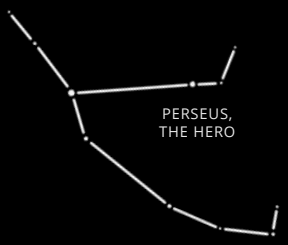
Astro SG

FEBRUARY 2025
EDITION 8



ASTRO DIGEST

A WELCOME TO 2025

THE GRANDEST PLANETARY ALIGNMENT THAT WE HAVE EVER SEEN, AND MORE ON THESE IMPRESSIVE EVENTS

THE MOON'S DARK SIDE

LET'S UNVEIL SOME SECRETS THAT THE MOON HAS BEEN HIDING FROM US, SHALL WE?

THE ELUSIVE MEMBER

UNRAVELING PLANET X'S MYSTERIES: A THRILLING QUEST BLENDING THEORIES, WITH CELESTIAL INTRIGUE!

TRIVIA

BECAUSE THE UNIVERSE LOVES TO KEEP US GUESSING!

EVENTS & STARGAZING

FEATURED STARGAZING LOCATION & OBJECTS

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AN ASTRONOMICAL WELCOME

As we greet the new year, the year greets us back with one of the rarest planetary alignments that we have seen, with a whopping 6 stars shining in the night sky. Let's take a closer look at this phenomena that lies right above in our sky!

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THE MOON'S DARK SIDE

We always see the same side of the Moon here on Earth, but just what else lies lurking on the other side? Beware, and be warned, as we jump in on an adventure to see what the "dark" side of the Moon has to offer!

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THE ELUSIVE MEMBER

Explore the enigmatic Planet X, a hypothesized distant world whose existence challenges our understanding of the solar system, through scientific discoveries in a cosmic mystery!

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TRIVIA, EVENTS & STARGAZING

Get ready to explore cosmic wonders with our latest trivia, upcoming events, top stargazing locations and sky objects—your ultimate guide to the night sky!

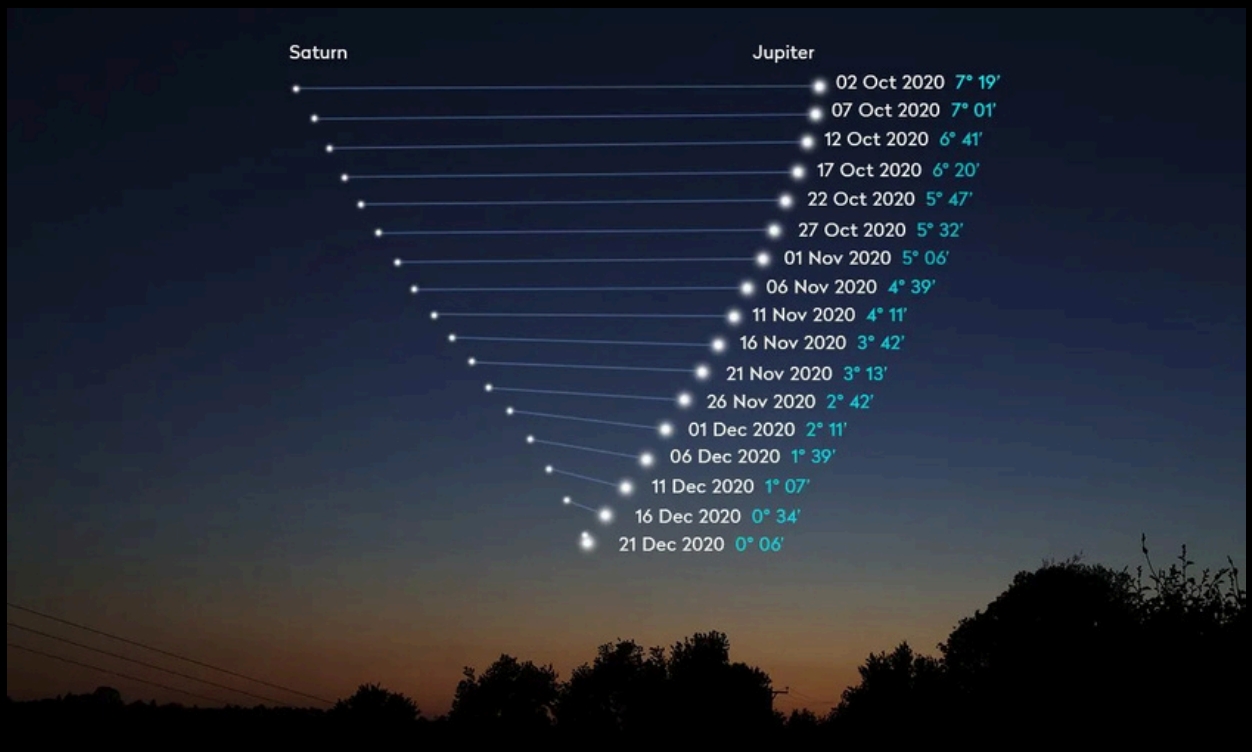
AN ASTRONOMICAL WELCOME TO 2025

THE RECENT PLANETARY ALIGNMENT [SOURCE: STARWALK]
Mars, Jupiter, Uranus, Neptune, Venus, and Saturn in a planetary alignment on January 21, 2025, as seen from the Northern Hemisphere. ©Vito Technology, Inc.

