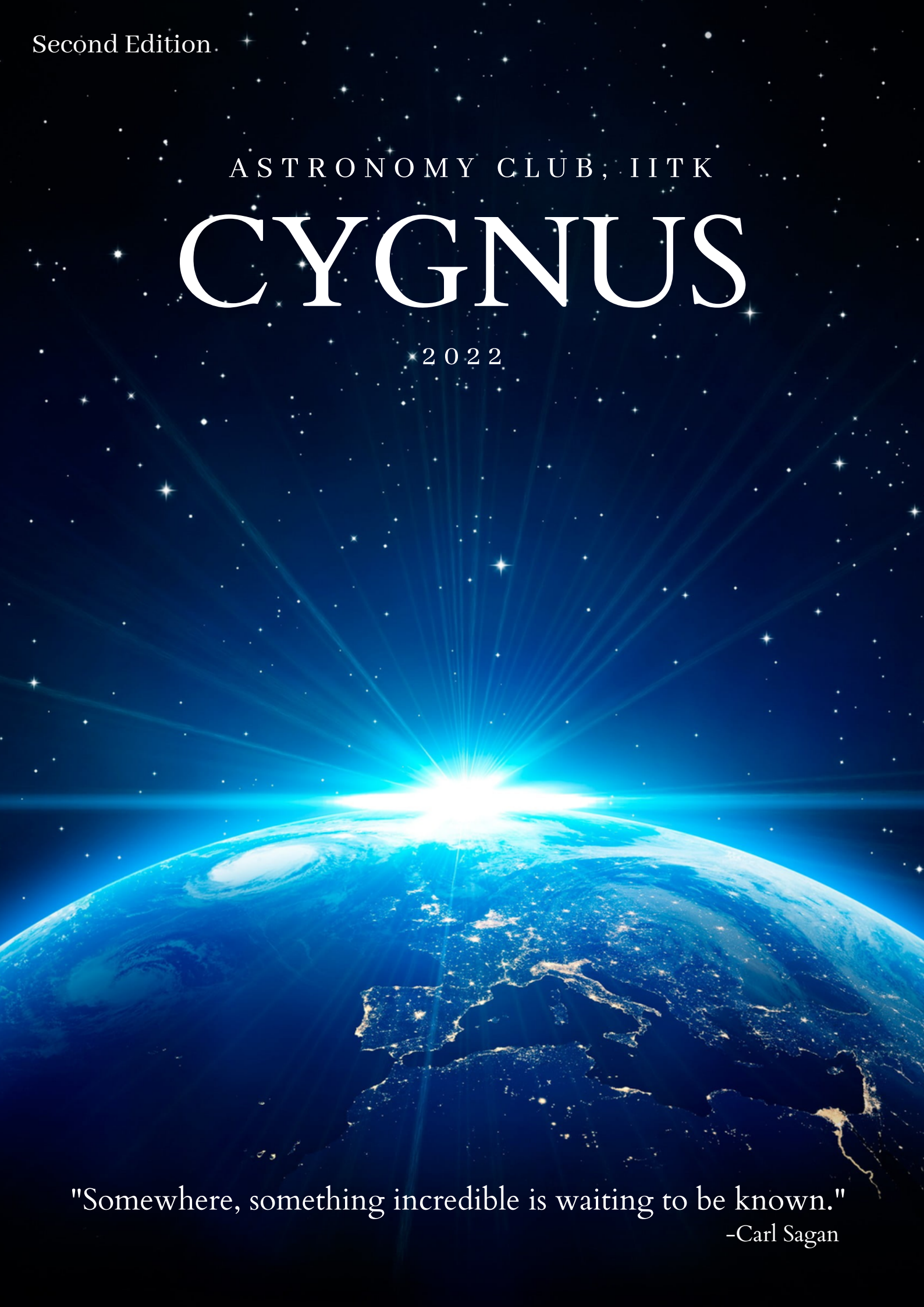
Second Edition

ASTRONOMY CLUB, IITK

CYGNUS

2022



"Somewhere, something incredible is waiting to be known."

-Carl Sagan

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ABOUT THE CLUB

The oldest thriving club of IIT Kanpur, the Astronomy Club, founded way back in 1975, engages in a myriad of activities all round the year. From winning the Inter-IIT Tech Meet to conducting open-for-all Observation Sessions and from doing R&D to hosting talks by leading researchers and scientists, we do it all.

We are a group of highly enthusiastic students from IIT Kanpur who love to appreciate the beauty of the cosmos. Not all of us have formal background in astronomy, but we are passionate about what our universe has to offer. The club is open to all the students: from the freshers to the final years and from the post-graduates to the ones doing their PhDs. The club consists of not only Physics majors but students across all departments. All you need is just a little interest in the stars and not even that, spend time with us and we'll make sure that you will fall in love with the cosmos because you yourself are made of stardust. So, even if you think that variable stars are demons trapped in a mysterious realm or that comets are omens of that war, we invite you to come and join us.

IIT-K first edu institute to get observatory

Astronomical Centre To Be Inaugurated Today

Abhinav Malhotra | TNN

Kanpur: The students of Indian Institute of Technology-Kanpur had assembled an observatory for astronomical research (OAAR). It is the first such facility in an educational institute in the country. The observatory will be inaugurated by IIT-K director Indranil Manna on Sunday. The telescope and other parts have been imported from US.

The observatory, which is in the form of a dome, had been established close to the airstrip of the institute. The fully automated 10 feet state-of-the-art computerised telescope would help the students and the space enthusiasts to see the galaxies, stars and other celestial bodies.

Akshat Singhal, one of the students who had been involved with this project, informed that the observatory consists of equipment, including a Schmidt-Cassegrain telescope with a 14-inch primary mirror and motorised tracking, a CCD (charged couple camera) camera for imaging has been housed in a fully automated remotely controlled dome.

It will be useful for observing, imaging and analysing stars and other celestial objects, extracting information related to their position, brightness, spectrum, composition and speed; studying astronomical events such as occultations and supernovae; tracking solar system objects; monitoring variable stars and much more," he said.

"We received the dome and the telescope in parts on June 1 and in 10 days, we managed to assemble them. The equipment is now ready for use," said another student.

The inside view of observatory for astronomical research (OAAR)

The observatory, in the form of a dome, had been made close to the airstrip of the institute. The fully automated 10 feet state-of-the-art computerised telescope would help the space enthusiasts to see the celestial bodies

The students of the astronomy club assembled the dome and the telescope.

The observatory is fully computerised and those provided with a username and a password, will be able to have access to the telescope from anywhere in the world and use the data collected by it.

By using the Local Area Network (LAN) if the telescope and the dome will be connected, the telescope can be used by the person while sitting at any place in the world.

The dome can rotate on a 360 degree angle. Further the telescope can also be pointed out in any direction.

The students pointed out that Pankaj Jain of physics department and dean, student affairs, AK Ghosh guided them in the project.

The times of India, 15 Jun 2014

INTER-IIT TECH MEET

Ever since the inception of Inter-IIT Tech meet in 2012, Astronomy Club, IITK has excelled in Astro-specific problem statements, achieving podium finishes every single time. Be it Messier marathons, data analysis or case studies, we have never failed to make a mark and have always helped the contingent of IIT Kanpur win laurels year after year. All this motivates us to preserve our legacy and work & prepare harder than the year before.

HYPERION '22

A Pan-India Case-study Challenge issued annually by the Astronomy Club, IITK. The topic for Hyperion Problem statement for the year 2022 was the "Dance of Heavenly Bodies," which featured problems about signals received in the form of Gravitational Waves from the inspiral of two stellar-mass Black-holes. It included the theoretical and instrumental aspects of Astronomy which required studying the merger event, confirming the two objects had to be black holes, physical constraints in the interferometers, losses of energy etc. Along with that, it required basic computational methods used in Astronomy to analyse data, remove noise and fit the curve in the required model to obtain parameters for the merger. It witnessed 1000+ registrations from all over the nation, including multiple IITs, NITs and IISERs.

Gravitational waves were first theorised in the General Theory of Relativity publication in 1916. Its origin was theorised in extreme events such as supernovae, mergers from compact binary objects such as supernovae remnants, in vicinity to which spacetime stretches and squeezes, creating ripples in its fabric. However, such an apposite system was not found until 1974, when astronomers observed a binary pulsar system in which energy and momenta varied according to the prediction. These observations, although consistent, were not very precise, and thus the most convincing proof was found only in Sept 2015, with the first-ever direct detection of Gravitational Waves. It was mere months after the upgradation of the LIGO and VIRGO project when the event was observed. These observatories have been active in observing other such events which thus became inspiration for Hyperion 2022.

JUPITER OBSERVATION SESSION

Trails of Jupiter & its Galilean moons

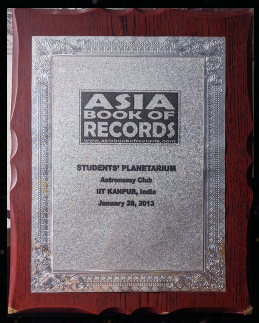
On September 26th and 27th, 2022, the Astronomy Club IITK organised a night sky observation session. The days marked the rare event of Jupiter passing by closest to the Earth, in opposition to the Sun, which last occurred in 1963. At low magnification, Jupiter observations were made along with its four Galilean moons, namely IO, Europa, Callisto and Ganymede. At higher magnification, more subtle features like the bands of Jupiter were discernable. Some other basics of astronomy, such as the Summer Triangle, Star Trails, Constellations, etc., were also presented to keen observers.

Being open to the entire Campus Community, this was the first Night Sky Observation Session organized by Astroclub since the outbreak of pandemic. The session marked the start of Live Astroclub sessions after almost 3 years. Over 3000 people joined to witness the opposition of Jupiter, including both students and faculty members.

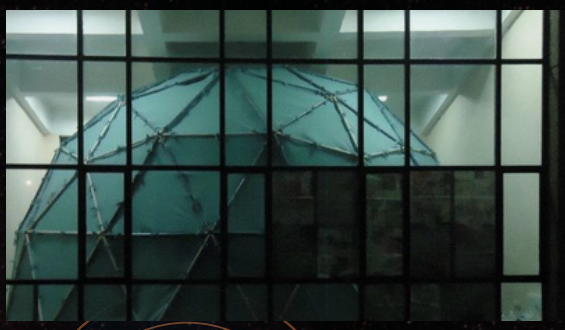
SNT PAVILLION

Astronomy Club IITK showcased it's prowess in the first ever SnT Pavillion post COVID for Y22 batch. Conducted over a span of 4 days from October 31st to November 3rd, we loved the opportunity to interact with the freshers of IITK.

