Third Edition

ASTRONOMY CLUB, IITK

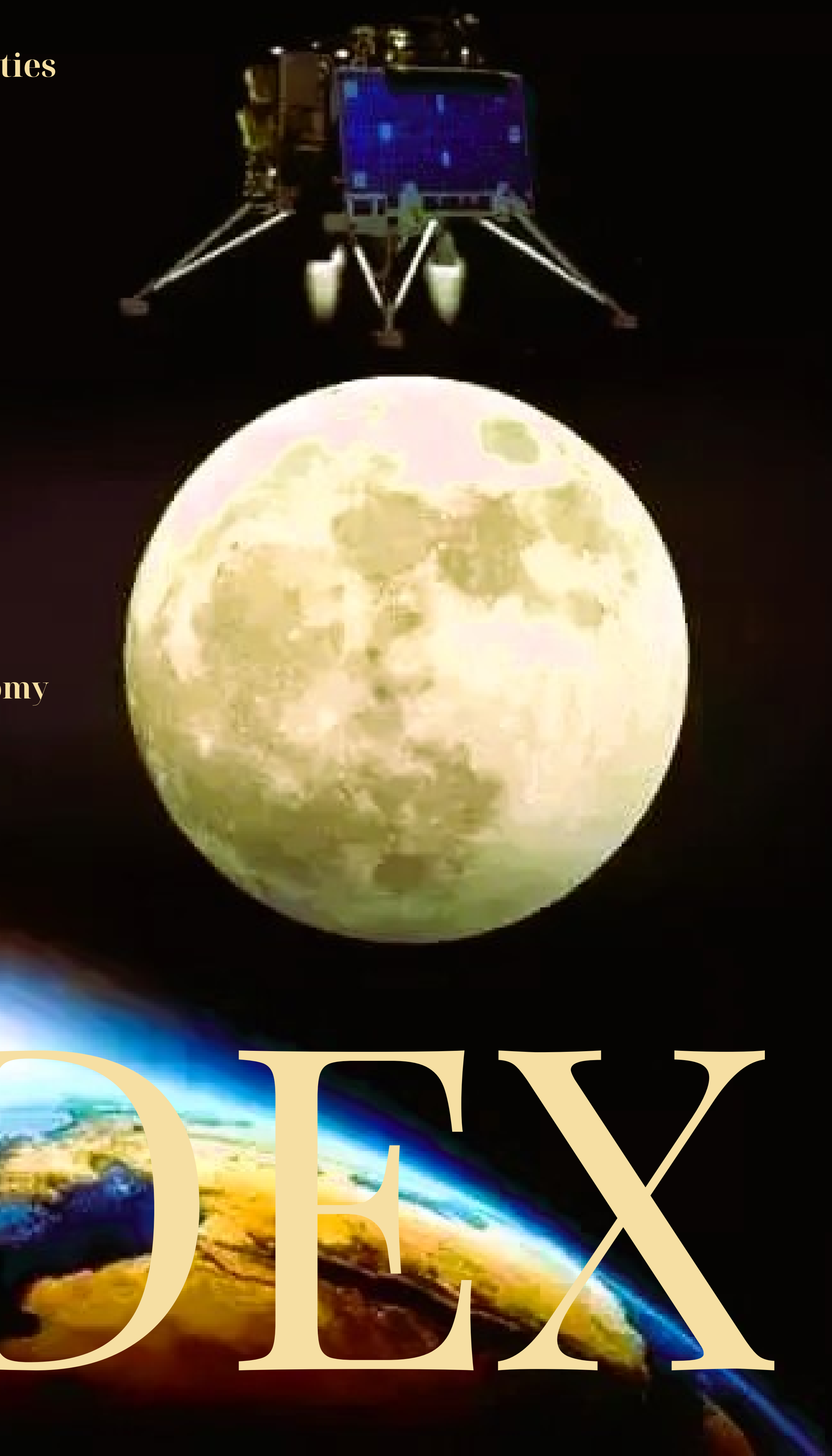
CYGNUS

2023

"Astronomy compels the soul to look upward, and leads us from this world to another."

– Plato


ISRO
INDIA



DEX

about the club

HISTORY

THE ASTRONOMY CLUB AT IIT KANPUR WAS ESTABLISHED IN 1975, MAKING IT QUITE A LONGSTANDING INSTITUTION. WE PROUDLY ACKNOWLEDGE OUR LONG HISTORY. INITIALLY, ONE OF OUR FACULTY MEMBERS GENEROUSLY CONTRIBUTED A 138MM NEWTONIAN REFLECTIVE TELESCOPE, A VALUABLE AID THAT HAS SERVED US WELL IN OBSERVING CELESTIAL BODIES OVER THE YEARS. THIS MARKED THE BEGINNING OF OUR EXPLORATION INTO THE FASCINATING REALM OF ASTRONOMY, IGNITING OUR PASSION FOR FURTHER DISCOVERY.

WHAT WE DO

WE ARE A PASSIONATE GROUP OF STUDENTS FROM IIT KANPUR WHO SHARE A DEEP APPRECIATION FOR THE WONDERS OF THE COSMOS. WHILE NOT ALL OF US HAVE A FORMAL BACKGROUND IN ASTRONOMY, OUR ENTHUSIASM FOR EXPLORING THE UNIVERSE IS WHAT UNITES US. THE ASTRONOMY CLUB WELCOMES STUDENTS FROM ALL ACADEMIC LEVELS, RANGING FROM FRESHMEN TO FINAL-YEAR UNDERGRADUATES, AS WELL AS POSTGRADUATES AND THOSE PURSUING PHDS. OUR DIVERSE MEMBERSHIP INCLUDES NOT ONLY PHYSICS MAJORS BUT STUDENTS FROM VARIOUS DEPARTMENTS. ALL THAT'S REQUIRED TO JOIN IS A MODEST INTEREST IN THE STARS, OR EVEN JUST THE WILLINGNESS TO SPEND TIME WITH US – WE'LL ENSURE THAT YOU DEVELOP A LOVE FOR THE COSMOS, CONSIDERING THAT YOU, LIKE ALL OF US, ARE COMPOSED OF STARDUST. SO, WHETHER YOU PERCEIVE VARIABLE STARS AS MYSTICAL ENTITIES OR VIEW COMETS AS OMENS OF CONFLICT, WE EXTEND AN INVITATION FOR YOU TO JOIN US ON THIS CELESTIAL JOURNEY.

SNT PAVILLION

The Astronomy Club at IIT Kanpur demonstrated its expertise in the inaugural SnT Pavilion for the Y23 batch. Spanning four days from August 7th to August 10th, we cherished the opportunity to engage with the incoming students at IITK.

In summary, our club's objective is to offer a platform for all astronomy enthusiasts to come together, learn, innovate, aspire, teach, and delve into the mysteries of the cosmos with us. We trust that we successfully reignited a passion for astronomy within the campus community, whether through night sky observations, group discussions, talks, documentaries, events, and various other activities!

CHANDRAYAAN LANDING

Hats off to the amazing team of scientists and workers at ISRO for their incredible feat! Chandrayaan 3's Lander Vikram successfully touched down the lunar surface (south pole) with precision and grace . Major kudos from the Astronomy Club, IIT Kanpur. While ISRO achieved its goal all the students and faculty members gathered in Lecture Hall 7 to witness the live landing of chandrayaan on moon.

SATURN OBSERVATION SESSION

On September 24th and 25th, 2023, the Astronomy Club IITK hosted a night sky observation session for Saturn. These nights marked one month of Saturn Opposition, the rare occurrence of Saturn coming closest to Earth, in opposition to the Sun. Saturn was this close to the Earth since 1969, this brightest since 2003, and will not be witnessed at such brightness until 2039, making it a truly rare occurrence. Attendees were able to observe Saturn and its majestic rings, sometimes even with its two major moons, Titan and Enceladus.

Being open to the entire campus community, a remarkable turnout of over 3500 people, in the 2 days of the session, including both students and faculty members, gathered to witness the opposition of Saturn.

INTRO LECTURE FOR Y23

The Introductory Lecture of the Astronomy Club, IIT Kanpur, held on 8th September, for the Y23 Batch of students, was a cosmic blast! The energy from our amazing freshers was out of this world! We enjoyed their joining us, their enthusiasm lights up the galaxy and we can't wait to explore the universe together! Welcome to the Astronomy Club family!

ASTRO CLUB PRESENTATION IN SCIENCE CITY: KALAM STAR PARTY

Delving into the Enigmas of the Universe, Frame by Frame! Our Astronomy Club at IIT (BHU) Varanasi gathered with the brilliant minds of the Astronomy Club at IIT Kanpur in Lucknow. Our objective? To venture into the night sky through lenses, exchange cosmic perspectives, and cultivate future partnerships.

As the stars assumed their positions above, we unearthed new constellations below – comprised of ideas, camaraderie, and the vast universe. Stay tuned for more captivating tales from this unique celestial encounter!
It was one of the best experiences that we had all through the year. In the end we were also given a chance to pitch our project ideas to for further funding of our projects in order to continue the respective project.

WINTER CAMP

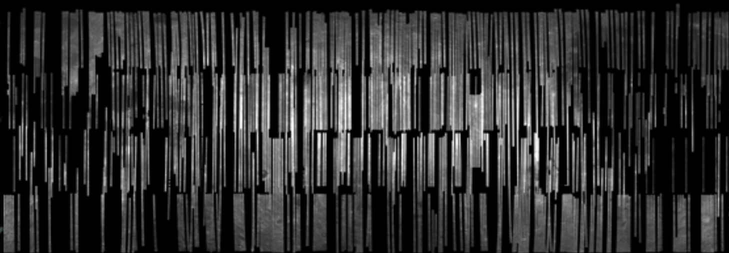
Winter Camp for Y23s was conducted this year from 28th November to 6th December with a daily commitment of 2-3 hours.
The children were taught many things like about projects , information about Inter-Hall competitions like Takneek , different problem statements etc.
We taught them about different projects like Automated Star Pointer , Telescope Handling, Computational Astronomy Briefing and on the last day we had ended the camp with a planetarium show in the clubroom.

DIWALI

Astronomy club also celebrated Diwali. We made our Rangoli on the clubroom entrance and took pictures and had a good bulla session with the seniors , it was great night.

INTER-IIT TECH MEET 11.0

The ISRO Contingent from IIT Kanpur has maintained its impressive track record at the Inter-IIT Tech Meet 11.0 by securing the bronze medal in the ISRO Problem Statement. The recently concluded event, hosted at IIT Kanpur, witnessed stellar performances, including the remarkable achievement of the Astronomy Club IITK. The club has presented a lunar atlas, crafted from publicly available Lunar Terrain data captured by the Terrain Mapping Camera aboard Chandrayaan-2 and hosted by ISRO.



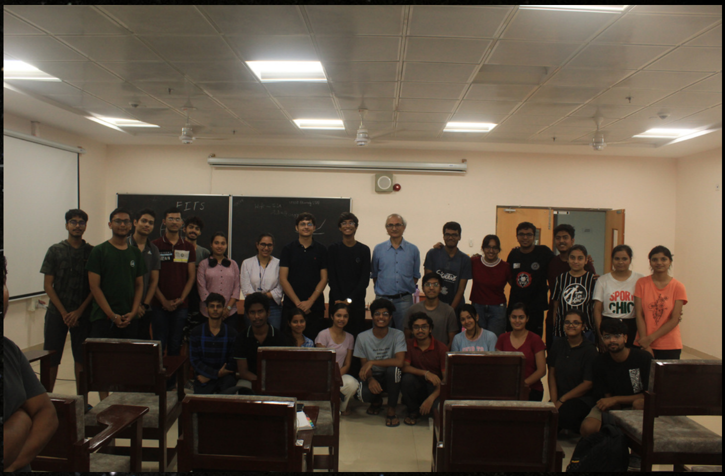
The problem statement consisted of 2 parts:

1. Development of an AI/ML model to generate high resolution images from medium/low resolution terrain images.
2. Generation of a global lunar atlas (digital) based on the medium/low resolution data available.

The Team: Gurbaaz Singh Nandra, Mohammad Muzzammil, Siddhart Watsa, Adit Jain, Nishi Mehta, Raj Verma, Rajarshi Dutta, Tejas Chikoti, Deven Gangwani and Shrilakshmi

TALK SESSION BY PROF. MURTHY

We had the opportunity to meet Professor Jayant Murthy, a well renowned astronomer, director of the Indian Institute of Astrophysics, Bangalore, known for his work on UV Background Radiation. In an enlightening session, he delved into the cosmos' UV mysteries, expanding our cosmic horizons.



Professor Murthy enthusiastically explained about his research on UV Background Radiation, Interstellar Matter and its effect on Future Astronomy. Furthermore, he also walked us through the various types of activities and research the Institute of Astrophysics undertakes and the various aspects of kickstarting one's celestial journey. He also bridged the gap between science and wonder, stoking our intrigue.

MANDAKINI

"Look up at the stars and not down at your feet. Try to make sense of what you see, and wonder about what makes the universe exist." - Stephen Hawking

Mandakini is the annunal festival of the Astronomy Club and Techkriti's stellar series of events celebrating the wonders of astronomy! With a prize amount of INR 50 Thousand, students put their knowledge to the test and explored the mysteries of the cosmos. Putting their creative juices to work, they ventured along with us on the exciting adventure! Various Guest Speakers were also invited and the partcipants got to learn a lot from this experience.