With the New Year just having started, the cosmos had given us a breathtaking welcome as of last month: a rare planetary alignment. Taken place in January 2025, this alignment had seen several planets, including Mercury, Venus, Mars, Jupiter, and Saturn, all gathering in a stunning display across the night sky. However, what is all this about? Is it truly as great as it is rumoured to be?

Firstly, what is a planetary alignment? A planetary alignment occurs when three or more planets align in the same region of the sky as viewed from Earth, essentially gathering on the same side of the Sun at the same time. While perfect alignments are rare, January 2025 will showcase a significant gathering of six planets, creating a visual spectacle that is sure to capture the imagination of all who gaze upward.

AN ASTRONOMICAL WELCOME TO 2025

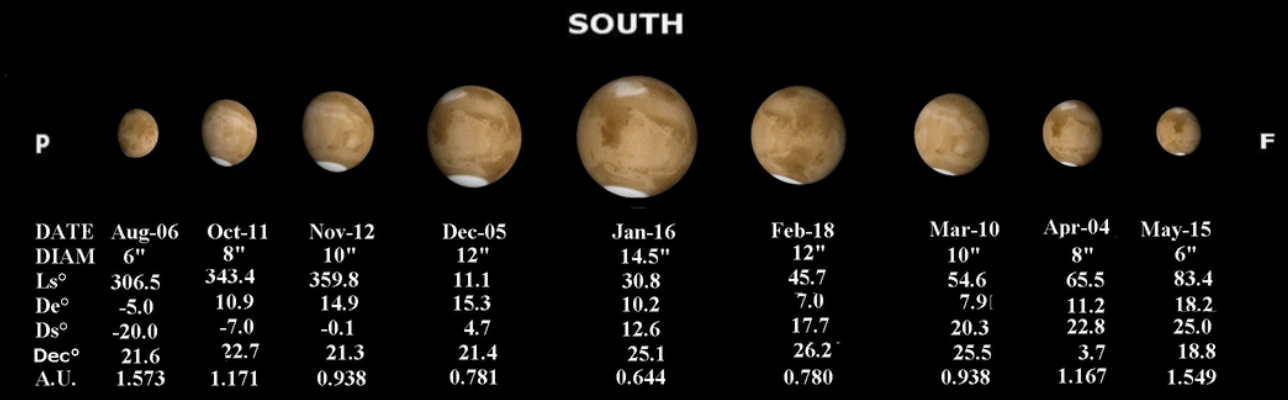


SATURN JUPITER CONJUNCTION [SOURCE: BBC STARATNIGHT]
Saturn and Jupiter appear to close in on each other as the Great Conjunction 2020 approaches on 21 December (apparent distance given in degrees and arcminutes). Credit: Pete Lawrence

Planetary alignments have fascinated humans for centuries, often intertwined with cultural myths and scientific discovery. Historically, alignments have sparked curiosity and wonder, leading to significant advances in our understanding of the cosmos. For instance, the Great Conjunction of Jupiter and Saturn in December 2020 reignited public interest in astronomy, drawing millions of viewers to the night sky.

The January 2025 alignment not only continued this tradition but also offered an opportunity to engage with the public about the significance of planetary movements. Especially with the growth of social media, we could see various social media networks report about this alignment, with the news reaching out to a wider and mostly uninformed audience, igniting and reigniting an interest in the skies.