In brief, The club aims to provide a platform for all the astro-enthusiasts to come learn, innovate, aspire, teach and explore the secrets of the cosmos with us. We hope we were able to ignite the passion for Astronomy among the campus junta once again, be it night sky observations, group discussions, talks, documentaries, events and so much more!



PLANETARIUM



One of the most awe-inspiring things our campus beholds is the Planetarium of Astronomy Club, IITK. This is a completely student built structure from scratch made up of 61 connection cubes and 160 connection rods. Inaugurated in 2012, it received the Asia Book Of Records for the Largest Student made Planetarium in 2013. It is fully functional and often holds Planetarium shows.

FUN FACT: The club-room is the planetarium itself!

OBSERVATORY

The Observatory for Astronomical Research (OAAR)

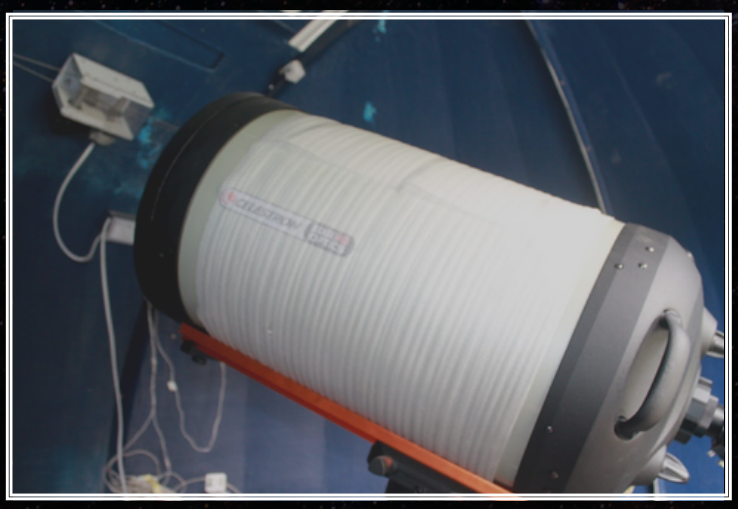
Astronomy Club, ITK, has built its own observatory for astronomical research. It hosts a mammoth 14 inch Celestron EdgeHD mounted on a Celestron CGEM and covered by Homedome ProDome 10, which brings the Heavens down to earth. The observatory was inaugurated in summers'14 and is located inside the Airstrip.

Apart from the magnificent telescope, it also beholds

- The Orion Refractor
- Star Shoot Auto Guider
- 9*50 Celestron Finder
- Observation Filters
- Focal Reducers
- Canon EOS 1100D
- Lens Cleaning kit and other maintenance kits.


अंतरिक्ष की गतिविधियों व रिसर्च वर्क में मदद करेगी आधुनिक प्रयोगशाला

Inauguration of the Observatory



CLUB PROJECTS

As we know that various SnT summer projects are offered every year and this year Astronomy Club offered three projects which were a really very great experience and provided the mentees with a range of knowledge. Apart from that, the club also conducted a reading project during Jan-Mar 2022.

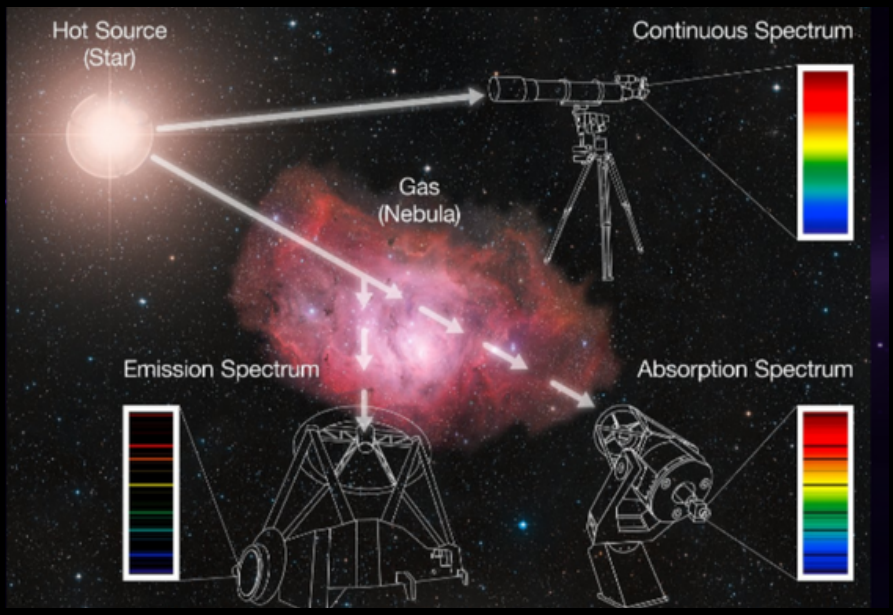
Astro Instruments 101

The project covered the basics and applications of astronomical instrumentation, involving all four components of it: namely, Optics, Modelling (CAD Designing), Electronics (Sensors, Detectors and Transducers) and Computer Interfacing (Data acquisition and digital input-output via LabVIEW). Celestial motion and orbital dynamics were also covered for an in-depth knowledge about the instrument's working. Mentees also look into the historical emergence of Astro instruments and how they evolved and developed with time, and what is to come next by undertaking detailed studies of the Hubble and James Webb Space Telescope and also learn about their subsystems. The mentees were also introduced to the workings and practical application of various mounts of telescopes. They were also able to fabricate various instruments such as sundials, spectroscopes, etc.

Blast Off!

The project focused on the fundamentals of Rocketry and appreciating the engineering and mechanism that goes into building rockets for successful space programs. It began by understanding the history and foundations of rocket design and propulsion systems and then moving on to the aerodynamics and mission planning.

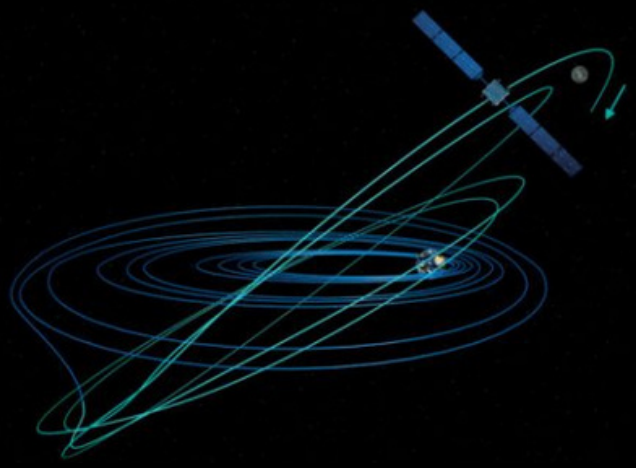
Mentees were then introduced to the optimisation of rocket models using Multi-Objective Genetic Algorithms, maximizing the payload mass to cost ratio in python. Towards the end of the project, we focused on building and successfully launched multiple model rockets, a first for IIT Kanpur.



XUVI

Light plays an extremely important role in analysing and quantifying the phenomenon happening in the observable universe. The primary method to detect an event happening is via Light-Curved. The mentees were introduced to various computational techniques, starting from the very basics in python and then moving on to various different libraries such as NumPy, Pandas, SciPy, AstroPy, etc. and functions provided in them. Exoplanet detection via the 4 most known methods of Direct Imaging, Radial Velocity, Astrometry and Transit Photometry was discussed in great detail. Moving close home to our host star, the Sun, Solar Flare detection and modelling were implemented using algorithms written in python. Hands on experience with light was done by making a DIY spectroscope. All the functions and code written have been published as a FOSS Python package called "JUX".

Orbital Perturbations



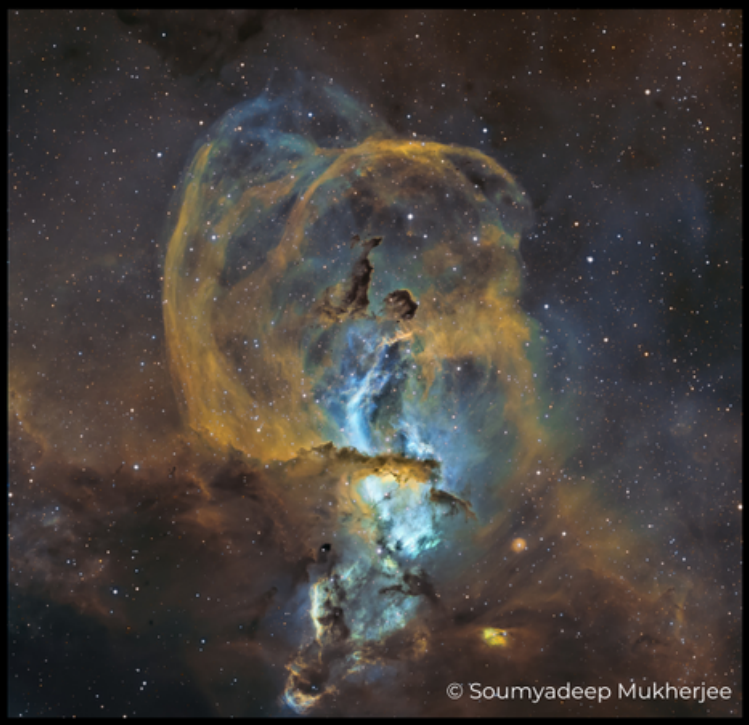
As a continuation of the summer project 2021 - Space: The final frontier, the project focused on spacecraft control and manoeuvring as well as accurate mapping of trajectories of asteroids requiring precision tracking of their movement in space. Satellites and debris in LEO (Low Earth Orbit) continuously get acted on by minor forces that over time result in a completely different orbit that the one simulated. Hence, in order to accurately predict their movement, these “perturbations'' were taken into account as well. Further, the mentees leaned into Newton’s n-body problem by running a simulation of stable periodic orbits of 3 equal-bodied masses and Lagrange points ending with a case study of the James Webb Space Telescope and it's positioning about the L2 point of the Sun-Earth system.