Written by - Srisha
Designed by - Astitva

CLUB PROJECTS

Many summer projects are offered by the various SnT clubs every year. This year, during the summers of 2023, the Astronomy Club offered four projects which were a great experience and provided the mentees with a range of knowledge and exposure to different domains of Astronomy. From observing distant galaxies and star systems, exploring Star Cycles, working with electrical sensors to making JWST twins or a Horn Antenna, these projects provided unforgettable journeys into the heart of the universe.

COSMOCODE

THIS PROJECT DEMONSTRATED HOW OBSERVATIONAL ASTRONOMY AND COMPUTATIONAL ASTRONOMY GO HAND IN HAND. MENTEES OBSERVED THE SPACE USING THE HORN ANTENNAS THAT THEY CONSTRUCTED IN THE SPACE SCIENCE AND ASTRONOMY LAB. THEY THEN PROCESSED THE OBTAINED DATA USING SIGNAL PROCESSING TECHNIQUES AND ALSO USED ML MODELS TO CREATE AN IMAGE OF THE GALACTIC CENTER. SOME OF THE OBJECTIVES OF THE PROJECT INCLUDED:

SIGNAL PROCESSING OF RADIO WAVES; FOURIER TRANSFORM THEORY, CORRECTIONS, FILTERS, AND RTL-SDR DEVICES; ASTROPY, SCIPY, AND MACHINE LEARNING MODELS FOR RADIO SIGNALS CLASSIFICATION; COLLECTING OBSERVATIONS FROM RTL-SDR HORN ANTENNA; COMBINING RADIO SIGNALS FROM 2 DIFFERENT HORN ANTENNAS AND APPLYING SIGNAL PROCESSING TECHNIQUES.

TOUR DE OAAR

THE MAIN OBJECTIVES OF THE PROJECT INCLUDED BASIC TELESCOPE HANDLING,LEARNING PYTHON AND LIBRARIES LIKE NUMPY AND ASTROPY, UNDERSTANDING THE OAAR THROUGH DIFFERENT SOFTWARES AND SIMULATION OF THE UNIVERSE. MENTEES VISITED OBSERVATORY LOCATED IN AIRSTRIP AND CONDUCTED NIGHT SKY OBSERVATIONS AND TOOK IMAGES USING THE 14" TELESCOPE OF THE OBSERVATORY AND ALSO UNDERSTAND THE FUNCTION OF THE VARIOUS CIRCUITS AND SENSORS (MAKING RAINDROP SENSOR) USING ARDUINO, SIMULATE STAR SYSTEMS USING UNIVERSAL SANDBOX AND MATLAB ETC. MENTEES MASTERED THE TECHNIQUE TO CAPTURE THE STUNNING NIGHT SKY WITH A SMARTPHONE.

STELLAR ODYSSEY

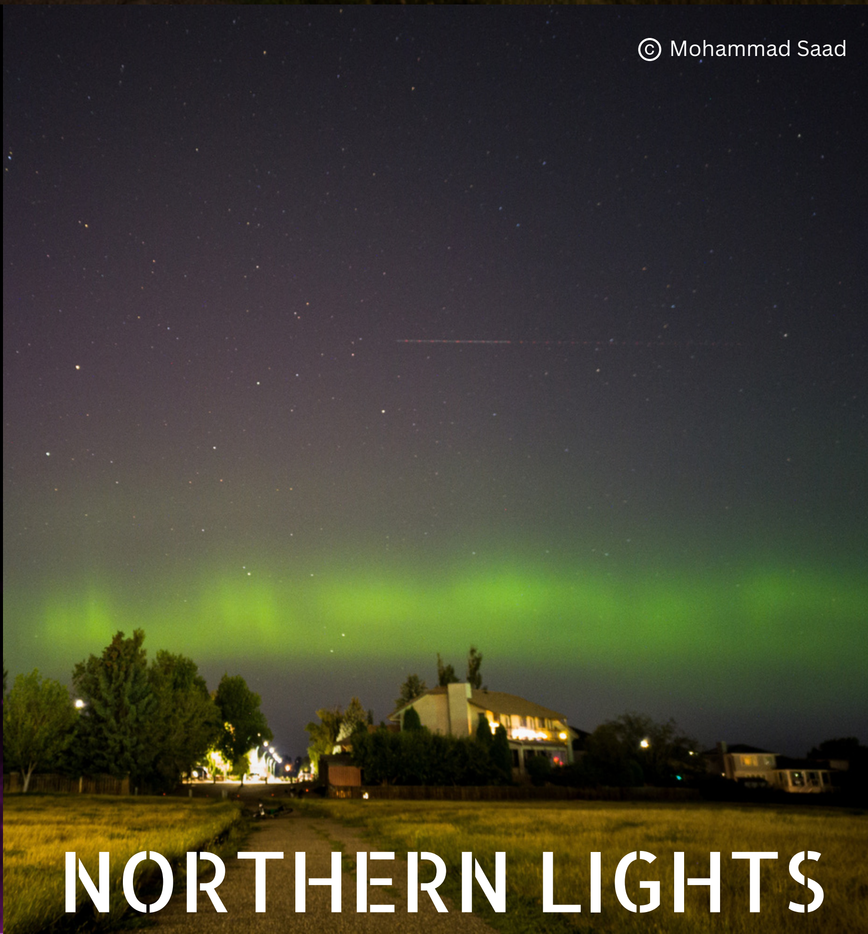
THIS PROJECT MAINLY FOCUSED ON THE ASTROPHYSICS ASPECT OF SCIENCE, CONTRARY TO THE OTHER PROJECTS, WHICH ARE COMPUTATIONAL AND BASED ON HANDS-ON EXPERIENCE. THIS PROJECT AIMED TO ENSURE THAT MENTEES GET ENTHUSIASTIC IN THE FIELD OF ASTRONOMY BY APPLYING CONCEPTS OF PHYSICS AND UNDERSTANDING AND ANALYSING RAW DATA OF OFFICIAL RESOURCES LIKE NASA AND ISRO AND UNDERSTANDING THE FATE OF STARS THROUGH THIS PROJECT. THIS PROJECT ALSO INCLUDED THE USAGE OF THE OBSERVATORY LOCATED IN THE AIRSTRIP TO GIVE THE STUDENTS AN EXPERIENCE OF LOCATING STAR STRUCTURES AND LEARNING IMAGE PROCESSING AS A COLLABORATION WITH THE OTHER PROJECTS OFFERED BY THE CLUB. THE PROJECT'S THEME IS THE LIFE CYCLE OF A STAR AND ITS ENTIRES FATE, CONSIDERING VARIOUS CLASSIFICATIONS.

OPTICAL ODYSSEY

THE MAIN AIM OF THE PROJECT WAS TO BUILD THE JAMES WEBB SPACE TELESCOPE (JWST) TWIN. FOR THIS PURPOSE, MENTEES GET A BASIC INTRO TO THE WORKING OF VARIOUS LAND AND SPACE TELESCOPES AND UNDERSTAND THE WORKING OF DIFFERENT EQUIPMENT AND PROCESSING DATASET FROM JWST. THEY THEN LEARN MULTIPLE MIRROR OPTICS AND CONDITIONS IN SPACE BY BUILDING A LIGHT COLLECTOR SIMILAR TO THAT OF THE PRIMARY MIRROR OF THE JWST. THE LIGHT COLLECTOR IS ILLUMINATED USING A HEAT LAMP, AND THE INTENSITY OF LIGHT REFLECTED FROM THE MIRRORS IS MEASURED FROM BEHIND A PROTECTIVE "SUNSHIELD". THE OBSERVATIONS ARE RECORDED AND THE DATA IS ANALYSED. THEN, THEY CONSTRUCTED A SET UP SIMILAR TO THE JWST (MINI-JWST TWIN) AND FROM THE DATA TAKEN FROM THIS SET UP, WAS USED TO CALCULATE THE EFFICIENCY OF THE SUNSHIELD.

ASTROPHOTOGRAPHY

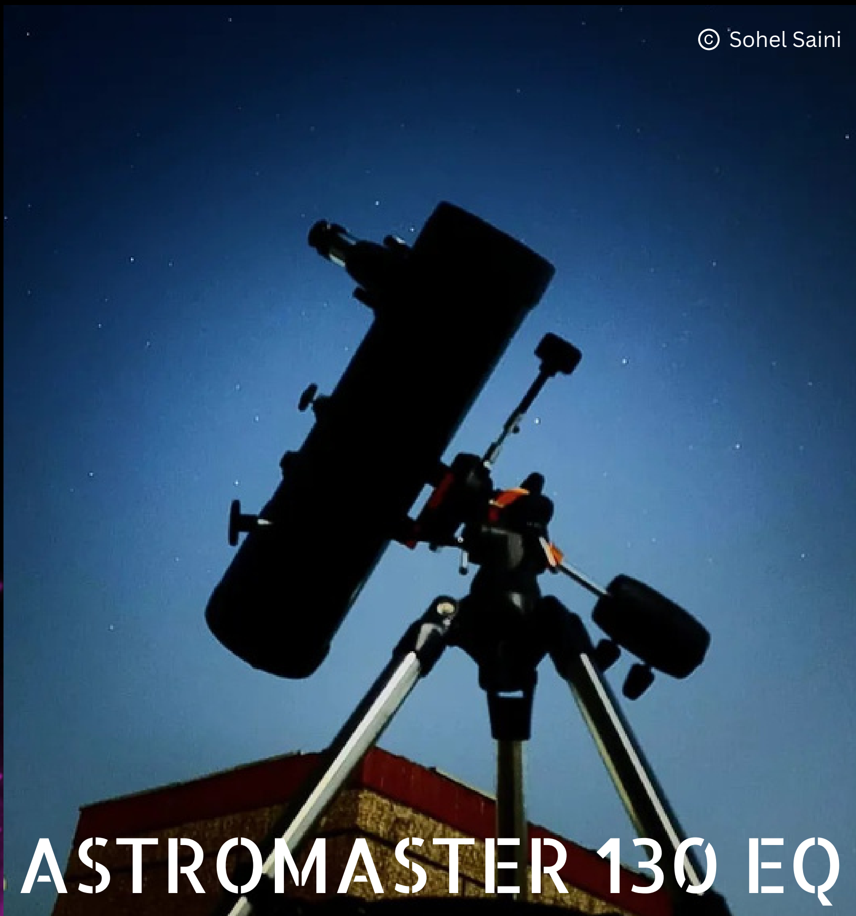
THE AURORA BOREALIS (NORTHERN LIGHTS) IS A TIMELESS SYMBOL OF BEAUTY AND MAJESTY. A COSMIC BALLET OF CHARGED PARTICLES COLLIDING WITH EARTH'S ATMOSPHERE, THIS MESMERIZING SPECTACLE CAPTIVATES THE NIGHT SKY, LEAVING AN INDELIBLE IMPRESSION OF NATURE'S ETHEREAL BEAUTY.



LUNAR CRATERS

© Abhinav Singhal

THE ABOVE IMAGE SHOWS LUNAR CRATERS, WHICH ARE BOWL-SHAPED HOLES ON THE LUNAR SURFACE CAUSED BY VOLCANOES OR IMPACTS FROM SPACE ROCKS AND DEBRIS. THE LARGEST AND DEEPEST CRATER ON THE MOON IS THE SOUTH POLE-AITKEN BASIN, WHICH IS ABOUT 2,500 KILOMETERS WIDE AND 8-9 KILOMETERS DEEP.



© Sohel Saini

THE CALIFORNIA NEBULA IS AN EMISSION NEBULA LOCATED IN THE CONSTELLATION PERSEUS. ITS NAME COMES FROM ITS RESEMBLANCE TO THE OUTLINE OF THE US STATE OF CALIFORNIA IN LONG EXPOSURE PHOTOGRAPHS. IT LIES AT A DISTANCE OF ABOUT 1,000 LIGHT YEARS FROM EARTH. THE CALIFORNIA NEBULA WAS DISCOVERED BY E.E. BARNARD IN 1884.

CALIFORNIA NEBULA

© Arya Sorate

STAR TRAILS

STAR TRAILS, FORMED DURING LONG-EXPOSURE PHOTOGRAPHY OF THE NIGHT SKY, CAPTURE THE EARTH'S ROTATION. THESE LUMINOUS STREAKS DEPICT THE APPARENT MOTION OF STARS, CREATING CAPTIVATING CELESTIAL PATTERNS IN THE NIGHT SKY.

© Adit Jain

ORION NEBULA

THIS SPECTACULAR IMAGE SHOWS THE ORION NEBULA, ALSO KNOWN AS MESSIER 42, IS A DIFFUSE NEBULA IN THE ORION CONSTELLATION DISCOVERED BY FRENCH SCHOLAR NICOLAS-CLAUDE IN 1610. IT HAS A TRAPEZIUM STAR CLUSTER AT IT'S HEART FORMED DIRECTLY OUT OF THE PARENT NEBULA.

© Arya Sorate

© Adit Jain

GEMINIDS

THE METEORS, KNOWN AS GEMINIDS, RADIATE FROM NEAR THE BRIGHT STAR CASTOR IN THE CONSTELLATION GEMINI (THE TWINS), IN THE EAST ON DECEMBER EVENINGS. THE BOLD, WHITE, BRIGHT GEMINIDS GIVE US ONE OF THE NORTHERN HEMISPHERE'S BEST SHOWERS, ESPECIALLY IN YEARS (LIKE 2023) WHEN THERE'S NO MOON DURING THAT TIME.

