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ASTRO MONTHLY

VOYAGER SURPRISE

VOYAGER 2 DATA REVEALS A STARTLING DISCOVERY ABOUT JUPITER

JWST

JAW-DROPPING IMAGES REVEAL BETTER THAN EVER DETAILS OF STELLAR REMNANTS

EVENTS

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PREFACE

Dear Readers,

Welcome to the inaugural edition of Astro Monthly, your guiding beacon amid the boundless expanse of information overflow. In a world inundated in data, we invite you to find solace in this undertaking which seeks to sieve through the noise and deliver only the relevant and most up-to-date astronomy-related news. Be it an unmissable local stargazing event, opportunities in astronomy research, or that you simply harbour a curiosity for the cosmos, we're here to distill the most captivating news directly to you.

Astro Monthly is more than just a newsletter; it's your compass to navigate the ever-expanding universe of astronomical knowledge. Our mission is to bring you stories that matter – from groundbreaking discoveries and space missions to the wonders of the night sky visible from our very own Singaporean vantage point. Let this newsletter be your telescope into the limitless wonders of space, providing clarity amid the information nebula that surrounds us.

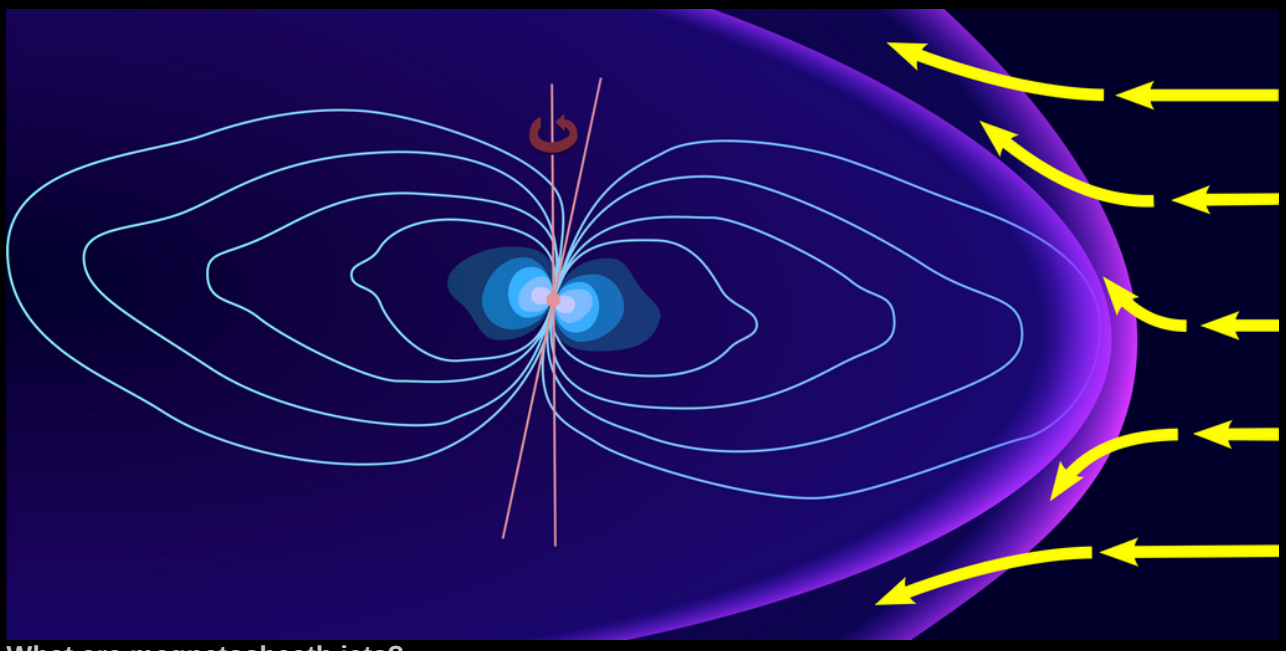
To the stars and beyond,
Raviraj
Editor, Astro Monthly

VOYAGER SURPRISE

A collaborative effort by astrophysicists and astronomers from Harbin Institute of Technology, Johns Hopkins University, and Peking University has revealed intriguing evidence, derived from Voyager 2 data, indicating the presence of at least three magnetosheath jets around Jupiter. This noteworthy study has been documented in the journal Nature Communications.