ASTROPHOTOGRAPHY

Our home: The Milky Way

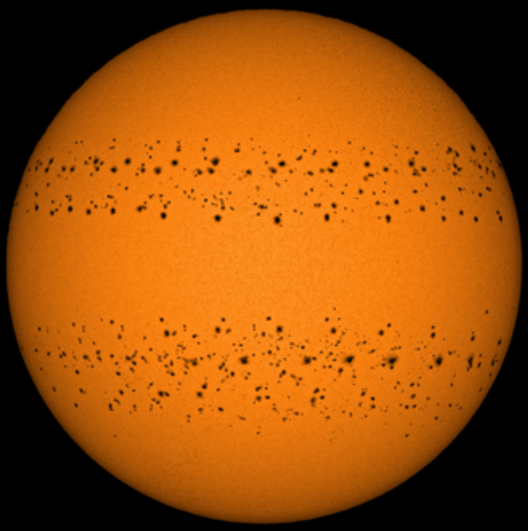
Southern Pinwheel Galaxy

Southern Pinwheel galaxy also known as Messier 83 or NGC 5236, is a barred spiral galaxy located 14.7 million light years from Earth in the southern constellation Hydra.



Statue of Liberty Nebula

NGC 3576, discovered in 1834, is an emission nebula situated in the Sagittarius arm of the Milky Way. In 2009, Dr. Steve Mazlin suggested the name "Statue of Liberty Nebula" for its shape and the name became popular.



© Soumyadeep Mukherjee

A Year in the Sun

This image, captured by Soumyadeep Mukherjee, a student at IITK was taken over an entire year. In his words, 'It is a blend of all the 365 images showing all the sunspots that appeared on the earth-facing solar disk'. It is awarded as the Astronomy Picture of the Year 2022

© Soumyadeep Mukherjee

In the search for Minerals

Earth's companion is a hot commodity. The global flotilla is also nudging us closer to when we'll mine the moon. Lunar regolith might bake into bricks, reap precious metals, or refine into fuel and solar panels.

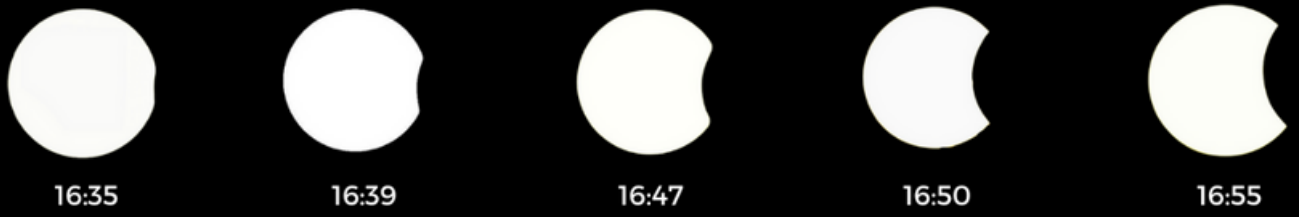
© Mohammad Saad

Star Trails at the Open Air Theatre

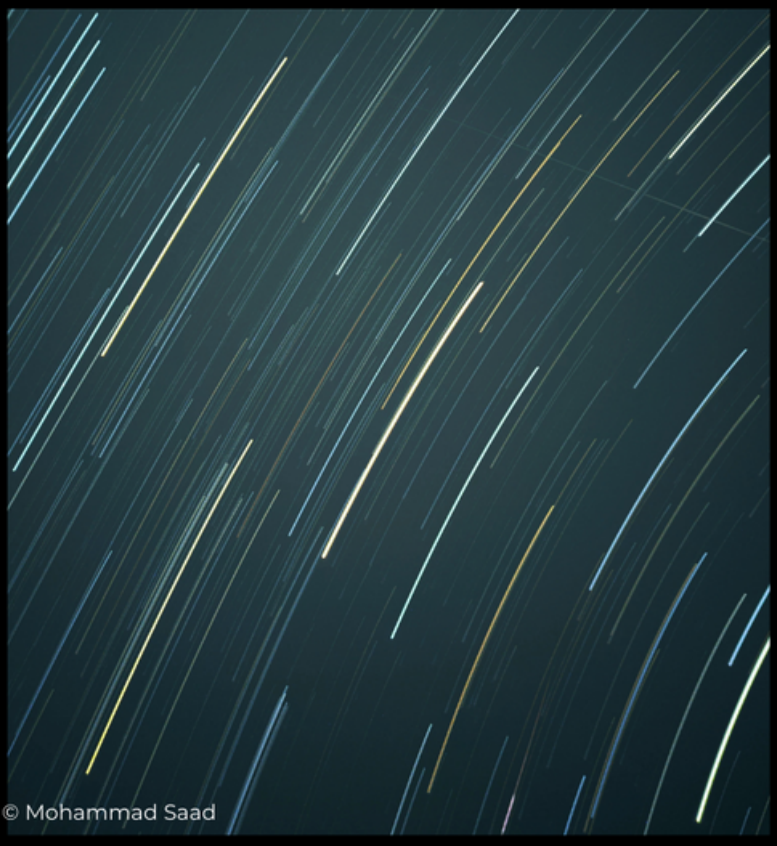
25th October, 2022
Sunset Time: 17:26

Progress of Partial Solar Eclipse | IIT Kanpur

26.515602, 80.230200



Progress of Partial Solar Eclipse



Orionids

The Orionids meteor shower are so-called because the point they appear to come from , called the radiant, lies in the constellation Orion, but they can be seen over a large area of the sky.

The Orionids, which peak during mid-October each year, are considered to be one of the most beautiful showers of the year. Orionid meteors are known for their brightness and for their speed.

© Mohammad Saad

© Soumyadeep Mukherjee

Last Lunar Eclipse till 2025

This spectacular picture of the Lunar Eclipse on November 8th, 2022 was captured on the beautiful Bithoor ghats over-looking the river Ganga. The world won't be seeing a complete lunar eclipse till March 14, 2025

HDR Astro Photography

This is an image of Lunar eclipse with HDR (High Dynamic Range) retention. It beautifully shows Japanese Lantern effect, or the turquoise/blue band on the moon can be seen during eclipses.

© Mohammad Saad

Sunset or Eclipse?

Why not both? A Solar Eclipse happens when the moon passes in between the Earth and the Sun causing some or all blockage of the light from the Sun reaching Earth. This magnificent image was captured on the evening of October 25th, 2022 from Technopark building, overlooking semi-rural Kanpur. Eclipses can frequently lead to scenery such as the Ring of Fire, Devil's Horns and many more awe-inducing moments.

Galactic Neighbours

The main galaxy that can be seen in the foreground is the closest one to ours, named Andromeda and is on a "collision course" with the Milky Way. Orbiting it can also be seen 2 Messier Objects, namely M32 and M110, both of which are dwarf galaxies and a part of the Local Group. From the skies of Kanpur, the Andromeda Galaxy may appear nothing more than a fuzzy patch in the night sky, but in reality, it's a treasure trove like no other.

© OAAR IITK

Origins *from* Stardust

Written by
Himanshu Mittal

Everything around you-your desk, your laptop, your coffee cup -and even you are made of stardust, the stuff forged in the fiery furnaces of stars that died even before our sun was born.

When Carl Sagan said that "we're made of star stuff," he wasn't being metaphoric. He was simply noting—in his uniquely precise and poetic way—that the raw materials that constitute our physical bodies were forged in the bellies of distant, long-extinguished stars.

When stars die they seed the cosmos with the elements that go on to coalesce into new stars and planets comets and everything of which we knew of, even life!

Carbon Nitrogen and Oxygen are the most abundant elements in the galaxies after Hydrogen and Helium. Whereas hydrogen and Helium emerged from the Big Bang, Carbon Nitrogen, and Oxygen are formed due to nucleosynthesis within the stars. Of particular interest are the isotopic ratios 12C/13C, 14N/15N, and 16O/17O because they are effective tracers of nucleosynthesis and help to benchmark the chemical processes that occurred in primitive interstellar material as it evolved into our Solar System. Researchers used Radio telescopes in Arizona and Spain to observe gas clouds in the young planetary nebula K4-47 approximately 15000 lightyears away from earth.

Classified as a nebula K4-47 is a stellar remnant that was created when a star not unlike our sun shed some of its material in a shell of outflowing gas before becoming a white dwarf. To their surprise, the researchers found that some of the elements that make up the nebula—carbon, nitrogen, and oxygen—are highly enriched with certain variants that match the

Fig: K4-47 nebulae

"The models invoking only novae and supernovae could never account for the amounts of 15N and 17O we observe in meteorite samples," says Lucy Ziurys, senior author of the paper, which appears in Nature. "The fact that we're finding these isotopes in K4-47 tells us that we don't need strange exotic stars to explain their origin. It turns out your average garden variety stars are capable of producing them as well."

abundances seen in some meteorite particles but are otherwise rare in our solar system: so-called heavy isotopes of carbon, nitrogen, and oxygen, or 13C, 15N, and 17O, respectively.

These isotopes differ from their more common forms by containing an extra neutron inside their nucleus. Fusing an additional neutron onto an atomic nucleus requires extreme temperatures over 200 million degrees Fahrenheit, leading scientists to conclude those isotopes could only be formed in novae—violent outbursts of energy in aging binary star systems—and supernovae, in which a star blows itself apart in one cataclysmic explosion.

Instead of cataclysmic explosive events forging heavy isotopes, the team

Thus we can safely say that almost every element came from the fiery furnaces of stars. Here is a picture of the periodic table which shows from where all the different elements may have come from:-

suggests they could be produced when an average-size star such as our sun becomes unstable toward the end of its life and undergoes a so-called helium flash, in which super-hot helium from the star's core punches through the overlaying hydrogen envelope.

Life is a miracle of Cosmic proportions. It's not just humans or other forms of life. It's the very bones of Earth, The elements of the Earth silicon, magnesium, iron, copper, and silver all of these atoms are formed in the same explosions which created all of the atoms in your body right now.

So it is not an analogy or politicking when Carl Sagan said:-

> "Cosmos is also within us. We are made of Stardust. We are a way for the cosmos to know itself."

PYRAM

WRITTEN BY
SHREYA RAJAK

Designed by-Manjusree Nayak

Astronomy - It's the oldest science known to humankind. It has taken us to the moon and back and helped us discover a lot about the universe. But before we had a clue about whatever any of this meant, our ancestors were looking up. Telling stories that connected the dots between the stars and planets to life down here on Earth.

But what do we actually know about how people of the past understood the sky and developed a cosmology?

The pyramids of Egypt are some of the most impressive ancient monuments, and several are oriented with high precision. The Egyptian pyramids at Giza were built during the third millennium BC as tombs for kings.