AN ASTRONOMICAL WELCOME TO 2025



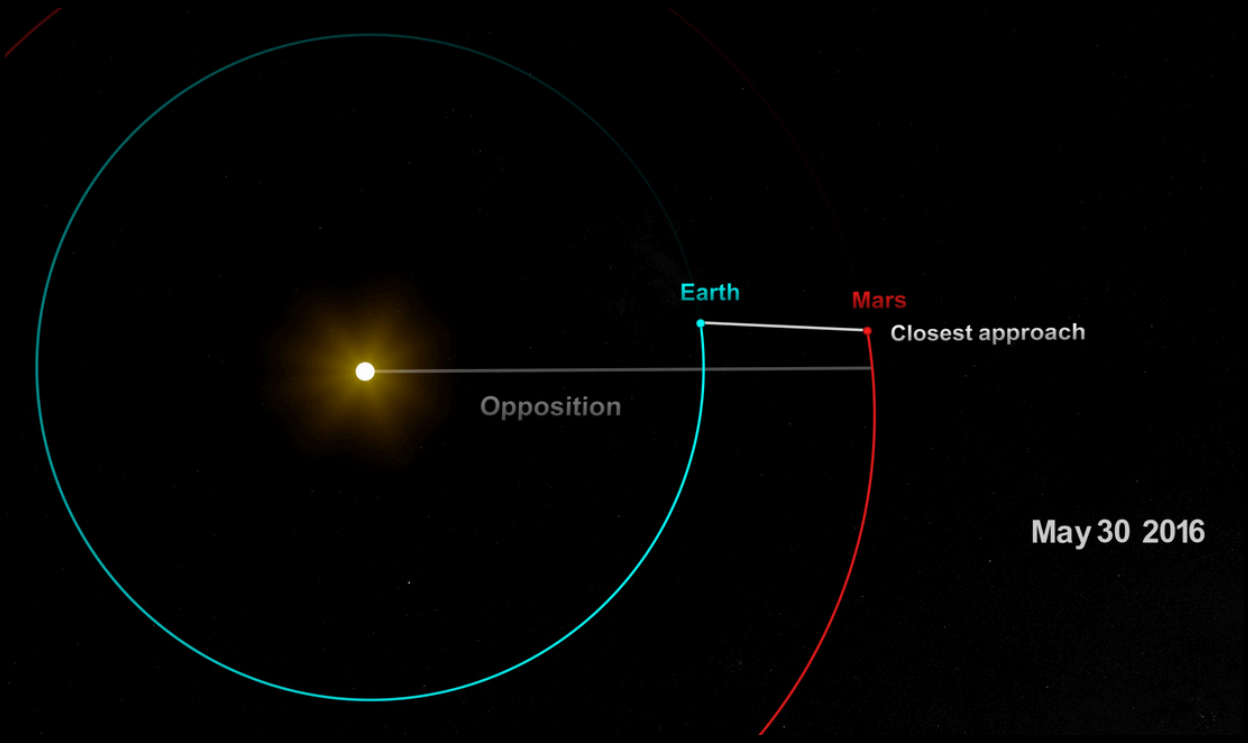
DATE	Aug-06	Oct-11	Nov-12	Dec-05	Jan-16	Feb-18	Mar-10	Apr-04	May-15
DIAM	6"	8"	10"	12"	14.5"	12"	10"	8"	6"
Ls°	306.5	343.4	359.8	11.1	30.8	45.7	54.6	65.5	83.4
De°	-5.0	10.9	14.9	15.3	10.2	7.0	7.9	11.2	18.2
Ds°	-20.0	-7.0	-0.1	4.7	12.6	17.7	20.3	22.8	25.0
Dec°	21.6	22.7	21.3	21.4	25.1	26.2	25.5	3.7	18.8
A.U.	1.573	1.171	0.938	0.781	0.644	0.780	0.938	1.167	1.549

MARS OPPOSITION IN 2025 [SOURCE: ALPO]
As it approaches Earth, it will swell from a small apparent disk of 6" in August 05, 2024 to a maximum diameter of 14.6″ at closest approach on May 17, 2025, and then shrink as it moves away. Images shown at 0h UT.

In addition to the above, we also witnessed Mars at it's opposition in January. The Mars opposition is a fascinating astronomical event that occurs roughly every 26 months when Earth and Mars line up on the same side of the Sun, when the two planets are the closest to each other, allowing Mars to shine brightly in our night sky.

Earth orbits the Sun at an average distance of about 150 million kilometers (93 million miles), completing one revolution in approximately 365 days. Mars, being further from the Sun, orbits at an average distance of 227 million kilometers (141 million miles) and takes about 687 days to complete one orbit. As both planets travel along their elliptical orbits, there are points where they come into a straight line with the Sun. During opposition, Earth is positioned directly between the Sun and Mars. This configuration allows Mars to be directly illuminated by the Sun from our view, making it appear up to 20 times brighter than when it is at its farthest point from Earth.

AN ASTRONOMICAL WELCOME TO 2025



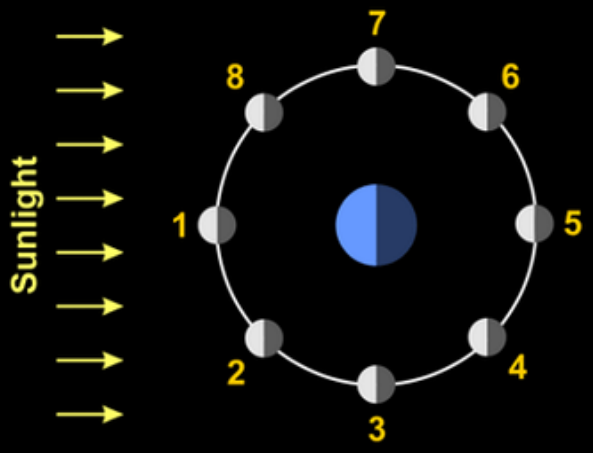
A VISUALIZATION DEPICTING MARS AT OPPOSITION AND ITS CLOSEST APPROACH.[SOURCE: NASA SCIENTIFIC VISUALIZATION STUDIO]
This image shows a visualisation of the 2016 Earth Mars opposition, due to the elliptical nature of their orbits the line is actually slightly "slanted".