While similar jets have been identified around Earth and Mars (as recently as the previous summer), there are indications that such jets might exist around Mercury.

Motivated by the discovery around Mars, scientists have been actively exploring the possibility of these jets around other celestial bodies. In this investigation, the research team directed their attention to the search for magnetosheath jets around Jupiter.



What are magnetosheath jets?

These are streams of plasma formed in the vicinity where a planet's magnetic field intersects with solar winds. These jets materialize through collisions that both decelerate and heat the solar wind.

Source: Wikmedia

VOYAGER SURPRISE

Why This is Significant

The detection of magnetosheath jets around Jupiter holds significant importance for planetary science. Analysis of Voyager 2 data unveiled an increase in proton distribution, serving as evidence for the existence of these jets. Notably, one jet was observed moving towards the sun, while two jets moved in the opposite direction.

The researchers also noted a comparable scale of Jupiter's bow shock (the point of interaction between solar winds and the magnetic field) in comparison to the bow shocks observed around Earth and Mars. The identification of these jets around Jupiter enhances the likelihood of their presence around other planets in our solar system and potentially beyond.

Source: Wikimedia

To scrutinize the presence of magnetosheath jets, the research team examined data collected by Voyager 2 during its close encounter with Jupiter in 1979. The choice of this older spacecraft over more recent ones was deliberate, as the researchers believed that evidence of these jets would be discernible from a reasonable distance due to Jupiter's expansive magnetosphere, extending up to 3 million kilometers from the planet.

The observed uptick in proton distribution provided compelling evidence of the magnetosheath jets, with their distinct motion patterns.

This contributes to a deeper understanding of the intricate interactions within planetary atmospheres, crucial knowledge as humanity endeavors to explore distant regions of the solar system.

JAMES WEBB SPACE TELESCOPE

JWST - The Wonder Telescope

If you are like me and thought of the Hubble Space Telescope's (HST) images as other-worldly, wait till you see the ones coming out of JWST; they are just about era-defining.

After a hair-raising deployment procedure, spanning the onboarding of the behemoth telescope onto the Ariane 5 rocket, to its nerve-wrecking launch and the unfolding of the mirrors and its tennis-court sized solar shields, it finally entered into service in July 2022 after its journey to the L2 Earth-Sun Lagrange point.

Source: NASA

The Why

So why would NASA spend $9 billion of taxpayer money, undergo grilling by the US Congress and take up such impossible odds just to launch a single telescope?

This can be easily answered by seeing just how much of a paradigm shift the JWST is going to (and is already) cause (causing) for nearly all astronomical disciplines.

Source: Wikimedia

JAMES WEBB SPACE TELESCOPE

Source: ESA/Webb

100 Times More Than Hubble

With a light collecting power 10 times greater than the HST, combined with a larger amount of celestial bodies being observable in the infrared range compared to the HST's visible range, many believe that the JWST will be able to see *100 times* the amount of objects that the HST is seeing.

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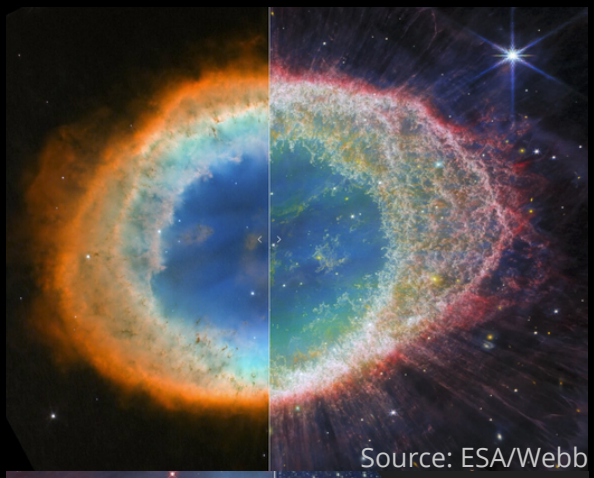
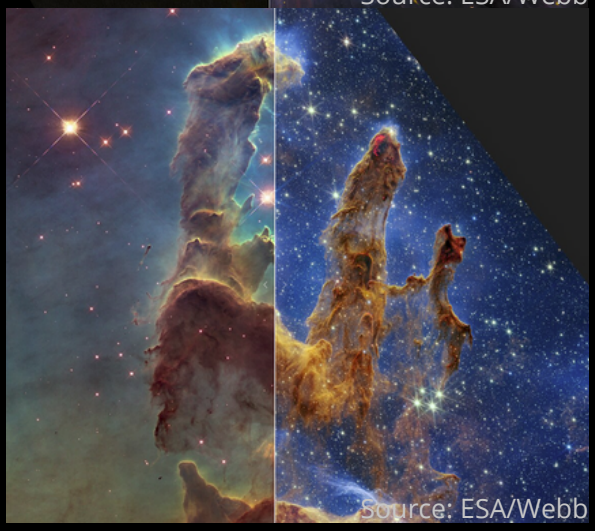
And the images that are pouring in do not dissapoint. Seen below are the images of Ring Nebula and Eagle Nebula taken by the HST (left) and JWST (right).



