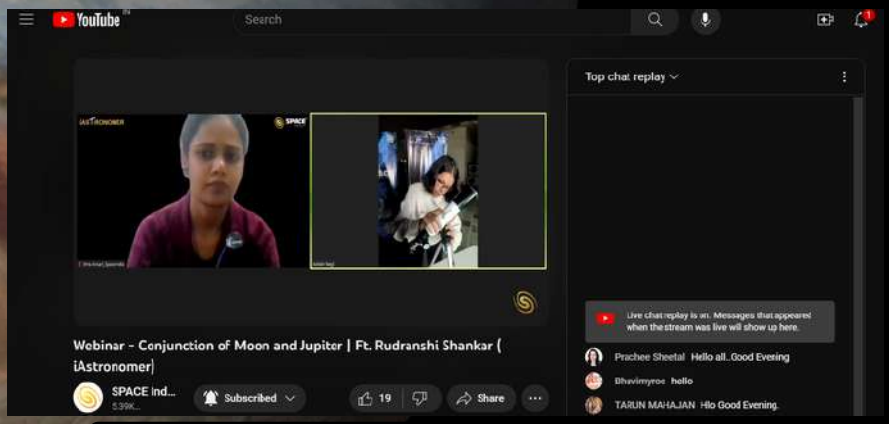
Members of the iAstronomer club witnessed a spectacular night sky marvel on November 25th, 2023. Jupiter, the largest planet in the solar system, looked to be close to the Earth's only natural satellite, Luna. Yes, Jupiter and the moon were in Conjunction on November 25th, 2023. A conjunction is a celestial phenomenon that occurs nearly every month. In conjunction, any two celestial objects in the night sky appear to be near one other, though they are quite far apart in reality. The two celestial objects during the Conjunction might be two planets, the moon and a planet, or a planet and a star cluster.

Every month, the iAstronomer Club which is an online Astronomy club of Space India, offers live webinars to catch such celestial phenomena. Such events are carried out by the iAstronomers of the iAstronomer Club, who have been supervised by their mentors. The event was hosted by Ilma Ansari, an educator at Space India, and facilitated by iAstronomer Rudranshi Shankar. The event was streamed live on Space India's YouTube channel, SpaceinternetTV. The host commenced the event at 7:00 p.m. with a hearty welcome. Host Ilma Ansari gave a quick overview of the program and introduced the facilitator to the live audience. With the use of an incredibly beautiful and insightful presentation, the facilitator "Rudranshi Shankar" introduced the Conjunction of the Moon and Jupiter, followed by an explanation of the astronomy behind it to the spectators. She began with a remark from Carl Sagan, a prominent astronomer and science popularizer.

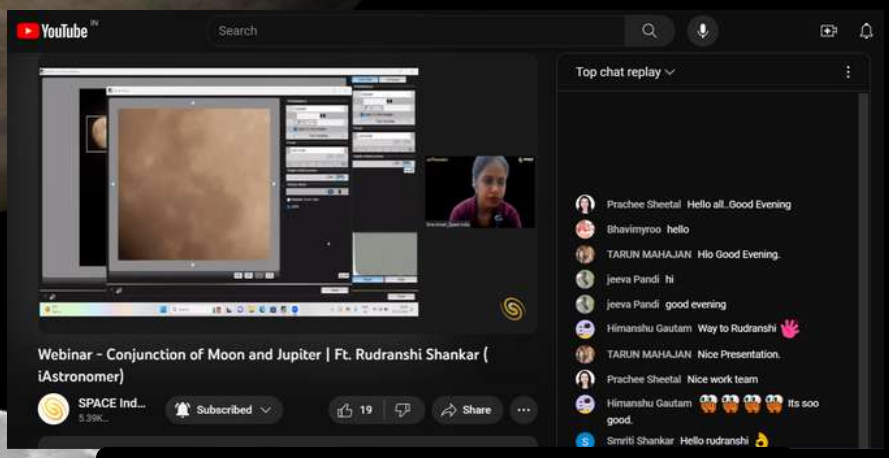
The facilitator "Rudranshi Shankar" explained the Conjunction well enough for a layperson to understand. She displayed images of the conjunction taken from Stellarium (a sky simulator app), which displayed the view of the conjunction as well as the constellation in which it happened. The angular gap between the Moon and Jupiter in the days preceding and after the conjunction was also highlighted, making the concept of conjunction obvious to everyone.



iAstronomer Rudranshi Shankar presented her presentation



iAstronomer Rudranshi Shankar assembled the Telescope



iAstronomer Rudranshi Shankar pointed towards the Moon

iAstronomer Rudranshi Shankar pointed towards the Jupiter

iAstronomer Rudranshi then showed everyone how to assemble the telescope and position it to any object of interest in the night sky. She displayed it with the help of her Space Arcade 50 mm telescope. The telescope she received when she enrolled herself in the iAstronomer Club's annual program.

The Club's educational team prepared to provide a live view of the conjunction that was slated to go for it at the same time. The event spectators were amazed when they witnessed the live view of the conjunction through a DSLR 7D with a 150 mm - 600 mm lens.

The event's host used the chance to describe the perspective to the audience and reveal some mind-blowing facts about the Moon, Jupiter, different types of Conjunctions, and a few rare Conjunctions in the past & future. She displayed and simultaneously explained numerous lunar characteristics such as mares and craters that were visible there. Following the live view from the DSLR, the host thanked everyone for showing up and wrapped the program.

STAR PARTY

Delhi Public School Greater Faridabad

A Star Party was set up with the joint efforts of astronomy educators and students of grades IV and V on November 28, 2023. The event aimed to inspire and educate students about the wonders of our universe and took them on an astronomical journey they will never forget. The evening was filled with an array of astronomical activities that left the students both educated and entertained. Apart from being a stress buster for the students, this was an interactive, informative, and fun zone in the school that caught everyone's attention.

It began at 06:00 PM and ended at 8:00 PM. There was a plethora of fun-filled astronomy activities like Astro Attire Extravaganza, Ring the planets, Weigh yourself on different planets, Stomp rocketry, Hydro Rocketry, Lunar Rover Tattoo station, VR, and so on. German Delegates, Teachers and Students enthusiastically participated in the activities and thoroughly enjoyed them. As the evening drew to a close, Principal Ma'am, Head Mistress Ma'am, German Delegates , Students, and teachers observed the waning gibbous phase of the Moon and Jupiter through a powerful Dobsonian telescope. In all, it was a "hands-on learning" event and was thoroughly enjoyed by everyone. Our star party was appreciated by everyone and received great feedback from students and Guests.



Inter-House Hydro-Rocketry Competition, 2023

The Interhouse Hydro-rocketry Competition held at Bal Bharati Public School, Pitampura began at around 07:30 am and ended at 9:00 a.m. It brought together students from Dayanand, Kabir, Gurunanak, and Vivekanand Houses. Each house formed a team of three students tasked with designing and launching three hydro- rockets within a specified time. The atmosphere was charged with excitement as rockets soared into the sky, propelled by water and air pressure. Gurunanak House emerged as the winner, showcasing their creativity and technical skills. As the rockets soared into the sky, they carried with them the dreams and aspirations of the students who dared to push the boundaries of their knowledge. The event not only left an indelible mark on the participants but also served as a testament to the power of experiential learning and the limitless potential that lies within the hearts and minds of our future scientists and engineers.

Online -Interaction with an Astronomer

In a remarkable initiative to ignite young minds with the wonders of astronomy, Space India organized the Online Workshop - Interaction with an Astronomer for the students who have enrolled in our Universe In the School program between Class 6 and 10 on November 25, 2023 from 10.30 a.m. to 12 noon with Professor Dipankar Banerjee.

Professor Banerjee is the Director of Aryabhatta Research Institute of Observational Sciences and a senior professor at India's Institute of Astrophysics where his research focuses on the sun and its effect on space weather. Throughout his career, he has participated in eclipse expeditions all over the world where he conducted experiments during the total solar eclipse.

He was a visiting professor at the Centre for Plasma Astrophysics in K.U. Leven, Belgium, and worked as a post-doctoral fellow at the United Kingdom's Armagh Observatory where he studied the dynamics of the solar atmosphere using data from the Solar and Heliospheric Observatory (SOHO) satellite.

Space India's commitment to interactive learning was evident throughout the workshop. Students were encouraged to actively participate, ask questions on Aditya L1 India's Solar observatory in Space, and share their own observations.

The Q&A sessions provided a platform for curious minds to interact directly with Professor Banerjee, fostering a dynamic and engaging learning environment.

The online workshop not only imparted astronomical knowledge but also served as a source of inspiration for the young participants. Professor Dipankar Banerjee's passion for his subject and his journey in the field of astrophysics encouraged students to dream big and consider pursuing careers in science and astronomy

iASTRONOMER

ASK AN ASTRONOMER

iAstronomer Club conducted "Ask an Astronomer" meeting on 11th November 2023, where we hosted Dr. Debadatta Mishra, Ex Senior Scientist, ISRO, to discuss the most awaited mission of the Indian Space Research Organization - Gaganyaan Mission. The Ask an Astronomer meeting was hosted by our iAstronomer Nandhitha Arooran. She graciously welcomed the guest for the discussion. The meeting was based on Human space exploration and the Gaganyaan Mission.

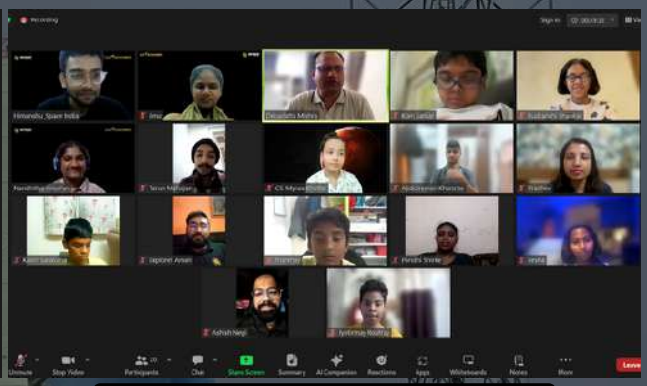
Gaganyaan Mission is India's first Human Space Program. The project's goal is to launch a crew of three astronauts into low Earth orbit and bring them back safely to Earth. Dr. Debadatta Mishra is an Aerospace Engineer from IIT Kharagpur. He joined ISRO as a Scientist/Engineer in 2007 at the ISRO Scientist training school at Vikram Sarabhai Space Centre (The birthplace of the Indian Space Program). He also worked in the Research and Development of indigenous Cryogenic upper stage for GSLV MK-II & MK-III (currently renamed as LVM-3 project) launch vehicle projects. He was also involved with prestigious satellite projects such as the Mars orbiter mission (MOM) and Chandrayaan -2 and 3 projects. Dr. Debadatta Mishra was one among the 23 scientists of ISRO who were selected by the Chairman, ISRO in 2018 initially to work on the prestigious 'Gaganyaan study team' (India's first Human Space flight program) and later he joined the Human Space Flight Centre (HSFC) of ISRO in 2019 as a Project Executive for the Gaganyaan Project.

Dr. Debadatta shed light on Interplanetary missions during the discussion and talked about Gaganyaan at length. iAstronomers discussed their doubts with Dr. Debadatta Mishra and had an interesting conversation on Gaganyaan Mission. iAstronomers were so curious about the mission as they asked questions on various aspects of Human space flight. The question that intrigued us the most was "What are the limitations of the current space infrastructure in India, and how is ISRO planning to upgrade it to support more complex space missions?"

The most enthralling part of the discussion was about the "Vyommitra", a female-looking spacefaring humanoid robot being developed by the Indian Space Research Organization to function onboard the Gaganyaan, a crewed orbital spacecraft. iAstronomers had a number of questions on Vyommitra as it will be the first time for ISRO to launch a female-looking robot in Space.

Ask an Astronomer meeting was a hit as it was attended by more than 50 participants. All the participants had such a good time as was visible through their smiles and the satisfaction on their faces.

iAstronomer Kian Sarkar asked his doubts to Dr. Debdatta Mishra



Dr. Debdatta Mishra interacted with iAstronomers

MONTHLY TELESCOPIC OBSERVATION

SPACE ARCADE team conducted their 11th Monthly Telescopic Experience session on the 25th of November in Delhi.

People from various places joined the observation with their telescopes, binoculars, and other astronomical equipment. They learned and experienced the breathtaking view of the Moon and planets such as Saturn and Jupiter. They also learned about different types of telescopes and cleared all their queries on the Alignment of various telescopes then did basic Astrophotography.

Everyone had their hands-on telescopic experience and enjoyed the view of the moon and its craters through the 8'' Dobsonian telescope and Schmidt-Cassegrain telescope set up by the SPACE team.

HIGHLIGHTS OF NOVEMBER 2023

Remnants of Moon-Forming 'Protoplanet' Possibly Lodged Near Earth's Core

New research suggests that remnants of the protoplanet involved in the giant impact that formed the moon might be located near Earth's core. Approximately 4.5 billion years ago, a Mars-size rock named Theia collided with the early Earth, leading to the moon's creation. While direct evidence of Theia has been elusive, scientists now propose that substantial portions of Theia may be buried deep within Earth's mantle near the core.

The study, led by geodynamicist Qian Yuan from the California Institute of Technology, focused on continent-sized anomalies in the lowermost mantle, located about 1,800 miles below Earth's surface. Previous seismic wave observations indicated that these anomalies were denser and compositionally distinct from the surrounding mantle.

Computer simulations conducted by the research team suggested that a fraction of Theia's mantle could have become integrated into the lower mantle of proto-Earth. These relic rocks from Theia, with a density 2 to 3.5 percent greater than proto-Earth's mantle, were estimated to be tens of miles wide. Over time, this molten rock could have sunk, solidified, and accumulated as dense blobs on top of Earth's core, collectively weighing about one-fortieth to one-sixtieth of Earth's mass.

The composition of these blobs is anticipated to be more iron-rich than Earth's normal mantle rock, resembling lunar volcanic rock. According to Yuan, traces of these relics could potentially reach Earth's surface through mantle plumes—superheated rock columns rising from near Earth's core. The study proposes that volcanic activity in certain regions, such as Iceland, Hawaii, and the Galapagos, may be influenced by mantle plumes carrying traces of Theia relics.

Yuan is now investigating whether these blobs might have played a role in driving unique geological activity on Earth. Earth's distinct surface features, including tectonic plates that drive earthquakes, volcanoes, and the process of subduction (one tectonic plate diving under another), could potentially be influenced by these relic blobs. Earth remains the only known planet where subduction occurs, and understanding the role of these remnants could shed light on the geological uniqueness of our planet.

In summary, this research not only provides new insights into the moon's formation but also raises intriguing questions about the potential impact of relic protoplanet remnants on Earth's geological evolution.

Artwork of the young Earth-moon system. The Earth had recently formed when it was struck by a protoplanet called Theia roughly three times the size of Mars. (Image credit: Mark Garlick/Science Photo Library/Getty Images)

Microbes May Enhance Lunar Soil Fertility for Sustainable Farming on the Moon

A recent study conducted by researchers at China Agricultural University in Beijing suggests that microbes could play a crucial role in unlocking vital nutrients in lunar soil, potentially enabling sustainable farming on the moon. The findings raise hopes that future lunar bases could utilize local resources to sustain life, reducing the need for transporting large amounts of soil or hydroponic systems from Earth.

Previous research has indicated that lunar soil contains essential elements for plant growth. The prospect of establishing greenhouse farms on the moon presents an opportunity not only to provide food for astronauts but also to contribute to air purification, water purification, and emotional well-being.

However, challenges arise from the fact that lunar soil lacks necessary carbon and nitrogen compounds for plant growth, and vital elements like phosphorus are often locked within insoluble compounds. The study, led by Yitong Xia, aimed to enhance lunar soil fertility by leveraging the transformative abilities of microbes, similar to how they have shaped Earth's soil over billions of years.

The researchers conducted experiments using Chinese volcanic powder with a composition similar to samples collected during the Apollo 14 mission in 1971. They focused on five bacterial species commonly found in microbial fertilizers used in agriculture. The goal was to determine if these bacteria could convert insoluble phosphorus in simulated lunar soil into a soluble form accessible to plants.

The microbes were mixed with samples of simulated lunar soil in a sugary broth over 21 days. Results showed that three bacterial species more than doubled the amount of soluble phosphorus within 10 to 21 days, indicating their ability to make the soil more acidic and release phosphorus from previously inaccessible compounds.

Subsequent experiments involved growing a tobacco relative known as benth in the treated simulated lunar soil for 18 days. Plants in soil treated with live bacteria exhibited significantly higher levels of chlorophyll, essential for harnessing energy from light, compared to plants in soil treated with dead bacteria. Additionally, these plants displayed longer stems and roots after six days of growth, and after 24 days, they were generally heavier with wider clusters of leaves.

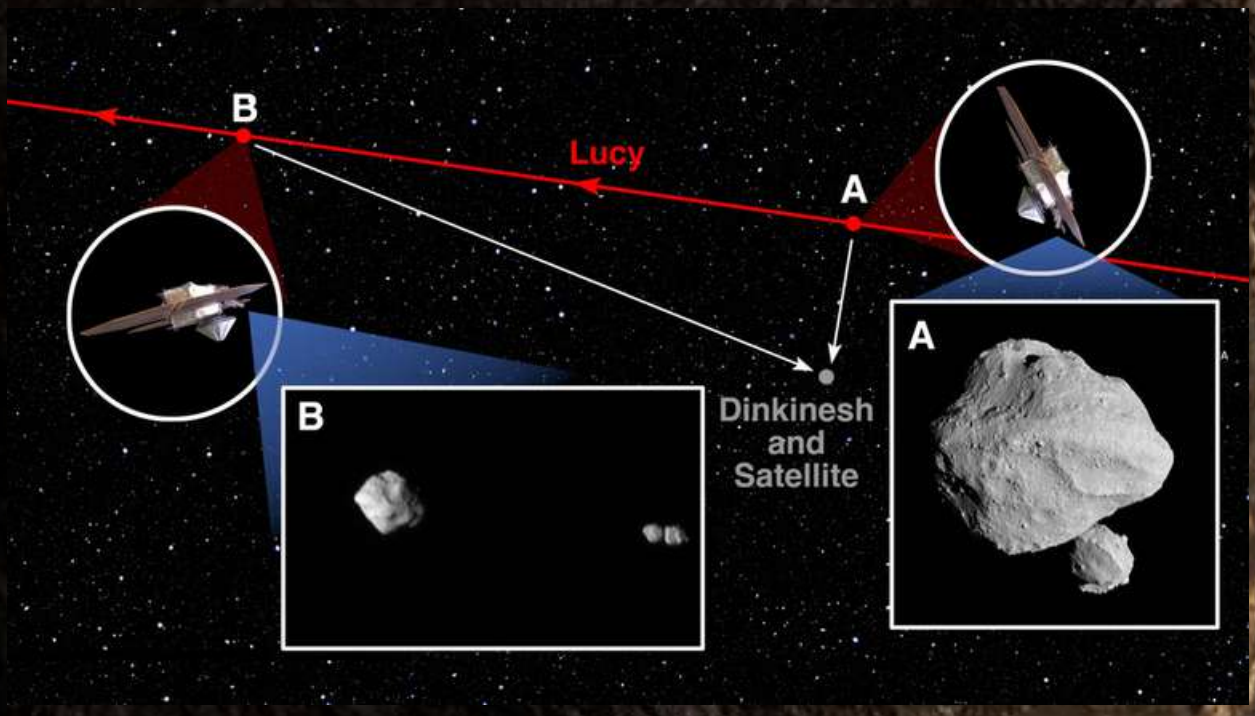
Looking ahead, the researchers plan to explore the combination of these bacteria with algae or compost to further enhance plant growth in simulated lunar soil. The study's findings offer a promising step toward developing sustainable agricultural systems on the moon, harnessing the transformative power of microbes to make lunar soil more conducive to plant growth and potentially support human life in extraterrestrial environments.