With the two extremely rare events taking place, with visibility from Singapore, it is undeniable that the cosmos has finally granted Singaporean Astronomers' wishes. That being said, the weather has been rather unfortunate, so stay strong, keep trying, and maybe you too will get the chance to witness more in the upcoming months!

THE MOON'S DARK SIDE

Astronomy enthusiasts probably know that the Moon is tidally locked to the Earth, which means that the same side of the Moon faces the Earth at all times. But due to lunar libration, we can actually see 59% of the moon.

However, that still means that there is 41% of the moon that remains far from our sight here on Earth. But fret not, astronomers have found their way to peek into this "oblivion". From this image taken by the Orion spacecraft in the Artemis 1 mission, you can see the dark side of the moon in all its glory. Realistically speaking, "dark side" is a misnomer since it gets the same amount of sunlight as the near side of the moon, hence leading to this rather well lit image on the right, just that this side is not visible to us here on Earth.



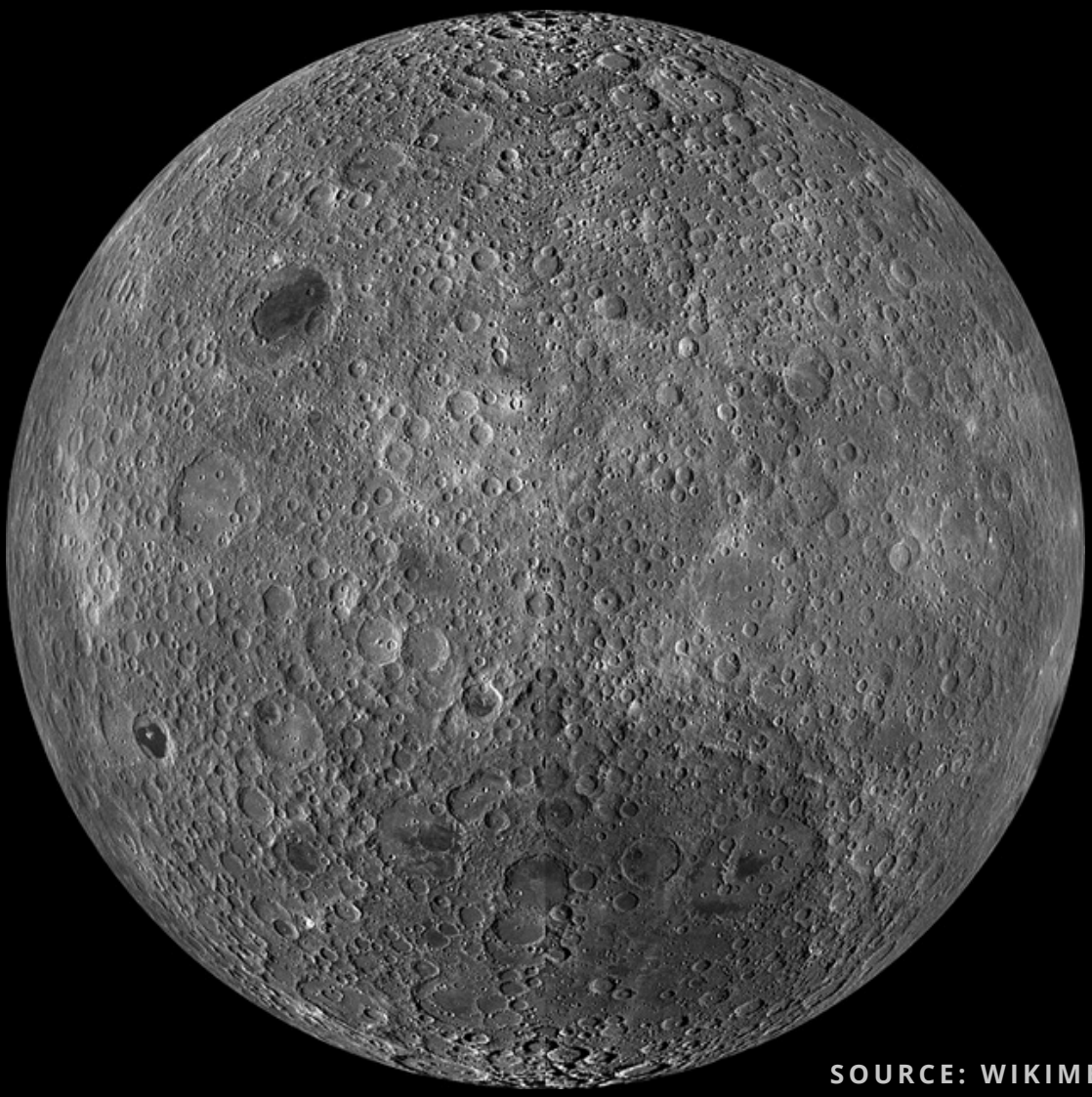
MOON PHASES. SOURCE: ASTRO UNL
The above diagram shows the lunar phases, note that the far side of the moon does obtain sunlight and hence is not actually dark