The tombs are aligned north-south with an accuracy of up to 0.05 degrees. How the Egyptians did this has been unclear. A study from 2001 proposed that two stars, **Megrez and Phad**, in the stellar constellation known as **Ursa Major** may have been the key. These stars are visible throughout the entire night. Experts thought that ancient Egyptians might have watched these stars circle this imaginary point at night and could mark the north using the **MERKHET** – an ancient timekeeping instrument comprising a bar with a plumb line attached to a wooden handle to track stars' alignment.

The Pyramid of Cheops was built to face the true north. In fact, it's the most accurately aligned to the north of any structure in the world. However, it has a minimal error because the North Pole shifts over time(due to the wobble in earth's axis, called Precession), which means at one time the pyramid was spot on. In the third millennium BC, it was assumed that **Thuban (alpha- Draconis)** was the closest star to the north pole.

Alternatively, they might have measured north by tracking the path of the Sun. An obvious method would be to note the directions of sunrise and sunset on a given day and bisect the angle between the two; the result marks the meridian. For instance, in this case the rising and setting sun must be seen over an absolutely flat horizon, which Giza lacks.

FIG: MERKHET

Then there is refraction in the earth's atmosphere: When one sees the lower edge of the setting sun just touching the horizon it has in fact already set. The light rays are bent to produce an image above the horizon, thereby shifting the direction in which the sun appears to set. this makes this method not much accurate.

ORION CORRELATION THEORY

The Egyptians believed that the gods lived in the Duat, the kingdom of Osiris. It is located in the region of the sky where Orion and Sirius rise helically just ahead of the sun at dawn on the summer solistice. Some Egyptologists have proposed that the Giza plaza, with its three large pyramids, the Sphinx and the Nile, is a mirror reflection of the Duat.

The three pyramids represent the three stars in the belt of Orion, which could have been the intention of the builders because the stars of Orion were associated with osiris,the god of rebirth and afterlife, by the ancient egyptians.

The **Sphinx** corresponds to the constellation **Leo** and the **Nile** represents the **Milky Way**. The concept of creating a sacred landscape on earth that reflects the night sky is not uncommon in other ancient cultures. By building pyramids, temples, and tombs aligned with stars and the earth's cardinal points, ancient people venerated their gods, bringing divine energy to the earth, which prevented the world from falling into chaos.

Also it was further found that the slope of the Pyramid is near the ratio 10:9, and that its height of 484.9 feet (or 0.09184 mile) multiplied by 10^9 equaled 91,840,000 miles.

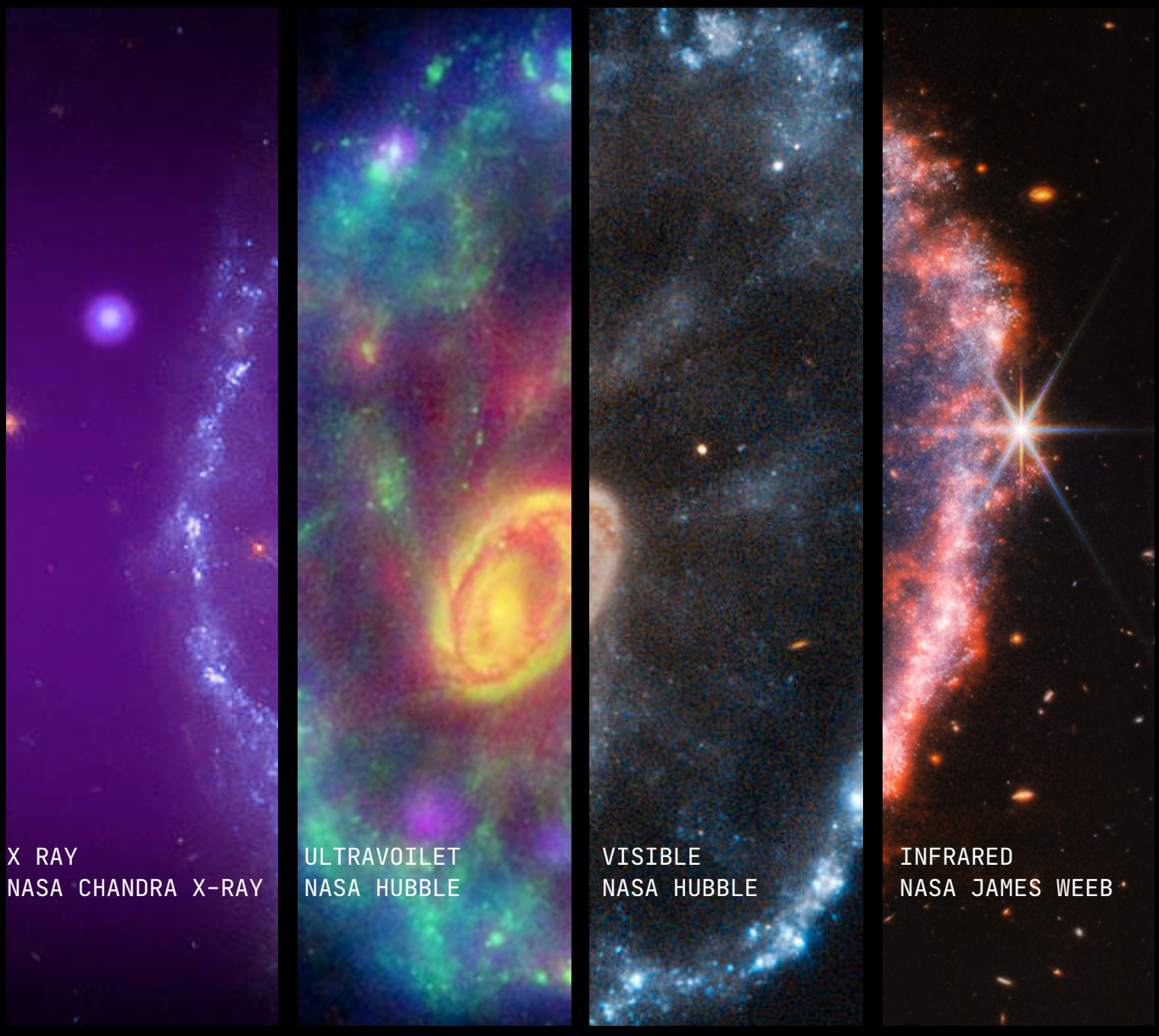
Coincidentally, that number is close to the actual distance between the Earth and the Sun. It is believed that the coincidence meant that the Pyramid builders must have also known this distance.

IDS MIMICKING THE Night Sky

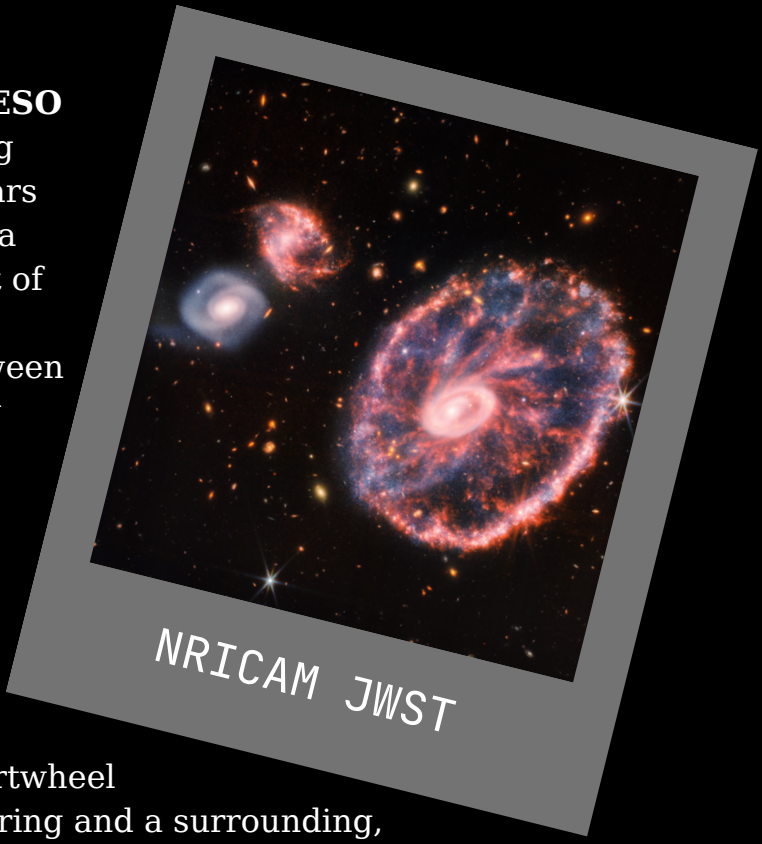
THE CARTWH

It was discovered by Fritz Zwicky in 1941. Although, in Zwicky's words, it is "one of the most complicated structures awaiting its explanation on the basis of stellar dynamics". The images from the recently launched James Webb Space Telescopes reveal astonishing details. Its complex stellar dynamics is expected to become easier to study and understand. Also, its rumored role in helping to understand the origin of the universe is also being studied now.

The structure of the Cartwheel Galaxy is noted to be extremely complicated and heavily disturbed. NASA's James Webb Space Telescope has peered into the chaos of the Cartwheel Galaxy, revealing new details about star formation and the galaxy's central black hole. Webb's powerful infrared gaze produced this detailed image of the Cartwheel and two smaller companion galaxies against a backdrop of many other galaxies. This image provides a new view of how the Cartwheel Galaxy has changed over billions of years.



HEEL GALAXY



The Cartwheel Galaxy (also known as **ESO 350-40** or **PGC 2248**), is a lenticular ring galaxy located about 500 million light-years away in the Sculptor constellation and is a rare sight. Its appearance, much like that of the wheel of a wagon, is the result of an intense event, a high-speed collision between a large spiral galaxy and a smaller galaxy not visible in this image. Collisions of galactic proportions cause a cascade of different, smaller events between the galaxies involved; the Cartwheel is no exception.

The collision most notably affected the galaxy's shape and structure. The Cartwheel Galaxy sports two rings — a bright inner ring and a surrounding, colorful ring. These two rings expand outwards from the center of the collision, like ripples in a pond after a stone is tossed into it. Because of these distinctive features, astronomers call this a "ring galaxy," a structure less common than spiral galaxies like our Milky Way.