Source: ESA/Webb



Source: ESA/Webb

JWST'S INSTRUMENTS

The enhanced spatial resolution of the JWST, in comparison to the HST, is attributed to its larger mirror area. In terms of spectral sensitivity, which pertains to its ability to capture intricate details across a broader range of temperatures, the JWST's advantage lies in its expansive wavelength coverage. The JWST spans a wavelength range from 600nm to 28,500nm, while the HST's range is limited to 0.1nm to 600nm. This significant difference in wavelength coverage is crucial, as the JWST's emphasis on infrared light enables it to observe cold gaseous nebulae and explore the deeply redshifted early universe. In contrast, the HST is effectively blind to this part of the universe due to its limited wavelength range, which extends only up to 600nm.

NIRCam - Near-Infrared Camera

This camera captures images in the 600nm-5000nm range, and is crucial for exoplanet studies. The latter is due to its coronographic capability which blocks out an exoplanet's host star.

MIRI - Mid-Infrared Instrument

MIRI cover the rest of JWST's operational spectrum, i.e. 4900nm to 27,900nm. Wien's law tells us that an object's peak spectral emission is inversely proportional to its temperature. Based on this, we can deduce that MIRI's lower wavelength allows it to observe cooler celestial structures. Primarily, this expands the realm of observation to encompass the exceedingly distant early galaxies that have long remained elusive to astronomers. This is predominantly due to the cosmological redshifting of their light, originally within the visible range, to the mid-infrared spectrum. The inherent faintness and minuscule angular size of these galaxies necessitate the use of large space-based telescopes for visibility.

NIRSpec -
Near-Infrared Spectrograph

The NIRSpec is a highly versatile

JWST'S INSTRUMENTS

spectrograph that operates in a wavelength range similar to NIRCam (600nm to 5300nm). It operates in various modes, the flagship one being its Multi-Object Spectroscopy mode. This is enabled by its microshutter array consisting of 250,000 individual 'windows' that allow scientists to observe multiple objects concurrently. This is yet another new technology that was invented for JWST and makes Webb extremely efficient for observing faint, distant galaxies.

NIRISS - Near-Infrared Imager and Slitless Spectrograph

NIRISS is another spectrograph aboard the JWST with a similar operating wavelength range (600nm to 5000nm) to NIRSpec. However, unlike NIRSpec, it observes brighter objects such as exoplanet systems and is crucial for characterising the atmospheres of pre-discovered exoplanets.

Already Revolutionising Astronomy

Ultimately, the collective capabilities of the JWST have already set it on a revolutionary path. The first images and data that poured in late 2022 already started showing unexpected discoveries, chief of which was the brighter and larger than expected early galaxies. In fact, they were also more than expected! Many of these galaxies also look far more 'mature' than current models predict. This is because a large proportion of them have taken regular shapes, such as barred-spiral, which is only expected of mature galaxies like the Milky Way.

Moreover, NIRSpec found the earliest galaxy known currently, Maisie's Galaxy (below), which is believed to have existed 390 million years after the Big Bang. Such discoveries push the boundaries of how early galaxies could have formed in the universe.