In this image, one can observe Mare Oriental [the dark patch near the bottom left] and Crater Apollo [the spread out crack looking thing near the top right].

THE FAR SIDE OF THE MOON CREDIT: WIKIMEDIA
Taken by the orion spacecraft, this image shows the far side of the moon in all its glory

Other missions have also mapped out this side of the moon, such as NASA's Lunar Reconnaissance Orbiter and China's Yutu 2 rover. Interestingly, this side of the moon has much less mare (seas) and correspondingly more craters than the near side of the moon,which this image shows more clearly. In fact, while 35% of the near side of the Moon comprises of lunar maria, only 1% of the far side is covered by it.

THE MOON'S DARK SIDE



SOURCE: WIKIMEDIA

And that's just the tip of the iceberg. The near-far asymmetry of the Moon also shows in crustal thickness, elevation, and composition, all of which raise one big question — Why? Well, it has been speculated that this difference is due to a collision on the near side of the moon with a secondary body, and that happened to the early Moon after it had formed a solid crust. Of course, to be sure of what's going on, it'd be best to have samples to work with. And that's exactly what the Apollo 17 mission did.

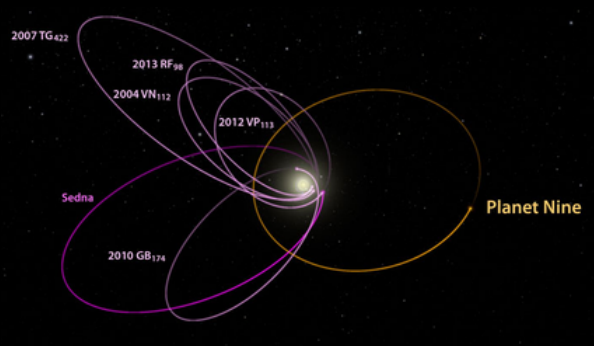
Sent off in December 1972 and returning weeks later, part of the mission involved retrieving lunar samples back to Earth for detailed analysis. From those samples, scientists recently discovered that the Moon's age might be 40-100 million years older than we had thought, but further confirmation would be required, which makes China's Chang'e 6 mission to the far side of the moon much to be anticipated.

THE ELUSIVE MEMBER

For centuries, the cosmos has beckoned humanity with its enigmatic allure, prompting us to chart the stars, explore distant planets, and ponder the unknown. Among the most captivating mysteries of our solar system is the hypothetical Planet X, a celestial body that has eluded astronomers for decades.

The genesis of Planet X:
The concept of Planet X emerged in the early 20th century as astronomers sought to explain irregularities in the orbits of Uranus and Neptune. Percival Lowell, an American astronomer, was among the first to propose the existence of a ninth planet beyond Neptune, which he termed "Planet X." Lowell's predictions led to the eventual discovery of Pluto in 1930; however, Pluto's diminutive size couldn't account for the gravitational anomalies observed, leaving the Planet X hypothesis unresolved.

Modern pursuits and discoveries:
In recent years, the quest for Planet X has experienced a resurgence, fueled by advancements in technology and new astronomical observations. In 2016, researchers Konstantin Batygin and Mike Brown from the California Institute of Technology presented compelling evidence suggesting a planet approximately 5 to 10 times the mass of Earth, orbiting the Sun at a distance 20 to 30 times farther than Neptune. This hypothetical planet, often referred to as "Planet Nine," is theorized to have an elongated orbit, taking between 10,000 and 20,000 Earth years to complete a single revolution around the Sun.



Planet Nine orbit.
Source: SKYANDTELESCOPE
Orbits for the six most distant known objects in the solar system as of early 2016, along with the proposed Planet X orbit.

The evidence for Planet X is primarily indirect, inferred from the peculiar clustering of orbits of distant Kuiper Belt objects—small icy bodies beyond Neptune. These objects exhibit orbital alignments that some scientists argue could be influenced by the gravitational pull of an unseen massive planet.