NASA's Lucy Mission Unveils Surprises in Asteroid Encounter

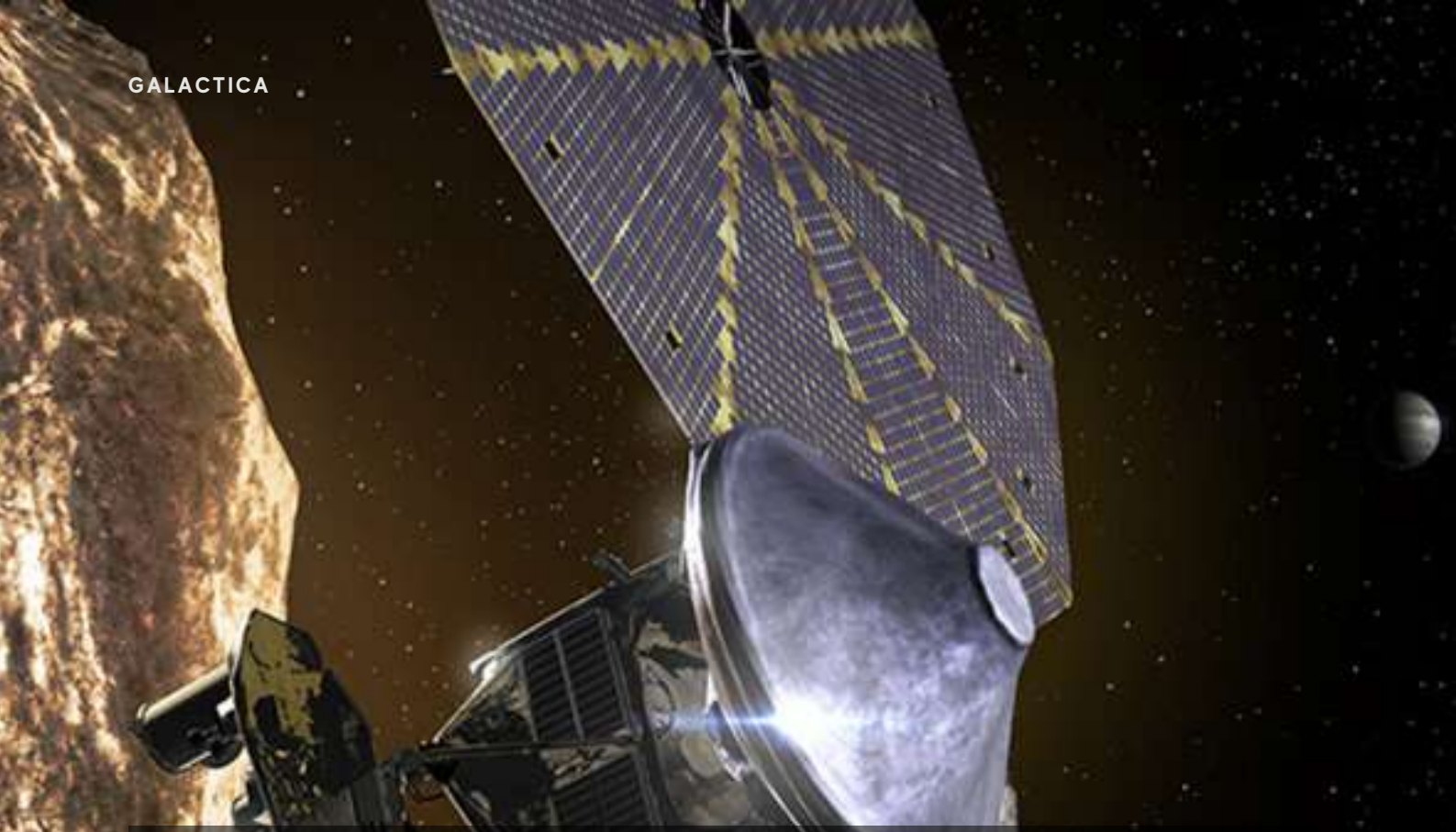
In a historic encounter on November 1, NASA's Lucy spacecraft surpassed expectations during its flyby of the small main belt asteroid, Dinkinesh, revealing an unexpected twist. Originally anticipated as a single asteroid, Lucy's observations unveiled that Dinkinesh is part of a binary system, marking the first-ever encounter of its kind for the mission. The probe, launched in October 2021, is on a mission to explore Trojan asteroids near Jupiter, shedding light on the early days of our solar system.

The excitement deepened as scientists discovered that Dinkinesh is not just a binary system but a contact binary, comprising three components – two similarly sized objects in contact with each other and a third separate rock. The revelation challenges previous assumptions and adds an extra layer of complexity to the mission's objectives.

Keith Noll, Lucy project scientist, expressed the significance of the discovery, stating, "We knew this was going to be the smallest main belt asteroid ever seen up close. The fact that it is two makes it even more exciting." The binary nature of Dinkinesh echoes some similarities with the near-Earth asteroid binary Didymos and Dimorphos, observed during NASA's Double Asteroid Redirection Test mission in September 2022.



A diagram showing the trajectory of the NASA Lucy spacecraft (red) during its flyby of the asteroid Dinkinesh and its satellite (gray). "A" marks the location of the spacecraft at 12:55 p.m. EDT (1655 UTC) Nov. 1, 2023, and an inset shows the L'LORRI image captured at that time. "B" marks the spacecraft's position a few minutes later at 1 p.m. EDT (1700 UTC), and the inset shows the corresponding L'LORRI view at that time. (Image credit: Overall graphic, NASA/Goddard/SwRI; Inset "A," NASA/Goddard/SwRI/Johns Hopkins APL/NOIRLab); Inset "B," NASA/Goddard/SwRI/Johns Hopkins APL)



While Dinkinesh isn't a Trojan asteroid, the flyby served a crucial purpose by testing Lucy's terminal tracking system. The system demonstrated its effectiveness in autonomously tracking the asteroid during the high-speed flyby, even with the unexpected challenge of a binary system. Tom Kennedy, a mission guidance and navigation engineer, emphasized the significance of witnessing the system in action, stating, "It's one thing to simulate, test, and practice. It's another thing entirely to see it actually happen."

Although the encounter with Dinkinesh primarily served as a test, Lucy gathered valuable data about the size of the two asteroids. Preliminary estimates suggest the larger rock is approximately 0.5 miles across at its widest point, while the smaller one measures about 0.15 miles wide. The mission team anticipates spending the next week analyzing the flyby data to glean additional insights.

The surprises don't end with Dinkinesh, as Lucy is set for more encounters on its 12-year mission. Following the flyby, the spacecraft will return to Earth for a gravity assist maneuver in December 2024. This maneuver aims to slingshot Lucy back into the main asteroid belt, where it will study the asteroid 52246 Donaldjohanson in 2025.

Hal Levison, Lucy's principal investigator, expressed enthusiasm about the mission's extended scope, noting, "With the addition of Dinkinesh, two Trojan moons, and now this satellite, we've turned it up to 11."
As Lucy continues its journey, it remains poised to become the first mission to explore the Trojan asteroids, with encounters planned between 2027 and 2033. The unexpected discoveries during the Dinkinesh flyby highlight the dynamic nature of space exploration and the thrill of uncovering new mysteries in our cosmic neighborhood.

In the words of Tom Statler, Lucy program scientist, "It's truly marvelous when nature surprises us with a new puzzle. Great science pushes us to ask questions that we never knew we needed to ask." Lucy's ongoing mission promises more revelations and groundbreaking insights into the formation and evolution of our solar system.

Venus Atmospheric Dynamics: Unraveling the Mystery of the Reactive Oxygen Layer

Recent research using the Stratospheric Observatory for Infrared Astronomy (SOFIA) has revealed the presence of atomic oxygen in both the day and night sides of Venus' atmosphere. Led by Heinz-Wilhelm Hübers, the team of astronomers observed a layer of atomic oxygen situated between two strong atmospheric currents on Venus. This layer, believed to be produced by ultraviolet radiation breaking down carbon dioxide and carbon monoxide, offers insights into the planet's atmospheric chemistry.

The Stratospheric Observatory, equipped with the upGREAT Terahertz heterodyne spectrometer, allowed astronomers to measure the frequency and wavelength of atomic oxygen, providing valuable data. The observed concentrations of atomic oxygen were lower than those in Earth's atmosphere, posing no significant threat to potential future missions. The scientists noted a local enhancement of atomic oxygen on Venus' nightside, near the terminator, which could be influenced by terminator winds.

The unique atmospheric conditions on Venus, with hurricane-force winds at lower altitudes and opposing winds at higher altitudes, contribute to the distribution of atomic oxygen around 100 kilometers in altitude. The study suggests that ultraviolet radiation from the sun plays a role in the production of atomic oxygen through photolysis.

The slow rotation of Venus, with one day lasting 243 Earth days, is attributed to early gravitational interactions with the sun, inducing tides on the planet when it was in a molten state. This slow rotation has significant implications for studying the Venusian atmosphere, as data must be collected from both the day and night sides.

While the concentration of atomic oxygen on Venus is much lower than on Earth, the research enhances our understanding of the planet's atmospheric evolution. The study highlights the drastic differences between Earth and Venus, emphasizing how small variations in the past can lead to vastly different planetary futures. Future missions to Venus stand to benefit from these findings as scientists continue to unravel the mysteries of our neighboring planet.

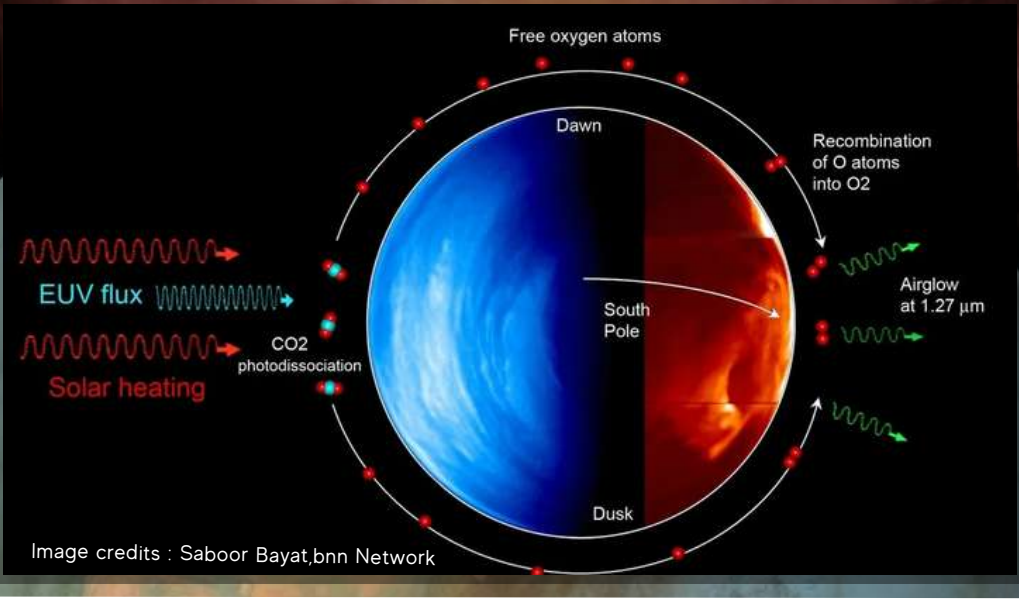


Image credits : Saboor Bayat,bnn Network

A GREEN GLOW IN THE MARTIAN NIGHT

ESA's ExoMars Trace Gas Orbiter (TGO) mission has made a groundbreaking discovery by detecting a visible nightglow in the Martian atmosphere, marking the first observation of this phenomenon in visible light on the Red Planet. The green glow, caused by the recombination of oxygen atoms at altitudes of 40 to 60 km, could potentially be bright enough for future astronauts to navigate and for rovers to operate in the dark.

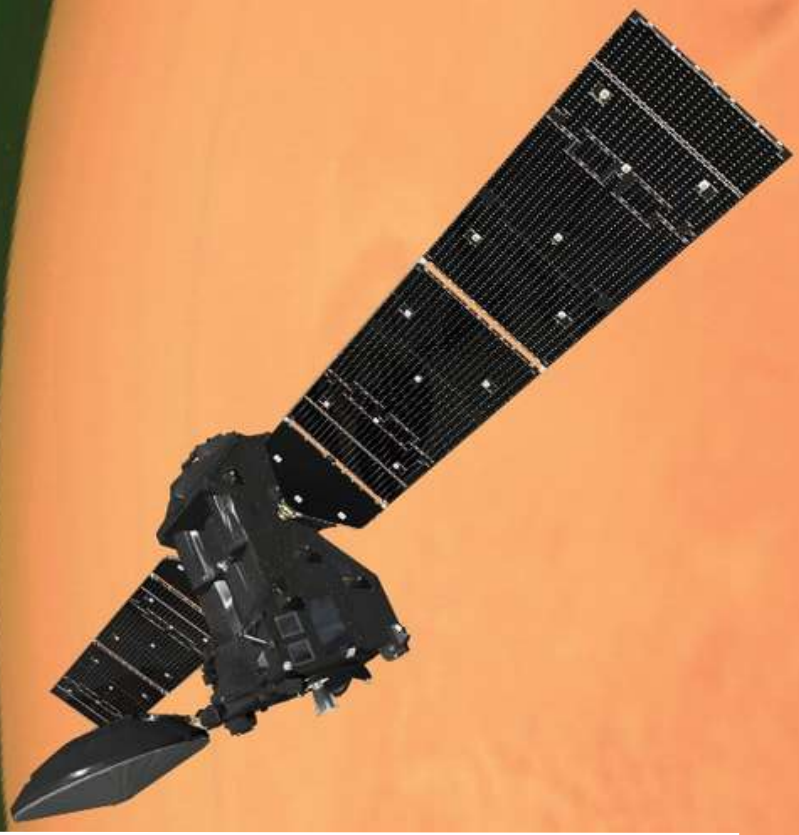
The nightglow occurs when oxygen atoms combine to form oxygen molecules, a process taking place about 50 km above Mars' surface. These oxygen atoms originate on Mars's dayside, where sunlight energizes carbon dioxide molecules, causing them to split apart. As these oxygen atoms migrate to the night side and lose their solar excitation, they regroup and emit light at lower altitudes, resulting in the observed nightglow.

The unexpected visibility of the nightglow offers valuable insights for future missions to Mars. The green glowing road, as described by scientists, serves as a tracer of atmospheric processes and provides information on the composition and dynamics of Mars' upper atmosphere. The detection was made possible by the ExoMars TGO, orbiting Mars at an altitude of 400 km, equipped with the NOMAD instrument's ultraviolet-visible channel.

Jean-Claude Gérard, lead author of the study and a planetary scientist at the University of Liège, expressed excitement about the unexpected observations and their relevance to upcoming trips to Mars. The NOMAD experiment, led by the Royal Belgian Institute for Space Aeronomy, involved collaboration with teams from Spain, Italy, and the United Kingdom.

Nightglow, distinct from auroras, is a phenomenon observed on both Earth and Mars. While auroras result from energetic electrons from the Sun interacting with the upper atmosphere, nightglow is more homogeneous and serves as a constant tracer of atmospheric properties. Understanding Mars' atmosphere is crucial for mission planning, impacting factors such as atmospheric density affecting satellite orbits and probe landings.

The discovery of the green nightglow on Mars adds a new dimension to our understanding of the planet's atmospheric dynamics and will contribute to the scientific preparation for future missions exploring the Red Planet's polar regions.



Exoplanets Experience Core-Powered Mass Loss, Shrinking Atmospheres, Study Finds

Astronomers have discovered that certain exoplanets, particularly those larger than Earth but smaller than Neptune, are undergoing a process known as "core-powered mass loss," causing them to lose their atmospheres and shrink in size. Unlike the gradual escape of Earth's atmosphere due to solar heating, these exoplanets are pushing away their atmospheres from within. The phenomenon sheds light on the scarcity of exoplanets within a specific size range, between 1.5 to two times the size of Earth, referred to as the "gap."

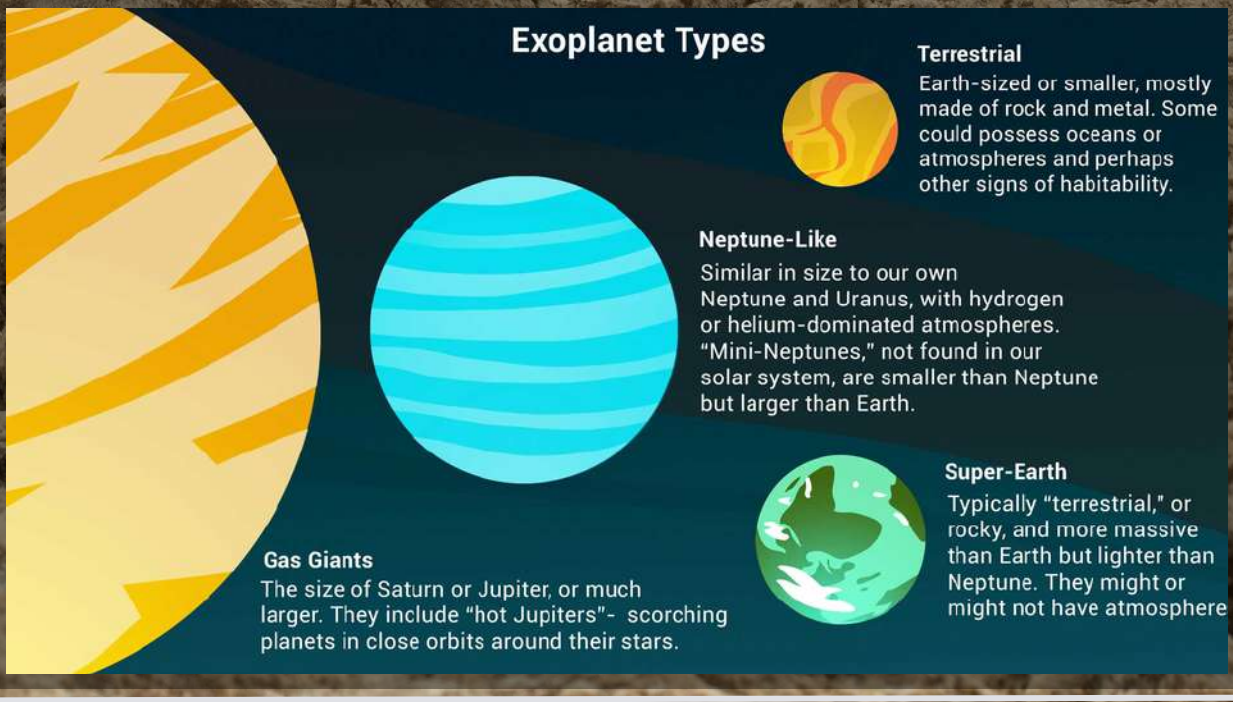
Lead author Jessie Christiansen from Caltech explains that the team analyzed data from NASA's Kepler 2 mission, focusing on sub-Neptunes orbiting stars in the Praesepe and Hyades star clusters. These clusters, aged at 600 million and 800 million years, respectively, allowed scientists to observe the prevalence of sub-Neptunes with atmospheres.