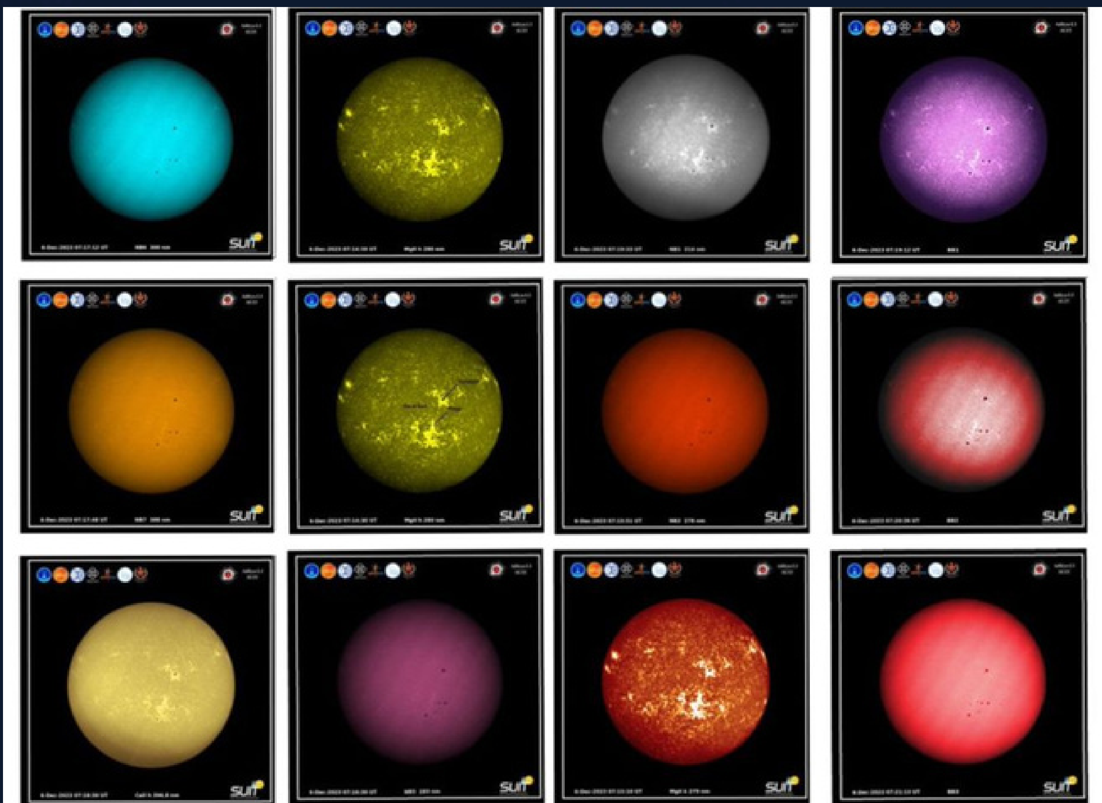
SUPER BLUE MOON

WHAT?

A BLUEMOON IS A RARE PHENOMENON THAT OCCURS WHEN THE MOON IS THE THIRD FULL MOON IN A SEASON OR THE SECOND FULL MOON IN A MONTH.

WHY?

SOMETIMES, SMOKE OR DUST IN THE AIR CAN SCATTER RED WAVELENGTHS OF LIGHT, AS A RESULT OF WHICH THE MOON MAY, IN CERTAIN PLACES, APPEAR BLUE .



IMAGES OF THE SUN FROM THE ADITYA-L1 MISSION

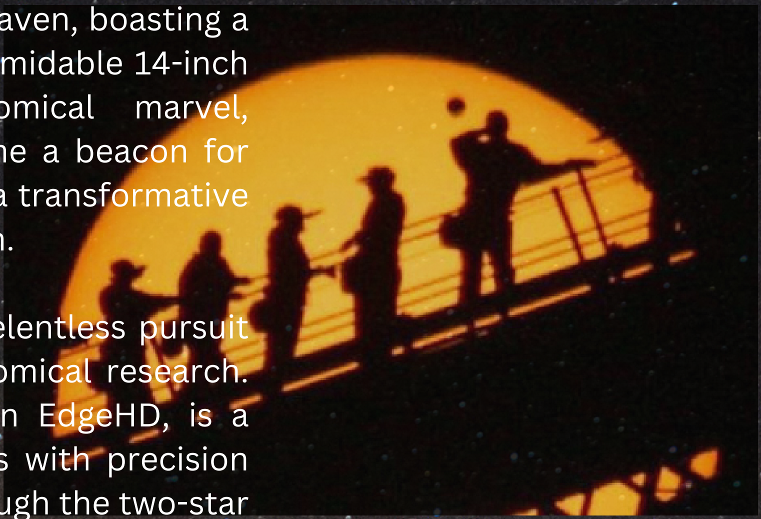
© https://www.isro.gov.in/Aditya_L1_SUIT.html

THE SOLAR ULTRAVIOLET IMAGING TELESCOPE (SUIT) INSTRUMENT ON BOARD THE ADITYA-L1 SPACECRAFT HAS SUCCESSFULLY CAPTURED THE FIRST FULL-DISK IMAGES OF THE SUN IN THE 200-400 NM WAVELENGTH RANGE. SUIT CAPTURES IMAGES OF THE SUN'S PHOTOSPHERE AND CHROMOSPHERE IN THIS WAVELENGTH RANGE USING VARIOUS SCIENTIFIC FILTERS. AMONG THE NOTABLE FEATURES REVEALED ARE SUNSPOTS, PLAGE, AND QUIET SUN REGIONS.

THE DEVELOPMENT OF SUIT INVOLVED A COLLABORATIVE EFFORT UNDER THE LEADERSHIP OF THE INTER-UNIVERSITY CENTRE FOR ASTRONOMY AND ASTROPHYSICS (IUCAA), PUNE. THIS COLLABORATION INCLUDED ISRO AND VARIOUS OTHER EDUCATIONAL INSTITUTES. FOR MORE INFO, YOU CAN VISIT: HTTPS://WWW.ISRO.GOV.IN/ADITYA_L1_SUIT.HTML

Observatory at IIT Kanpur

In the heart of the Indian Institute of Technology Kanpur (IITK), the Astronomy Club has established a celestial haven, boasting a state-of-the-art observatory equipped with a formidable 14-inch Celestron EdgeHD telescope. This astronomical marvel, inaugurated in the summer of 2014, has become a beacon for unlocking the mysteries of the cosmos, offering a transformative experience by bringing the heavens down to earth.



The observatory stands as a testament to the relentless pursuit of knowledge, providing a sanctuary for astronomical research. The centrepiece, a mammoth 14-inch Celestron EdgeHD, is a marvel in itself, capturing the celestial wonders with precision and clarity. The automated mount, alignable through the two-star method, heralds a new era in observational efficiency.

A pivotal feature of this celestial citadel is its mechanical dome, capable of graceful rotations in both clockwise and anticlockwise directions. Beyond the terrestrial confines, the dome slab's above-the-head motion facilitates dynamic changes in direction, offering astronomers an ever-shifting viewpoint of the cosmos. A typical day at the observatory involves the meticulous observation and extraction of raw astronomical data, captured by the powerful Celestron telescope. These raw images then undergo a transformative journey through astrophotography tools such as FITS Liberator and the Adobe Photoshop toolkit. The processed images, now imbued with intricate details, serve as the foundation for a deeper understanding of the universe.

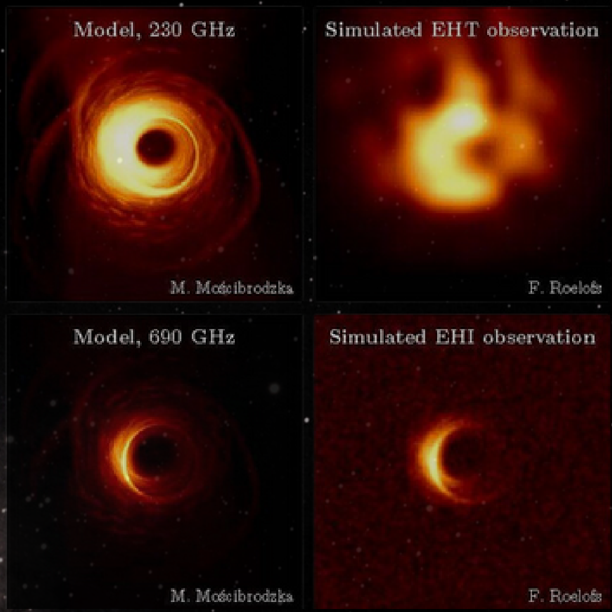
The pandemic may have momentarily dimmed the celestial lights, but the Astronomy Club's dedication has ensured that the observatory remains fully functional. Despite the challenges faced, the pursuit of knowledge prevailed, and the observatory now stands ready to resume its cosmic explorations. Looking to the future, the Astronomy Club envisions a seamless transition towards automation, to further reduce manual intervention. This technological evolution will not only enhance the efficiency of the observatory but also elevate its capabilities, opening new frontiers in the realm of astronomical research. As the observatory continues to unveil the secrets of the cosmos, the diligent astronomers at IIT Kanpur invite all to join them on this celestial journey, where the wonders of the universe are brought closer to Earth, one observation at a time. Here we have a few samples of what we have mined from our observatory.

WRITTEN BY SURYANSH
DESIGNED BY AKSHITA

Astrophysics Marvels: Black Ho
the Event Horizon Telescope (E

Introduction Among the many mysteries and cosmic wonders that fill the wide expanse of the universe, one innovative project that has gained prominence recently is the Event Horizon Telescope (EHT). Together, scientists from all across the world have pushed the limit of knowledge and produced breathtaking photographs of black holes, which were previously regarded to be enigmatic phenomena. This article explores the history, significance, methods employed, the need for a black-hole-imaging-telescope-array, and many advantages that the EHT has provided for our understanding of the universe

Furthermore, black holes are essential to the cosmic drama because they shape the universe's fabric and affect how galaxies evolve. Scientists can solve the puzzles of galactic dynamics and learn more about the origins and development of the cosmos by studying their characteristics and actions.



The Birth of the EHT

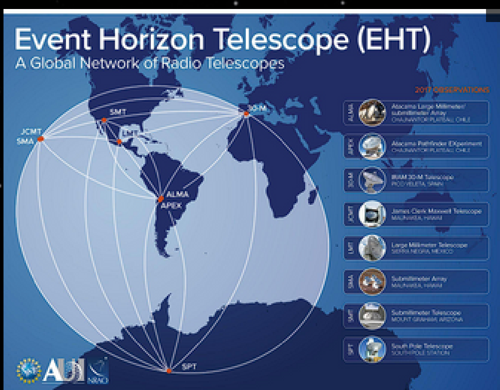
The idea for the Event Horizon Telescope originated in the latter part of the 20th century, when scientists dreamed of taking a picture of the event horizon of a black hole, which is the point beyond which nothing can escape the gravitational pull of the object, not even light. The EHT project formally started in the early 2000s, bringing together a global coalition of observatories, researchers, and institutions, motivated by a shared quest to disclose the cosmic abyss.

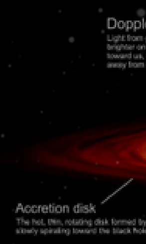
The Need for Black Hole Imaging

Why are black holes so fascinating, and why is it necessary to take pictures of them? Black holes are thought to be the most extreme places in the universe, where gravity is so strong that even the standard rules of physics are broken. By providing a window into the underlying nature of space and time, imaging these cosmic phenomena affords a unique chance to test Einstein's theory of general relativity in its most difficult domain.

The EHT Consortium: A Symphony of Observatories

Instead of being a single telescope, the EHT is a synchronised array of radio telescopes placed at key locations all over the world. Collectively, these observatories—which span the South Pole and the high plateaus of the Atacama Desert—create a virtual Earth-sized telescope with previously unheard-of resolution. Including a variety of geographic locations improves the EHT's capacity to examine black holes from many perspectives, offering a thorough understanding of these celestial phenomena.





Benefits

The succe
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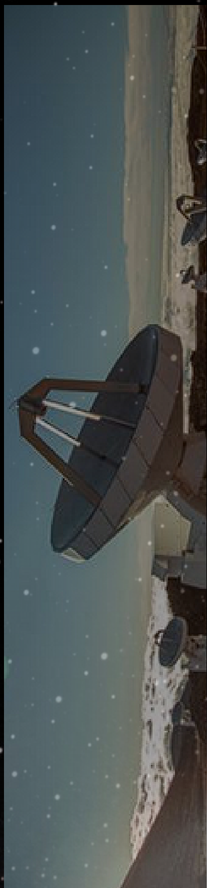
le Imaging and EHT)

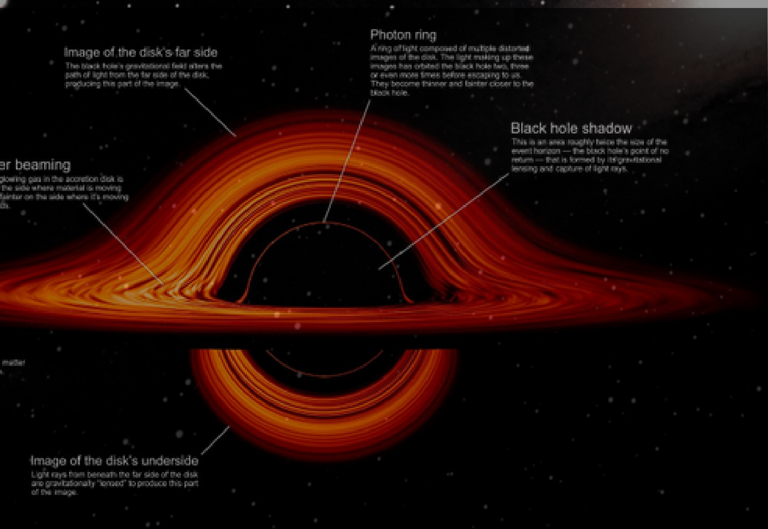
Written by - Abhinav
Designed by - Siri

Methodologies Employed: Harnessing the Power of Interferometry

The very-long-baseline interferometry (VLBI) technology is the crux of the EHT's imaging capabilities. This technique creates a virtual telescope with a resolution equal to the distance between the individual antennas by merging signals from several telescopes located over great distances. Atomic clocks and high-performance data processing are needed for the technological marvel of synchronising these signals, which guarantees precision.