Webb's observations underscore that the Cartwheel is in a very transitory stage. The galaxy, which was presumably a normal spiral galaxy like the Milky Way before its collision, will continue to transform. While Webb gives us a snapshot of the current state of the Cartwheel, it also provides insight into what happened to this galaxy in the past and how it will evolve in the future as time goes on.

Written by : Abhinav Singhal
Designed by: Ashmit Bathla

Quasars

BY VAISHNAVI SINGH

A quasar is an active galactic nucleus. It is short for quasi-stellar radio source. In view of the fact that the universe is expanding at a very high-speed relative to us, radiations emitted are red-shifted; thus, we observe things at a much lower frequency, which is why it is named a quasi-stellar radio source.

A quasar is formed by accreting large quantities of material surrounding it to create an extraordinarily luminous and powerful accretion disc. It is formed either when a young galaxy is forming or when two galaxies collide. In contrast, a black hole is formed when a large star dies in a supernova explosion. Quasars give rise to an ordinary galaxy after billions of years when it finishes accreting the surrounding gas and dust. They do not exhibit time dilation.

Friction causes quasars to heat up when gas falls towards the centre of the accretion disc. Quasars release energy in the form of electromagnetic radiation. The radiant energy produced is enormous. The most powerful quasars have thousands of times greater luminosities than the Milky Way Galaxy. The brightest quasars devour 1000 solar masses per year, which calculates to ten earths per second.

The brightest quasar known is 3C 273 in the constellation of Virgo. Its luminosity is about 4 trillion times that of the Sun, and its core has an effective temperature of more than 10 trillion degrees.

Since most quasars are more than 3 billion light years away, we view them as they were 3 billion years ago, and thus they provide us with information about the universe at an earlier stage.

With images of double quasars 0957+561 observed in 1979, the theory of gravitational lens effect, speculated by Albert Einstein's general theory of relativity, was certified observationally for the first time. It is predicted that the Andromeda Galaxy will collide with the Milky Way galaxy approximately after 3–5 billion years, leading to the formation of a quasar at the centre.

Blazars are the quasars that particularly propel high-powered jet particles towards the Earth.

GODZILLA

The Most Luminous Star Known

By Abhinav Singhal

A star that may be the brightest ever seen has been found by astronomers. The object, known as Godzilla, is located approximately 3 gigaparsecs, or 11 billion light years, away in a galaxy.

The Sunburst Arc is a far-off galaxy that was found in 2016. A group of galaxies warp and magnify the light of this galaxy as it travels to Earth. Like a result, the Sunburst galaxy appears as a collection of arcs via telescopes. Scientists discovered an odd object in one of these arcs in 2020, but their nature is still unknown.

With the use of observations and modelling of the Sunburst Arc, Jose Diego from the University of Cantabria in Spain and his colleagues may have found the answer to this riddle. The authors conclude that the mysterious object is most likely a brilliant blue variable star, which is a hot, massive star. They claim that the object, which they have christened Godzilla, is experiencing a strong outburst, during which its size and brightness have sharply increased.

The bow-shaped Sunburst Arc galaxy, home to the star nicknamed Godzilla, is visible multiple times in this image because of an effect called gravitational lensing.

Godzilla stands out as a standout for a variety of reasons. Although its luminosity is brighter than Eta Carinae at the time of the Great Eruption, it is still comparable. In other words, the light Godzilla is currently emitting was released during one of its eruptions, briefly increasing its luminance by a factor of 100 over the course of several years or decades. Eta Carinae is one of our galaxy's most massive and brightest stars.

Godzilla may soon be observed by the James Webb Space Telescope, which may also occasionally find thousands of stars that resemble it.

COSMIC DUST

and how clueless we are about them

On the constant falling and presence of celestial soot around us.

Every year more than 5200 tons of space dust falls on Earth, which makes more than millions of tons accumulated over the lifespan of the earth. It is fascinating to realise that we are surrounded by so much extraterrestrial stuff around us

A researcher collects micrometeorites at Dome C in central Antarctica, in 2002.

Why is cosmic dust important? How come it is present in such large amounts on our planet?

The research importance of cosmic dust goes far beyond just material properties of extraterrestrial debris but also has helped in predicting significant and vital astrophysical processes including the formation of the Solar System. Cosmic Dust material testing has found radioactive samples which have provided us with ages of many celestial objects in our solar system. Inspection of cosmic dust has also given us an idea of debris created by man in the near earth system, which have provided concerns upon how scientific pursuits of man have been affecting the cosmos.

Cosmic dust is the main source of extraterrestrial material on our planet. Everyday a lot of it comes as objects like asteroids and satellites pass through our atmosphere, the residual parts after the ignition of these objects by atmospheric phenomena.

A lot of cosmic dust is extracted from the poles as there is less human interaction.

How do we know it is cosmic dust?

Years of research have provided us with ways to differentiate terrestrial and extraterrestrial dust. There are various detection methods for finding cosmic dust. Specifically for stardust, we use information from refractory pieces of individual presolar stars.

Infrared light can penetrate cosmic dust clouds so that we can see far away galaxies, so spectra of cosmic dust can be figured by telescopes which is also useful in detecting them.Scientists like Don Brownlee have been developing ways to detect cosmic dust since the 1970s.

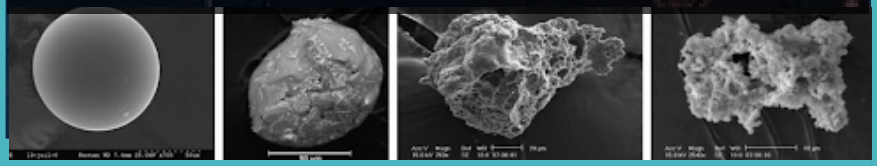
What are the ways to collect cosmic dust?

Though spacecrafts with dust detectors have been built and flown, and many are also presently flying in interplanetary space.

Dust detectors in the past flew on the HOES-2, Helios, Pioneer 10, Pioneer 11, Glotto, Galileo and Cassini space missions. On Earth-orbiting satellites there have been dust-detectors to collect cosmic dust.

Are there some formations of dust in the Universe?

Our Solar system has its own interplanetary dust cloud, as do extrasolar systems. There are different types of nebulae with different physical causes and processes.



Microscope images of four extraterrestrial dust particles the researchers discovered in Antarctica

Image credit: Jean Duprat/ Cécile Engrand/CNRS Photothèque

Image credit: Rojas, et al./Earth and Planetary Science Letters 2021 (CC BY-NC-ND 4.0)

Some other facts

- Discovery program's Stardust mission launched in 1999 collected sample from the coma of comet *Wild 2*, as well as samples of cosmic dust.
- It returned in 2006 and particles were recovered from it in 2007.
- Nebula with dust clouds are pretty common because there is a lot of star formation happening that causes formation of these cosmic dust clouds.
- Organic composition of these dust particles are a subject to high research and have affected the development of instruments like telescopes as well as space-crafts

Written by Manas Pandey

Designed by Manjusree Nayak

CHANDRASHEKHAR LIMIT

"The black holes of nature are the most perfect macroscopic objects there are in the universe: the only elements in their construction are our concepts of space and time."

– Subrahmanyan Chandrasekhar

The night sky is filled with astounding twinkling stars. One might wonder, “What is the destiny of a star? Are all stars the same? Do they follow the same life cycle? What factors make them different from each other?” Equations possess an amazing ability to convey the beauty of our universe in the form of some symbols and operation. And, one such equation that gives a glimpse of the importance of statistical mechanics in astrophysics is the famous Chandrasekhar limit.

A star is a hot ball of plasma. There is a core region in the star that hosts a nuclear fusion reaction. A star spends 90% of its life fusing the most basic nuclear fusion reaction: hydrogen to helium in its core. Such a star is known as the main sequence star, an example is our Sun. The main characteristic of such a star is that it is in perfect hydrostatic equilibrium. The star is massive. So massive that it starts collapsing under its own gravity. But what stops the inward gravitational collapse is the outward (gas) pressure of the core nuclear reaction. So, the inward gravitational collapse is perfectly balanced by the outward gas pressure and such a star is said to be in hydrostatic equilibrium.

When all the hydrogen is converted into helium, the next element in the chain, carbon, forms. The temperature required for hydrogen fusion was about 15 million K and for helium fusion to carbon is about 100 million K. One day, again, all the helium burns out into carbon and what is left is an inert carbon core. The temperature required to fuse carbon is whooping 500 million K. Small to mid-sized stars do not have the potential to host a full-scale carbon fusion. Now in the absence of the core reaction, gravity gains the upper hand and starts collapsing the star. This collapse starts increasing the density of the core region. Thus, the mean separation between the constituent particles decreases and becomes of the order of de-Broglie wavelength. Such a system of high density is known as a degenerate system. This system is highly unstable.

Now, who will save the star? The answer is electrons! And, this is where Pauli’s exclusion principle comes to action. No more than two electrons (one with spin up and the other with spin down) can occupy the same quantum state. So as gravity tries to crush the star, all the available lower energy states start getting filled. Now since other electrons cannot occupy the already filled lower energy states, they have to fill the higher energy states. In a stable white dwarf star, the inward gravitational collapse is balanced by this electron degeneracy pressure. But if the mass of the star becomes more than 1.4 solar masses, even the electron degeneracy pressure will break down. The electrons will then combine with protons and form neutrons and thus, a neutron star. This mass limit, below which the white dwarf star is stable, is known as the Chandrasekhar limit.

Formulated by the Indian-American astrophysicist Subrahmanyan Chandrasekhar, the Chandrasekhar limit defines a limit on the mass of white dwarf stars. It says that if the mass of a white dwarf exceeds 1.4 solar masses ($M_\odot$), it will collapse under its own gravity. Thus $1.4M_\odot$ is the maximum mass of a stable white dwarf star. The Chandrasekhar limit not only defines a limit for the maximum mass of white dwarfs but also highlights the fact that how much important statistical mechanics is to astrophysics.
All direct mass determinations of actual white dwarf stars have resulted in masses less than the Chandrasekhar limit. A star that ends its nuclear-burning lifetime with a mass greater than the Chandrasekhar limit must become either a neutron star or a black hole.

"Science is a perception of the world around us. Science is a place where what you find in nature pleases you." ~ Subrahmanyan Chandrasekhar.

by K Arnav

CYGNUS X-1, the first black hole ever discovered, was located within the Milky Way in the constellation of Cygnus, the Swan.

How funny that it coincides with the name of this magazine !!