The study dismisses the possibility of photoevaporation, a process where a star's radiation blasts away a planet's atmosphere like a "hair dryer on an ice cube." Photoevaporation is considered unlikely because the analyzed sub-Neptunes are much older than the typical timeframe for this phenomenon. Instead, the team suggests that radiation from the hot cores of these planets is responsible for pushing away their atmospheres from underneath.

The research indicates that the core-powered mass loss mechanism is likely the cause behind atmospheric escape on these exoplanets. In stars over 800 million years old, the study found that only 25 percent exhibited orbiting sub-Neptunes, aligning with the expected timeframe for core-powered mass loss to occur.

The findings contribute valuable insights into the atmospheric evolution of exoplanets and explain the observed gap in the size distribution of exoplanets. The study underscores the significance of mass in retaining atmospheres, emphasizing that insufficient mass leads to atmospheric loss and planetary shrinkage.

This research, published in The Astronomical Journal, showcases the importance of continued exploration and analysis of exoplanetary systems, advancing our understanding of the diverse processes shaping planetary atmospheres beyond our solar system.



International Space Station's Cold Atom Lab Achieves Milestone in Quantum Research

Scientists operating the Cold Atom Lab aboard the International Space Station (ISS) have achieved a significant milestone by generating a quantum gas containing two species of atoms. Operated remotely by NASA's Jet Propulsion Laboratory (JPL), the Cold Atom Lab has been instrumental in researching the quantum properties of atoms in microgravity. This breakthrough, announced on November 15, opens the door for novel space-based experiments in quantum chemistry.

The Cold Atom Lab, roughly the size of a small refrigerator, produces Bose-Einstein condensates, an exotic fifth state of matter first discovered in the 1990s. In this state, achieved by chilling a cloud of atoms close to absolute zero, atoms slow down, allowing scientists to observe quantum effects that are challenging to investigate under normal conditions.

While Bose-Einstein condensates created on Earth dissipate due to gravity once the cooling mechanisms are turned off, the microgravity environment of space prevents this dissipation. In 2018, scientists successfully created Bose-Einstein condensates in the Cold Atom Lab on the ISS, marking a crucial step in microgravity quantum research.

The recent milestone involves the creation of a quantum gas containing two types of atoms—potassium and rubidium. This achievement has potential applications in developing space-based quantum technologies, such as highly sensitive sensors for small rotations. These cold atoms in Bose-Einstein condensates could be utilized in gyroscopes, providing a fixed reference point in space for deep space navigation.

Nicholas Bigelow, a co-author of the findings and a professor of physics and optics at the University of Rochester, emphasizes the significance of developing better clocks in space. Improved clocks are essential for modern technologies like high-speed internet and GPS.

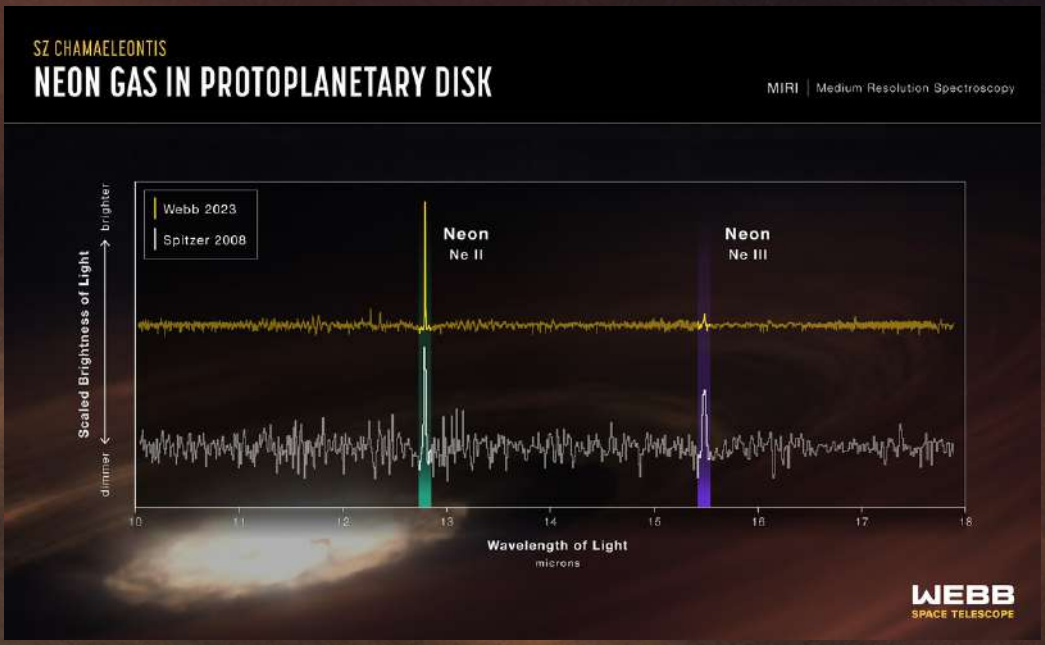
Researchers also anticipate that future experiments in the Cold Atom Lab could contribute to testing the equivalence principle, a fundamental aspect of Albert Einstein's theory of general relativity. This principle asserts that gravity affects all objects equally, regardless of their masses. Quantum experiments in space might offer precise insights into the relationship between gravity and quantum mechanics, addressing challenges in reconciling the two theories.

Bose-Einstein Condensate: Cold Atom LaboratoryPhoto credit: NASA

GALACTICA

JWST

WEBB FOLLOWS NEON SIGNS TOWARDS NEW THINKING OF PLANET FORMATION



Scientists are looking for clues to the future of one planetary system and the past of another - our own solar system - by following neon signs. Differences in neon readings between Spitzer and Webb indicate a previously unseen change in high-energy radiation that reaches the disk and eventually causes it to evaporate, limiting the time planets have to form.

"The raw materials for Earth, and eventually life, were present in the disk of material that surrounded the Sun after it formed, and so studying these other young systems is as close as we can get to going back in time to see how our own story began."

Neon is used by scientists to determine how much and what type of radiation is hitting and eroding the disk around a star. Spitzer discovered an outlier in SZ Cha in 2008, with neon readings unlike any other young T-Tauri disk. The detection of neon III, which is typically scarce in protoplanetary disks bombarded by high-energy X-rays, made the difference.

This meant that the high-energy radiation in the SZ Cha disk was caused by UV light rather than X-rays. Aside from being the lone outlier in a sample of 50-60 young stellar disks, the UV vs. X-ray difference is significant for the disk's lifetime and potential planets.

The research team believes that the differences in neon signatures in the SZ Cha system are caused by variable wind, which absorbs UV light while allowing X-rays to pummel the disk. Winds are common in a system with a newly formed, energetic star, according to the team, but it is possible to catch the system during a quiet, wind-free period, as Spitzer did. Espaillat's team is already planning additional observations of SZ Cha with Webb and other telescopes in order to solve its mysteries.

"It will be critical to study SZ Cha and other young systems in multiple wavelengths of light, such as X-ray and visible light, to discover the true nature of this variability we've discovered," said Boston University co-author Caeley Pittman. "It's possible that brief, quiet periods dominated by extreme UV radiation are common in many young planetary systems, but we just have not been able to catch them."

"Once again, the universe demonstrates that none of its methods are as simple as we would like to believe. We need to reconsider, re-observe, and gather more data. "We'll follow the neon signs," Espaillat said.

NASA'S WEBB, HUBBLE COMBINE TO CREATE MOST COLORFUL VIEW OF UNIVERSE

NASA's James Webb Space Telescope and Hubble Space Telescope have joined forces to study MACS0416, an expansive galaxy cluster. The resulting panchromatic image combines visible and infrared light to form one of the most complete views of the universe ever captured. MACS0416, located approximately 4.3 billion light-years from Earth, is a pair of colliding galaxy clusters that will eventually merge to form a larger cluster.

The image contains numerous details that could only be revealed by combining the power of both space telescopes. It contains a smattering of sources that change over time, most likely due to gravitational lensing - the distortion and amplification of light from distant background sources.

This cluster was the first of a series of unprecedented, super-deep views of the universe from the Frontier Fields, an ambitious, collaborative Hubble program launched in 2014. Hubble pioneered the search for some of the universe's most faint and young galaxies.

Webb's infrared vision adds significantly to this deep look by reaching even further into the early universe. The image was created by color-coding the shortest wavelengths of light blue, the longest wavelengths red, and the intermediate wavelengths green. The wide range of wavelengths, from 0.4 to 5 microns, produces a particularly vivid galaxy landscape.

These colors provide information about galaxy distances: The bluest galaxies are relatively close and frequently exhibit intense star formation, as best detected by Hubble, whereas the redder galaxies are more distant, as best detected by Webb. Some galaxies also appear very red because they contain a lot of cosmic dust, which absorbs the bluer colors of starlight.
"The entire picture does not become clear until Webb data is combined with Hubble data."

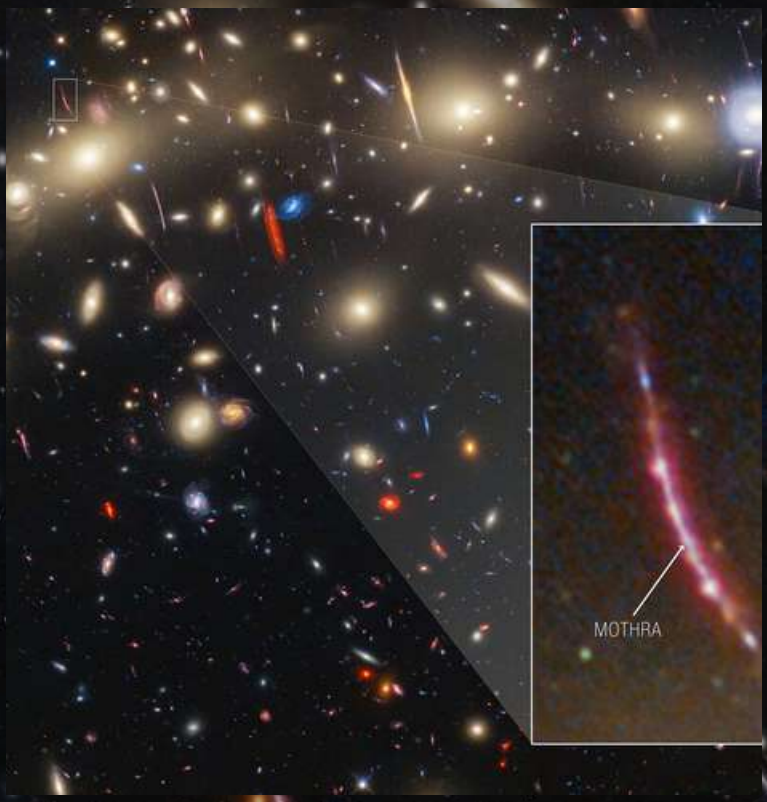
- Christmas Tree Galaxy Cluster:

The goal was to look for transients, or objects that change in brightness over time. They call MACS0416 the Christmas Tree Galaxy Cluster because of its bright colors and the flickering lights we discovered within it." "We can see transients everywhere.

- A Kaiju Star (Giant Monster):

One transient stood out among the identified, magnified by a factor of at least 4,000 and, located in a galaxy that existed about 3 billion years after the big bang.

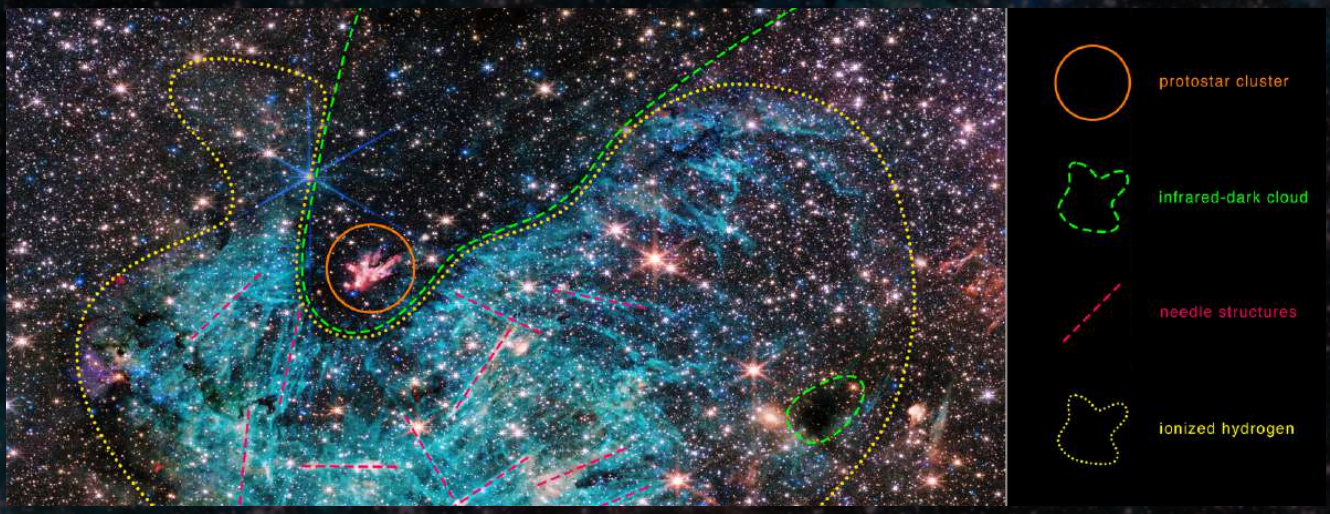
The team nicknamed the star system "Mothra" in honor of its "monster nature," as it was both extremely bright and magnified. It joins another lensed star discovered and nicknamed "Godzilla."



WEBB REVEALS NEW FEATURES IN HEART OF MILKY WAY

The most recent image from NASA's James Webb Space Telescope depicts a portion of our galaxy's dense center in unprecedented detail, including previously unseen features that astronomers have yet to explain. Sagittarius C (Sgr C) is a star-forming region located approximately 300 light-years from the Milky Way's central supermassive black hole, Sagittarius A*.

"Webb reveals an incredible amount of detail, allowing us to study star formation in this sort of environment in a way that wasn't possible previously." A cluster of protostars - stars that are still forming and gaining mass - produces outflows that glow like a bonfire in the midst of an infrared-dark cloud among the image's estimated 500,000 stars.



A previously unknown massive protostar 30 times the mass of our Sun is at the heart of this young cluster. The cloud from which the protostars emerge is so dense that light from stars behind it cannot reach Webb, making it appear less crowded when, in fact, it is one of the image's most densely packed areas. Smaller infrared-dark clouds dot the image, creating the appearance of holes in the starfield. That is where future stars are being formed.

Webb's NIRCam (Near-Infrared Camera) instrument also captured large-scale emission from ionized hydrogen surrounding the lower side of the dark cloud, which is shown in cyan in the image.This is typically caused by energetic photons emitted by young massive stars, but the vast extent of the region shown by Webb is a surprise that warrants further investigation. Crowe also intends to investigate the needle-like structures in the ionized hydrogen, which appear chaotically oriented in many directions.

"The galactic center is a tumultuous, crammed place." "There are turbulent, magnetized gas clouds forming stars, which then impact the surrounding gas with their outflowing winds, jets, and radiation," explained Rubén Fedriani. "Webb has provided us with a ton of data on this extreme environment, and we are just starting to dig into it."

The galactic center is close enough to Earth to study individual stars with the Webb telescope, allowing astronomers to gather unprecedented information on how stars form and how this process may be affected by the cosmic environment, especially when compared to other regions of the galaxy.

For example, are more massive stars formed in the center of the Milky Way than on its spiral arms' edges?

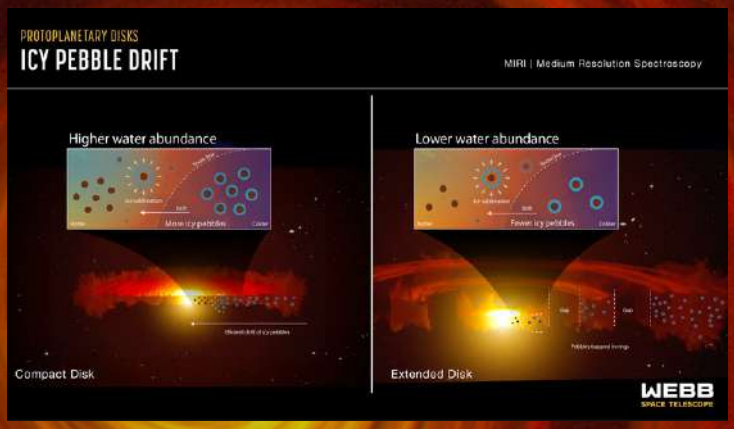
"The image from Webb is stunning, and the science we will get from it is even better," he said. "Massive stars are factories that produce heavy elements in their nuclear cores, so understanding them better is like learning the origin story of much of the universe."

WEBB FINDINGS SUPPORT LONG-PROPOSED PROCESS OF PLANET FORMATION

Scientists using James Webb Space Telescope have made a significant accomplishment in comprehending the way planets form. Webb confirmed a physical process involving the drifting of ice-coated solids from the disk's outer regions into the rocky-planet zone by observing water vapor in protoplanetary disks.

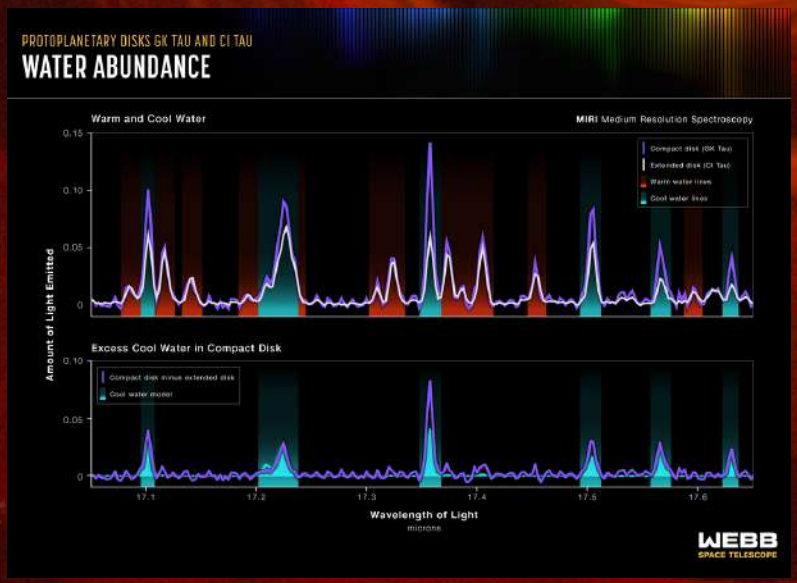
Ice pebbles forming in the cold, outer regions of protoplanetary disks – the same area where comets form in our solar system – have long been proposed as the fundamental seeds of planet formation. The main premise of these theories is that pebbles drift inward toward the star due to friction in the gaseous disk, delivering solids and water to planets.

This theory predicts that as icy pebbles enter the warmer region within the "snowline" – where ice transitions to vapor – they will release large amounts of cold water vapor.



Webb was able to establish a link between water vapor in the inner disk and the drift of icy pebbles from the outer disk. "This opens up exciting prospects for studying rocky planet formation with Webb!"

The researchers studied four disks – two compact and two extended – around Sun-like stars using Webb's MIRI (the Mid-Infrared Instrument). All four of these stars are estimated to be between 2 and 3 million years old, making them cosmic newborns.