Source: Webb Telescope

Source: NASA

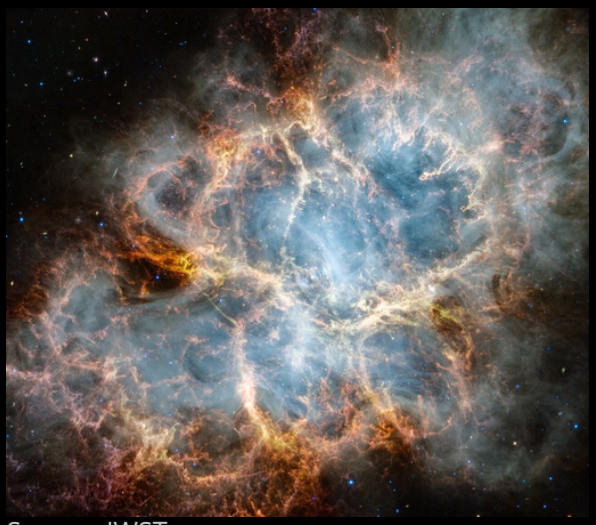
SOME MORE OF JWST'S PHOTOS!

This page is solely for sharing some more of JWST's breathtaking images.

Source: JWST

HH 211 Herbig Haro Object

Formerly, the Spitzer Space Telescope only vaguely captured this Herbig Haro object, but with the advent of the JWST, we can now discern it with unparalleled precision. A Herbig Haro object, characterized by a proto-stellar jet accelerating at supersonic velocities away from a nascent star, is depicted with remarkable clarity in the image. The shockwaves coursing through the jet are prominently visible, showcasing the enhanced observational capabilities of the JWST.



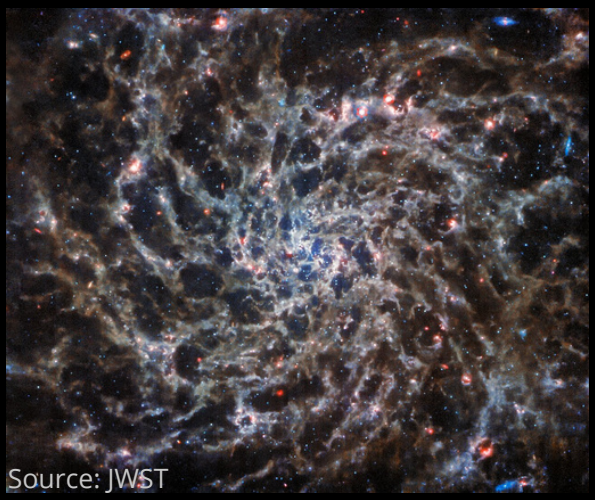
Source: JWST

M1 Crab Nebula

Captured in this image is the iconic Crab Nebula, featuring its distinctive supernova remnant cloud rapidly screaming away from the central pulsar at relativistic speeds. While previously observable solely through the sensitive camera of the Chandra X-ray telescope, the toroidal pulsar wind nebula is now clearly discernible by JWST's images. Notably, the JWST surpasses all other space telescopes, boasting unparalleled spatial and spectral resolution, cementing its position as the unrivaled champion of all space telescopes.

SOME MORE OF JWST'S PHOTOS!

We cannot get enough of its pictures!



Source: JWST

IC 5332 Intermediate Spiral Galaxy

Once veiled in secrecy due to its low surface brightness and delicate spiral arms, this spiral galaxy was initially glimpsed by the HST. However, the JWST has now completely blown away the sheath concealing the mysteries within this galaxy. This breakthrough is attributed to MIRI's proficiency in penetrating dust, unveiling the galaxy's diverse regions. Among thousands of galaxies, IC 5332 and its counterparts serve as invaluable data for refining galaxy classifications and deepening our understanding of the intricate processes involved in galactic formation.

Source: JWST

Second gravitationally lensed supernova

A distant galaxy named MRG-M0138 is currently gravitationally lensed by a massive cluster of galaxies. In-fact we can see 5 images of this galaxy due to the lensing! Previously captured by the HST, which observed a supernova inside it in 2016, scientists were pleasantly surprised to see yet another supernova (and 2 images of it as shown above!) from this galaxy in 2023. This time, it was by the vastly more powerful JWST. To add icing on the cake, another image of the 2023 supernova is expected to appear in 2035 due to 'slightly' different distances in travelling lengths for the gravitationally lensed images.

EVENTS AND STARGAZING

This section is for all the avid stargazers and social butterflies here itching for a chance to network with fellow like-minded astronomers!

Galaxy Community Club, Woodlands

Accessible to the public on Friday nights for merely $1, the Galaxy CC observatory is a great spot to bring your fellow astro buddies for a chill stargazing and planetary observation session. Do remember to book beforehand!

Science Center Singapore

Open every 4th and 5th Friday of the month to the public, the 40cm telescope allows for many breathtaking views of iconic celestial objects like the Moon, Jupiter, Saturn and possibly even a few DSOs if the skies are crisply clear! Slots are limited so do remember to book before heading down!

Numerous open parks and reserves

The list for ideal locations to stargaze in Singapore is nearly limiteless (subject to sky pollution and weather of course!). Some notable ones include Fort Canning Park (Central), Bishan-Ang Mo Kio Park (North), Labrador Park (South), Punggol Waterway park (Northeast), West Coast Park (West) and East Coast Park (East).
Again, do check the weather before heading down!

Upcoming Astronomy Events

Do keep a lookout for the following events happening this year! School Astronomy Networking Dinner, Astronite, GalACSI, NUS-NTU Astrochallenge, Astrigue.

EVENTS AND STARGAZING

The March Sky in Singapore has countless jewels to offer, regardless of the light pollution. Depending on your available tools, you will be able to see ever more elusive objects. Regardless of this, there are ample objects to observe for anyone patient and avid enough.

Free-hand stargazing

- **March 21st** Venus-Saturn conjunction: Rise early and gaze upon Venus and Saturn, which will appear 0.3° within each other, close enough to be seen within the field of view of a telescope!

- **March 24th** Mercury at greatest elongation: Seen in the evening, this is one of the rarer opportunities to see Mercury given our light-polluted skies.

- **March 30th** Antares-Moon conjunction: The brilliant supergiant star will be within 0.3° of the moon, allowing for some cool pictures of these juxtaposed objects.

Source: Stellarium

EVENTS AND STARGAZING

Free-hand stargazing (cont'd)
Prominent constellations and asterisms: If you're a stargazer, it is almost obligatory for you to find the Spring Triangle consisting of the 3 bright stars; Regulus in Leo, Arcturus in Boötes, and Spica in Virgo. Some other fun constellations to trace would be the winding Hydra and majestic Leo.

Binoculars

- Mizar and Alcor: This iconic binary would look especially pretty via a pair of binocs, given that Mizar itself is a double star. In effect, you would be seeing a triple-star system!
- Omega Centauri: Although it is certainly a difficult one to spot given its dimness, success would yield immense satisfaction. Look to the right side of the midpoint of Alnair and Menkent after your eyes are dark-adjusted. Good luck!
- Jewel Box Cluster: This is certainly a treat for the eyes, and is easily seen beside Mimosa (located in Crux) with a good pair of binocs!

Source: Celestron

Source: Stellarium

EVENTS AND STARGAZING

Telescope

- Beehive Cluster: While visible to the naked eye as a faint fuzzy patch, the experience of looking at it through a scope is orders of magnitude (pun intended) more rewarding. Click here to learn how to find it!

- Algieba: Surprise, surprise! The gamma-star of Leo, Algieba, is actually a binary system. Try to visually resolve the 2 stars and ready yourself for a treat!

Source: Stellarium

SOURCES

Webb's Instruments
- Webb's Scientific Instruments

Images & Illustrations
- Lagrange Points Simple
- Ariane 5 with James Webb Space Telescope Prelaunch
- Jovian magnetosphere vs solar wind
- Voyager spacecraft model
- Esa Webb Images
- Ring Nebula (NIRCam Image)
- Join NASA to Celebrate Webb Space Telescope's First Year of Science
- James Webb Space Telescope primary mirror prepared for testing
- View of the night sky at Rancho Sierra Vista/Satwiwa
- Hubble and Webb Showcase the Pillars of Creation
- Webb and Hubble's views of the Ring Nebula
- CEERS: Flight to Maisie's Galaxy
- Rho Ophiuchi cloud complex

Stargazing locations
- Galaxy CC Observatory
- Science Center
- Best Spots for Stargazing

Guide to stargazing
- The Ultimate Guide to Observing the Spring Sky (Northern Hemisphere)