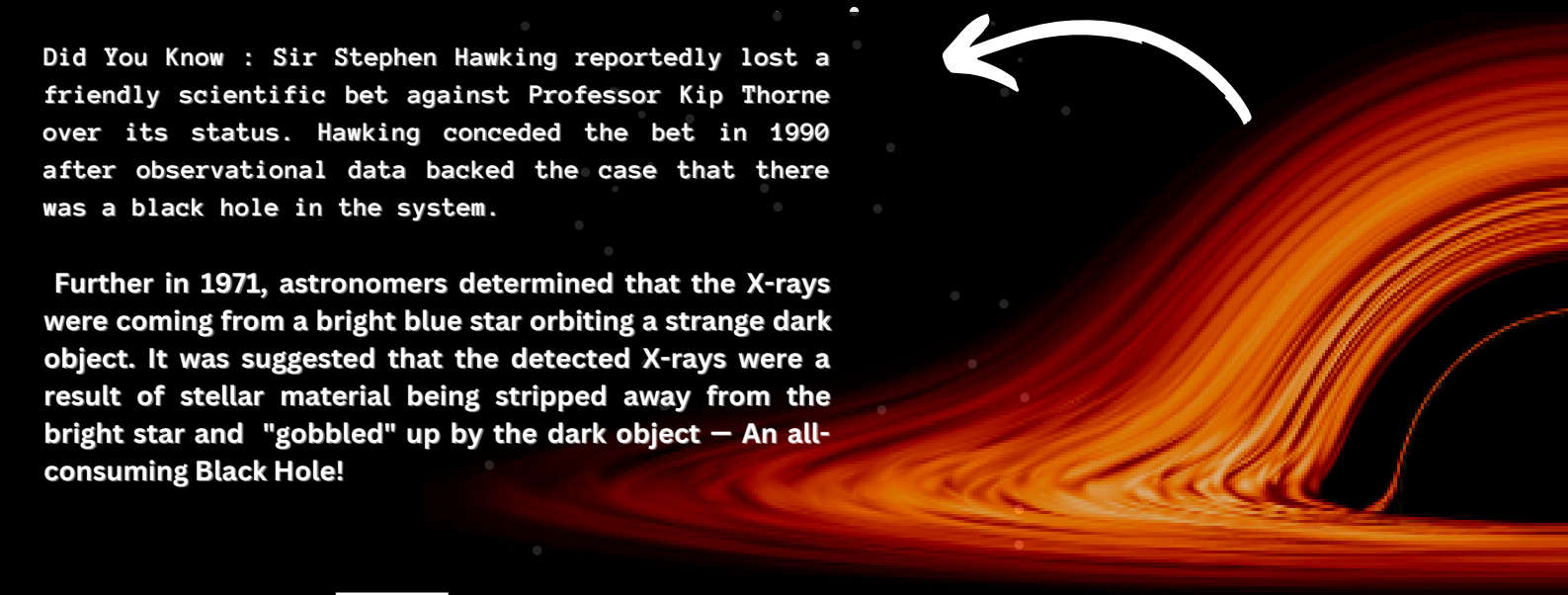
Black holes are some of the strangest and most bewildering objects in space. They're extremely dense, with such strong gravitational attraction that not even light can escape their grasp

Astronomers saw the first signs of the black hole in 1964 when a pair of Geiger counters (an electronic instrument for detecting measuring ionization radiation) were sent to space on a rocket.

Did You Know : Sir Stephen Hawking reportedly lost a friendly scientific bet against Professor Kip Thorne over its status. Hawking conceded the bet in 1990 after observational data backed the case that there was a black hole in the system.

Further in 1971, astronomers determined that the X-rays were coming from a bright blue star orbiting a strange dark object. It was suggested that the detected X-rays were a result of stellar material being stripped away from the bright star and "gobbled" up by the dark object — An all-consuming Black Hole!

Don't go too ne



POWEHI– M87
APRIL 10,2019

A black hole is invisible by nature. A black hole emits no radiation we can detect, and it swallows up everything that falls on it, matter and light alike. So it might seem paradoxical to talk about capturing an image of a black hole, but this is precisely the mission of the Event Horizon Telescope (EHT).

It was 2019. It's not one in our own Galactic centre, but is at the centre of the galaxy M87 – a resident of the neighbouring Virgo galaxy cluster, which is the home of several trillion stars. It was the first time in history that astronomers have seen the shape of an event horizon. It's an unprecedented map of gravity at its strongest, involving hundreds of astronomers, engineers, and data scientists from around the world.

DISCOVERY OF

"It's something that moved from the realm of the imagination to the real."

The EHT has also been observing Sagittarius A*, the supermassive black hole at the centre of the Milky Way. However, our galaxy is much 'messier' than M87 - meaning there is much more gas and dust that obscure the picture.

o.

ar, but not too far!!

When we consider that ours is just one out of hundreds of billions of galaxies in the universe, it is not difficult to see how contemplation of the cosmos can lead to feelings of religious awe and reverence. There are many striking parallels between Eastern thought and modern astrophysics, especially in their imagining of space, time and the birth of the universe.

Another name for the Hindu god Shiva is MAHAKALA, the lord of TIME. Mahakala is typically visualised as black in colour. Just as all colours are absorbed and dissolved into black, all names and forms are said to merge into Mahakala- symbolising the void at the dissolution of the universe and has the power to subsume even time and space into himself.
BLACK also represents total stillness or the complete absence of light, signifying the nature of Mahakala as the primordial source of creation known as BINDU in Yogic terminology, conceptually identical to the SINGULARITY in astrophysics.

The idea of blackness as the primordial state of the universe can also be found in the Rig Veda :

At first there was only darkness wrapped in darkness.
All this was only unillumined cosmic water.
That One which came to be, enclosed in nothing,
arose at last, born of the power of heat . (Nasadiya Sukta)

BLACKHOLES

BY SHREYA RAJAK

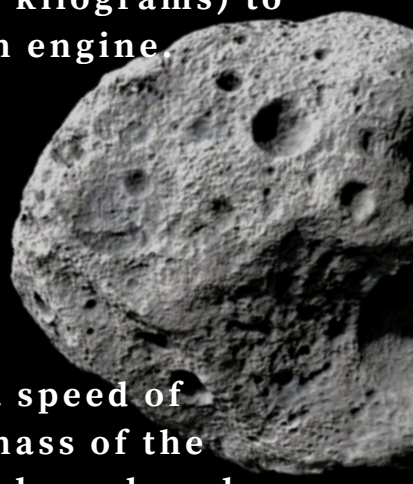
THE DART MISSION

Our galaxy is a home for thousands of asteroids and comets which have pummeled planets for billions of years . Now with the help of the advanced technology , humans have finally found a way to protect our home planet from these planetoids .On November 23,2021 ; NASA along with Johns Hopkins University Applied Physics Laboratory launched the Double Asteroid Redirection Test , officialy known as The DART Mission .

The Double Asteroid Redirection Test is the first-ever space mission to demonstrate asteroid deflection by kinetic impactor , impacting an asteroid to adjust its speed and path . It seeks to test and validate the method to protect Earth in case of an asteroid impact threat. DART is a spacecraft designed to impact an asteroid as a test of technology .On November 23 ,2022 , DART successfully shifted an asteroid's orbit through kinetic impact – specifically, by successfully smashing a spacecraft into the smaller member of the binary asteroid system Didymos. The asteroid system is not a threat to the earth but a perfect testing ground to see if intentionally crashing a spacecraft into an asteroid is an effective way to change its course, in case an Earth-threatening asteroid be discovered in the future.

DART is a low-cost spacecraft with dimensions of roughly 1.2 × 1.3 × 1.3 meters), from which other structures extend to result in measurements of roughly 1.8 meters in width, 1.9 meters in length, and 2.6 meters in height. The spacecraft also consists of two large solar arrays which are around 8.5m each .The DART payload consists only the Didymos Reconnaissance and Asteroid Camera for Optical Navigation (DRACO).DRACO is a narrow-angle telescope with a 208-millimeter aperture and field of view of 0.29 degrees. DART also had a CubeSat named LICIACube .

The DART spacecraft deployed LICIACube 15 days prior to the DART impact on Dimorphos and it captured beautiful images of both the DART impact and the resulting ejecta cloud .DART carries both hydrazine propellant (about 50 kilograms) for spacecraft maneuvers and attitude control, and xenon (about 60 kilograms) to operate the ion propulsion technology demonstration engine.

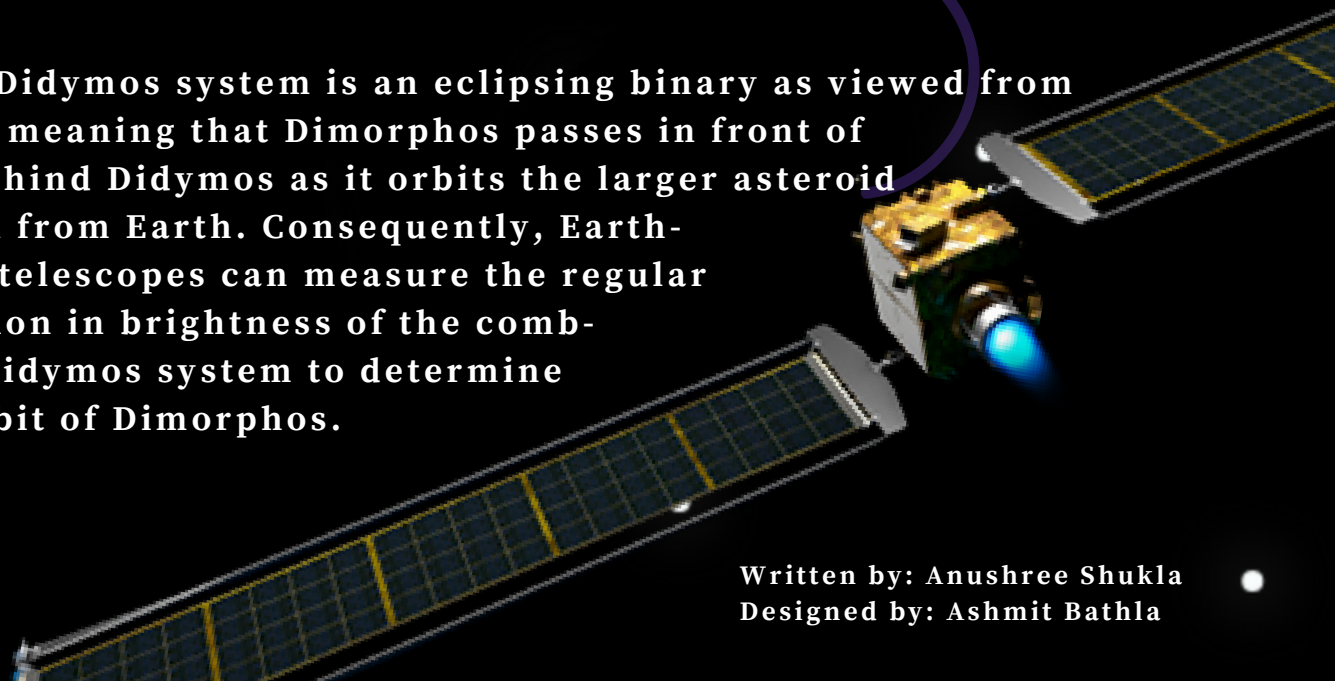


THE IMPACT

DART navigated to crash itself into Dimorphos at a speed of approximately 6.1 kilometers per second. The total mass of the DART spacecraft was approximately 610 kilograms at launch and roughly 570 kilograms at impact.