The Webb observations were designed to see if compact disks have more water in their inner, rocky planet region, as expected if pebble drift is more efficient and delivers a lot of solid mass and water to inner planets.

As the pebbles drift, they tend to gather whenever they come across a pressure bump – an increase in pressure.

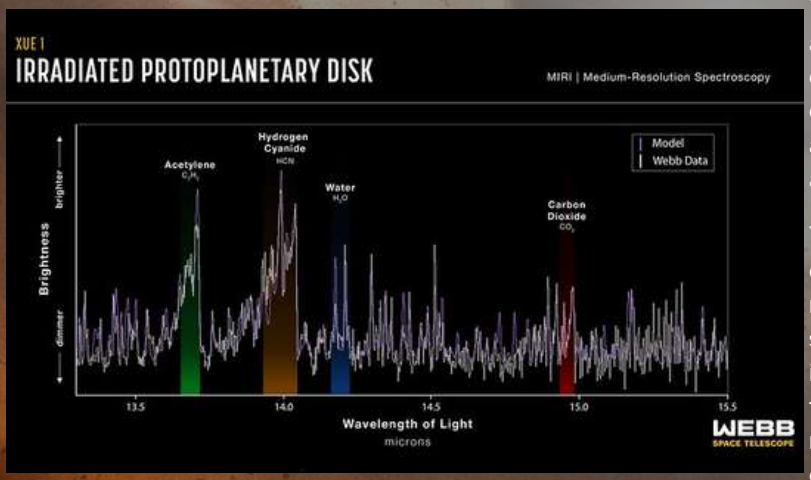
These pressure traps do not necessarily stop pebble drift, but they do slow it down. This appears to be the case in the large disks with rings and gaps.

According to current research, large planets may cause rings of increased pressure, where pebbles tend to collect. Jupiter could also have played this role in our solar system, preventing pebbles and water delivery to our small, inner, and relatively water-poor rocky planets.

WEBB'S STUDY REVEALS ROCKY PLANETS CAN FORM IN EXTREME ENVIRONMENTS

The first observation of water and other molecules in the intensely irradiated inner, rocky-planet-forming regions of a disk in one of the most extreme environments in our galaxy has been made by an international team of astronomers using JWST. These findings imply that a wider range of environments may be capable of producing the conditions necessary for the formation of rocky planets than previously believed.

These first findings from the JWST program called eXtreme Ultraviolet Environments (XUE), aims to characterize planet-forming disks–large, spinning clouds of gas, dust, and rock chunks where planets form and evolve–in massive star-forming regions. These areas probably reflect the conditions under which the majority of planetary systems originated. It is crucial for scientists to comprehend how the environment affects planet formation in order to acquire a deeper understanding of the variety of exoplanet types.



The Lobster Nebula, also known as NGC 6357, is a massive emission nebula located in the constellation Scorpius and approximately 5,500 light-years away from Earth.

The XUE program targets 15 disks total in three areas of the nebula. Some of the largest stars in our galaxy can be found in the Lobster Nebula, one of the youngest and closest massive star-formation complexes

The disk's anticipated lifetime could be as short as a million years as a result of this dispersing the gas. Astronomers can now investigate how UV radiation affects the inner regions of protoplanetary disks around stars like our Sun that form planets.

Astronomers hope to better understand the physical characteristics and chemical makeup of the rocky planet-forming regions of disks in the Lobster Nebula. The protoplanetary disk known as XUE 1, situated in the star cluster Pismis 24, is the subject of this first result.

Because XUE 1 is situated close to multiple massive stars in NGC 6357, scientists anticipate that it has been exposed to high UV radiation levels continuously throughout its life and a variety of molecules in this harsh environment that serve as the foundation for terrestrial planets were found.

Remarkably similar to those in neighboring star-forming regions, is the inner disk surrounding XUE 1. In addition to water, we have found other molecules such as acetylene, hydrogen cyanide, carbon monoxide, and carbon dioxide, says researchers. It was discovered that the emission was weaker than some models had predicted, suggesting a narrow outer disk radius.

The science team finds that the conditions in the inner disk are similar to those found in the well-studied disks located in nearby star-forming regions, where only low-mass stars form, which is good news for rocky planet formation. This implies that a far wider range of environments than previously thought may be suitable for the formation of rocky planets.

A PROMINENT PROTOSTAR IN PERSEUS

Complex contours of Herbig Haro object number 797 (HH 797) are revealed in this month's new Picture of the Month from the NASA/ESA/CSA James Webb Space Telescope. Herbig-Haro objects are bright areas that encircle newly formed stars, also referred to as protostars.

These objects are created when the shockwaves from the newborn stars' stellar winds or gas jets strike nearby gas and dust at a high speed. The lower half of this image is dominated by HH 797, which is situated near the eastern edge of the Perseus dark cloud complex, near the young open star cluster IC 348. Two additional protostars are believed to be hosted by the bright infrared objects in the upper part of the image.

Using Webb's Near-InfraRed Camera (NIRCam), this picture was snapped. Since the youngest stars are almost always entwined in the gas and dust from which they formed, infrared imaging is a powerful tool for studying newborn stars and their outflows. Since the star's outflows emit infrared light that can pass through obscuring gas and dust, Herbig-Haro objects are perfect candidates for Webb's sensitive infrared instruments to observe.

Molecular hydrogen and carbon monoxide, among other molecules excited by the turbulent conditions, release infrared light, which Webb can gather to see the outflows' structure. When it comes to observing the extremely hot (thousands of degrees Celsius) molecules that are excited by shocks, NIRCam excels.

Researchers have earlier discovered that, for cold molecular gas associated with HH 797, the majority of the blue-shifted gas, which is traveling towards us, is located to the north (bottom left), and the majority of the red-shifted gas, which is moving away from us, is located to the south (bottom right), using ground-based observations.

Additionally, a gradient was discovered across the outflow, meaning that the gas near the eastern edge of the jet has a greater redshift than the gas on the western edge, for a given distance from the young central star. In the past, astronomers believed that this was caused by the rotation of the outflow.

However, this higher resolution Webb image reveals that the previously believed single outflow is actually composed of two nearly parallel outflows, each with its own distinct series of shocks (which accounts for the velocity asymmetries). This means that the source, which is a double star and is situated in the small dark area (bottom right of center), is not a single star as previously thought. Every star is generating a unique and striking emission. This image also shows other outflows, one from the protostar with its illuminated cavity walls located in the upper right corner.

HH 797 is situated exactly north of HH 211 (about 30 arcseconds apart), which was the subject of a September 2023 Webb image release.

WHAT'S UP IN THE SKY - DECEMBER 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
Evening planet, not really viable this month due to low altitude after sunset.

Venus
Bright morning planet, visible against dark skies all month.

Mars
Solar conjunction on 17 November. Too close to the Sun to be seen this month.

Jupiter
Superbly placed, reaching opposition on 3 November. Attains 50° altitude when due south.

Saturn
Well-placed evening planet. Moon close on 20 November.

Uranus
The planet is at opposition on 13 November. It sits 2.2° south of Botein

Neptune
Well-placed evening planet. All month, Neptune reaches its highest position in darkness.

BRIGHT DEEP SKY OBJECTS

M29 is a binocular and telescope open cluster that's situated in the highly crowded Milky Way region of Cygnus. The cluster is certainly worth a look due to its location and unusual shape. It appears like a squashed dipper that loosely resembles the main stars of Ursa Major. Adding to the view is a stunning backdrop of literally thousands of distant Milky Way stars

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.

M27 was the first planetary nebula ever discovered. The term "planetary nebula" is based on the nebula's round, planet-like appearance when viewed through smaller telescopes. The nebula results from an old star that has shed its outer layers in a glowing display of color. In Hubble's image, blue represents oxygen, green represents hydrogen, and red indicates sulfur and nitrogen.

The Andromeda Galaxy is a barred spiral galaxy and is the nearest major galaxy to the Milky Way. It was originally named the Andromeda Nebula and is cataloged as Messier 31, M31, and NGC 224. Andromeda has a diameter of about 152,000 light-years and is approximately 2.5 million light-years from Earth.

ROCKET LAUNCHES IN DECEMBER 2023

Progress MS-25 (86P)

Scheduled for launch from the iconic Baikonur Cosmodrome in Kazakhstan, the Progress MS-25 (86P) mission represents the next venture of ROSCOSMOS, aiming to resupply the International Space Station (ISS). This forthcoming cargo expedition is poised to be a pivotal milestone, marking the 25th flight of the Progress MS capsule. Utilizing an uncrewed Progress MS spacecraft mounted atop a Soyuz 2.1a launch vehicle, ROSCOSMOS plans to ferry essential supplies and equipment to the ISS. Departing from Launch Complex 31/6, the rocket

The cargo manifest of Progress MS-25 comprises 500 kg of propellant, 420 kg of water destined for the Rodnik system, and an additional 40 kg of nitrogen. Alongside these essential resources, the spacecraft will ferry a diverse array of supplies, including 1,535 kg of resource equipment, tools, experiment setups, clothing, and provisions tailored for the ISS crew. Overall, the mission aims to deliver approximately 2,495 kg of cargo to the orbital laboratory.

Following launch, Progress MS-25 is slated to separate from the third stage of the Soyuz 2.1a approximately nine minutes after liftoff. The spacecraft will then embark on an autonomous journey to rendezvous with and dock to the Poisk module of the ISS. Functioning as both a research facility and a docking compartment for Soyuz spacecraft and Progress capsules, the Poisk module plays a critical role in facilitating scientific endeavors and operational support within the ISS framework.

ARKTIKA-M NO.2

The ROSCOSMOS is planning to launch Arktika-M n°2 satellite on 16 November 2023 at 9:17 AM UTC. This is a series of planned Russian remote-sensing and emergency communications satellites operating in an highly elliptical 12-hour orbit. The constellation of two Aktika-M satellites is designed to monitor high-latitude areas of the Earth. The spacecraft will be based on Lavochkin's Elektro-L meteorological satellite.

The payload consists of the MSU-GSM multi-spectral imager as well as transmitters for meteorological and rescue systems.Russia is developing a unique satellite network dedicated to monitoring of the Arctic. With its territory stretching thousands of kilometers along the Arctic Ocean, Russian Federation faces many challenges when trying to balance the economic development and the environmental protection of these vast regions. In particular, traditional communications and weather-forecasting satellites "hanging" over the Equator are ill-suited for serving high-latitude areas of the globe.

A pair of Arktika-M satellites fully funded from the Russian space budget would be focused on meteorology and emergency communications. Each spacecraft will carry a multi-spectral imager, known as MSU-GSM, along with transmitters for meteorological and rescue systems. An apogee (highest point) of their orbit would be 40,000 kilometers above the Earth surface and a perigee 1,000 kilometers. Such orbital parameters would enable frequent overflies of the polar regions with practically uninterrupted view of the northern hemisphere. In contrast, most civilian meteorological satellites deployed in the geostationary orbit can see little or no useful details beyond the 60th parallel, due to curvature of the Earth, while the satellites in traditional polar orbits do not have continuous view of all polar regions.

X-RAY POLARIMETER SATELLITE (XPOSAT)

XPoSat (X-ray Polarimeter Satellite) is India's first dedicated polarimetry mission to study various dynamics of bright astronomical X-ray sources in extreme conditions. The spacecraft will carry two scientific payloads in a low earth orbit. The primary payload POLIX (Polarimeter Instrument in X-rays) will measure the polarimetry parameters (degree and angle of polarization) in medium X-ray energy range of 8-30 keV photons of astronomical origin. The XSPECT (X-ray Spectroscopy and Timing) payload will give spectroscopic information in the energy range of 0.8-15 keXPoSat (X-ray Polarimeter Satellite) is India's first dedicated polarimetry mission to study various dynamics of bright astronomical X-ray sources in extreme conditions. The spacecraft will carry two scientific payloads in a low earth orbit. The primary payload POLIX (Polarimeter Instrument in X-rays) will measure the polarimetry parameters (degree and angle of polarization) in medium X-ray energy range of 8-30 keV photons of astronomical origin. The XSPECT (X-ray Spectroscopy and Timing) payload will give spectroscopic information in the energy range of 0.8-15 keV.

The emission mechanism from various astronomical sources such as blackhole, neutron stars, active galactic nuclei, pulsar wind nebulae etc. originates from complex physical processes and are challenging to understand. While the spectroscopic and timing information by various space based observatories provide a wealth of information, the exact nature of the emission from such sources still poses deeper challenges to astronomers. The polarimetry measurements add two more dimension to our understanding, the degree of polarization and the angle of polarization and thus is an excellent diagnostic tool to understand the emission processes from astronomical sources. The polarimetric observations along with spectroscopic measurements are expected to break the degeneracy of various theoretical models of astronomical emission processes. This would be the major direction of research from XPoSat by Indian science community.

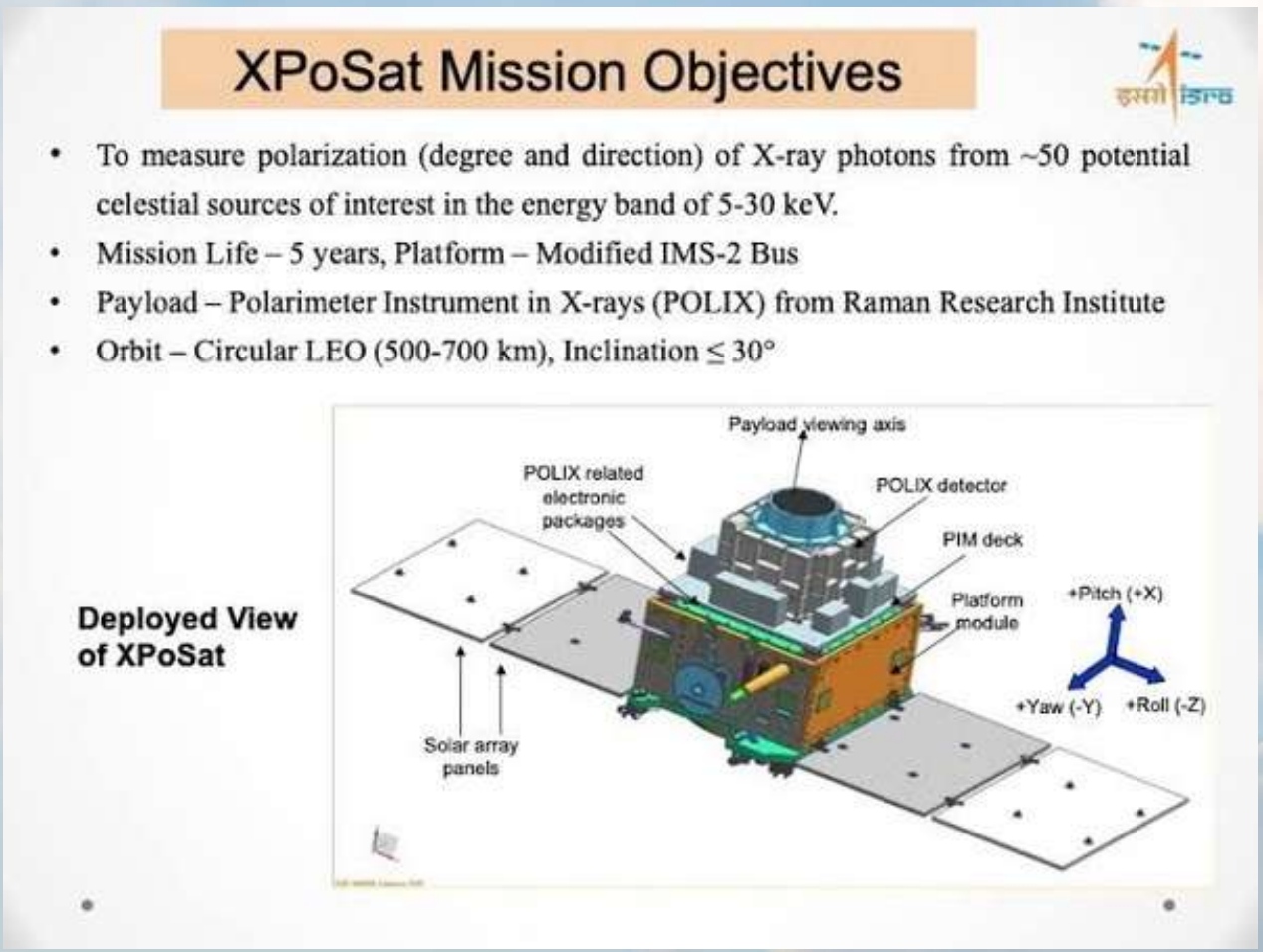
XPoSat payloads:

POLIX

POLIX is an X-ray Polarimeter for astronomical observations in the energy band of 8-30 keV. The payload is being developed by Ramam Research Institute (RRI), Bangalore in collaboration with U R Rao Satellite Centre (URSC). The instrument is made of a collimator, a scatterer, and four X-ray proportional counter detectors that surround the scatterer. The scatterer is made of low atomic mass material which causes anisotropic Thomson scattering of incoming polarised X-rays. The collimator restricts the field of view to 3 degrees x 3 degrees so as to have only one bright source in the field of view for most observations. POLIX is expected to observe about 40 bright astronomical sources of different categories during the planned lifetime of the XPoSat mission of about 5 years. This is the first payload in the medium X-ray energy band dedicated for polarimetry measurements.

XSPECT

XSPECT is an X-ray SPECtroscopy and Timing payload onboard XPoSat, which can provide fast timing and good spectroscopic resolution in soft X-rays. Taking advantage of the long-duration observations required by POLIX to measure X-ray polarization, XSPECT can provide long-term monitoring of spectral state changes in continuum emission, changes in their line flux and profile, simultaneous long-term temporal monitoring of soft X-ray emission in the X-ray energy range 0.8-15 keV. An array of Swept Charge Devices (SCDs) provide an effective area >30 cm2 at 6 keV with energy resolution better than 200 eV at 6 keV. Passive collimators are used to reduce the background by narrowing the field of view of XSPECT. XSPECT would observe several types of sources viz X-ray pulsars, blackhole binaries, low-magnetic field neutron stars (NS) in LMXBs, AGNs, and Magnetars.



PEREGRINE MISSION 1 (TO2-AB)

Peregrine Mission 1, also known as TO2-AB or the Peregrine Lunar Lander, is designed to transport scientific and other payloads to the Moon, aiming to touch down on the lunar surface within Sinus Viscositatis. The primary scientific objectives of this mission encompass exploring various aspects of the lunar environment, including the lunar exosphere, thermal properties, hydrogen abundance within the lunar regolith, magnetic fields, and the radiation environment. Additionally, the mission aims to evaluate advanced solar arrays. Selected under NASA's Commercial Lunar Payload Services (CLPS) initiative, Astrobotic, the commercial partner, will oversee both the launch and landing operations.

The spacecraft of Peregrine Mission 1 stands at around 1.9 meters in height and approximately 2.5 meters in width, presenting a box-shaped main body supported by four landing legs. Its main structural landing bus comprises aluminum isogrid shear panels and aluminum honeycomb mounting surfaces, housing a primary deck divided into four parts. Propulsion is facilitated by five TALOS-150 667-N thrusters located at the base of the lander, using a hypergolic system fueled by Mono-Methyl Hydrazine (MMH) and dinitrogen tetroxide/nitrogen dioxide, 25% Mixed Oxides of Nitrogen (MON-25) oxidizer. Maintaining orientation involves four sets of three 45-N attitude control thrusters, aided by Sun and star trackers, inertial measurement, Doppler radio, LIDAR, and landing sensors positioned on the bus's underside.