THE ELUSIVE MEMBER

Skepticism and Alternate Theories:
Despite the intriguing evidence, the existence of Planet X remains a topic of debate within the scientific community. Some astronomers argue that the observed orbital anomalies could be the result of observational biases or the collective gravitational effects of multiple smaller objects rather than a single massive planet.

Notably, NASA's Wide-field Infrared Survey Explorer (WISE) mission, which conducted an extensive survey of the sky in infrared light, found no evidence supporting the existence of a large, undiscovered planet in the outer solar system.

The cultural impact of Planet Nine:
Beyond the scientific realm, Planet X has captured the imagination of the public, inspiring a plethora of theories, books, and even doomsday predictions. One of the most infamous is the Nibiru cataclysm, a supposed disastrous encounter between Earth and a large planetary object. Despite being debunked by scientists, such theories persist in popular culture, highlighting humanity's fascination with the unknown.

The Ongoing Search:
The hunt for Planet X continues with renewed vigour. Modern telescopes, both ground-based and space-borne, equipped with advanced imaging technologies, are scanning the distant reaches of our solar system in hopes of capturing direct evidence of this elusive planet.

The Vera C. Rubin Observatory, set to commence operations in the near future, is expected to play a pivotal role in this search. Its wide-field survey capabilities will enable astronomers to detect faint, distant objects, potentially shedding light on the existence of Planet X.

The Vera Rubin Observatory
Source: AURA Astronomy
The Vera Rubin Observatory will advance science in four main areas: the nature of dark matter and understanding dark energy, cataloging the Solar System, exploring the changing sky, and Milky Way structure and formation.

THE ELUSIVE MEMBER

The Challenges of finding Planet NIne:

The search for Planet X is one of the most ambitious undertakings in modern astronomy, but it comes with a unique set of challenges. Locating a planet in the vast expanse of space is no simple task, especially when it is hypothesized to be far beyond the known boundaries of our solar system.

One of the primary challenges in finding Planet X is its incredible distance from the Sun. If it exists, Planet X is thought to orbit the Sun at a distance of 200 to 1,000 astronomical units (AU), with 1 AU being the distance between the Earth and the Sun. At such distances, even a large planet would appear extremely faint, making it difficult to detect using conventional telescopes. The light from the Sun would be so dim at that range that Planet X would likely reflect very little of it, blending into the background of space.

Planet X is theorized to have an orbital period of 10,000 to 20,000 years, meaning it moves incredibly slowly across the sky relative to the stars. This slow movement complicates the search, as astronomers must meticulously track its potential position over time. Observations require long exposure times and multiple scans of the same region to confirm any motion indicative of a planet.

The area of the sky astronomers must search is enormous, and distinguishing a distant planet from millions of stars, galaxies, and other celestial objects is akin to finding a needle in a haystack. Advanced image-processing techniques and algorithms are used to sift through the immense amount of data, searching for faint, moving objects that could be Planet X.

Detecting such a distant and faint object requires highly sensitive instruments. Infrared telescopes, like NASA’s WISE mission, are particularly suited for this task because they can detect the heat emitted by distant celestial bodies, even those that reflect little sunlight. Ground-based telescopes with wide fields of view, such as the Vera C. Rubin Observatory, are also crucial for covering vast sections of the sky efficiently.

The search for Planet X isn’t just about looking through telescopes; it also involves complex theoretical modeling.

THE ELUSIVE MEMBER

Astronomers use computer simulations to predict where Planet X might be based on the gravitational effects it could have on other objects in the solar system. These simulations are computationally intensive, requiring supercomputers to analyze the data and refine the planet's potential location.

Despite these challenges, the hunt for Planet X is more than just a scientific curiosity—it's a chance to expand our understanding of the solar system's history and structure. If discovered, Planet X would reshape our knowledge of planetary formation, the Kuiper Belt, and the gravitational dynamics of distant solar system objects.

The obstacles may be daunting, but the rewards of finding Planet X promise to be monumental, offering a glimpse into the hidden reaches of our cosmic neighborhood and possibly answering fundamental questions about how our solar system came to be. It could provide insights into the distribution of mass in the outer solar system, influence models of planetary migration, and offer explanations for the current configuration of planetary orbits. Moreover, studying such a distant planet could enhance our understanding of exoplanetary systems, many of which contain planets located far from their host stars.

Conclusion:
The enigma of Planet X embodies the spirit of exploration and discovery that drives astronomy. Whether it exists or not, the search for this hypothetical planet pushes the boundaries of our knowledge, challenges our understanding of the cosmos, and inspires us to continue exploring the vast, uncharted territories of space.