The binary asteroid system Didymos(Greek word :- meaning twin) was the ideal candidate for science's first planetary defense experiment, although it was not on a path to collide with Earth and neither is it after the collision; thus guaranteeing the safety of the planet.The system is composed of two asteroids: the larger asteroid Didymos (diameter: 780 meters), and the smaller moonlet asteroid, Dimorphos (diameter: 160 meters), which orbits the larger asteroid. Before the collision, the orbital period of Dimorphos was 11 hours and 55 minutes, and the separation between the centers of the two asteroids was 1.18 kilometers . The DART spacecraft impacted Dimorphos which resulted in reduction of its time period around Didymos .

The Didymos system is an eclipsing binary as viewed from Earth, meaning that Dimorphos passes in front of and behind Didymos as it orbits the larger asteroid as seen from Earth. Consequently, Earth-based telescopes can measure the regular variation in brightness of the comb--ined Didymos system to determine the orbit of Dimorphos.

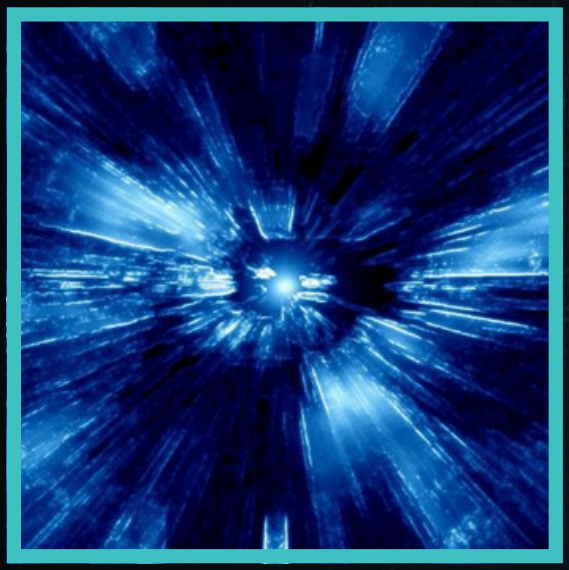


Written by: Anushree Shukla
Designed by: Ashmit Bathla

WARP DRIVE

BY PRINCY CHAUHAN

Suppose you wanted to take a trip to the North Star like actually going there. Well, the North Star is 4 million billion miles away, and there is a universal speed limit - the speed of light. Now we don't have any ships that can go even nearly that fast. But even if we did, it would take over 400 years to get there. But what if instead of travelling through space, we move distance around us in order to get to our final destination? And what if instead of taking 400 years, it took more like four months? Now, this sounds like science fiction. But NASA is actually funding some really, really early research related to the Warp Drive, which would allow us to appear to be breaking the universe's speed limit by bending space itself around us.



If you take a slinky and stretch it out like this, it represents the space between Earth and the North Star, quite a way to travel.But if we can somehow find a way to expand the space behind us and contract the space in front of us, then we've made it most of the way to the North Star without having hardly moved at all. And that is precisely how the Warp Drive works. You would contract space far enough in front of you, and expand space far enough behind you, leaving you with a stable bubble to ride in your ship.

The space in this bubble hasn't been warped, so you still experience time the same way you normally would. That's different from if your ship itself was travelling close to the speed of light, where time would pass more slowly.

The space in this bubble hasn't been warped, so you still experience time the same way you normally would. That's different from if your ship itself was travelling close to the speed of light, where time would pass more slowly.

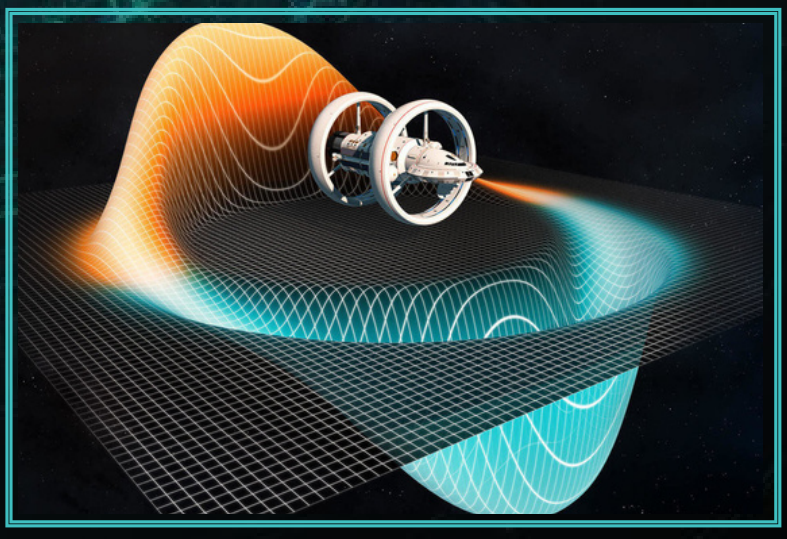
The idea of space contracting or expanding sounds weird, but the universe has been expanding since the Big Bang and has been doing so faster than the speed of light. So the universe started 14 billion years ago from a single point with a Big Bang. If we assume that it started expanding in every direction at the speed of light, then today it would be 14 billion light-years wide. But astronomers have calculated that it's actually over 3 times that size. So this means that it must be expanding faster than the speed of light. It turns out that the universe's speed limit only applies to objects moving through space.

Space can expand and contract at any speed whatsoever. So if we can squish and stretch space really fast, we can make it seem like we travel faster than the speed of light. So how would we workspace like this? With mass. You may be familiar with Einstein's famous equation - energy is equal to mass times the speed of light, squared.

In other words, mass is just another form of energy. Einstein also noticed that a lot of energy or mass does something funny to space - it contracts it. But in order to get enough contraction to build a warp drive, you need a lot of mass, the bare minimum, something as massive as Jupiter. And that's the easy part. The hard part is figuring out how to expand the space behind us. It turns out that you need negative mass, which is a weird thing. An apple of negative mass is lighter than nothing, it's repelled by gravity, and falls away from the Earth instead of towards Isaac Newton's head.When you push it away, it accelerates towards you. I mean, warping space is weird enough, but negative mass?

That just crosses a line, right? Turns out that negative mass is also technically possible. In the field known to physicists as quantum field theory and to the rest of the world as basically magic, you can get negative mass by holding two conducting metal plates extremely close to each other in a closed, empty space.In the universe, virtual particles spontaneously and constantly appear, bump into each other, and disappear. The total number of particles appearing and disappe aring is the same throughout space. So the overall energy or mass throughout space is also the same. But if we bring our plates together, then they act as a filter for particles of certain energy, so fewer particles can appear and disappear in the space between them.

The overall energy or mass in the space between our plates is less than that in normal space. Effectively, it's negative mass. But it's not like a chunk of negative mass that you could just throw behind your ship. Moreover, the positive mass of the plates is huge with respect to the negative mass. So any useful effects would be totally cancelled out. It's possible the chunks of negative mass do exist, they'd be called exotic matter. But even if the exotic matter is floating around in the universe, it would be nearly impossible to find, because it's repelled by gravity and nowhere near us. And there are some other reasons we're not all hoping on warp drives and heading off to the North Star right now. Even if you manage to collect enough positive and negative mass to get the warp going, the ship would be basically unsteerable once you did, because it is impossible to communicate with the outside of the bubble. And even if you manage to make it to the North Star, your warp bubble would pick up a bunch of dust and light on the way there. And all the space junk would build up a ton of energy at the edge of the warp bubble.



So when you go to return space to its normal shape in order to land, all that high-energy space stuff would basically blast every living thing in your destination into oblivion. So all NASA is doing now is trying to create teeny, tiny warp fields in order to see if this sort of thing is even possible. And if it is, we're still probably a millennium away from actually using it.

FATE OF THE UNIVERSE

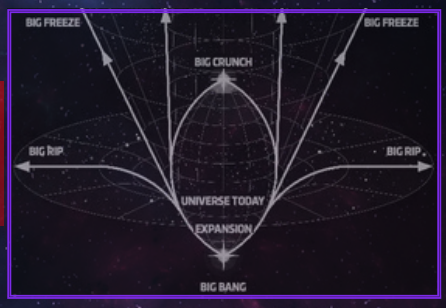
By Suryansh Gaur

Among the theories of how the universe was ultimately created and how miraculously living beings were formed, there are a few theories upon how this vast space with stars, galaxies, black holes and many other things will come down to nothing i.e how this Universe will end or what will happen to it.

Stars will continue to explode long after the universe is cold and "dead," one scientist determined in diving down the rabbit hole to find the last supernova that will ever happen.

When the universe as we know it "dies," it will be "a bit of a sad, lonely, cold place," theoretical physicist Matt Caplan, an assistant professor of physics at Illinois State University, said in a statement. In a new study, Caplan calculated how dead stars might change over time and determined when the last supernova will explode in the universe's distant future. So here we will look through some of the proposed theories of how the universe's ultimate END is predicted.