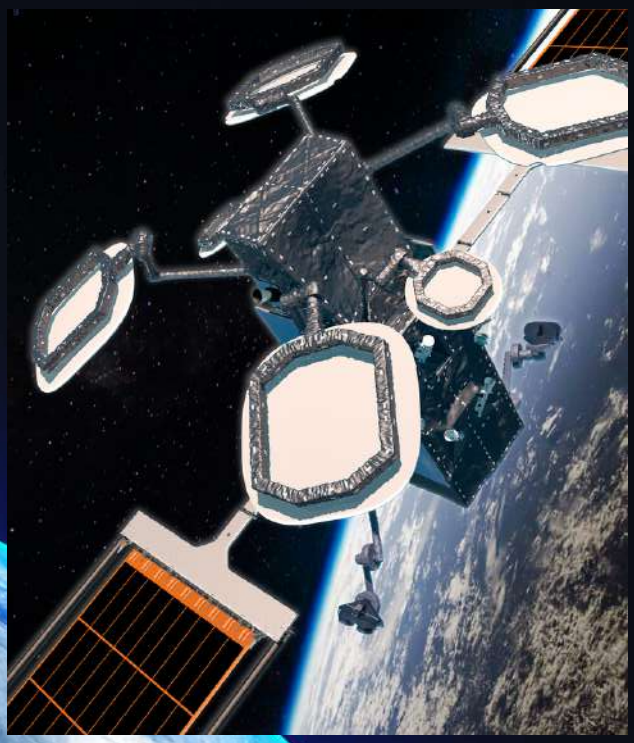
The mission is geared to transport approximately 10 payloads of diverse types, with the lander accommodating a payload mass capacity of 90 kg. Scientific payloads include the Laser Retro-Reflector Array (LRA), Linear Energy Transfer Spectrometer (LETS), Near-Infrared Volatile Spectrometer System (NIRVSS), PROSPECT Ion-Trap Mass Spectrometer (PITMS), and Neutron Spectrometer System (NSS). Five other initially planned science payloads have been reassigned to future lunar delivery missions, such as Photovoltaic Investigation on Lunar Surface (PILS), Mass Spectrometer Observing Lunar Operations (MSolo), Neutron Measurements at the Lunar Surface (NMLS), Fluxgate Magnetometer (MAG), and Surface Exosphere Alterations by Landers (SEAL).

SPACEX LAUNCHES FOR DECEMBER 2023

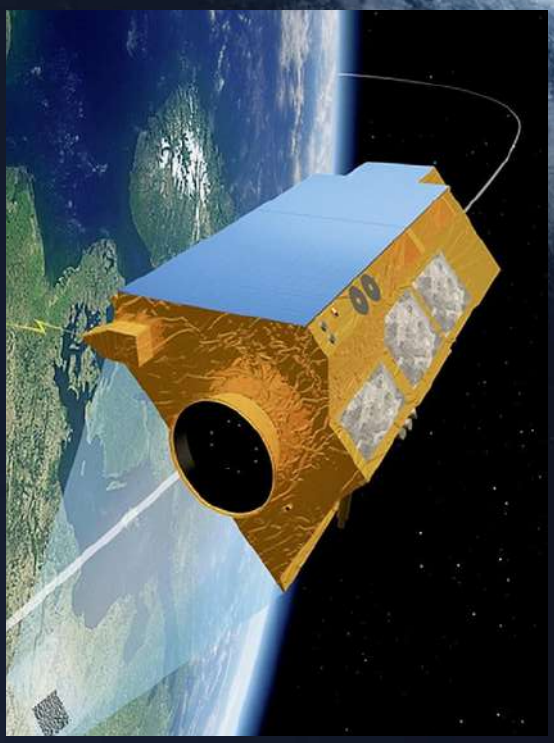
OVZON-3

A SpaceX Falcon 9 rocket will launch the Ovzon-3 mission on Thursday, December 14, 2023 at 9:00 PM (UTC). From the launchpad SLC-40 or LC-39A, Florida, USA

Ovzon offers world-leading mobile satellite communications services, SATCOM-as-a-Service, to customers across the globe. The services combine high data speed with high mobility. Ovzon's SATCOM-as-a-Service meets the growing demand for global connectivity for customers with high performance and security requirements such as Defense, Emergency Services, NGOs, Media and Commercial organizations.



SARAH 2 & 3



SARah is the planned follow-on system for the SAR-Lupe radar satellite constellation operated by the German armed forces (Bundeswehr). SARah consists of one active phased array-antenna satellite built by EADS Astrium and two passive reflector antenna satellites provided by OHB-System. This system is planned to provide a higher resolution than the predecessor SAR-Lupe. Authorisation of the program is planned for June 2013.

The SARah 2 and 3 satellites form the second component of the SARah system. These satellites will be based on the reflector-antenna technology of the SAR-Lupe satellites. They will fly in formation with SARah 1. The three satellite constellation is planned at a cost of 800 million Euro.

STARLINK GROUP 6-33 & 6-34

SpaceX's Starlink Group 6-33 mission will launch 23 Starlink v2 Mini satellites atop a Falcon 9 rocket. The Falcon 9 will lift off from Space Launch Complex 40 (SLC-40), at the Cape Canaveral Space Force Station, in Florida, United States. Starlink Group 6-33 will mark the 125th operational Starlink mission, boosting the total number of Starlink satellites launched to 5,559, of which ~5,187 will still be in orbit around the Earth once launched.

A stack of 60 Starlink v1.0 satellites prior to be encapsulated into Falcon 9's payload fairing.

Each Starlink v1.5 satellite has a compact design and a mass of 307 kg. SpaceX developed a flat-panel design, allowing them to fit as many satellites as possible into the Falcon 9's 5.2-meter wide payload fairing. Due to this flat design, SpaceX is able to fit up to 60 Starlink satellites and the payload dispenser into the second stage, while still being able to recover the first stage. This is near the recoverable payload capacity of the Falcon 9 to LEO, around 18 tonnes.

As small as each Starlink satellite is, each one is packed with high-tech communication and cost-saving technology. Each Starlink satellite is equipped with four phased array antennas, for high bandwidth and low-latency communication, and two parabolic antennas. The satellites also include a star tracker, which provides the satellite with attitude data, ensuring precision in broadband communication.

Each Starlink v1.5 satellite is also equipped with an inter-satellite laser communication system. This allows each satellite to communicate directly with other satellites, not having to go through ground stations. This reduces the number of ground stations needed, allowing coverage of the entire Earth's surface, including the poles.

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

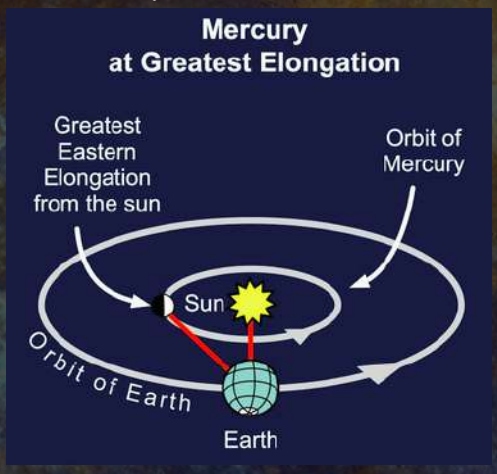
ASTRONOMICAL EVENTS - DECEMBER 2023

MERCURY AT GREATEST ELONGATION EAST

Mercury's orbit is closer to the Sun than Earth's, therefore it constantly looks near to the Sun and is often obscured by the Sun's glare. It is only visible for a few weeks at a time when it is at its greatest separation from the Sun, which is referred to as the greatest elongation. These apparitions occur around once every 3-4 months, alternating in the morning and evening skies, depending on whether Mercury is to the east or west of the Sun. It rises and sets shortly after the Sun in the east and is noticeable in the early evening twilight. It rises and sets a little time before the Sun and is visible immediately before sunrise when it is to the west of the Sun.

Mercury is always near a line in the sky known as the ecliptic, which is the sun's apparent path on the celestial sphere during the year. This line depicts the plane of the Earth's orbit around the Sun as well as the route that the Sun follows through the zodiacal constellations each year. Because all planets orbit the Sun in almost the same plane, it also closely follows the planes of the other planets' orbits. When Mercury is far distanced from the Sun, it is separated along the ecliptic line. At sunset, however, the ecliptic intersects the horizon at varied angles depending on the time of year. This implies that Mercury appears at varying elevations above the horizon at different times of year, even if its distance from the Sun remains constant.

Mercury's separation from the Sun varies between 18 and 28 degrees with each apparition. At maximal elongation, it will reach a maximum separation of 21° to the east of the Sun during its November-December 2023 apparition.



BEST DAY TO OBSERVE MERCURY

Where to look: Look west, in the sunset direction – shortly after sunset.

Greatest elongation: At 7:30 p.m. IST on December 4, 2023. It's 21 degrees from the sun.

Brightness: Mercury emerged in the evening sky the second week of November at -0.5 magnitude but it's at a far southerly declination so it is difficult to observe for the Northern Hemisphere. At greatest elongation, Mercury shines at magnitude -0.3, making it brighter than most stars. But, after the greatest elongation, the innermost planet will rapidly fade as it sweeps toward Earth. It'll probably disappear by mid-month and will reach inferior conjunction when it passes between Earth and the sun – on December 22.

Through a telescope: Mercury will appear about 62% illuminated, at greatest elongation. It'll measure 6.7 arcseconds across.

Constellation: Mercury will lie in front of the constellation Sagittarius the Archer at this elongation. But most of the stars in this constellation will be lost in the twilight.

Geminids Meteor Shower

The Geminid meteor shower is caused by the asteroid 3200 Phaethon. This is in contrast to most meteor showers, which are caused by comets rather than asteroids. Simon Green and John Davies identified 3200 Phaethon on photos taken by the IRAS (Infrared Astronomical Satellite) on October 11, 1983. In 1985, it was awarded the asteroid designation 3200 Phaethon after being given the naming 1983 TB. Fred Whipple revealed after the orbit was computed that this asteroid had the same orbit as the Geminid meteor shower. This was extremely uncommon, as an asteroid had never previously been linked to a meteor shower. It's still unclear how debris from the asteroid's surface or interior ends up in the meteoroid stream.

3200 Phaethon is half the distance between the sun and the innermost planet, Mercury. Then it pushes beyond Mars' orbit. As a result, in mid-December, the meteor material contacts the Earth's orbit, giving rise to the Geminid meteor shower. DESTINY+ (Demonstration and Experiment of Space Technology for Interplanetary Voyage with Phaethon Flyby and Dust Science) is a Japanese spacecraft that will be launched in 2024 and will visit the asteroid in 2028. One proposal from 2006 suggested crashing an object into 3200 Phaethon to produce an artificial meteor shower to better study the asteroid. DESTINY+, however, will not be hitting the asteroid.

Predicted peak: For December 14, 2023, at 12:57 a.m. IST

When to watch: Since the radiant rises in mid-evening, you can watch for Geminids all night around the peak dates of December 13 and 14. Also, the young waxing crescent moon will not interfere with the Geminids in 2023

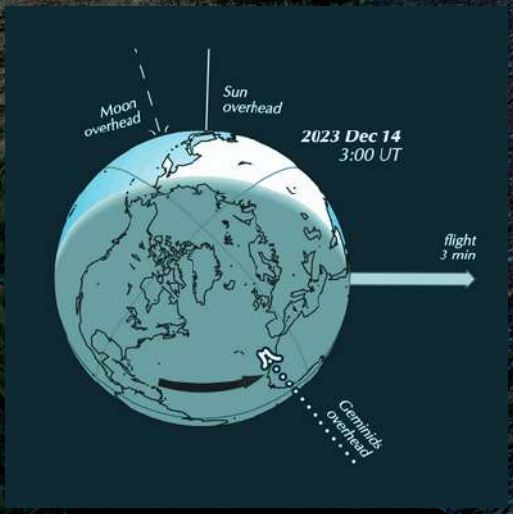
Overall duration of the shower: November 19 to December 24, 2023

Radiant: Rises in mid-evening, highest around 2 a.m.

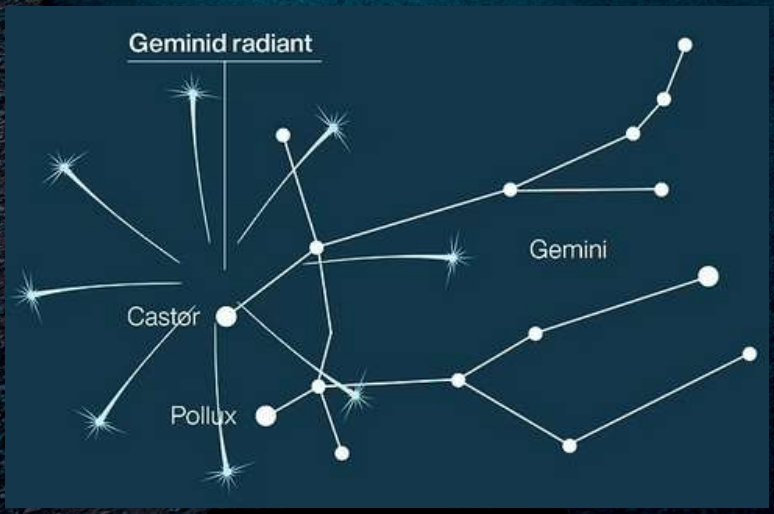
Nearest moon phase: In 2023, the new moon falls on December 12. So there will be a dark sky during the peak of the 2023 Geminid meteor shower.

Expected meteors at peak, under ideal conditions: Under a dark sky with no moon, you might catch 120 Geminid meteors per hour

Note: The bold, white, bright Geminids give us one of the Northern Hemisphere's best showers, especially in years when there's no moon. They're also visible, at lower rates, from the Southern Hemisphere. The meteors are plentiful, rivaling the August Perseids.



(Image Credit & Copyright: Earthsky.org)

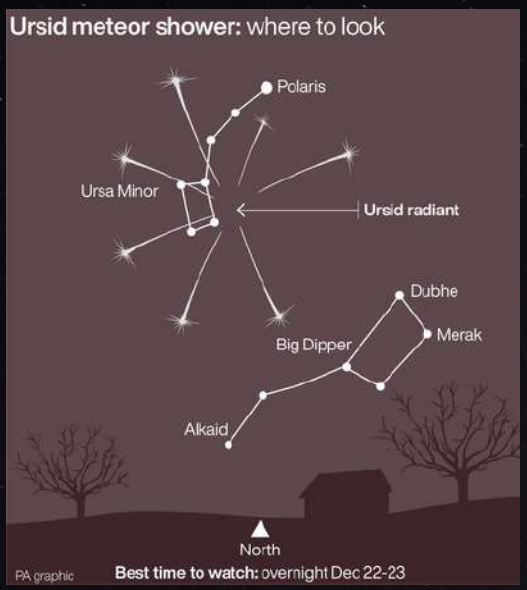


(Image Credit & Copyright: PA graphic)

Ursid meteor shower

The Ursid meteors stem from a stream of debris from the 8P/Tuttle comet. On January 9, 1790, Pierre Mechain found it in Paris, France. This comet's arrival in 1790 offered an estimated orbit, which Mechain computed. There were insufficient data points to suggest that the comet will ever return. But it happened. Horace Tuttle of Harvard University College spotted it up in the dusk sky 68 years later, on January 5, 1858. It was studied for many months and an orbit with a return date of 13.7 years was estimated. Tuttle connected it to Mechain's comet found in 1790, and it became known as periodic Comet Tuttle. Because it was not detected as a periodic comet from Mechain's orbit, it is not known as periodic Comet Mechain-Tuttle. As a result of the revised naming regulations implemented in 1995, the official name of this comet is 8P/Tuttle (also known as Tuttle's Comet or Comet Tuttle).

Comet 8P/Tuttle approaches the sun as closely as the planet Earth does, then orbits Saturn. Its trajectory is inclined to the Earth's orbit, and we intercept the material as it descends from above. The comet's most recent journey to the inner solar system was in August 2021. The comet is still traveling away from Earth and the sun in 2023. But it doesn't stop its stuff from coming in and colliding with Earth in late December. When the slow-moving Ursid meteors' tracks are traced backward, they appear to emerge from the area of sky designated by the Little Dipper star Kochab, which is in the constellation Ursa Minor. Hence, the shower is named the Ursids.



(Image Credit & copyright: PA Graphics)

Predicted peak: December 23, 2023, at 9:30 a.m. IST. Under a dark sky with no moon, the Ursids offer perhaps 5 to 10 meteors per hour.

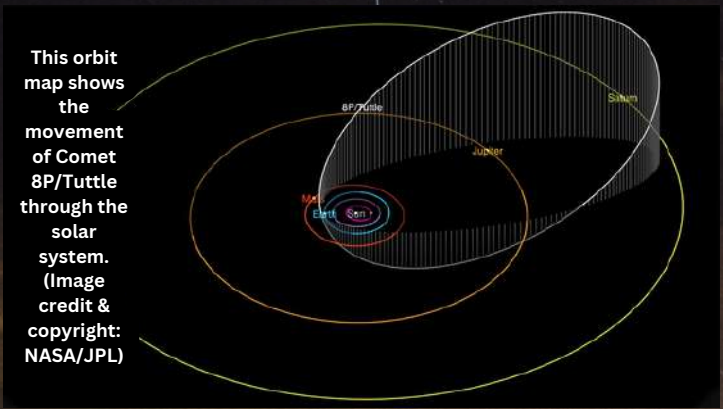
When to watch: In the early morning hours of December 22 and 23

Duration of the shower: December 13 to 24, so you might see some intermingling with the Geminids' peak

Radiant: Constellation Ursa Minor

Nearest moon phase: 1st quarter moon occurs at 12:09 p.m. IST on Dec. 19. So, the waxing gibbous moon at 85% illumination may interfere with the Ursids in 2023 until the moon sets about three hours before sunrise.

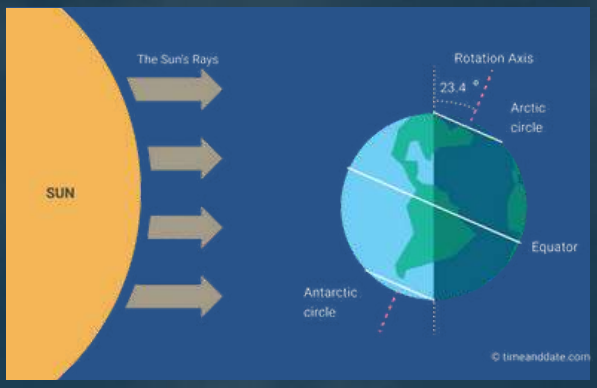
Note: Due to the Christmas season, this low-key meteor shower, which always peaks around the solstice, is generally neglected. Its hourly rate is lower than that of the Geminid shower, which peaks nearly a week earlier. With several hours of darkness before sunrise in 2023, the Ursids are worth a look!