TRIVIA

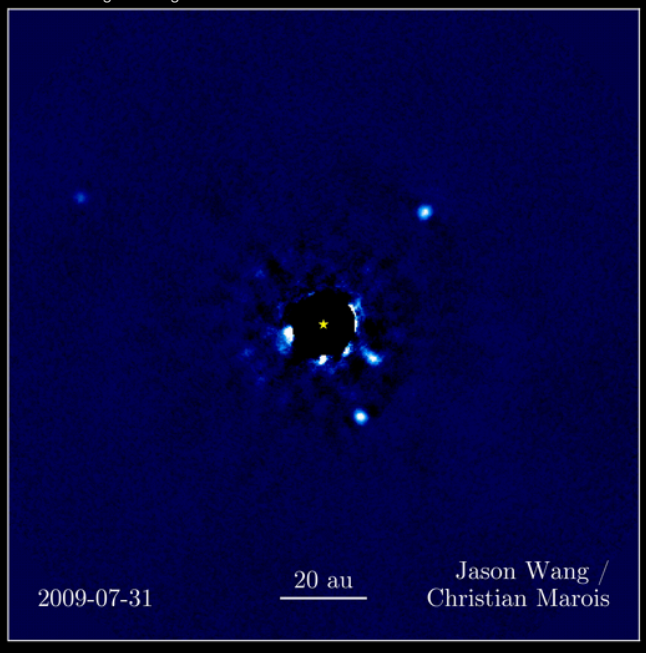
Welcome to the Trivia! Here, we will include interesting facts and problems that we have curated for you, the reader.

The answers to the problems can be found in the next newsletter, but for now, we hope you'll enjoy this new segment!

Fun-Fact-of-the-Month:

Although stars can outshine their planets up billions of times over, recent advancements in technology have allowed astronomers to directly observe faint light from nearby exoplanets. Using a coronagraph to block light from the host stars, we can take in light directly emitted from its planets. This technique allows astronomers to better study the atmospheres of these planets offering new data on these planets and on the formation of star systems.

The below depicts 4 super-jupiters orbiting their host star, HR8799. This mode of imaging requires large and far-off planets with the closest of the 4 imaged being as far as Uranus.



Problem I

Locate Cassiopeia's 'W' asterism

Source: Stellarium

Problem II

Nuclear fusion is the mechanism by which stars maintain their high temperature by balancing it with its pressure, by what mechanism do stars initially get hot from cool gas clouds? (hint: When stars enter their red giant their cores increase greatly in temperature; is this caused by nuclear fusion?)

Source: NASA

ANSWERS FOR THE PREVIOUS NEWSLETTER

Problem I

Problem II

During the Sun's AGB phase, near the end of its life, elements heavier than iron can be produced from heavy seed nuclei hailing from past generations of stars via the s-process. Through the s-process, a starting "seed nuclei" of iron slowly captures free neutrons within the star; through beta decay of the neutron the nuclei is able to gain protons slowly. Although decades between each neutron capture, this slow and steady process is responsible for the production half nuclei heavier than iron.

EVENTS AND STARGAZING

A HITCHHIKER'S GUIDE TO SPACE SCIENCES

Join Dr. Poh Gang Kai, NASA research scientist, as he shares his inspiring journey from Singapore to space and discusses how space sciences are integral to our everyday lives.

EVENT HIGHLIGHTS:

- Talk
- Q&A Session
- Networking Session

SPEAKER:
DR POH GANG KAI

FRI 28 FEB 2025, 7PM
Raffles Institution
LT3 (Year 5-6 Campus)
Registration: 6.30PM

OPEN TO SECONDARY SCHOOLS & PRE-UNIVERSITY INSTITUTIONS

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RI Science & Astronomy Club (Year 1-4) and RI Astronomy Club (Year 5-6)

EVENTS AND STARGAZING

Inaugural SAND Bingo Challenge

Join us for another round of our astrophysics-themed Bingo, where you can take on challenges and help your school collect points. With SAND 2025 still more than half a year away, there's still time to complete as many challenges as possible and aim for stellar prizes! The Bingo Challenge is still live on our Discord channel—come join the fun! Not sure how to enter? Just drop us an email/message and we'll get back to you!

Please note: This event is only eligible for secondary and tertiary schools that are open to participate in SAND 2025.

Featured Stargazing Location: Lazarus Island

Boasting a Bortle scale of 6 against Singapore's mainland's 9, Lazarus Island features some of the darkest spots available in Singapore. Managed by the Singapore Land Authority, overnight camping permits for the island are available online. So why not grab some friends and take in the peace and calm of the island and enjoy a night under familiar and new stars!