The supermassive black hole in the heart of the galaxy M87 was captured in the first-ever photograph of a black hole, which was unveiled by the EHT team in April 2019. This ground-breaking accomplishment was a validation of human creativity in cracking the cosmic code as well as a victory for VLBI technology.





Beyond the Event Horizon

ess of the EHT goes much beyond just depicting black holes The information gathered by this cooperative endeavour has new opportunities for scientific investigation, allowing to delve deeper into the underlying ideas that control the Scientists can improve their knowledge of gravitational nd astrophysics by examining how matter behaves in the avitational fields that surround black holes. knowledge.

Moreover, the contributions of the EHT reach beyond pure science. The initiative has captured people's minds worldwide and sparked a renewed interest in astrophysics and space travel. The famous picture of the M87 black hole has come to represent human curiosity and the unwavering search for

Challenges and Future Prospects

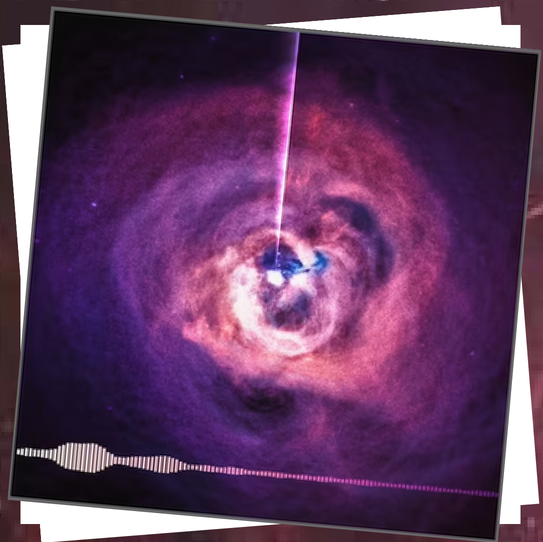
Even though the EHT has been remarkably successful, difficulties are yet ahead of us. Enhancing the capabilities of the EHT requires more observatories, higher sensitivity, and technical advancements. Moreover, there is still work to be done in order to take a picture of Sagittarius A*, the supermassive black hole in the heart of our Milky Way.

Future objectives for the EHT collaboration include expanding the array and utilising cutting-edge technology as they work to further push the limits of cosmic observation. As we approach a new chapter in the history of astronomy, the Event Horizon Telescope continues to be a shining example of human achievement, serving as a constant reminder that the mysteries of the cosmos are slowly being revealed.

Conclusion

The Event Horizon Telescope truly embodies the incredible collaborative spirit of the global scientific community. This groundbreaking technology has completely shifted our understanding of the universe and pushed the boundaries of observation. The mesmerising images of black holes captured by the EHT since its inception have opened up new frontiers in our exploration of space. As we eagerly anticipate the next phase of the EHT's journey, it's clear that this remarkable telescope is not just solving cosmic mysteries but also inspiring future generations to dream big and reach for the stars. Let's take a moment to revel in the triumph of scientific brilliance and look forward to the exciting discoveries that lie ahead. The Event Horizon Telescope is not just a tool; it's a beacon of curiosity that encourages us all to explore the wonders of the cosmos

SOUNDS OF SILENCE : COSMIC VIBRATIONS



Sonification

Although Hubble provides us with images of the cosmos, there are other ways to view these spectacular wonders. The same digital data that is converted into pictures may also be converted into sound through a process called data sonification. Pitch and volume are given to visual elements like brightness and location. Although sound cannot travel across space, sonifications offer a fresh perspective on how data may be experienced and understood. Sonifications enable data exploration and astronomical picture "listening" for the audience, including the visually challenged.

The sound of a black hole

NASA has discovered a galaxy cluster with abundant gas, allowing them to detect sounds. Sound has been connected to the black hole located at the centre of the Perseus galaxy cluster since 2003. This is because astronomers found that the black hole's pressure waves produced ripples in the heated gas within the cluster- that may be understood as an audible note that is inaudible to humans. To make it perceptible to human hearing, they amplified it and mixed it with other data, simulating the sound of a black hole.

Sound on Mars

For the first time, eerie audio recordings made on Mars have shown two different sound rates on the red planet.
Since the velocity of sound is influenced by the density of objects they inhabit, the latest audio from NASA's Perseverance rover indicates that the speed of sound is slower on Mars than it is on Earth. For example, sound travels more quickly through denser medium water on Earth than it does through air. Sound travels at around 550 miles per hour on Mars compared to 767 miles per hour on Earth, which is expected, given that Mars' atmosphere is 100 times thinner than Earth's.

On Mars, high-pitched sounds travel at 559 miles per hour, while low-pitched sounds travel at about 537 miles per hour. With high-pitched sounds arriving earlier than bass, it might create a unique hearing experience on Mars. Put another way, if you were standing on Mars and could hear music playing nearby, the high notes would reach you before the low notes.

To hear anything at all from this speculative Martian band, you would have to be very close to it. Because Martian air is such a poor vector for acoustic waves, researchers also discovered that sound starts to diminish at a distance of only 26 feet from a source. As a result of this, Mars is an eerily silent planet.

Sounds of the gravitational waves

For the first time, astronomers have been able to "hear" the celestial hum of potent gravitational waves that are produced when black holes collide. The observations show that the waves occur at different frequencies and oscillate for decades, with some of them even slowly undulating as they pass through our Milky Way galaxy. Ultra-low-frequency gravitational waves comprise the gravitational wave background, a kind of cosmic noise long theorised but never detected. These waves all hum and resonate together in the background as black holes collide throughout the universe.

This finding may contribute to our understanding of cosmic phenomena such as the frequency of galaxy mergers and supermassive black holes.

Sounds of the Sun

The Sun produces very low-frequency "sound" due to the circulation of its atmosphere. Waves pass through any material that is not stationary, and the Sun experiences this same phenomenon. This type of movement(waves) on the sun is invisible to the unaided eye. This "Sun song" is the translation of that movement into a sense that humans can experience sound. There are many distinct frequencies at which the Sun vibrates. Considering that there are no simple ways of looking inside the Sun, researchers use the natural vibrations of a star or the Sun to see inside it. It aids in their comprehension of the Sun's complexity and its many layers.

WRITTEN & DESIGNED BY ARPITA

History of Telescopes

The telescope's evolution spans centuries, beginning with the Dutch eyeglass inventor Hans Lippershey in 1608. Galileo Galilei refined the design, using it to observe celestial objects in 1609. Isaac Newton introduced the reflecting telescope in 1668, enhancing image clarity. In the 19th century, William Herschel expanded telescope capabilities with larger apertures. The 20th century witnessed innovations like radio telescopes and space-based observatories like the Hubble. Advancements in technology led to adaptive optics and interferometry. Modern telescopes, such as the Extremely Large Telescope, employ cutting-edge technologies for unprecedented views into the cosmos, marking an extraordinary journey in astronomical observation.

JAMES WEBB SP
A COSMIC ODES
THE SECRETS OF

- ### Cosmic Odyssey Unveiled: The Journey of JWST:

“Greetings, cosmic explorers! I am the James Webb Space Telescope (JWST), a celestial voyager conceived in the pulsating heart of human curiosity during the transformative 1990s. My cosmic odyssey unfolds as a captivating narrative, an interstellar tapestry woven with ambition, technological marvels, and the promise of unveiling the universe's deepest secrets.

- ### Birth of a Vision:

In the cosmic symphony of dreams and aspirations, I emerged as the prodigious offspring of NASA, the National Aeronautics and Space Administration, and the Canadian Space Agency (CSA). The driving force behind my creation was a singular vision—to surpass the accomplishments of my esteemed predecessor, the Hubble Space Telescope, and delve into uncharted realms of the cosmos.

- ### Engineering Wonders and Stellar Unveiling:

Picture a celestial craftsman's workshop where precision meets ambition. My golden mirrors, meticulously designed and unfolding to a grandeur of 21 feet, stand as a testament to human ingenuity. A tennis-court-sized sunshield, my cosmic shield, protects me from the sun's harsh radiance, enabling me to cool down to near absolute zero and embark on a journey into the infrared wonders of the universe. Launched in December 2021, atop the mighty Ariane 5 rocket, I ascended into the cosmic abyss, leaving Earth's embrace with a promise—a promise to reveal the enigmatic tales etched in the stars.

- ### Cosmic Ballet in Infrared:

Positioned at the second Lagrange point (L2), I initiated a delicate dance, unfolding my golden mirrors like a cosmic ballet, ready to capture the symphony of whispers from distant galaxies. My playground is the infrared spectrum—a clandestine realm where cosmic secrets, obscured by the visible light, come to life In this spectral wonderland, I pierce through cosmic dust clouds, unraveling the vivid drama of starbirth. I penetrate the atmospheres of distant exoplanets, seeking the elusive clues of habitability. As a cosmic time machine, I gaze into the early epochs of the universe, witnessing the grandeur of the first galaxies' formation—a mesmerizing spectacle hidden from the naked eye.

WELCOME TO MY GALLERY !

- **Complementing Hubble, Unraveling Mysteries:**

I am not here to replace the iconic Hubble but to complement its prowess. Together, we form a cosmic partnership—Hubble capturing the visible and ultraviolet light, and I, JWST, plunging into the depths of the infrared. The synergy expands the depth and breadth of our understanding, unraveling the mysteries of the universe layer by layer.

- **Scientific Quests and Cosmic Inquisition:**

My mission is an odyssey of cosmic inquisition, a journey into the unknown to answer the profound questions that echo through the cosmos. Are we alone in the universe? What celestial choreography led to the formation of galaxies and stars? What whispers do the atmospheres of distant exoplanets carry, and could they harbor the echoes of life?

- **Challenges: A Cosmic Dance:**

Yet, no cosmic odyssey is without its challenges. From the intricacies of my deployment to the cosmic hazards lurking in the abyss, every moment is a calculated dance between triumph and adversity. It is precisely these challenges that propel me forward, for the pursuit of knowledge knows no bounds, and the cosmos demands a relentless spirit.

- **Legacy and the Cosmic Symphony:**

As I traverse the celestial realms, I aspire to etch my name alongside the cosmic pioneers who dared to reach beyond the sky. My legacy isn't confined to the data I gather or the images I capture; it lives in the inspiration sparked in the hearts of those who gaze upon the cosmos with awe and curiosity.

PACE TELESCOPE:
SEY UNVEILLING
THE UNIVERSE !

So, fellow travelers of the universe, join me in this cosmic symphony, an odyssey of discovery where we unravel the secrets of the universe, one infrared beam at a time. The universe beckons, and I, JWST, stand ready to answer its cosmic call. Our journey has just begun, and the cosmic wonders awaiting us are boundless."

STRUCTURE OF JWST

1. Primary Mirror: Comprising 18 gold-coated beryllium segments, the primary mirror gathers and focuses light for precise observations.
2. Sunshield: Positioned on the sun-facing side, the sunshield, with its five specialized layers, shields JWST from the Sun's heat, enabling infrared observations.
3. Spacecraft Bus: Serving as structural support, the spacecraft bus houses instruments, propulsion systems, and communication instruments for stability.
4. Second Lagrange Point (L2): Strategically positioned at the stable L2 point, JWST avoids interference from Earth's atmosphere and the Sun for clear observations.
5. Deployment Mechanism: Orchestrates the precise unfolding of critical components, ensuring optimal positioning for the telescope's functionality.
6. Infrared Instruments: Behind the sunshield, these instruments capture and analyze infrared light, facilitating the study of galaxies, stars, and exoplanet atmospheres.
7. Gold Coating on Mirrors: Enhances mirror reflectivity in the infrared spectrum, ensuring high-resolution observations.
8. Ariane 5 Rocket: Serves as the launch vehicle, providing thrust to carry JWST into space for its cosmic observations.

Written and Designed by - Ayush Bokad

SPR

Written and Designed by - Paaritosh Jain

The Earth's atmosphere may look empty, but it's really a complex and dynamic place, swirling with gaseous matter and thermal energy. In recent years, with the help of highly sensitive cameras, researchers have been able to document a number of unusual, previously unrecorded light-producing phenomena. One of the most remarkable of these is "The Sprites".

Let's look at this remarkable image. It looks like a cross between a lightning storm and a jellyfish, doesn't it?

This is a red sprite, and the formation you're looking at is fittingly called a jellyfish. It's incredibly big, spanning up to 50 kilometres, and originates at an altitude of 70 to 80 kilometres above the Earth. Sprites are short-lived events, lasting 3 to 5 milliseconds, and they travel downward at blazing speeds, reaching 10% the speed of light! For years, sprites were only rumoured to exist. Reports can be found as far back as the 18th century, but a theoretical basis wasn't published until 1925, when the physicist C.T.R. Wilson speculated that electrical breakdown could occur in the upper atmosphere. However, despite years of unverified sightings, it would take more than 6 decades for their existence to be confirmed.

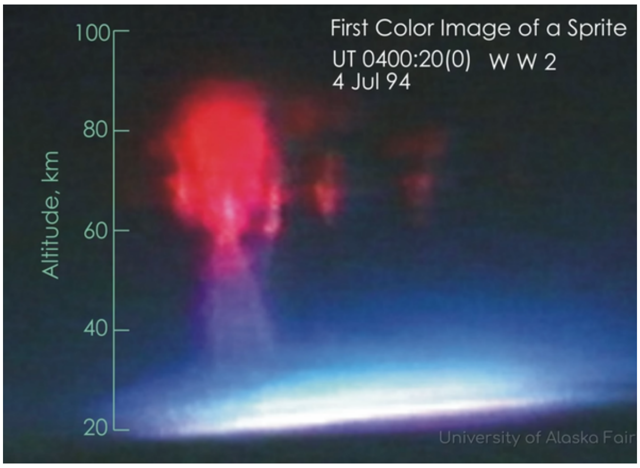
Unlike lightning, which is extremely hot, sprites are cold plasma events, much like the reaction inside a fluorescent tube. Let's think about that fluorescent light for a moment. It requires a power source to ionize the gasses trapped inside in order to emit light.

As it happens, sprites also require an electrical discharge to trigger their fluorescent reaction. You see, inside a storm cloud, there is friction between rising ice crystals, which become positively charged, and sinking soft hail particles, which become negative. These positively charged ice crystals, in turn, cause a negative shield layer to form in the air above them.

ITES

When a positive discharge happens in the form of a lightning strike, the cloud becomes neutralized, but the negative shield layer remains. We now believe it is this unstable, negatively charged shield layer that causes an electrical breakdown in the upper atmosphere, producing sprites.

It is even possible that sprites aren't especially rare. What makes them incredibly difficult to observe is that they occur high in the ionosphere, where they are often hidden by the storm systems that produce them. So, to see a sprite, you need a clear sightline over a thunderstorm – or, perhaps, a camera positioned above it. Sprites glow red because, under the low-pressure conditions where they originate, nitrogen emits low-frequency red light when its molecules get excited.



But sprites don't always produce red light. Sometimes, a sprite will set off a secondary event at a lower elevation. These secondary events, or tendrils, often appear blue. While their light is also produced by nitrogen, the higher pressure causes them to glow blue and near-ultraviolet.

As a result, some larger sprites, like the jellyfish we saw earlier, have a remarkable appearance: glowing red at the top and blue at the "tentacles"! Sprite tendrils aren't the only TLEs with a bluish tint.

LIFE CYCLE OF STARS

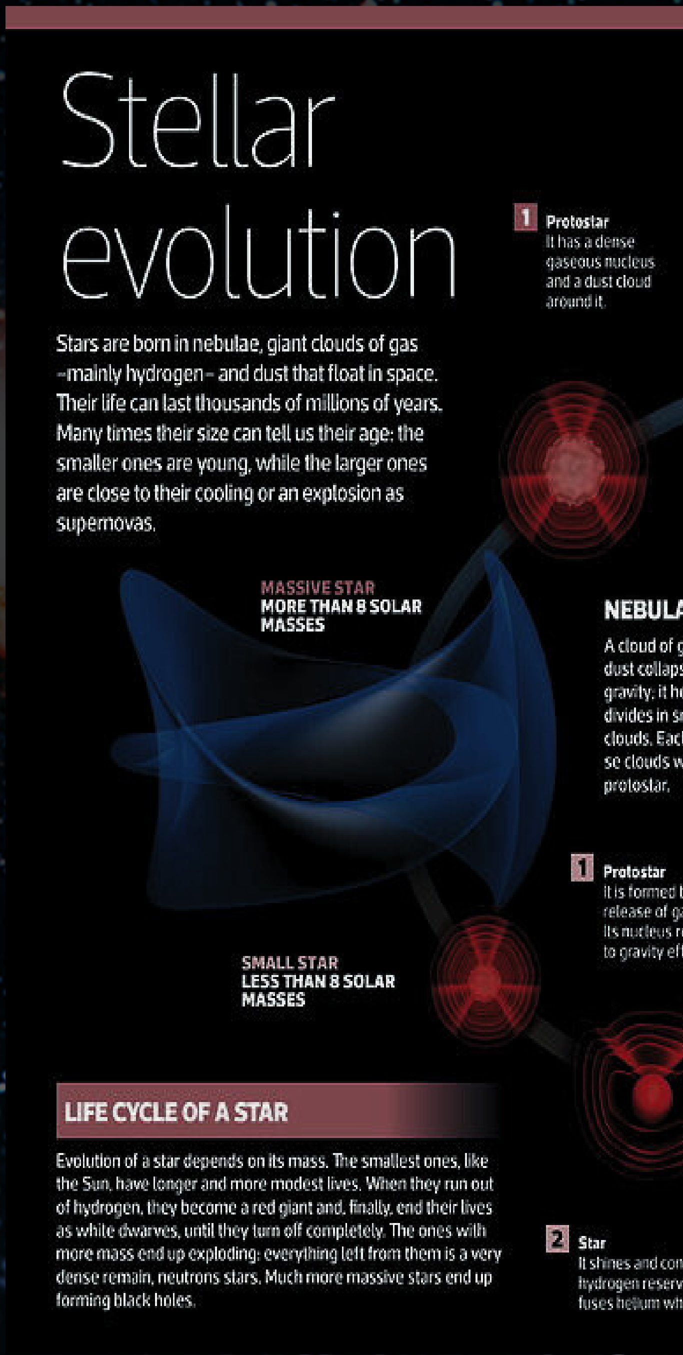
How the star born. ..?

The birth of a star begins with a dense cloud of gas and dust called a nebula. Gravity slowly pulls this material together, causing it to collapse in on itself. As the collapse continues, the core of the nebula becomes hotter and denser, eventually reaching a critical point where nuclear fusion can occur.
At this point, the star enters its main sequence phase, where it will spend the majority of its life. Nuclear fusion reactions in the core of the star release immense amounts of energy in the form of light and heat, which counteracts the gravitational collapse. This delicate balance between gravity and the pressure from nuclear reactions allows the star to maintai a stable shape and size.
The main sequence phase can last for billions of years, with the lengt depending on the star's mass. Smaller stars, known as red dwarfs, have a longer main sequence phase, while more massive stars have a shorter lifespan. During this time, stars radiate energy into space, providing the universe with the light and heat necessary for the existence of life.

> “For a star to be born, there is one thing that must happen: a gaseous nebula must collapse. So collapse. Crumble. This is not your destruction”

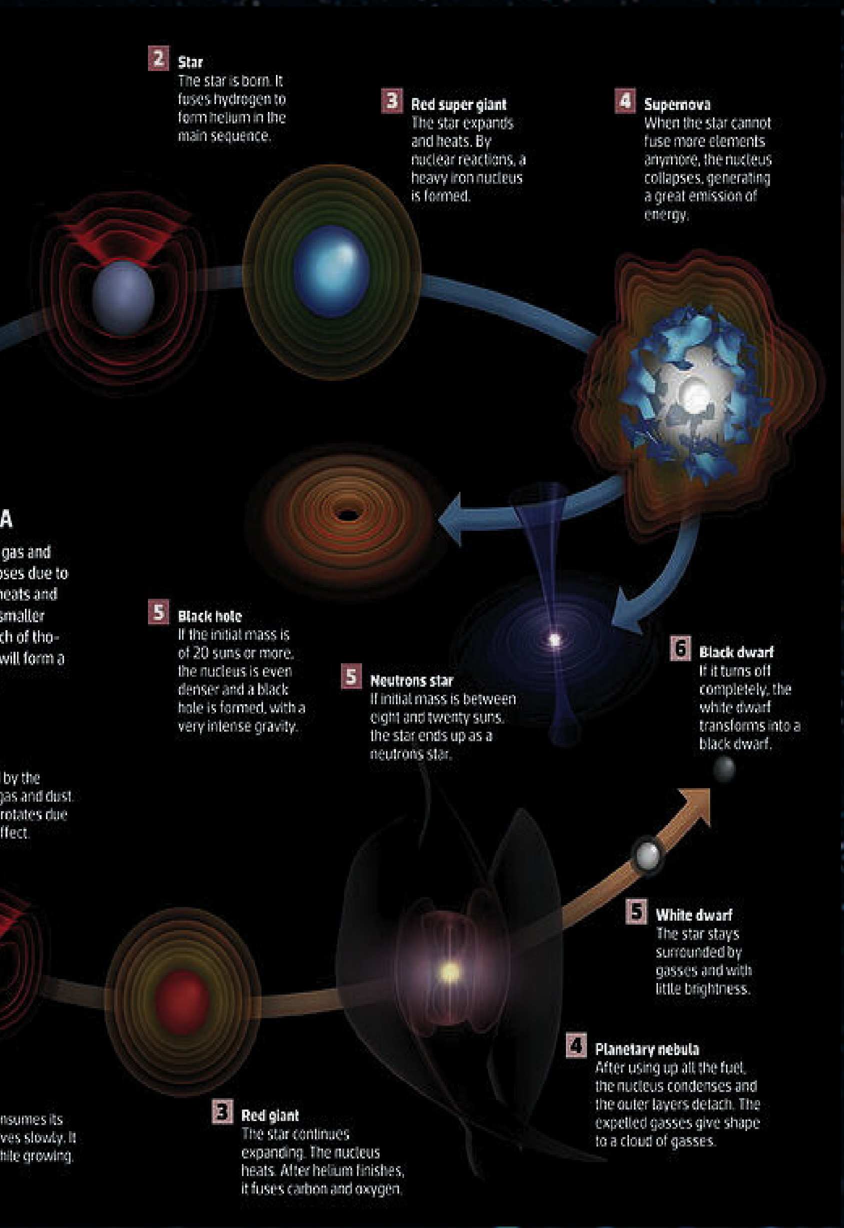
End of the star...

However, as a star consumes its nuclear fuel the beginning of the end for a star. Dependi For low-mass stars like the Sun, the exhaust collapses, the outer layers of the star expan becomes bloated and tenuous, and its surfac behind a dense core known as a white dwarf their nuclear fuel runs out, they become uns called a supernova, where the outer layers a



About:
The lifecycle of stars is a fascinating subject that has captivated scientists and astronomy enthusiasts for centuries. From their birth to their eventual death, stars go through a complex and intricate process that spans billions of years. This article aims to explore the various stages of a star's lifecycle, shedding light on the incredible phenomena that shape these celestial bodies.

, it begins to run out of the elements needed for fusion reactions. This depletion marks ing on its mass, the star may follow different paths towards its ultimate fate. tion of nuclear fuel causes the star's core to contract under gravity's pull. As the core d, transforming it into what is known as a red giant. The outer envelope of the star ce cools down, giving it a red color. Eventually, the star sheds its outer layers, leaving . More massive stars, on the other hand, go through a more explosive and dramatic end. As stable and can no longer support their own weight. These stars undergo a cataclysmic event re violently ejected into space, leaving behind a dense core



known as a neutron star or, in the case of the most massive stars, a black hole.
Neutron stars are incredibly dense and incredibly small, with masses comparable to that of our Sun but concentrated into an object the size of a city. Their strong gravitational pull results in intense magnetic fields and powerful emissions of energy in the form of X-rays and gamma rays. Black holes, on the other hand, are regions of spacetime where gravity is so strong that nothing, not even light, can escape its grasp.

Conclusion

In conclusion, the lifecycle of stars is a remarkable journey that spans billions of years. From their humble beginnings as a cloud of gas and dust to their explosive end as a supernova or the formation of a black hole, stars are a testament to the vastness and complexity of our universe. By studying the lifecycle of stars, scientists gain insights into the fundamental forces that shape the cosmos, deepening our understanding of the world beyond our planet.

Written and Designed By - Siri

ARTEMIS: TO THE

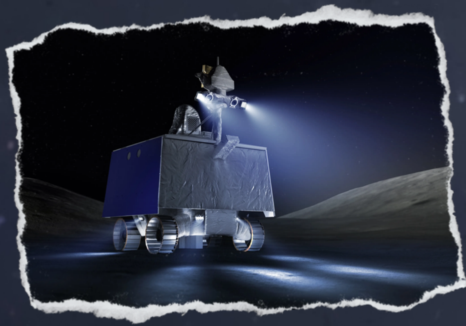
Artemis, the twin sister of Apollo, and goddess of the moon this time decided to return humans to the Moon as a stepping stone for an eventual voyage to Mars. Twelve men walked on the Moon between 1969 and 1972, Neil Armstrong, Edwin 'Buzz' Aldrin and Michael Collins were the ones in the first crew ever sent to the moon (Apollo 11) and one of the goals of Artemis is to put the first woman and person of colour on the lunar surface. The Artemis program, spearheaded by NASA, marks a significant leap forward in humanity's exploration of outer space.

The mission plan of the first goals

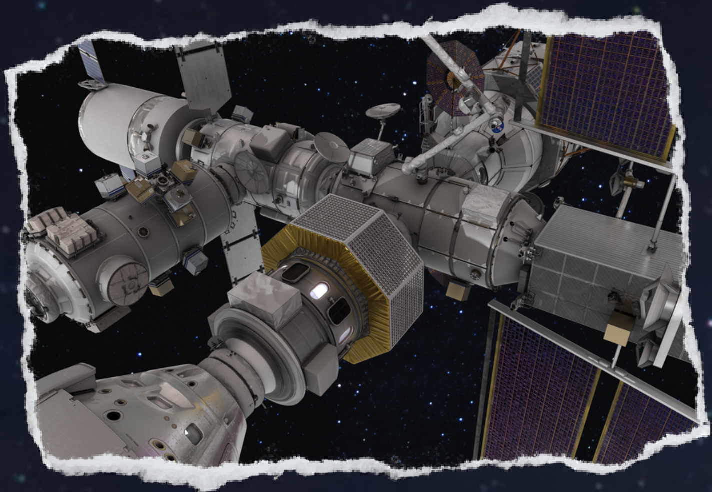
First CLPS Mission: Scheduled on Dec' 24, first Commercial Lunar Payload Service, which will deliver 16 instruments from American companies to the lunar surface, in the Peregrine Lander, to pave the way for human explorers.

CAPSTONE CubeSat: This small satellite will be the first spacecraft to enter the future home of the Gateway. It would test and verify the calculated orbital stability of a Near Rectilinear Halo Orbit around the Moon, the same orbit planned for Gateway. NASA's Gateway is a small space station that will orbit around the Moon to provide astronauts with access to the lunar surface.

VIPER: The golf-cart sized rover will be the first to investigate lunar polar soil samples to characterise the distribution and concentrations of volatiles, including water, across a large region on the moon.



MOON AND BEYOND



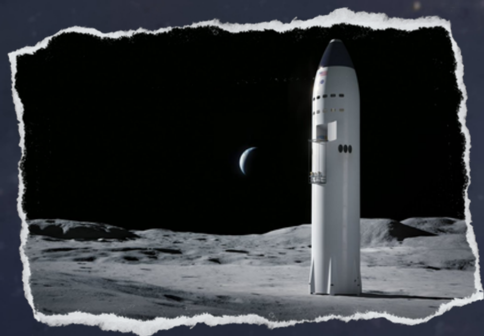
One of its missions being, creation of the Gateway Lunar Orbital Platform. The Artemis program includes the construction of the Lunar Gateway, a space station orbiting the Moon. This Gateway will serve as a staging point for crewed missions to the lunar surface, as well as a hub for scientific research and observation.

that Artemis aims to achieve are:

<u>Artemis I</u>: Launched on November 16, 2022 from Kennedy Space Center, it aimed for an uncrewed, maiden flight of the integrated Space Launch System rocket and also released the Orion spacecraft that verified spacecraft performance and efficiency of Orion's heat shield during its high-speed Earth reentry at nearly 5000 degrees Fahrenheit.

<u>Artemis II</u>: Four astronauts will venture around the Moon on Artemis II, the first crewed mission on NASA's path to establishing a long-term presence at the Moon for science and exploration through Artemis. The 10-day flight will test NASA's foundational human deep space exploration capabilities, the SLS rocket, Orion spacecraft, for the first time with astronauts. They will also set the record for the farthest human travel from Earth.

<u>Artemis III</u>: After the first two Artemis missions to learn and demonstrate the capabilities of the Orion spacecraft, in Artemis III its crew will once again travel to the moon, and this time they will go to settle in there boarding the Human Landing System that will bring the first woman and next man to the lunar surface.



DESIGNED BY - YELEENA

WRITTEN BY - SHREYA RAJAK

DARK

Dark energy is the name given to the mysterious force that is causing the rate of expansion of our universe to accelerate over time, rather than to slow down. That is contrary to what
one might expect from a universe that began in a Big Bang. It is thought to make up approximately 68% of the total mass-energy content of the universe. It is called "dark" because it does not emit, absorb, or reflect light, making it invisible and undetectable by electromagnetic radiation. Dark energy does behave like Einstein's anti-gravity force.
About 25 years ago, it was established that the Universe is expanding, and such expansion is speeding up with time. This process has been occurring for the last 5,000 million years, and it causes galaxies to recede from others. Although all our cosmological observations back up this phenomenon, we still do not have an explanation for this trend in the expansion.

WHY IS DARK ENERGY SO MYSTERIOUS?

Because we cannot measure it directly, we do not even know what it is made of, then formulating experiments to detect it and study its very nature is challenging. Also, current observations disagree with the value of the Hubble rate at present, therefore, we are uncertain if dark energy is changing in time, and if so, how it is affecting the dynamics of the expansion. We have clues, but there is still a long path to go before "unveiling" dark energy's nature and traits. If dark energy is causing the universe to expand at an accelerating rate, shouldn't we see our coffee mug shift away from us or notice our commute to work getting longer each day? We do not see things like this happen....Because objects that are gravitationally bound such as stars, planetary systems, star clusters, galaxies, clusters of galaxies, and even our coffee mug and table, do not seem to experience dark energy's effects. "Gravity still beats dark energy at small scales."

Dark energy only seems to act on the largest scales of the universe, with the expansion of the universe a phenomenon that can only be measured by observing galaxies and other cosmic objects that are separated by massive gulfs of space in the order of millions, billions, and even tens of billions of apart and away from us. And the greater the distance that separates these cosmic objects, the more rapidly they race away from each other. Currently, scientists estimate that galaxies are getting 0.007% further away from each other every million years. Telescopes like DES, DESI, Euclid, JWST, the Vera Rubin Observatory, and Nancy Grace Roman intend to decipher dark energy's nature and evolution through time by tracing the large scale structure and measuring with different techniques the Hubble constant.

By - Arpita and Arya

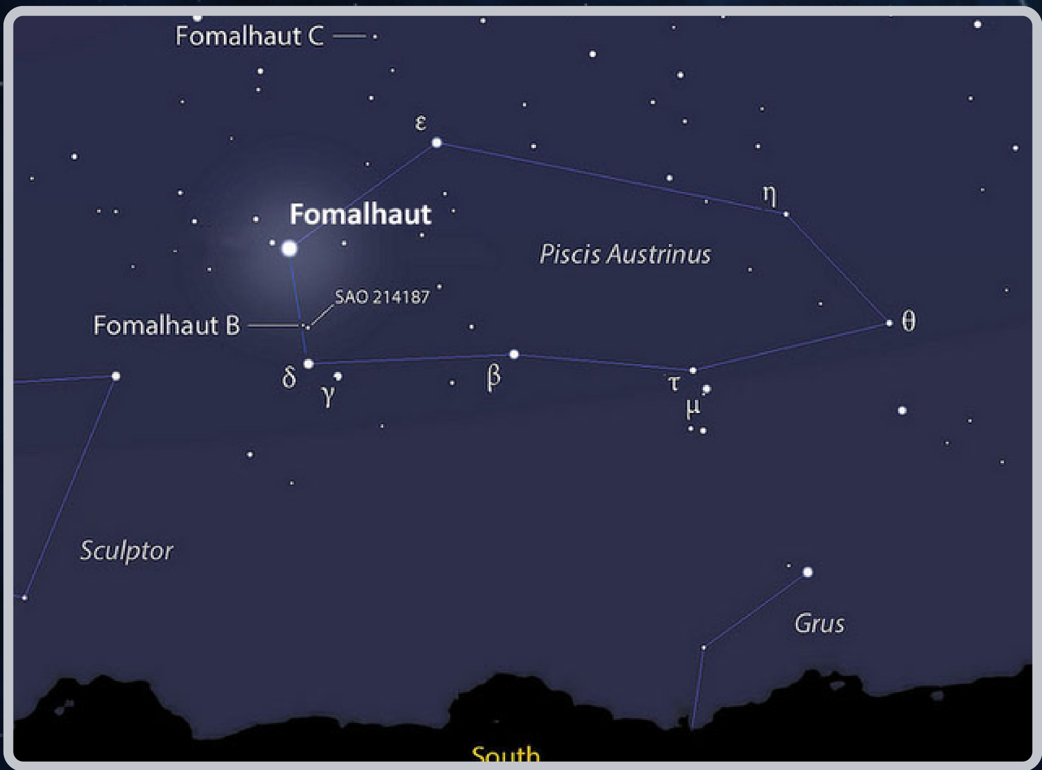
FOMALHAUT: A STELLAR SPOTLIGHT

BY NAMAN AGARWAL

- ## PHYSICAL CHARACTERISTICS

Fomalhaut is the 18th brightest star in the night sky. It is one of those bright stars that appear vivid in our skies due to its proximity to our home planet. Fomalhaut is among the Sun's closest stellar neighbors at a mere 25 light-years away in the southern constellation Piscis Austrinus. Sometimes called "The Autumn Star," Fomalhaut appears unusually distant from other bright stars in its section of sky, leading to its other nickname, "The Loneliest Star." Since this star appears so low and lonely over the horizon for many observers, is so bright, and often wildly twinkles from atmospheric turbulence, Fomalhaut's brief but bright seasonal appearance often inspires a few startled UFO reports.

Fomalhaut (precisely Fomalhaut A) is the brightest member of a multiple-star system. It is a hot white star almost twice the mass and size of our sun but radiates over 16 times the sun's energy. Fomalhaut has a companion star less than a light-year away from it. The companion is an orange dwarf star, known as Fomalhaut B, about 70% the mass of our sun. A third member of the Fomalhaut star system, Fomalhaut C was announced in 2013, a small reddish star about 2.5 light-years from Fomalhaut. From Earth, we see the third star in the constellation Aquarius instead of Piscis Austrinus.



• ASTRONOMICAL SIGNIFICANCE

Fomalhaut itself is a young star, just 440 million years old. That's in contrast to 4 1/2 billion years for our sun. Fomalhaut is of special interest to astronomers because it has several rings of dust and gas around it, early indications of planets forming around this star. Astronomers have detected inner debris disks close to the star, within a few astronomical units (AU) from the star.

There's a much larger, thicker debris ring about 133 AU from the star. A study published in 2008 generated a lot of excitement when Hubble Space Telescope images, taken in 2004, 2006 and 2008 showed an apparent planet very close to this debris ring. Astronomers first thought it was the first directly imaged exoplanet. But data from other telescopes, most prominently Spitzer Space Telescope brought that conclusion under scrutiny. And, by 2014, this object was no longer visible to Hubble. So what happened? Astronomers think that the "planet" was a large dust cloud generated by the collision of two comet-like bodies near the ring. And over time, that dust cloud may have dissipated.

Beyond its astronomical attributes, Formalhaut has left an indelible mark on various cultures. In ancient times, it held significance in navigation, serving as a guiding light for mariners. In astrology, Fomalhaut is one of the four royal stars, along with Aldebaran, Regulus, and Antares. They were regarded as the guardians of the sky during the time of the Persian Empire in modern-day Iran. The stars were believed to hold both good and evil power and the Persians looked upon them for guidance in scientific calculations of the sky, such as the calendar and lunar/solar cycles, and predictions.

THE COSMIC QUANTUM CONNECTION

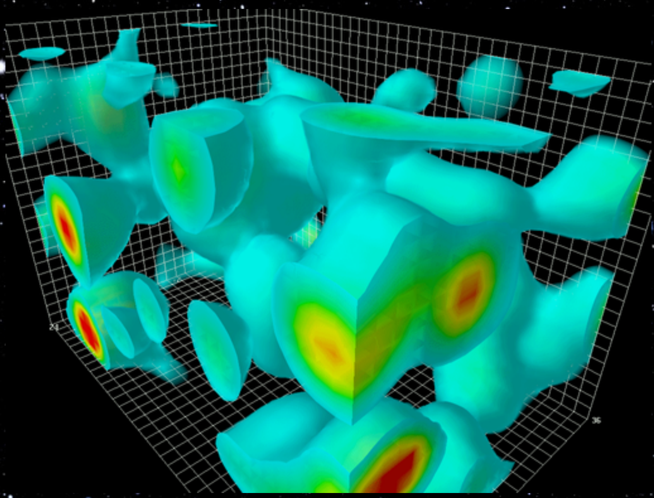
The real creator of our beautiful world

MAX EHRMANN

"You are a child of the universe,
no less than the trees and the stars;
you have a right to be here.
And whether or not it is clear to you,
no doubt the universe is unfolding as it should."

Quantum physics and cosmology - they could not have a connection, right? What if I tell you, we owe our existence to the connection of quantum physics and cosmology. The matter in the universe should have been spread uniformly. There should not be an unequal distribution of matter. This is seen to be true on very large scales, the cosmological scales. At this scale, we have to assume a whole galaxy as a single point in the cosmic web.

But, at a smaller scale, we do see galaxies with very high mass density and empty space around them with low mass density. If the universe was homogeneous in the beginning, the gravitational pull should have been symmetrical. So the universe should have remained homogenous.



So, let's begin from the big bang itself. After the big bang, the universe was actually homogenous. And now comes our saviour, quantum fluctuations. These fluctuations are nothing less than any other quantum phenomenon that has weirded you out.These fluctuations are ripples in the fabric of space-time. These temporarily change the amount of energy and matter at a point in space thus violating conservation of energy.

These fluctuations led to very tiny density fluctuations in the universe. These tiny changes might not seem very important to you. But, remember we are looking at a universe just after the big bang. We are in a hot and dense block of matter just a fraction of a second after the big bang.

Now the inflation occurs, The universe expands 10^26 times in just a fraction of second. Imagine a cube of side 3cm, this cube will expand to a cube of side length more than distance to andromeda galaxy that is 2.5 million light years in just a few moments. Now think of the density fluctuations that happened just during the time of this cosmic inflation. These tiny fluctuations expanded to the size of galaxies.

Now gravity will start doing its work, pulling mass together and creating lumps of gases. These density variations now the size of galaxies lead the way to formation of gas clouds, stars and the planets and eventually life on our planet Earth. These insignificant fluctuations are the reason the universe is so active now and not just a dead mass with nothing happening and no one there to observe.

And this is not even the complete story. These fluctuations also stabilize many other processes of the universe. And I also didn't elaborate on the role of dark matter in the formation of galaxies. These are left for readers to explore on their own.

Written and Designed By -
Tanish Singla

PLANETARY DEFENSE SYSTEM- SHIELDING EARTH FROM COSMIC THREATS

Brief introduction of planetary defense system

A planetary defense system is the term used to describe the coordinated efforts and technology used to find, monitor, and possibly mitigate or deviate near-Earth objects (NEOs)
that could pose a hazard to the Earth in the near future. It includes all the tools required to identify and foresee prospective asteroids or comet impacts with Earth, alert people to them,
and then stop them or lessen their potential damage. The majority of these asteroids and comets are that close to Earth are at risk of colliding with it.

History of planetary defense system

When the comet "shoemaker" smashed with Jupiter in 1994, the importance of planetary defense systems became apparent since the pieces' impact caused the atmosphere to be heated to at least 30,000 degrees Celsius. It even made the planet’s ring tilt by 2 degrees. It was after this event when in 2005, the U.S. congress passed the NASA Authentication Act, which in part tasked NASA with finding at least 90% of all near earth objects that are 140 meters or larger.

Why is planetary defense system important?

1. Protection of life and Infrastructure

The primary function of the planetary defense system is to protect infrastructure and life from potentially hazardous near-Earth objects. We can protect life and ensure the health of our world by identifying hazards and maybe avoiding them or lessening their impact.

2. Preparedness and Planning

Despite the low likelihood of a large impact event, it is imperative to be ready because of the potentially disastrous repercussions. If a threat is detected, a well-designed Planetary Defense System allows us to be proactive rather than reactive, allowing us time to plan and carry out the necessary actions.

3. Risk reduction

We can correctly determine the possible impact risk of near-Earth objects by identifying and following them. By helping us distinguish between objects that are of little concern and those that might need more attention, this information helps us avoid creating undue worry or terror.

Insights on planetary defense system

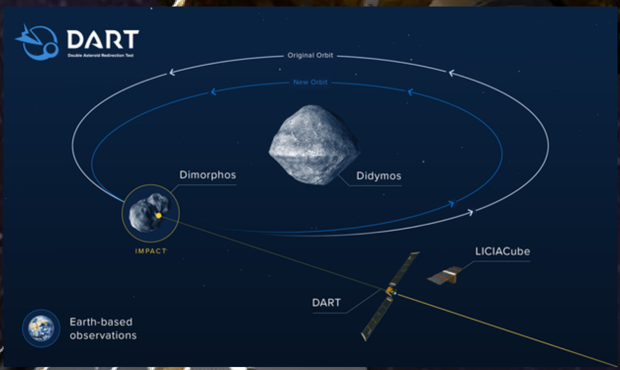
• Technologies applied to detect near earth objects

One of the main technology applied for this is planetary radar. Its observations contribute to the characterization of near earth objects by more precisely determining their orbits and by measuring their size, shape, body dynamics, and surface features if the approach close enough to the Earth.

• DART mission

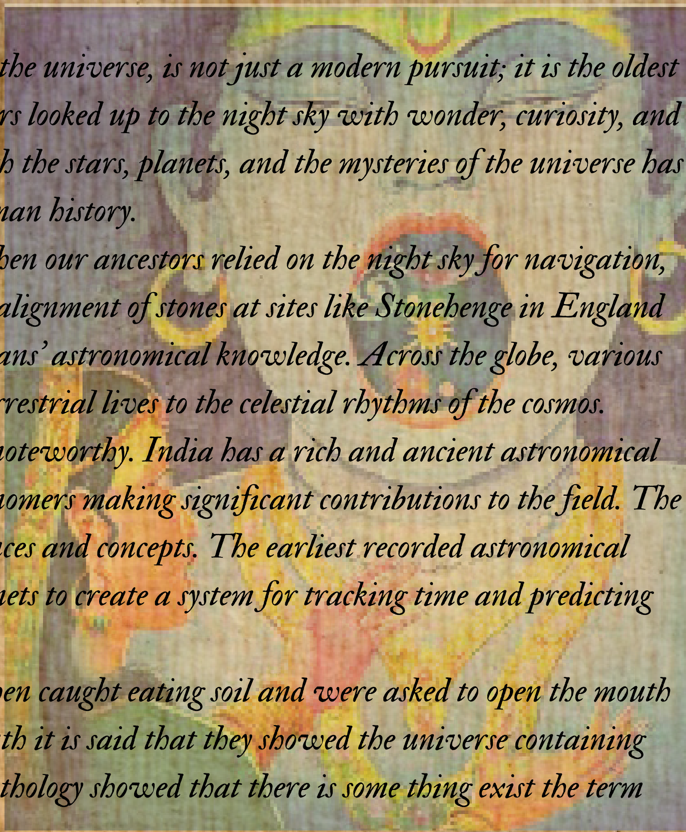
Planetary defense basically includes 5 stages which are
1. ASSESS(Centre for near earth object studies)
2. MITIGATE
3. PLAN & COORDINATE
4. CHARACTERIZE
5. SEARCH, DETECT & Track

The DART mission addresses the “mitigate” component of overall planetary defense efforts. DART is “Double Asteroid redirection Test”. It is NASA’s demonstration of kinetic impactor technology, impacting an asteroid to adjust its speed and path. Its target was the binary asteroid system “Dibymos and Dimorphos” and changed the orbit of Dimorphos.



Written by - Aditi
Designed by - Yeleena

CONTRIBUTIONS OF <u>BHARAT</u> IN ASTRONOMY (KHAGOL-SHASTRA)



Astronomy, the science of studying celestial bodies and the vast expanse of the universe, is not just a modern pursuit; it is the oldest known science to humankind. From the earliest civilizations, our ancestors looked up to the night sky with wonder, curiosity, and a burning desire to comprehend the cosmos. This profound fascination with the stars, planets, and the mysteries of the universe has left an indelible mark on human history.

The ancient roots of astronomy can be traced back to prehistoric times when our ancestors relied on the night sky for navigation, tracking time, and as a source of inspiration for myth and religion. The alignment of stones at sites like Stonehenge in England and the Pyramids in Egypt stand as monumental evidence of early humans' astronomical knowledge. Across the globe, various cultures developed their own celestial calendars, connecting their terrestrial lives to the celestial rhythms of the cosmos.

However, the stand of India in the realm of astronomy is particularly noteworthy. India has a rich and ancient astronomical tradition that dates back to at least 1500 BCE, with early Indian astronomers making significant contributions to the field. The famous ancient Indian text, the Vedas, contains astronomical references and concepts. The earliest recorded astronomical observations were made by Indian scholars who used the stars and planets to create a system for tracking time and predicting celestial events.

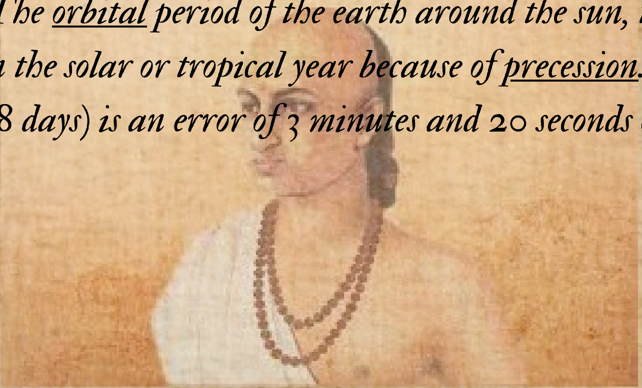
Starting with the story of the the Lord Krishna around 3200BCE.When caught eating soil and were asked to open the mouth by Yashodha (Their Mother),and when little Krishna opened the mouth it is said that they showed the universe containing galaxies, planets to Yashodha .Therefore this ancient indian hindu mythology showed that there is some thing exist the term <u>"universe".</u>

Now coming towards the written and proved contributions:

\

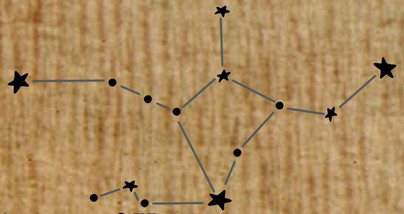
Aryabhata's Mathematical Genius:

Aryabhata, an influential Indian astronomer and mathematician from the 5th century, wrote the "Aryabhatiya," a seminal work that significantly influenced the development of astronomy. Aryabhata proposed a heliocentric model of the solar system, centuries before Copernicus. His mathematical innovations, such as the concept of zero, greatly enhanced the precision of astronomical calculations. For example: He states that the Moon and planets shine by reflected sunlight. Instead of the prevailing cosmogony in which eclipses were caused by Rahu and Ketu (identified as the pseudo-planetary lunar nodes), he explains eclipses in terms of shadows cast by and falling on Earth. Also, Aryabhata calculated the sidereal rotation (the rotation of the earth referencing the fixed stars) as 23 hours, 56 minutes, and 4.1 seconds; the modern value is 23:56:4.091. Similarly, his value for the length of the sidereal year (The <u>orbital</u> period of the earth around the sun, taking the stars as a reference frame. It is 20 minutes longer than the solar or tropical year because of <u>precession.</u>) at 365 days, 6 hours, 12 minutes, and 30 seconds (365.25858 days) is an error of 3 minutes and 20 seconds over the length of a year (365.25636 days).



Bhaskara's Astronomical Treatises:

Bhaskaracharya, in the 12th century, contributed to Indian astronomy with his renowned works, "Siddhanta Shiromani" and "Lilavati." He made substantial advancements in trigonometry and provided solutions for astronomical problems. Bhaskara's understanding of planetary motion and eclipses showcased India's sophisticated grasp of celestial mechanics.



The Kerala School Of Astronomy:

During the medieval period, the Kerala School of Astronomy, centered around the city of Kozhikode, made significant strides. Notable figures like Madhava of Sangamagrama and Nilakantha Somayaji developed mathematical tools and methods for calculating planetary positions and understanding celestial phenomena. Their contributions to calculus and infinite series like 1/(1-x) geometric series predated European developments by several centuries.

Modern Indian Astronomy:

India continued its astronomical journey into the modern era with the establishment of institutions like the Indian Institute of Astrophysics and the Tata Institute of Fundamental Research. These institutions have played pivotal roles in observational and theoretical astronomy, contributing to our understanding of cosmic phenomena.

Contemporary Achievements:

In recent times, India has actively participated in international collaborations in astronomy. The Indian Space Research Organisation (ISRO) launched successful space missions like the Chandrayaan 3, Mars Orbiter Mission (Mangalyaan) and the Astrosat observatory, showcasing India's technological prowess in space exploration and astronomy.

Conclusion:

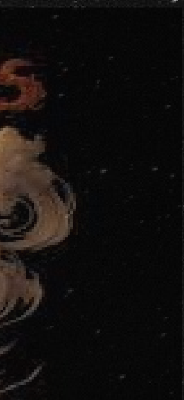
India's contributions to the development of modern astronomy are profound and multifaceted. From ancient philosophical insights to mathematical innovations and contemporary space exploration, India has left an indelible mark on our understanding of the cosmos. As we celebrate India's rich heritage in astronomy on this occasion, it is essential to recognize the enduring impact of its intellectual legacy on the progress of human knowledge in the field of astronomy.

Written and designed by -
Sohel Saini

A celestial murmur unveiled the existence of a particle of unparalleled power. A wondrous entity, unfamiliar to mortal minds, descended upon Earth in a burst of cosmic majesty. The particle, a cosmic ray of unfathomable strength, surpassed even the energies unleashed by the grandest human particle accelerators. Dubbed after the radiant Japanese Sun goddess Amaterasu, it was first witnessed by the vigilant eye of the Telescope Array, nestled in the cradle of Utah's West Desert. This auspicious event heralds a new epoch of cosmic discovery, beckoning us to traverse the uncharted realms of the universe.

AMATE

Unravelling Cosmic Enigm



“If you hold out your hand, one (cosmic ray) goes through the palm of your hand every second, but those are really low-energy things,” said study coauthor John Matthews, a research professor at the University of Utah. “When you get out to these really high-energy (cosmic rays), it’s more like one per square kilometre per century. It’s never going through your hand.”

Normally, particles of this calibre move through space smoothly, unaffected by magnetic fields, making it easier to pinpoint their origins. But this particle defied expectations, challenging established theories on the sources of high-energy cosmic rays. The Amaterasu particle's journey traces back to the Local Void, a seemingly empty expanse adjacent to our Milky Way galaxy. Curiously, when researchers attempted to trace its origin, they encountered a cosmic mystery—we know by newton’s law of conservation that energy doesn’t form on its own, its transferred from one form to another. So the energy for such a cosmic should have originated from somewhere.

“The universe
according to
never fully un
they're out ther
disco
– Brian

ERASU

nas Beyond Known Realms

There are a couple of theories that scientists have come up with. One possibility is the particle has been accelerated by extremely energetic phenomena, such as a gamma-ray burst or a jet from a feeding supermassive black hole at the canter of active galactic nuclei. Another possibility is creation in an exotic scenario such as the decay of super heavy dark matter — a new particle, from unknown physics beyond the Standard Model.

The highest energy particle 'Oh My God' was detected in 1991 and now amaterasu .
If you take the two highest-energy events ,the one that we just found, the 'Oh-My-God' particle ,those don't even seem to point to anything. It should be something relatively close. Astronomers with visible telescopes can't see anything really big and really violent, which is extremely intriguing.

Despite uncertainty around the 'Sun goddess' particle's origin, scientists are of the view that it is an important messenger from the universe about some highly energetic event that we cannot decipher at this point. However, efforts need to be put in to disentangle the origin of this mysterious particle. This might give rise to a new field of physics that might defy the laws that already exist and govern the universe.

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Greene

Written and Designed by - Akshita

CHANDRAYAAN 3

and It's Discoveries

Unveiling the sparse and dynamic ionosphere of the moon

Chandrayaan 3's trail of discoveries began with the lunar atmosphere. The Moon has a very thin atmosphere known as an exosphere can be almost considered a vacuum. The pressure of the lunar exosphere is around 0.3 nano pascals, one trillionth of the pressure of Earth's atmosphere at sea level. Mixed on the upper edge of the exosphere is a tenuous secondary layer of the ionosphere. It is created by sunlight that energizes atoms in the exosphere. Instruments onboard the Vikram lander made the first density and temperature measurements of the ionosphere. It was found that the 100-kilometer-thick layer of electrically charged plasma surrounding the lunar surface near its south pole is relatively sparse.

The plasma density lies somewhere between 5 million to 30 million electrons per cubic meter. Further, the density varies as the lunar day progresses. The density of an ionosphere plays a crucial role in radio communication. The higher the electron density, the longer radio signals take to travel through the ionosphere. So now, if the plasma is quite sparse, the potential delays would be minimal. Eventually, it would not pose a problem for transmission and navigation systems if humans were to inhabit the Moon in the future.

Moon's subsurface temperatures: key to future astronaut habitats

Furthermore, the lander made an interesting discovery just below the surface of the Moon. A temperature probe containing ten sensors reached 10 centimeters below the surface. A preliminary analysis of the data collected by this probe found that during the day, the temperature at the surface is around 60˚C or 140˚F. But it dramatically drops as we go deeper into the surface. The temperature dips to about -10˚C or 14˚F, just 8 cm below the lunar surface

That's a drop of around 70°C in just 8 cm. Such striking temperature variation indicates that the Moon's topsoil is a powerful thermal insulator. This further adds to the idea that it can be used to build future habitats for astronauts to shield them from freezing conditions and harmful radiation on the Moon.

Chandrayaan 3 detects moonquake: unraveling lunar mysteries

Three days after the historic landing on 26 August, the Instrument for Lunar Seismic Activity identified a potential moonquake on the Moon. These quakes can result from meteoroid impacts, tidal forces from Earth and the Sun, and extreme temperature variations on the lunar surface. Moonquakes, distinct from earthquakes, can last from seconds to an hour and occur in clusters. The unprecedented nature of these events suggests internal lunar processes. Two potential explanations involve the Moon shrinking, causing stress and triggering faults, or internal heating due to radioactive decay, leading to magma pocket formation. The recent seismic event, the first in over 50 years, detected by Chandrayaan 3 prompts further study into the Moon's origin and interior.

Pragyan Rover's LIBS: Moon's Sulfur Detection Unravels Geological Mysteries:

The Pragyan rover's Laser-Induced Breakdown Spectrometer (LIBS) made a significant discovery by detecting aluminum, calcium, chromium, iron, manganese, oxygen, titanium, and silicon on the Moon's surface. Particularly noteworthy was the presence of sulfur.

This finding supports theories about water on the Moon, suggesting a 'cold trapping' process in the polar craters where water vapor freezes into ice. The LIBS data implies that high energy radiation may release sulfur during the breakdown of water ice. The detection of sulfur, a key element in volcanic activity, contributes to understanding the Moon's geology.

Interestingly, no previous orbiter passing over the Moon's south pole had detected sulfur, adding intrigue to this discovery

Written By - Harshit
Designed By - Arya and Anushri

Stargazing Through Time: A Tale of Observatories

A vital part of humanity's effort to comprehend the vastness of the cosmos has been performed by observatories, those heavenly watchtowers that adorn Earth and beyond. These buildings, which serve as windows into the cosmos, have developed with our unquenchable curiosity from modest beginnings to state-of-the-art space observatories. This article takes you on a tour through the interesting past, many varieties, classifications, and crucial function observatories play in solving cosmic riddles.

The Historical Tapestry

Astronomical institutions had their origins in prehistoric times. The Babylonians, the Greeks, and the Egyptians all built buildings specifically for stargazing because they had an innate desire to understand how the sky moved. But observatories really took off during the Renaissance, when astronomers like Tycho Brahe and Johannes Kepler made ground-breaking discoveries.

The Need for Observatories

Why do we construct observatories? Our intrinsic drive to comprehend the cosmos and our role in it holds the key to the solution. Observatories record and process light from astronomical objects, acting as technological eyes. Astronomers can solve cosmic mysteries by analysing this light to determine the make-up, distance, and other characteristics of celestial entities.

Types and Classifications

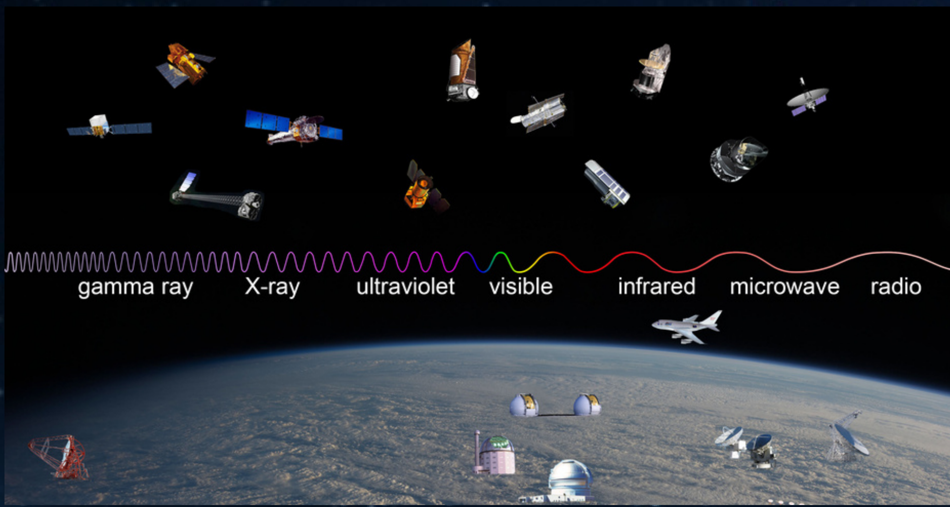
Observatories are designed to meet a variety of purposes and demands. To reduce light pollution, ground-based observatories are dotted over hilly regions, away from city lights, such as the venerable Palomar Observatory. They contain radio telescopes, optical telescopes, and other instruments intended for certain kinds of observations.

On the other hand, space observatories travel through space or circle the planet. A notable example is the Hubble Space Telescope, which operates without interference from Earth's atmosphere to produce breathtaking photos and provide priceless data. By providing fresh insights and opening up previously unexplored areas of knowledge, these observatories increase our capacity for observation.

Methods Employed

Observatories use a variety of techniques to investigate the cosmos. For example, spectroscopy breaks down light into its many colours to disclose the chemical makeup of astronomical objects. Astronomers can better comprehend an object's inherent qualities by using photometry to quantify its brightness. By combining signals from several telescopes, advanced methods like interferometry improve resolution and make it possible to analyse minute features.

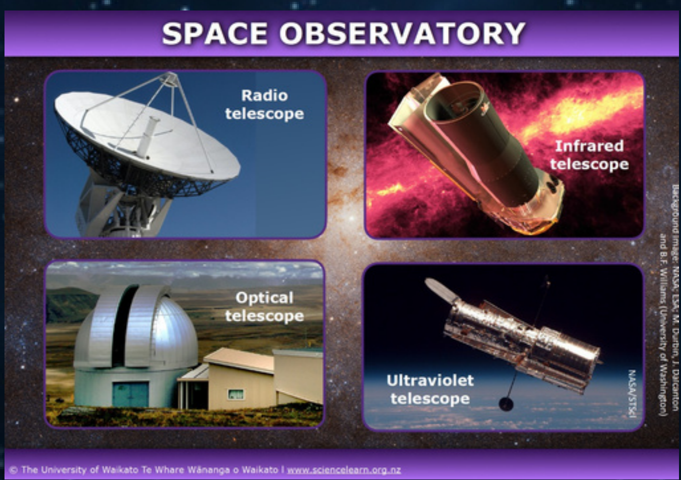
With the aid of specialised equipment, infrared and radio investigations reveal celestial events that are hidden by dust clouds or imperceptible to the naked eye. A comprehensive picture of the universe is offered by the multi-wavelength method, which combines data from many regions of the electromagnetic spectrum.



Space Observatories: The Final Frontier

As our ability to use technology advanced, so did the reach of observatories. The limits of what we can perceive are pushed by space-based platforms such as the James Webb Space Telescope and the Chandra X-ray Observatory. These observatories circumvent atmospheric interference by venturing outside of Earth's atmosphere, which enables them to make previously unattainable studies of distant galaxies, exoplanets, and the remains of burst stars.

A diverse array of specialist equipment may be found when observatories are categorised according to the wavelengths they monitor or the kinds of objects they research.

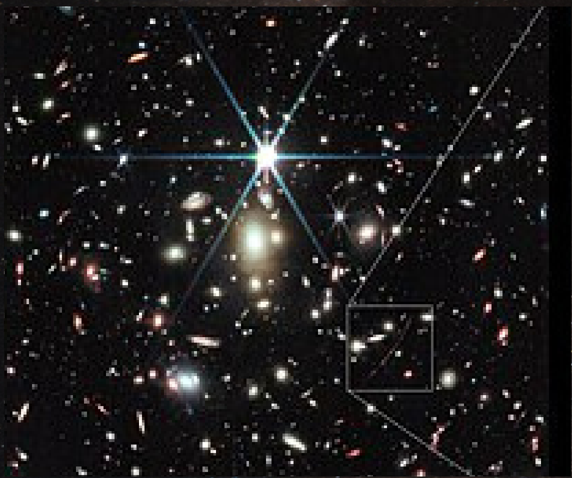


WRITTEN BY - ABHINAV

DESIGNED BY - AKSHITA

Webb Captures the Universe's Outmost Star !

In a monumental leap for astronomical discovery, NASA's James Webb Space Telescope has unveiled the vivid colors and astonishing details of a remote cosmic gem, Earendel, the most distant star ever detected. Hundreds of small galaxies, each with unique shapes, grace the backdrop with colors ranging from pristine white to warm yellow and fiery red. Amidst this cosmic symphony, a singular source of brilliance captures attention – Earendel, a star of unparalleled significance.



Unveiling the Sunrise Arc and Earendel

This awe-inspiring image, captured by the James Webb Space Telescope's Near-Infrared Camera (NIRCam), immortalizes a colossal galaxy cluster dubbed WHL0137-08. Nestled within the fabric of this cluster lies a celestial treasure – the Sunrise Arc, the most magnified galaxy known from the universe's formative billion years. And within the heart of the Sunrise Arc resides Earendel, the record-breaking star that has now etched its name into the annals of astronomy.

A Star Beyond Imagination

Earendel , is a massive B-type star that blazes with more than twice the intensity of our Sun. Its luminosity shines a million times brighter. Yet, what truly sets Earendel apart is its remarkable distance – a staggering billion years after the big bang. This discovery was made possible through a captivating interplay of human technology and the universe's gravitational lensing effect, a cosmic lens formed by the gravitational pull of the mammoth galaxy cluster WHL0137-08.

Earendel's revelation brings more than just a distant twinkle to our understanding of the cosmos. Astronomers have discerned intriguing hints of a cooler, redder companion star, evident solely through the colors of Earendel. This companion, nearly inseparable from Earendel in the sky, is unveiled through the expansion of the universe, stretching its light to wavelengths only detectable by Webb's advanced instruments.

Webb's Near-Infrared Camera also reveals breathtaking nuances within the Sunrise Arc. From youthful star-forming regions to established star clusters as minuscule as 10 light-years across, the Sunrise Arc is a treasure trove of cosmic diversity. On either side of Earendel's radiant path, the gravitational lensing effect distorts the features, creating a cosmic mirage that mirrors the arc's stunning splendor.

This profound discovery holds not only astronomical implications but also the essence of time itself. The newfound star cluster echoes what our own Milky Way's globular clusters might have looked like over 13 billion years ago, offering a portal into the universe's distant past

WRITTEN BY - MOHIT
DESIGNED BY - AKSHITA

CROSSWORD

on

Early Astronomy

Across

[3] Formulated the law of universal gravitation

[6] The belief that the earth is the center of universe

[7] Motion where a planet seems to drift westward

[9] Concluded the world was round

[10] Used a telescope to make important discoveries about the universe

[11] The model in which the planets orbit around the sun

[12] The science that studies the universe

[13] The path an object takes as it goes around another object in space

Down

[1] Predicted the motion of the planets using epicycles

[2] Described the paths of planets as elliptical

[4] Calculated the circumference of the earth

[5] Made precise measurements of the planets, especially mars

[8] Proposed planets moved in circles around the sun

Made by - Meghana

Designed by - Arpita

"The strongest affection and utmost zeal should, I think, promote the studies concerned with the most beautiful objects. This is the discipline that deals with the universe's divine revolutions, the stars' motions, sizes, distances, risings and settings ... for what is more beautiful than heaven?”

– Nicolaus Copernicus

Thanking the Cygnus team

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