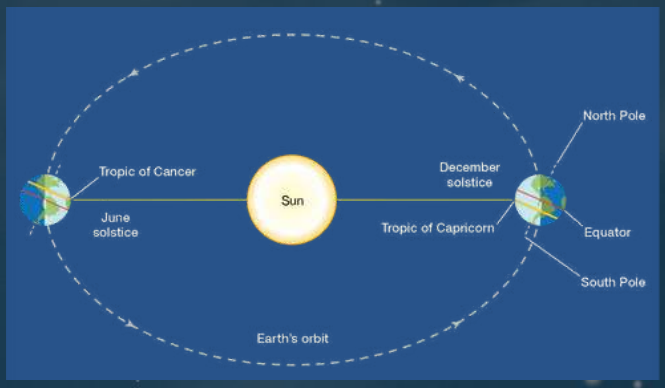
This orbit map shows the movement of Comet 8P/Tuttle through the solar system. (Image credit & copyright: NASA/JPL)

WINTER SOLSTICE

Our Earth is 23.5° tilted, and without it, not only would there be no Winter Solstice, but there would be no seasons at all. Without the axial tilt, the sun would remain directly above the Equator all year, and everyone on the Earth would receive the same quantity of light.



(Image Credit & Copyright: timeanddate.com)



(Image Credit & Copyright: 2015 Encyclopaedia Britannica, Inc.)

Though the Winter Solstice occurs once a year, the Earth really experiences two Winter Solstices every year. One is located in the Northern Hemisphere, while the other is located in the Southern Hemisphere. So, the solstice is one of two times of the year when the Sun's apparent path is furthest north or south from Earth's equator. The path of the Sun in the sky on the winter solstice is farthest south in the Northern Hemisphere (On Dec. 21 or 22) and farthest north in the Southern Hemisphere (On June 20 or 21).

When the winter solstice occurs in the Northern Hemisphere, the North Pole is tilted roughly 23.5° away from the Sun. The vertical noon rays lie exactly overhead at the Tropic of Capricorn (23.5° S) because the Sun's rays are displaced southward from the Equator by the same amount. Six months later, the South Pole is tilted 23.5° away from the Sun. Now the Sun's vertical overhead rays move to their northernmost location i.e. Tropic of Cancer (23.5° N) on this day of the winter solstice in the Southern Hemisphere. According to astronomical definitions, the winter solstice also marks the start of the winter season, which lasts until the spring equinox (March 20 or 21 in the Northern Hemisphere, or September 22 or 23 in the Southern Hemisphere).

Furthermore, because the Sun takes the shortest trip around the sky that day, there's the least daylight and the longest night. After the solstice, the days become longer and many civilizations see it as a time of rebirth.

Just as the Winter Solstice represents the point in Earth's tilting axis at which it points the furthest away from the sun, the Summer Solstice indicates the point in our planet's tilting axis at which it points the most towards our star. The winter solstice symbolizes the transition from autumn to winter for many people. However, there is a distinction between the winter solstice, known as the astronomical first day of winter, and the first day of the winter season, known as the meteorological first day of winter. Meteorologists examine weather and climate every year to identify the start day of the winter season based on temperature data.

WHEN WILL THE WINTER SOLSTICE BE IN 2023?

The Winter Solstice will fall on Dec. 22 this year. The Northern Hemisphere will have around 7 hours and 14 minutes of daylight during the day, marking the shortest day of the year. The Earth's axis will then be positioned the furthest away from the sun at 8:57 a.m. IST on Dec. 22.

CONJUNCTIONS FOR THE MONTH

A phenomenon grabs the imagination of scientists and stargazers alike in the vast panorama of the night sky, where stars shine like distant diamonds and planets roam over the cosmic canvas. Conjunctions, those ethereal moments in the heavens when heavenly bodies appear to collide, provide a mesmerizing sight that connects us to the beauty of the cosmos. The word "Conjunction" comes from Latin, meaning to join together. From Earth's perspective, a conjunction occurs when two planets or a planet and the Moon or Sun align. Solar conjunctions are invisible to us. Moon-planet conjunctions occur throughout the month, every month, as the Moon passes past each planet. The planets in The Great Conjunction and when multiple align are rare and captivating conjunctions. 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.

Conjunction of Moon and Venus

On December 10th, the Earth's twin sister Venus will meet the 26-day-old Moon in the constellation Virgo. The apparent distance between the two objects will be 3°54' in the late night. They will be in the Eastern direction. Venus is at a magnitude of -4.14 and the Moon has a magnitude of -8.35.

Place: New Delhi / Date: 9th December / Time: 4:45 a.m.

Place: New Delhi / Date: 17th December / Time: 06:30 p.m.

Conjunction of Moon and Saturn

On December 17th, the ringed planet Saturn will meet the 4-day-old Moon in the constellation Aquarius. The apparent distance between the two objects will be 2°16' in the late night. They will be in the South-western direction. Saturn is at a magnitude of 0.92 and the Moon has a magnitude of -9.11.

Conjunction of Moon and Jupiter

On December 22nd, the gaseous giant Jupiter will meet the 10-day-old Moon in the constellation Aries. The apparent distance between the two objects will be 2°42' in the late night. They will be in the Eastern direction. Jupiter is at a magnitude of -2.67 and the Moon has a magnitude of -11.57.


Place: New Delhi / Date: 22nd December / Time: 06:38 p.m.

STUDENT'S CORNER

The Enigmatic Phenomenon of White Holes: Unveiling the Cosmic Mystery

Nikhilesh B
Iastronomer

In the vast cosmic expanse where black holes have long captivated the imagination of scientists and enthusiasts alike, a theoretical counterpart exists - the elusive and enigmatic white holes. Unlike black holes, which devour everything in their vicinity, white holes are postulated to expel matter and light. This essay explores the theoretical concept of white holes, examining their hypothetical nature, potential astrophysical implications, and the challenges in detecting or proving their existence.

White holes are theoretical solutions derived from the equations of general relativity, the cornerstone of our current understanding of gravity formulated by Albert Einstein. While black holes represent regions of spacetime where gravity is so intense that nothing, not even light, can escape, white holes are conceptualized as regions where matter and light are expelled with equal force. Essentially, if a black hole is a "sink" in spacetime, a white hole is its opposite - a "source."

White holes, as per theoretical models, exhibit a one-way flow of time. While time near black holes is dilated, near white holes, it would appear to move at an accelerated pace. This temporal asymmetry adds to the perplexity surrounding these cosmic entities.

Theoretical spacetime diagrams often depict a black hole connected to a white hole through a wormhole, forming what is known as an Einstein-Rosen bridge. This speculative structure suggests a cosmic connection between the ingestion and expulsion of matter.

To date, no direct observations or conclusive evidence of white holes have been made. Their existence remains purely theoretical, and their detection presents a significant challenge due to the expected rarity and transient nature of these hypothetical objects.

The existence of white holes could have profound implications for our understanding of the universe:

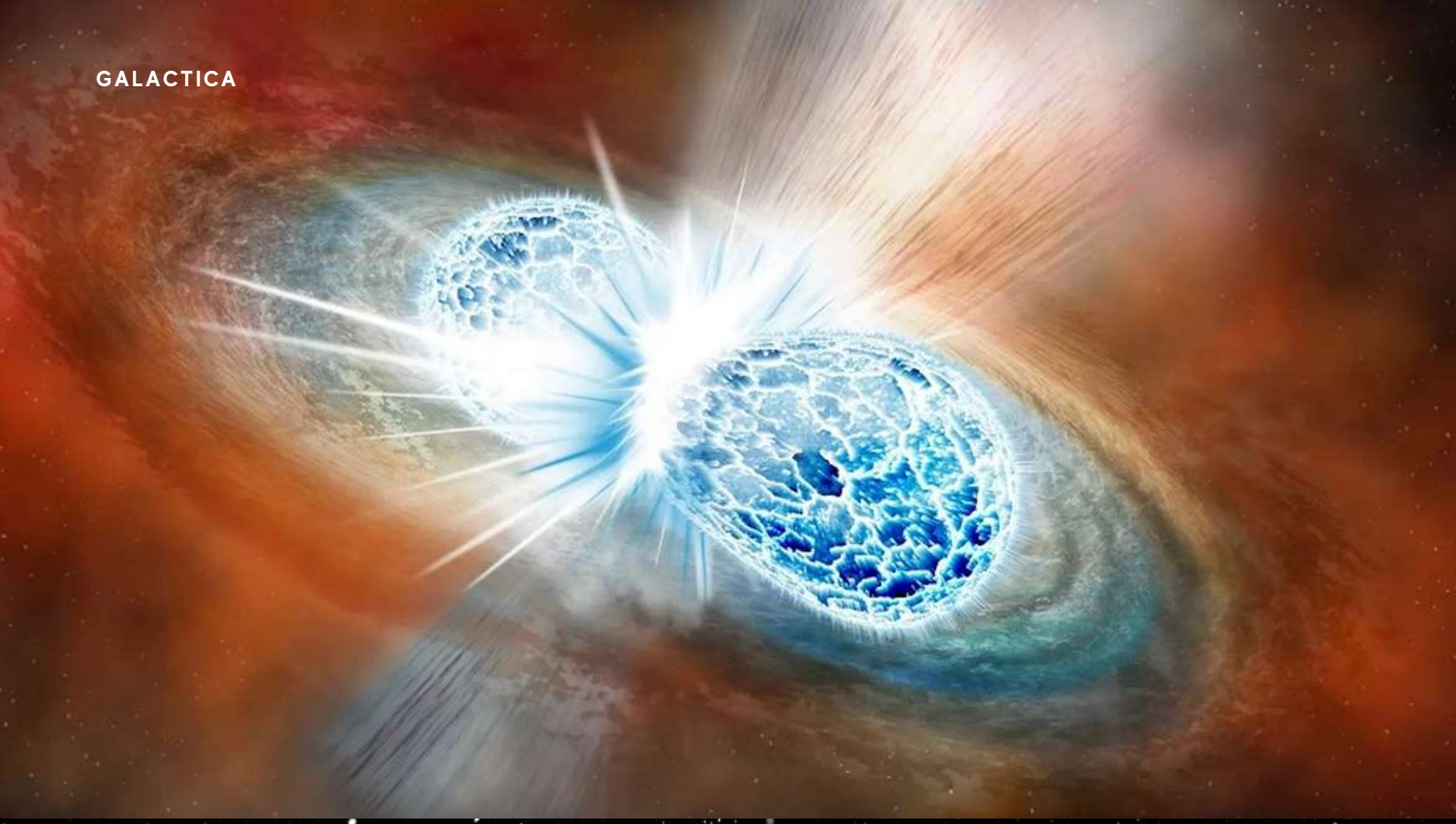
If white holes do exist, they could play a role in a cosmic recycling process. Matter and energy falling into a black hole might emerge from a white hole, potentially contributing to the continuous renewal and redistribution of cosmic materials.

Theoretical models propose that white holes could be formed through processes such as the collapse of massive objects. Understanding the stability and conditions for the formation of white holes could provide insights into the life cycle of astrophysical phenomena.

The primary challenge lies in the observational aspect. Unlike black holes, which can be indirectly observed through their effects on nearby matter, white holes, if they exist, have remained elusive due to the lack of direct evidence.

Incorporating quantum mechanics into the study of white holes is a complex task. Bridging the gap between general relativity and quantum mechanics remains a central challenge in theoretical physics.

White holes, though purely theoretical at present, represent a fascinating realm at the intersection of general relativity and quantum mechanics. While their existence is yet to be confirmed, the pursuit of understanding these cosmic enigmas pushes the boundaries of our knowledge and challenges our perception of the fundamental nature of spacetime. As scientific advancements continue, the cosmic mystery of white holes may one day be unraveled, offering new insights into the intricate tapestry of the universe.



Kilonovas... A potential danger?

Sourajit Mandal
Astronomy camp

Kilonovas are disastrous events that occur when two extremely dense celestial bodies such as two neutron stars, a neutron star and a blackhole or two blackholes collide. This rare event is thousands of times brighter than a nova (when a white dwarf erupts) and can possibly destroy all life on Earth in an instant if it occurred nearby.

In a recent discovery scientists at University of Illinois Urbana-Champaign have found the terrifying potential of kilonovas. A kilonova has the potential to destroy all life on Earth for at least a millennium if it happens in a range that is closer to 36 light years.

A kilonova explosion might wipe out life as we know it by releasing deadly radiation and particles into space. An expanding bubble of cosmic rays created by the merger of neutron stars would swallow everything in its path and bombard Earth with very powerful charged particles. Among the particles that have been studied, cosmic rays are thought to pose the greatest hazard. Furthermore, two focused streams of gamma rays would be released, which could destroy any object in a 297-light-year radius. Our ozone layer might be seriously damaged by even a tangential exposure to gamma radiation, with a four-year healing period. Moreover, X-ray emissions from gamma-ray collisions with interstellar dust have an identical ionizing impact on Earth's ozone layer.

The likelihood of a kilonova explosion occurring at the required distance to endanger life on Earth is extremely unlikely. The nearest known neutron stars are 400 light-years away from Earth. Asteroid strikes, solar flares, and supernova explosions are examples of additional occurrences that scientists stress is more likely to endanger Earth.

Although there might be disastrous effects on Earthly life from a kilonova explosion, these explosions are extremely uncommon and unlikely to happen in a way that poses a threat to our planet. Our planet's future can be protected against potential hazards and threats by the scientific community's ongoing exploration and understanding of the cosmos.

QUASARS- WONDERS OF SPACE

By Navya Kiran
Iastronomer

QUASARS- WONDERS OF SPACE

Space has many wonders, from galaxies to black holes and stars to awesome exoplanets. We have known each of them as we get to hear them almost every day. But as you read the title, we are not learning about them today. Today's space topic is Quasars. Have you ever heard of this word? Very few have, but don't worry, I will tell you everything about them today.

WHAT ARE QUASARS?

Quasars are the remarkable bright active cores of the galactic bodies. They are what scientists call "Active Galactic Nuclei" or AGN. They are black holes at the center of some specific galaxies in the distant universe that suck up everything.

WHAT IS IT CALLED QUASAR?

Quasar is short for 'quasi-stellar' radio source because when quasars were discovered, scientists thought of them as star-like emitters of radio waves.

WHO DISCOVERED QUASARS?

Quasars were discovered by a famous scientist Maarten Schmidt in 1963. He discovered a small intense galaxy spreading radio waves in both directions, and after further study, he discovered that they were a type of 'quasi-stellar' radio source. Later, in 1964, they were renamed to Quasars.

HOW ARE QUASARS FORMED?

Quasars are formed when the central black holes of certain galaxies emit gases at a high pressure and rate, possibly triggered by merging with another galaxy, building up the mass of the central black hole.

DIFFERENT TYPES OF QUASARS

Quasars are classified in different ways. When it comes to radio waves, quasars are classified as:-

1. Radio Loud Quasars- Radio-loud quasars are quasars with powerful jets that are strong sources of radio-wavelength emission. These makeup about 10% of the overall quasar population.
2. Radio Quite Quasars-Radio-quiet quasars are those quasars lacking powerful jets, with relatively weaker radio emission than the radio-loud population.

When it comes to color, quasars are classified as:-

1. Red Quasars- These quasars are full of cosmic dust and produce strong and a lot of radio waves. They are very powerful and have a lot of energy.
2. Blue Quasars- These quasars are somewhat related to the red ones. There comes a point when the red ones produce a lot of energy, absorbing all the dust and gas, converting the whole thing into a blue quasar. Blue quasars are dust-free and produce a little less energy as compared to the red ones.

HOW DO WE LOOK INTO THESE QUASARS?

Usually, whenever you want to spot a quasar, you should always look for celestial bodies a little bluer than the normal stars you see every day. As we can't see them through an eyepiece, we need proper laboratory equipment, which is fit to see such deep and far things.

FUN FACTS

1. Do you know, that in around 5 billion years, the Milky Way is also likely to turn into a quasar after merging with its next-door neighbor, Andromeda?
2. Quasars help in finding out about the origins of the universe and the mysteries of the Big Bang.
3. The largest known quasar is the Huge-LQG, which has been announced as the largest known object in the universe. It has 74 known quasars.
4. The most powerful known quasar is the J1144. It is also the most recent quasar discovered (June 2022). It shines almost 100,000 times brighter than the sun.

Shukrayaan: The Mission to Venus

Kishore Babu, Club student

The Indian Space Research Organisation (ISRO) is planning an upcoming mission known as Shukrayaan, also called The Venus Orbiter Mission, which aims to study the surface and atmosphere of Venus.

Past missions to Venus:
Venus Express, launched in 2005 by the European Space Agency (ESA) from the Baikonur Cosmodrome in Kazakhstan, orbited the planet Venus from 2006 to 2014. In 2010, the Japan Aerospace Exploration Agency (JAXA) launched the Akatsuki Venus Climate Orbiter, which has been in Venus' orbit since 2016. In 2018, the National Aeronautics and Space Administration (NASA) launched the Parker Solar Probe spacecraft to observe the outer corona of the Sun. During its flyby in February 2021, Parker Solar Probe successfully captured visible light images of the surface of Venus. Previous missions to Venus have found evidence of granite-like rocks that would have needed water for formation. It is possible that Venus could have contained liquid water and even oceans like Earth with a milder climate, making it habitable approximately 2 billion years ago. However, NASA is presently doubtful about the possibility of life on Venus due to its surface being too hot to support life or liquid water. Although the lower atmosphere of Venus contains toxic clouds of sulfuric acids, some scientists have not ruled out the potential existence of microbes in the upper atmosphere of Venus where the pressure is like that of Earth's surface.

Shukrayaan mission:
The Shukrayaan mission is named after a combination of two Sanskrit words - 'Shukra' which means Venus, and 'Yaana' which means craft or vehicle. Shukrayaan will be ISRO's mission to Venus planet, which is often referred to as Earth's "twin sister". Venus and Earth share many similarities in terms of their sizes, densities, composition, and gravity. Scientists believe that both planets might have originated simultaneously from a common source (a condensing swirl of gas and dust) about 4.5 billion years ago. However, Venus is closer to the Sun than Earth, which means that it's exposed to significantly higher levels of solar radiation and other solar phenomena such as solar wind.

Objectives of Shukrayaan mission:
The objective of the Shukrayaan mission seems to be quite interesting. It aims to conduct a comprehensive study of the Venus planet and explore various parameters associated with it. Shukrayaan, the spacecraft that will be deployed for the mission, will conduct a detailed analysis of the planet's dense, hot and super-rotating atmosphere, the effect of solar radiation and solar wind, the surface of the planet, its geological composition, and other relevant factors. It will be interesting to see what discoveries the mission will bring forward.

Planning of Shukrayaan mission:
The initiative for a mission to Venus was proposed back in 2012 and funds were finally released in the year 2017 to make this mission a reality. Since then, there have been several preliminary studies and proposals for the payloads to be carried by the satellite. Payload refers to the scientific instruments that will be carried by the satellite. This orbiter is expected to have a scientific payload capacity of approximately 100 kilograms.

Current status of Shukrayaan mission:
After the successful soft landing of Chandrayaan-3 on the Moon's south pole and the launch of the nation's first solar mission Aditya-L1, ISRO's chairman Shri. S. Somanath announced in September 2023 that the organization is now focusing on a Venus mission. The launch of this mission is planned for December 2024, as the Earth and Venus will be aligned in a way that will allow the spacecraft to be put into the planet's orbit using minimum propellant. However, due to the recent COVID-19 pandemic, there may be delays in the mission's timeline, and ISRO has not yet officially released any updates on the Venus mission launch. We hope that the Sukrayaan project will continue to make progress for launching; thanks to the untiring efforts of ISRO.