Source: dollarsandsense.sg

LAZARUS ISLAND
With one of the lowest levels of light pollution in the island, Lazarus Island is the perfect for all levels of stargazing

EVENTS AND STARGAZING

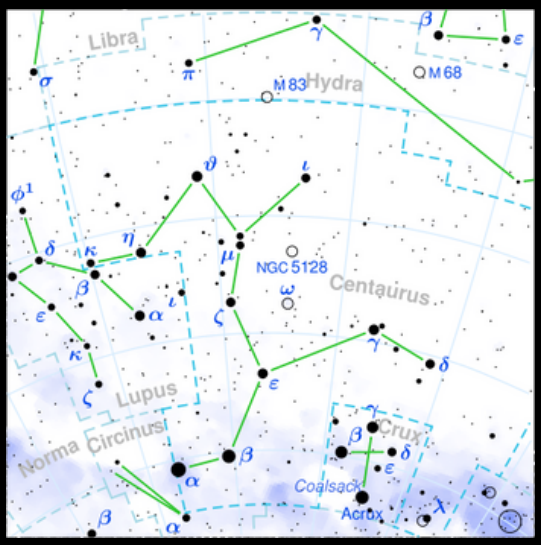
January's skies offer a new chapter of the celestial sphere. As the cloud cover gradually recedes, January offers crisp skies perfect for stargazing. As we step into the new year, spend a few minutes staring outside your window at the wonders the universe has to offer.

Free-hand stargazing

- **Jupiter and Mars.** These wandering stars will be high up this month and should be dotting the skies at even the most built-up and bright regions of Singapore. The Zodiacs have generously offered lodging for these 2 wanderers with Taurus and Gemini taking in Jupiter and Mars respectively. Be sure to correct all your friends on these "bright stars"!

- **α-Centaurids meteor shower** The α-Centaurids will be reaching their peak activity on the 8th of February, its activities are best viewed a couple of hours before dawn when the southernCentaurus has risen and the Moon well below the horizon.

Source: Stellarium



Source: Wikimedia

EVENTS AND STARGAZING

Free-hand stargazing (Cont'd)

- **Hyades Cluster.** Our nearest open star cluster, the Hyades Cluster is located at the center of Taurus, its brightest few forming the bull's distinctive V shape. The Hyades can be easily located by Alderbaren, the bright red star pointed out by Orion's belt. Its observational history runs back by many centuries and is thought to have inspired the Norse myth of Ragnarok.

Source: Wikimedia

Binoculars

- **Shoe Buckle Cluster (M35).** Located just above Orion's right hand, on Castor's left foot, lies the shoe buckle cluster. Castor, located westwards from his brighter twin, houses one of the closest star clusters to Earth. The entire cluster spans up to a full moon in size and thus is quite spread out, as most open clusters are.

Source: Wikimedia

EVENTS AND STARGAZING

Binoculars (Cont'd)

- **Little Beehive cluster (M41).** Forming an equilateral triangle with Sirius and its lower star, Nu^2 Canis Major, is often observed as a cluster of curved lines of stars. The cluster may have been observed as early as the 3rd century BCE by Aristotle.

Source: Wikimedia

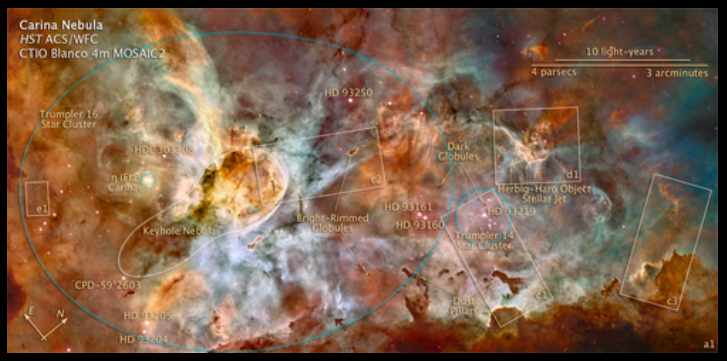
- **Jewel Box Cluster (NGC4755).** Located at the left arm of crux, this NTU-NUS AstroChallenge classic is one of the brightest DSOs of the southern sky. Most distinctly identified by it's A shaped asterism this iridescent open cluster is regarded as one of the finest jewels of the Southern sky

Source: Wikimedia

EVENTS AND STARGAZING

Telescope

- **Carina Nebula (Caldwell 92).** The Carina Nebula is 4 times as large and even brighter than that of the celestial celebrity, Orion's Nebula. Caldwell 92 enjoys a quieter life sailing through our stars on the keel of Argo Navis. The constellation has since been split with Caldwell 92 lying within Carina. It was one of five selected to be first observed by the James Webb Telescope!



Source: Wikimedia

- **NGC2158**. Immediately southwest of our above-mentioned Shoe Buckle Cluster, NCC2158 is a more compact open cluster. Once thought to be a globular cluster this ultra compact open cluster is a easily identified by its vicinity to its large and brighter neighbouring cluster.

Source: Wikimedia

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