The Big Freeze Theory



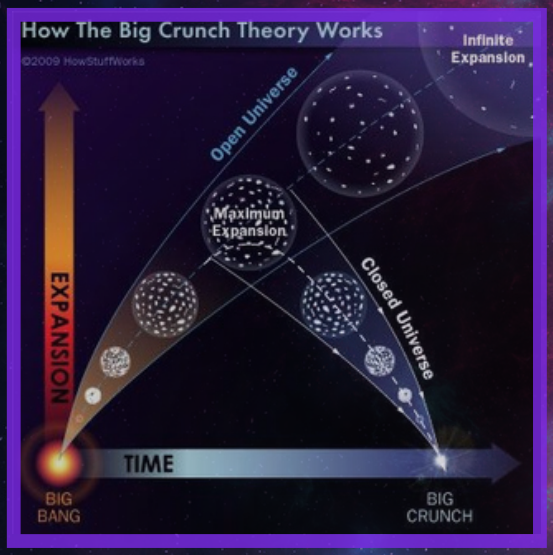
The theory states the flat or hyperbolic shape of the universe on the basis of the density that it contains and will significantly become part of the Big Freeze being in the shape of a saddle. This ending suggests that the Universe will expand forever ultimately making everything too cold to sustain life.

The Big Rip Theory

Following the Law of Relativity, the universe which is accelerating at a pace will lead everything to be ripped and torn apart through the means of expansion. Robert Caldwell from Dartmouth University, the lead author of this theory, mentions that “The expansion becomes so fast that it literally rips apart all bound objects.”

This theory puts phantom or dark energy, an unknown force, as the culprit for the expansion and ultimately the ‘big rip’ of all galaxies, stars, planets, and any matter that exists in the universe.

The Big Crunch Theory



Also known to be the Cyclic Universe Theory, developed by Princeton University’s Paul Steinhardt and Neil Turok of Cambridge, it describes how the Universe goes into a series of ‘big bangs’ and then ‘big crunches’ over and over again. It also suggests how the universe must have formed and how it would end as another big crunch and wait for another big bang to occur.

In one of the journals of “A Cyclic model of the Universe”, Paul and Neil stated that “ In this way, the Universe is creating and destroying itself in a never-ending cycle.

The Multiverse Theory

This theory does not relate to the end of the universe. Instead, it is an assumption that there might be various other universes or the multiverse. Theoretical physicist Michio Kaku explains how this could be possible due to the notion that energy expands faster than the bubble that the Universe can sustain, thus creating many other Universe bubbles.

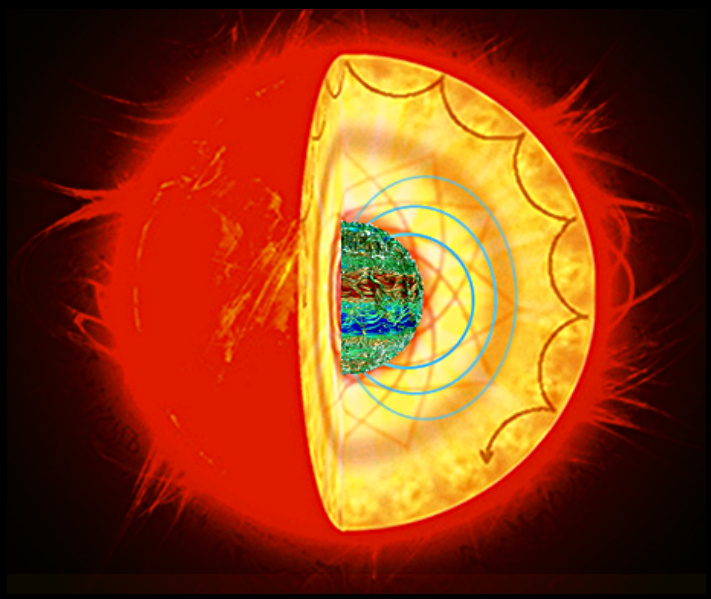
In this model, linked to the String Theory, it is believed that parallel universes would exist simultaneously in the Universe as it is today, but invisibly residing in higher or lower dimensions that cannot be seen by the human eye. However, this theory is just a conceptualization, like in the movies and memes. The scientists still don’t have many things to validate it.

SONG OF THE STARS

Listen carefully. Do you hear it? No? Try listening harder. It's the song of the stars. Millions of them, singing melodiously in unison like a Christmas Carol! So why would they sing to us? Well, the answer lies in the structure and processes through which stars thrive for millions of years. Stars are like onions. Every star that has ongoing thermonuclear reactions inside has a Core - the hottest region where nuclear fusion occurs i.e., lighter elements are combined to form heavier elements and energy is released; a Radiation Zone - the heat and light generated from the core travels to the outer region of stars which might take thousands of years; a Convection Zone - where very hot gasses travel in loops to cool off the star; and an Atmosphere - the outermost layer visible to our eyes. But wait, if we can see only the Atmosphere, how do we know that any other layers exist? Well, as you'll see, although we might not be able to see them, we can definitely hear them.

You might think that the stars keep humming tunefully, but their song selection is rather more of Jazzy and Rocky type. They growl, modulate their voices, and hit the highs and lows without voice cracks. The layers of stars are in a state of oscillations, a lot of oscillations. When a layer of star sings, the other layers harmonize with it. The lead singing and harmonies reflect from different layers throughout the star's body like echoes. Not only that, the reflection depends upon the pitch and origin of singing. This is quite a spontaneous and stochastic process. The song finally presents itself as fluctuations in the light and size of the star, which can be broken down into fundamental pitches owing to the data we receive from satellite imaging. The study of these processes is called Astroseismology. Famous Belgian astronomer Conny Aerts released one such song to which people in the clubs danced off.

The singing of stars helps us identify the age of the star. For example, Betelgeuse, a red giant in the constellation Orion, is near the end of its life so it keeps on switching to vastly different pitches and sizes. Sadly, the farther and the smaller a star is, the more difficult it is to properly distinguish its singing. Therefore, we might not hear the melancholic singing of Betelgeuse clearly, but the Sun sings to us loudly and clearly.



The Astroseismology of our Sun is called Helioseismology. The fields of Astroseismology & Helioseismology exploded with the launch in March 2009 of NASA's Kepler satellite which stared at the same small area of the sky for approximately three years. Although its primary mission was the detection of exoplanets - planets outside our solar system, and from Kepler data, a list of several thousand candidate exoplanets was generated, the mission also yielded light curves of more than 100,000 stars with exquisite precision and time sampling. Kepler has enabled us to hear about 16,000 Red Giants. The study of sun-like oscillations in giants has led to a number of breakthrough discoveries, such as the classification of the evolutionary stages of red giants, measurement of internal rotation and possible detection of magnetic fields in radiative cores. It has also provided us with an excellent opportunity to implement Galactic archaeology - the study of the formation of galaxy and stars - and to characterise exoplanet properties.

WRITTEN & DESIGNED BY
RITIK B KUMAR

LIFE IN THE UNIVERSE

"Two possibilities exist: either we are alone in the Universe or we are not. Both are equally terrifying."

– Arthur C Clarke

Long has been the history of human beings wondering about this very question – "Are we alone? If not, where is everybody else?" In the quest to find the answer, SETI (Search for Extra Terrestrial Intelligence) Institute has been actively looking for nonhuman technosignatures like radio emissions from exoplanetary systems that might possibly contain life. Moreover, NASA Astrobiology Institute (NAI) has been consistently contributing to what we know about life in the Universe. We've been steadily looking out for them, but for anyone seeking us, they are somewhat fortunate as we have tried to make our presence known in many ways. The most famous are the Arecibo message, the plaques aboard the Pioneer Probes and the Golden records aboard the Voyager spacecrafts. Our messages, if ever intercepted and decoded by intelligent species, would be our first "Hello" to them.

The Voyager Golden Record

The cover (on the left) contains instructions on how to use the record, information about the location of our Solar System and a Uranium-based clock. The record (on the right) contains images, music, sounds of Earth and greetings in 55 languages

Speaking of intelligent species, there is a hypothetical scale - The Kardashev scale, used to measure a civilization's level of technological advancement based on the amount of energy it can use. A Type I civilization is usually one that can harness all the power reaching its home planet from its parent star. According to estimates, we are currently at a level of 0.73 on the scale.

Type II would be capable of constructing a Dyson Sphere. Finally, Type III civilizations can manipulate energy at the scale of their galaxy.

One would then again wonder, despite the immense likelihood of the existence of intelligent alien species (as suggested by Drake's Equation and several other probabilistic estimates), why we haven't found any substantial evidence of them whatsoever. This inconsistency, known as the Fermi Paradox, seems daunting when given enough thought. We aren't entirely clueless, though. Maybe, the chemistry of inorganic material giving rise to life is extremely rare; or possibly, microbial life is widespread, but evolution into intelligent multicellular organisms is challenging for nature to accomplish. Some suggest that catastrophic events frequently occur, which prevent civilizations from becoming interstellar species. The most horrifying of all is the Dark Forest Hypothesis. It is the idea that intelligent civilizations exist throughout the Universe but are paranoid of others. The hypothesis suggests that any space-faring society would be highly vigilant and view any other intelligent life as an inevitable threat. Such advanced species would destroy any evolving life that would make its presence known. Following the hypothesis, it seems best to keep one's electromagnetic emissions to a minimum and stay silent in this *dark forest full of ferocious predators.*

There are innumerable other speculations. Sadly, since there is a lack of conclusive evidence, for the time being, one can only wonder, "Why is it so silent out there?" It reminds us of the countless other mysteries of the Universe. Hopefully, we will someday obtain answers to all our questions. Indeed, the Cosmos is beautiful, but it is also strange in its way.

by Antriksh Gupta

To,

Astronomy Club

IIT Kanpur

June 20, 2012

We are pleased to inform you that you have set a new **National Record '**
FIRST STUDENT IN -HOUSE PLANETARIUM IN INDIA'

The details of your achievement have been entered into our record book as Follows

The students of Astronomy Club, IIT Kanpur, made a students's planetarium named "In house planetarium" of 24 feet diameter dome with 61 connection cubes and 160 connection rods which were PVC pipes and local cloth used for mirror projection system which was constructed inside Astronomy Club room in duration of 1 year. It can accommodate 50 people and was inaugurated by Manindra Agrawal, Dean of Resources, Planning and Generation, IIT Kanpur.

Welcome to the very selected brand of national record holders!

Yours Sincerely,
Priyanka Bhatia,
(Talent search Department)
India Book of Records

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“People who believe they are ignorant of nothing have neither looked for, nor stumbled upon, the boundary between what is known and unknown in the universe.”

—Neil deGrasse Tyson.

ASTRO IIT KANPUR

Astronomy Club, IITK

Coordinators - Adit Jain | Atharva Dehadraya | Nikita Singh | Shashank Sinha

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