Happy

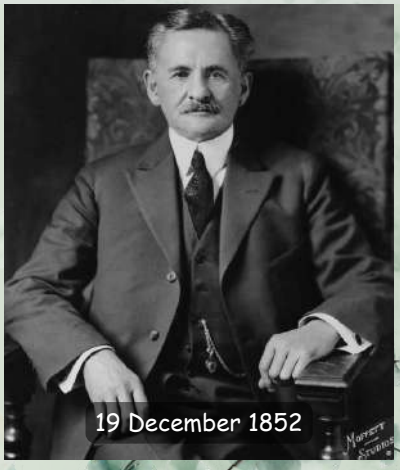
Gerard Kuiper

Gerard Kuiper, born Gerrit Kuiper (7 December 1905 - 23 December 1973), was a Dutch-American astronomer known as "The Father of Planetary Science." Kuiper collaborated with Ewen Whitaker to produce four lunar atlases, which led him to serve as the Principal Investigator on NASA's Ranger program and identify the landing spots for the Apollo missions. During the 1960s and 1970s, he played a crucial role in developing infrared airborne technology while also serving as an experimenter on the NASA surveyor program. Kuiper had speculated about the existence of a disc after Neptune's orbits, which is the source of many solar system comets. This region in space is now known as Kuiper's Belt, named in his honour.

Tycho Brahe

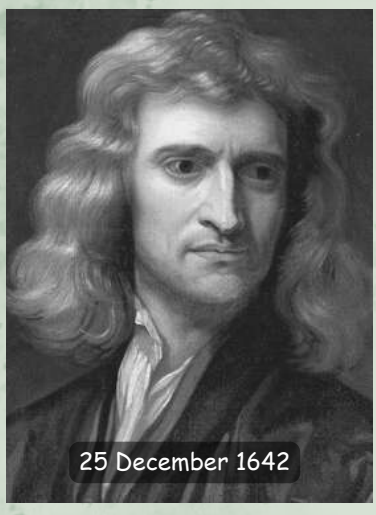
Tycho Brahe (14th December 1546 - 24th October 1601) was the last major astronomer before the invention of the telescope. The Danish astronomer is known for his comprehensive and unprecedentedly accurate astronomical observations, which he did without a telescope. Through his observations, he refuted the prevailing beliefs at the time of an unchanging celestial realm. One of Tycho's many contributions was inventing the concept of data. This was because he repeated his observations or experiments to verify his results. The vast body of data that he collected helped astronomers who followed him, namely Johannes Kepler, who worked as Tycho Brahe's assistant before his death. Kepler used Brahe's data to develop his three laws of planetary motion.

Albert A. Michekson



Albert Abraham Michelson (19th December 1852 – 9th May 1931) was a Prussian-born American physicist of Jewish Descent. Born in Strzelno, Prussia (now Poland), Michelson devoted the majority of his career to improving earlier scientific research. Widely remembered for proving that the hypothetical medium of light, ether, does not exist, he also established the, at the time, the most accurate value of the speed of light at 299,853 kilometers per second. This measurement remained unchallenged for an entire generation when Michelson improved the value. Michelson's research laid the groundwork for further discoveries in the properties of light, space exploration, and atomic energy. He also developed an astronomical interferometer, which he used to measure the diameter of stars and measure the separation distances in a stellar binary pair. In 1907, Michelson received the Nobel Prize in Physics. He was the first American to win the Nobel Prize in any science category.

Birthday

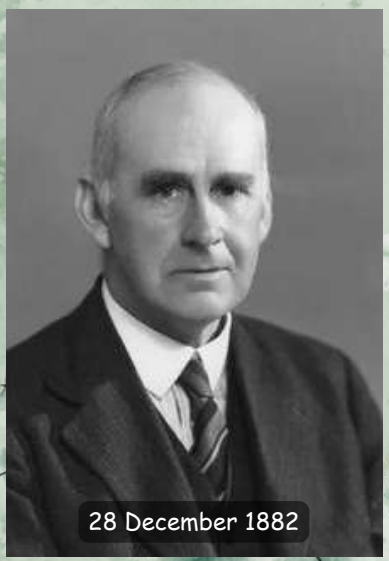


Sir Issac Newton

Sir Isaac Newton (25 December 1642 - 20 March 1727) is one of the greatest and most influential scientists in history. He was a key figure in the Scientific Revolution that took place in the 17th and 18th centuries and the Enlightenment that followed. In his pioneering book Philosophiæ Naturalis Principia Mathematica, he formulated the three laws of motion that laid the groundwork for all modern thoughts about physics and reality. His theory of universal gravitation says that every particle in the universe attracts every other particle through the force of gravity. It dominated the scientific view until the theory of relativity superseded it. He invented the reflector telescope that is nowadays called the Newtonian telescope.

Johannes Kepler

Johannes Kepler (27 December 1571 - 15 November 1639) was a German astronomer. He is one of the founders of modern astronomy and sought to understand and explain the movements of the celestial objects in the skies above. He also invented the Keplerian telescope, which the modern refractor telescope is based on. Kepler was the apprentice of Tycho Brahe, one of the best observational astronomers of the time. With the data Brahe collected, Kepler devised his three laws of planetary motions. The laws of planetary motions immortalized Kepler and revolutionized astronomy.



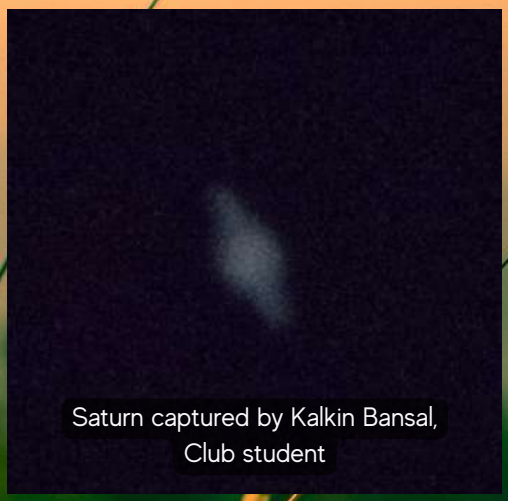
Sir Arthur S. Eddington

Sir Arthur Stanley Eddington (28 December 1882 - 22 November 1944) was an English physicist, astronomer, and mathematician, sometimes known as the 'Father of Modern Theoretical Astrophysics'. He popularised Einstein's theory of General Relativity. In 1919, he successfully proved Einstein's general relativity predictions through the solar eclipse expedition to Brazil he organized. Eddington correctly speculated that the source of stellar energy was the fusion of hydrogen into helium. He also pointed out that for a star to be in stellar equilibrium, three forces have to be equal: gravity, gas pressure and radiation pressure. Eddington also formulated the theoretical relationship between the mass and luminosity of a star, where the star's luminosity is finite for a specific mass. A part of this equation is now known as Eddington's limits.

VISUAL ARTS FROM SPACE ASSOCIATED ASTRONOMERS

Jupiter and its Moon captured by Kalkin Bansal, Club student

Moon captured by Ruhaan Gemawath, Club student



Saturn captured by Kalkin Bansal, Club student

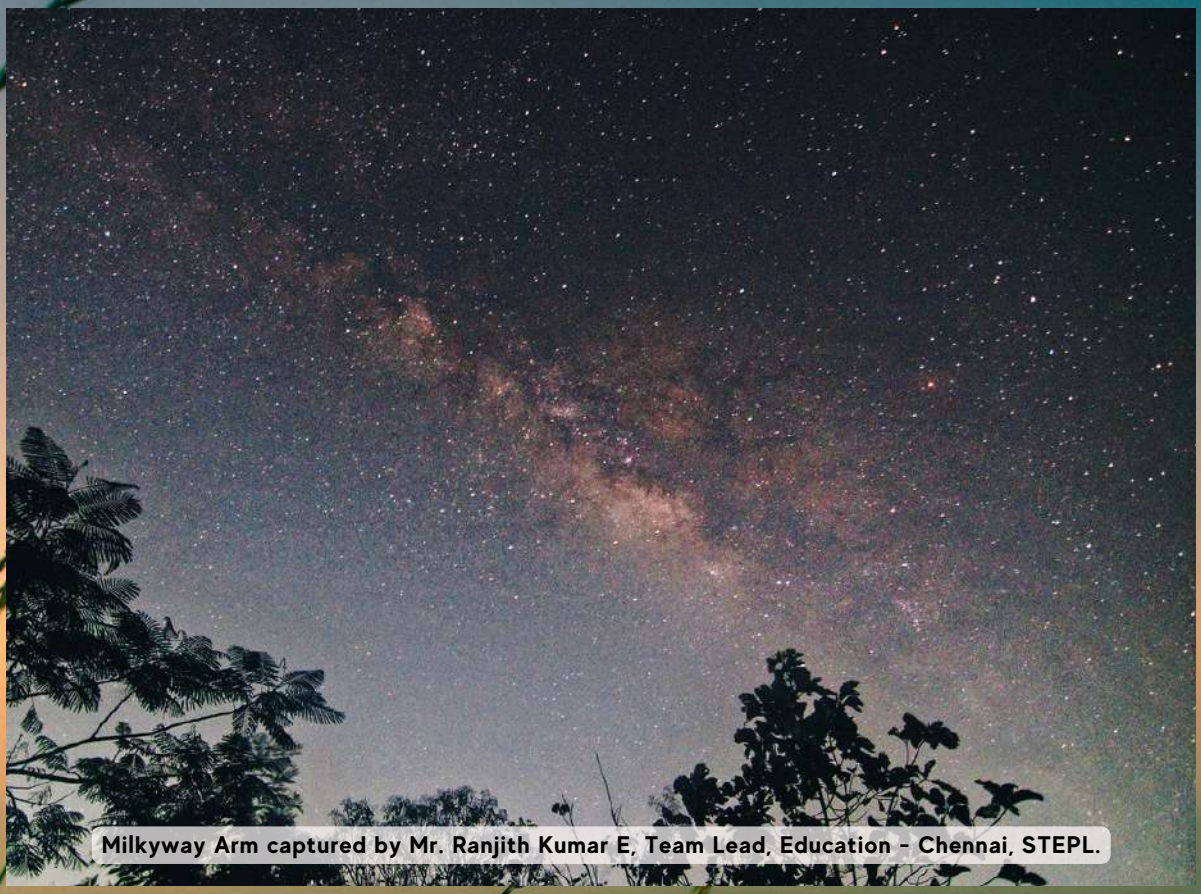
Moon captured by Kalkin Bansal, Club student

Moon captured by Sripriya Venugopal, lastronomer

Moon captured by Vansh jain , Club Student

Moon captured by Daksh Rathi , lastronomer

ASTROPHOTOGRAPHS BY SPACE



Milkyway Arm captured by Mr. Ranjith Kumar E, Team Lead, Education - Chennai, STEPL.

Earthshine Lights up the 'Dark Side' of the Moon captured by Ms. D Priyadharshini, Educator, STEPL.

HISTORICAL EVENTS HAPPENED IN DECEMBER

FIRST LANDER ON MARS

On 2 December 1971, Mars 3's lander soft-landed successfully on the Martian Surface. However, the first lander to deliberately land on Mars was lost to the sands of time as it failed shortly after landing. Mars 3 was part of the Soviet Union's Martian program and was the sister mission to Mars 2. Launching on 28 May 1971, Mars 3 consisted of an orbiter, lander and rover. It reached the Martian orbit in late November. A few days later, the lander was released from the orbiter. Due to the failure of the lander, the rover wasn't deployed. However, the orbiter worked successfully and returned photographic data of the Martian surface.

The reason for the lander's failure is unknown though the raging dust storm that was going on could have interfered with the lander's electronics. In the early to mid-2010s, Vitaliy Egorov, A Russian space enthusiast, announced that he and other space enthusiasts may have found Mars 3's lander.

HEARING MARTIAN WIND

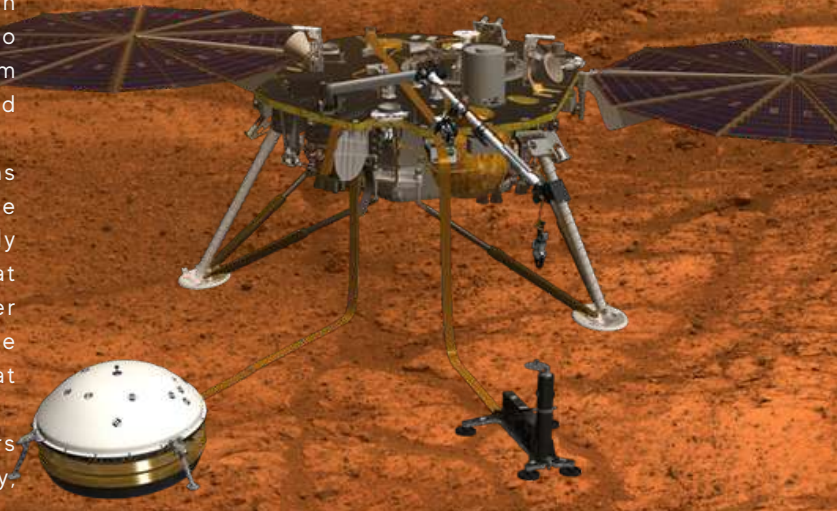
On 1st December 2018, 47 years after the successful landing of Mars 3, INSIGHT captured the sound of the Martian wind.

INSIGHT's, short for Interior Exploration using Seismic Investigations, Geodesy and Heat Transport, mission on the Martian surface was to monitor for marsquakes so that researchers can get details on Mars' interior, formation and any activity that takes place. Since it landed on 26 November 2018 till the end of the mission, INSIGHT was the only active seismic monitoring station beyond Earth.

Less than a week after landing, on 1st December, INSIGHT's sensors caught a low rumble caused by vibrations from the Martian wind. Researchers estimate the wind's speed to be between 5 and 7 meters per second. From orbit, dust devil streaks were observed around the landing area.

The sensors that picked up the wind vibrations were very sensitive. One was an air pressure sensor that picked up the air vibrations directly from inside the lander. Another sensor that picked up the wind motion was the seismometer placed on the lander's deck. It recorded the vibrations of INSIGHT's solar panels that occurred when the wind moved over them.

On 21 December 2022, after mission controllers determined that the lander ran out of energy, the INSIGHT mission formally ended.



PIONEERING PIONEER 10

When Pioneer 10 launched into space on 2 March 1972, it achieved several "firsts". It was the first spacecraft to reach the velocity required to leave the solar system. It was the first spacecraft to fly past Mars' orbits and through the asteroid belt, thus proving that the asteroid belt could be safely traversed. This enabled future explorations of the outer solar system. Pioneer 10 was also the first probe to take images of a giant planet.

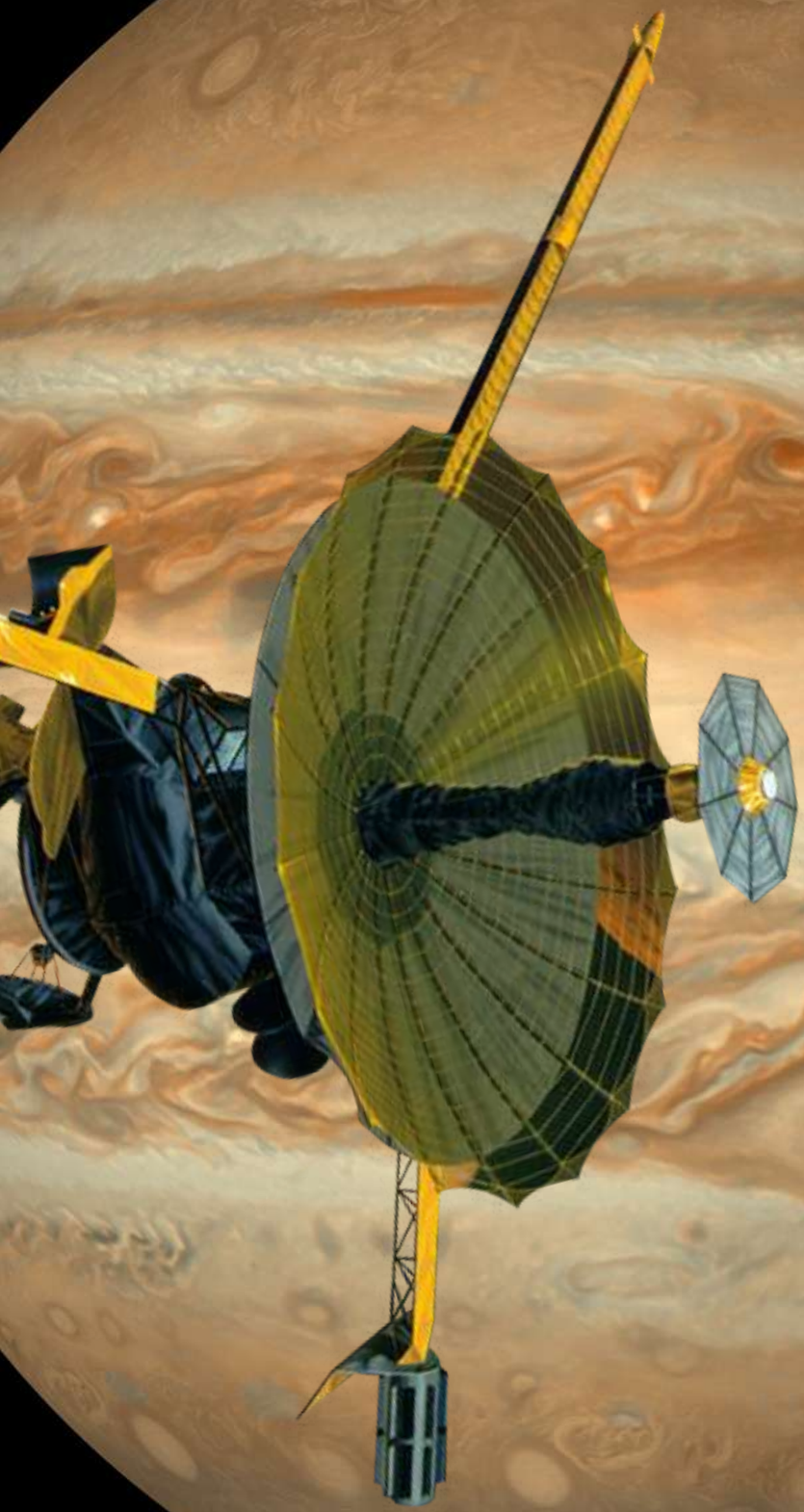
On 3rd December 1973, Pioneer 10 started to collect data during its flyby of Jupiter. It obtained close-up images of the planet, charted Jupiter's intense radiation belts, located the Jovivian magnetic field, and discovered that Jupiter is a predominately liquid planet. Pioneer 10 also captured data on Jupiter's interaction with the solar wind and cosmic radiation while confirming internal heating inside the planet made Jupiter radiate more heat than it received from the sun. On 2nd January 1974, Pioneer 10 continued on, leaving Jupiter and its home planet behind.

The planned lifetime for Pioneer 10 was 21 months, long enough to reach the planet and study it. Plucky Pioneer lived past this and continued to send back data of the interplanetary space it travelled through. On 13 June 1983, Pioneer 10 flew past Neptune's orbit, which, at the time, was the furthest planet from the sun and until 17 February 1998, Pioneer 10 was the furthest human-made object. After this, Voyager 1 took the title and still holds it today.

Before Voyagers' Golden Record, Carl Sagan, Frank Drake and Linda Salzman-Sagan designed a plaque that the spacecraft carries. Any alien civilisation that intercepts the spacecraft will learn about its creators and origin.

NASA maintained contact with Pioneer 10 until 23rd January 2003, when its last signal reached Earth. Despite the loss of contact, Pioneer 10 continues on, silently, heading towards Aldebaran with an expected arrival date 2 million years from now.

Jupiter's First Artificial Satellite



Many famous astronomers have had a spacecraft named after them, and Galileo Galilei is no exception. Galileo was a NASA space probe that studied the largest planet in the solar system and its moons.

Launched into orbit on 18 October 1989 by the space shuttle ATLANTIS, Galileo consisted of an orbiter and an entry probe. It arrived at the Jovinian planet on 7th December 1995 after being gravitationally assisted by Earth and Venus.

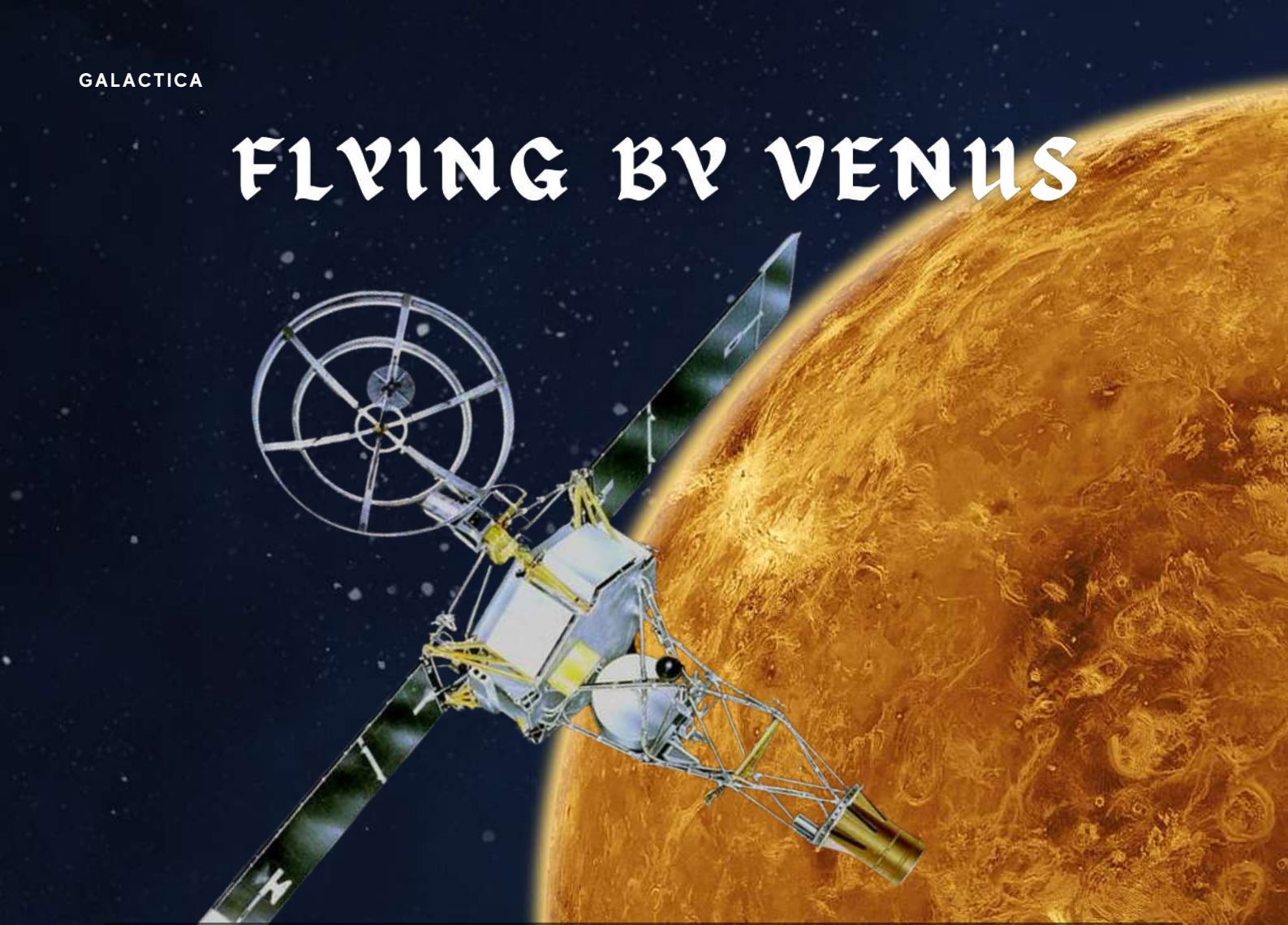
When Galileo was approximately 80 million kilometers away from Jupiter, the probe detached and began its fall toward the giant planet. On 7th December 1995, it hit the atmosphere, and for 58 minutes, it returned valuable information. Sixty-one minutes after contact with the atmosphere, it failed, succumbing to the enormous atmospheric pressure.

The Galileo orbiter reached Jupiter around the same time but maintained an orbit around the planet. This made Galileo the first artificial satellite of Jupiter. Galileo orbited Jupiter for almost eight years. It dutifully sent back data about the planet and its moons and aided in changing our view of the solar system. Through Galileo, we learned the existence of an ocean beneath Europa's surface, and we got to observe a comet colliding with a planet.

On 21st September 2003, mission control deliberately destroyed Galileo by flying it into the Jovianian atmosphere. This was to avoid the unsterilised spacecraft contaminating Europa through a potential collision of the two bodies.

Galileo's successor Juno, still orbits the king of the solar system.

FLYING BY VENUS



Before 1962, Venus was unknown except for its size, the planet's position in the solar system and the high concentration of carbon dioxide present in the Venusian atmosphere. Scientists assumed that Venus's climate would be similar to Earth's tropics. A young scientist, Carl Sagan, disagreed. Instead, he proposed that the high levels of carbon dioxide would have created a runaway greenhouse effect, which means extremely high temperatures on Venus.

Mariner 2 changed that (while proving Sagan was correct).

Launched on 27 August 1962, Mariner 2 flew by Venus on 14 December 1962, almost 35,000 km from the planet's surface. During the 42-minute scan, despite the lack of a camera, the spacecraft gathered significant data on the Venusian atmosphere and surface.

The data gathered implied that the temperature difference throughout the planet wasn't much. This includes the equators, poles, day and night. The spacecraft also discovered the presence of a thick layer of cloud that starts from 56 km above the surface and extends up to 80 km up the surface. Mariner 2 did not detect a Venusian magnetic field but - at the time, it was believed to be due to the distance between the spacecraft and the planet.

Mariner 2 was the first spacecraft to successfully fly by another planet and the first spacecraft to measure the solar wind. It was also the first successful spacecraft from the Mariner program. A program NASA conducted to explore the inner planets between 1962 and 1973. Contact with the spacecraft was lost on 3 January 1962, after which Mariner 2 fell into a heliocentric orbit.

"Parker Solar Probe" touching the Sun

Since humanity launched into the space age, we have landed on the moon, sent satellites, landers, and rovers to other planets, heard the wind on another planet and even have spacecraft that have left the influence of the Sun's gravitational force. On 14 December 2021, humanity collected another feather for their space-age cap, when the Parker Solar Probe (Parker) passed the Alfvén's critical surface of the Sun, touching the stellar atmosphere.

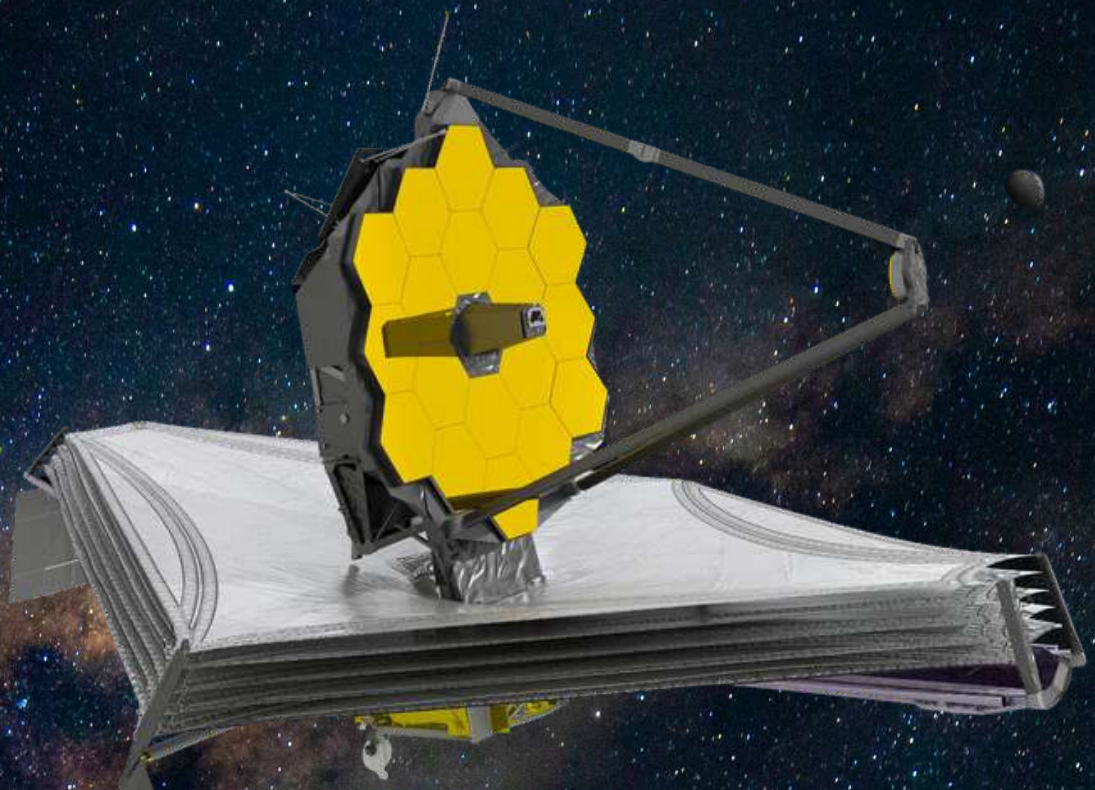
Parker launched on 21 August 2018 with the mission objective of observing the sun's outer corona. At the time of writing, Parker is currently the fastest human-built object. As of 27 September 2023, Parker's fastest speed is 635,274 km/h.

Parker is notable as it is the first NASA spacecraft named after a living person who got to see its launch. Professor Eugene Newman Parker, in the 1950s, proposed the existence of the solar wind. Like its namesake, Parker will revolutionize our understanding of the Sun by collecting measurements and images on the evolution of the solar wind and its origins. Its measurements will also contribute to forecasting any changes taking place in the space environment.

In 2019, Parker discovered that magnetic zig-zag structures in the solar wind, called switchbacks, are numerous close to the Sun. Later, after travelling closer to the Sun, it identified a potential source: the solar surface.

When Parker passes through the Alfvén critical surface (the point is where the solar atmosphere ends and the solar wind begins), at 18.8 solar radii over the photosphere, it proved that the surface isn't shaped like a smooth ball but has spikes and valleys that wrinkle on the surface. Before Parker, through remote imaging of the corona, researchers guessed that Alfvén's critical surface is between 10 and 20 solar radii from the solar surface.

In 2025, Parker will reach its closest approach within approximately 9 solar radii (from the solar surface) and reach its fastest speed 690, 000 km/h.



The Launch of WEBB

On Christmas Day, at 07.20 a.m. local time, Ariane 5 shot to space from Arianespace's ELA-3 launch complex near Kourou, French Guiana. Its cargo was extremely precious. JWST or James Webb Space Telescope, the largest telescope that NASA has ever built. It was decades in the making.

Conceptualized before the Hubble Space Telescope, HST or JWST's predecessor, started its mission, Ricardo Giacco, the then director of Space Telescope Science Institute, knew that it would take a long time for Hubble's successor to launch and directed his team to start thinking about it. Since that date, more than 30 years have passed.

Famously named after James E. Webb, the administrator of NASA between 1961 and 1968, the telescope development was plagued by years of delays and near cancellations. Yet, NASA, CSA, and ESA, the three agencies that contributed to the development of the world's most powerful and complex space observatory, persevered.

IJWST reached its observation post on 22 January 2022. During its travel, the telescope, with aid from Earth, unfolded its mirrors and unfurled the sun shield. Once done, the instruments were cooled, aligned, and calibrated before getting tested. Less than 6 months later, on 12 July 2022, the first image was released to the public. Since then, JWST's view of the universe has enthralled us.

Even though JWST has just started its mission in observing deep space, discussions are underway for the next space telescope, JWST's successor.

To learn about the numerous discoveries by WEBB, you can refer to JWST news in Space's GALACTICA from Volume 1 Issue 7 onwards.

HAPPY Diwali

Diwali at Space:

Diwali is a time of great joy and enthusiasm as people come together to celebrate the Festival of Lights. Picture the night sky aglow with the sparkle of countless candles and vibrant lights - that's the magic of Diwali!!

The Spacians were thrilled to welcome joy, happiness, and success to the Spaceship for the auspicious Diwali celebrations with open hearts. As the festival of Diwali approached, all the Spacians came together to celebrate. They showed off their festive outfits on the ramp, created beautiful Rangoli designs with vibrant colors, participated in the Diwali quiz, while illuminating the surroundings with countless Diya's.

Ramp Walk:

When it comes to ramp walking, no one can match the Spacians. The Spacians were ecstatic to display their exquisite attire, which embodies happiness, modernity, and culture, over the entire ramp.

Rangoli Competition:

We were astounded by the talents of Spacians in creating the most intriguing Rangoli designs with the wonderful colors on the floor. We faced a major dilemma in selecting only one winning team, but eventually it was the team of 5 that designed Chandrayaan 3.

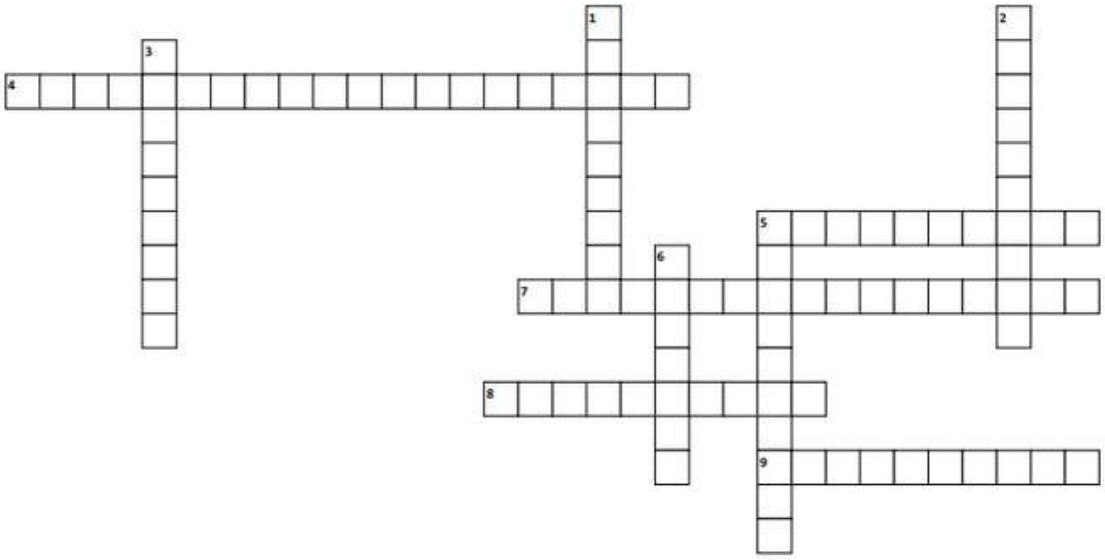
Lightning Diyas:
To bring the warmth and vibe of the Diwali at our Spaceship, we lightened the countless Diya's and took amazing group photos to treasure the memories of Diwali with our Space Family.

Birthday Month: November
Celebrated all amazing people's birthday that were born in November month with delicious food and cake!

Intern's Point of View- Ms. Pragya Verma:
During my Internship at Space, I got the opportunity to acquire various skills and knowledge under the guidance and support of Avani ma'am and the whole HR Department. I am immensely grateful for the valuable mentorship of Avani Ma'am throughout this journey. The collaborative work environment provided me with invaluable insights into the professional landscape. The internship not only deepened my understanding of HR but also affirmed my passion for the field.

TRAIN YOUR BRAIN

CROSSWORD



ACROSS

4. Any celestial body causing the light to curve is called
5. Hypothesis suggests that the expansion of the universe is accelerating.
7. Theory proposes that the speed of light is constant for all observers and is independent of the motion of the light source.
8. A theory/Hypothesis where humans experience the world in a simulated reality is called
9. Proposed theory that suggests the existence of parallel universes.

DOWN

1. Theoretical cosmic regions that function oppositely to a black hole is
2. The idea that life on Earth may have originated from microorganisms or chemical precursors brought to Earth by comets or meteorites.
3. A hypothesis that gives the ultimate fate of the universe is
5. The idea is that the universe is made up of mysterious dark matter and dark energy.
6. A theory suggesting that the universe is constantly expanding.

ASTRONOMY WORD PUZZLE

Find the names of the Largest moons in our Solar system from the mixed letters and mark them.

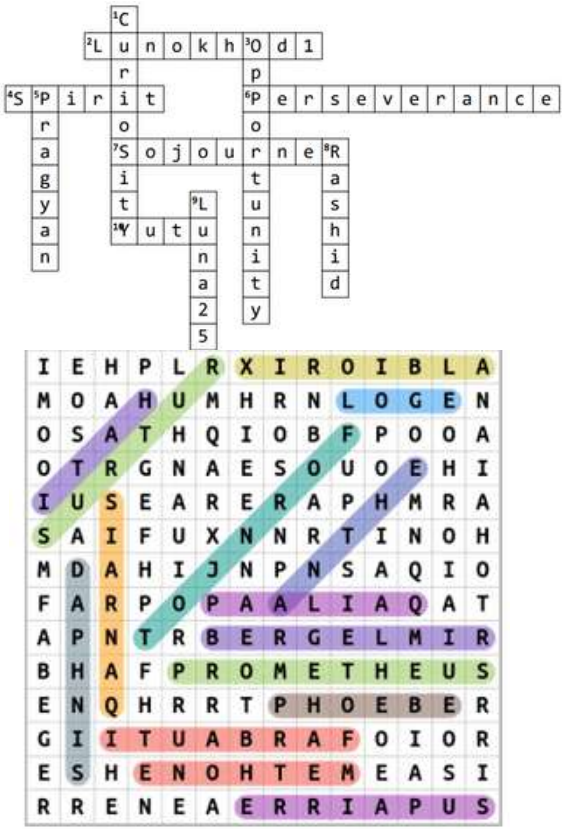
Largest Moons in our Solar system

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

ARIEL
TITAN
IAPETUS
CHARON
CALLISTO
UMBRIEL
TRITON
LUNA
DIONE
OBERON
DYSNOMIA
TETHYS
GANYMEDE
RHEA
EUROPA

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

Answers for last month puzzles.



CHECK OUT SPACE OFFERINGS

SPACE™

EMPOWERING LIFE

Making School Education Fun & Rocket-Science Easier

In Compliance With New Education Policy

SPACE INSIGHTS | SCHOOL PROGRAMS | ONLINE PROGRAMS | ASTROTOURISM
SPACE OUTREACH | ASTRONOMICAL EQUIPMENTS | SPACE LABS

GALACTICA MAGAZINE

SPACE TECHNOLOGY & EDUCATION PVT. LTD.

Plot No.3, Institutional Area, Sector 11, Dwarka, New Delhi 110075, India

www.space-global.com info@space-global.com +91-95991 91909 / 295784 | +91-92126 69920 / 29

Explore our websites

DECEMBER 2023 | VOLUME 2 | ISSUE XII

FOLLOW US ON: