ASTRONOMICAL SOCIETY OF SOUTHERN AFRICA

Durban ’nDaba

Monthly Newsletter of the Durban Centre - December 2021

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Member Submissions Disclaimer

The views expressed in 'nDaba are solely those of the writer and are not necessarily the views of the ASSA Durban Centre, nor that of the Editor.

Chairman's Chatter

December 2021

Dear ASSA members.

The year is almost over but amazing astronomy events are still taking place. One of which is the James Webb Space Telescope, which is set to launch on 22 December 2021. We know that telescope mirrors in the past have been coated with silver and in more recent time's aluminum.

An interesting fact which eluded me was that the mirror coating on the JWST is coated in gold, albeit a microscopic layer. The total amount of gold used on the James Webb telescope though, was just over 48 grams. (To know more about the JWST, please refer to page 23).

Our year end function is almost upon us. I would like to thank those that have RSVP'd together with your meal and drinks choice and I look forward to being in your company on the 9th of December at the Morningside Sports Club.

To those that have not yet responded; kindly ensure your drink and food requirements, are sent to Claire@astronomydurban.co.za by close of business (COB) on Friday 3rd December to ensure that we have the fridge stocked with the drinks you require. Kindly note that it is a cash bar and I request all members to bring cash with them for the purchase thereof.

In addition food preferences should by now be given Claire@astronomydurban.co.za to the ensure the correct catering is available.

To those that cannot make it, I appreciate your efforts in trying to attend. I do understand that circumstances may not permit everyone to join but do hope that the pandemic fades to a point allowing us all to meet face to face once again.

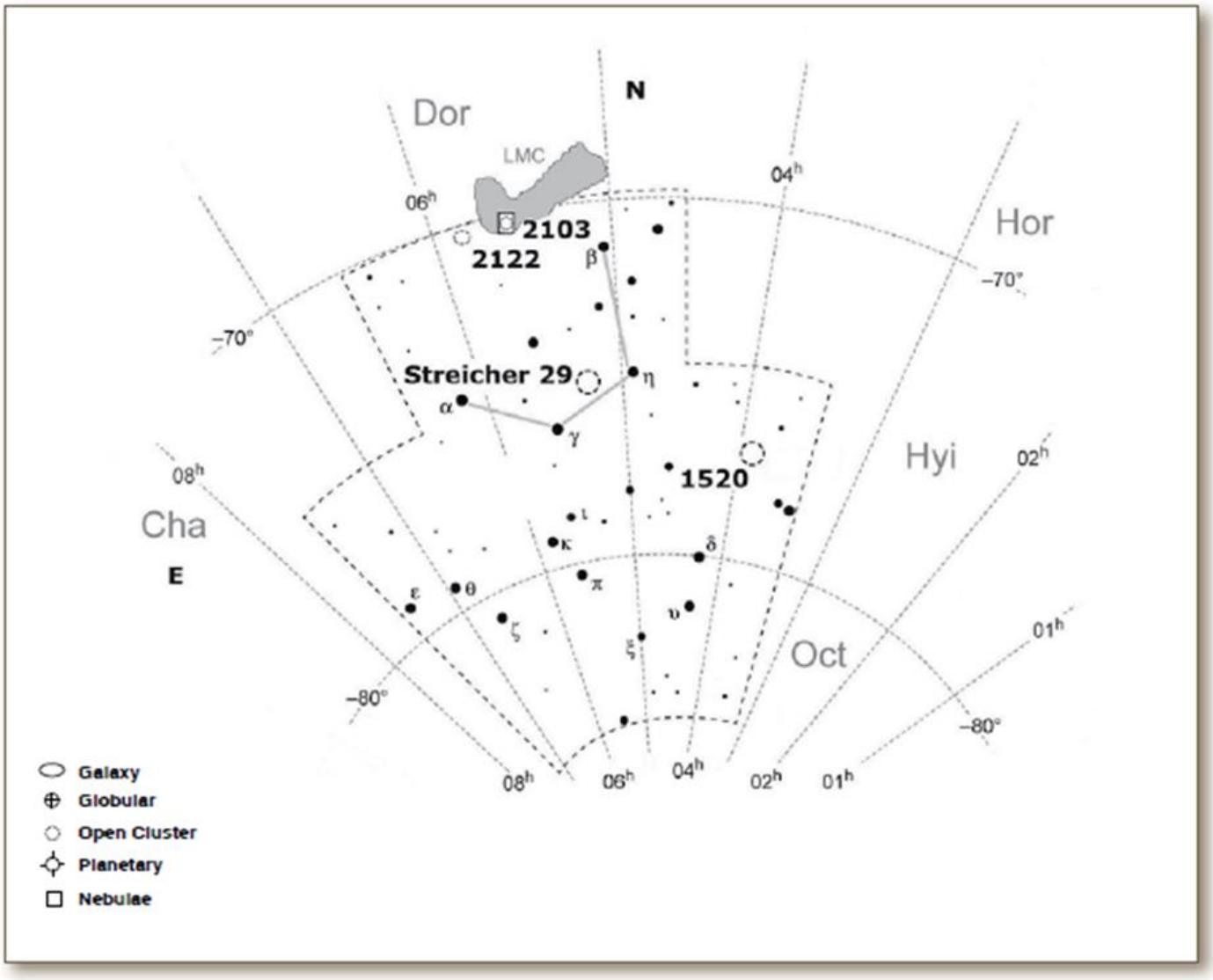
I would like to wish all members and their families everything of the best for the festive period and if you are travelling, please stay safe on the roads.

As always, stay safe and wishing you all many clear skies for the New Year.

Amith Rajpal.

Astronomy Delights: Mensa the Mountain

By Magda Streicher



The constellation of Mensa

Table Mountain South Africa – Photograph: Andra Swart le Roux

...Mensa - the Mountain

The great astronomer Nicolas Louis de Lacaille formed the figure Mensa from stars situated close to the Large Magellanic Cloud, and just south of the polar constellation Octans. The constellation is honoured by Lacaille as our own Table Mountain at the Cape of Good Hope.

The open clusters in Mensa can be described only as faint hazy dots, seeing that it is part of our distant satellite galaxy and relatively far away to gasp through ordinary telescopes.

However, **NGC 2122** displays a small roundish drop of moist with fading edges. With careful observation the south -western part seems slightly more defined with a peppery impression. The cluster is situated on the southern edge of the LMC, a field of view that is filled with faint stars and nebulosity.

The emission nebula **NGC 2103**, 1.5 degrees further south from NGC 2122, reveals a barely seen misty piece of nebulosity slightly oval in shape. Higher magnification brings to the fore a few faint stars embedded in the hazy, uneven surface.

STREICHER 29 is a rather faint group of stars that displays the letter G in an amazingly realistic representation. Most of the stars are of a similar magnitude in the midst of a busy star field. The globular cluster IC 2134 is situated towards the southern end of the group.

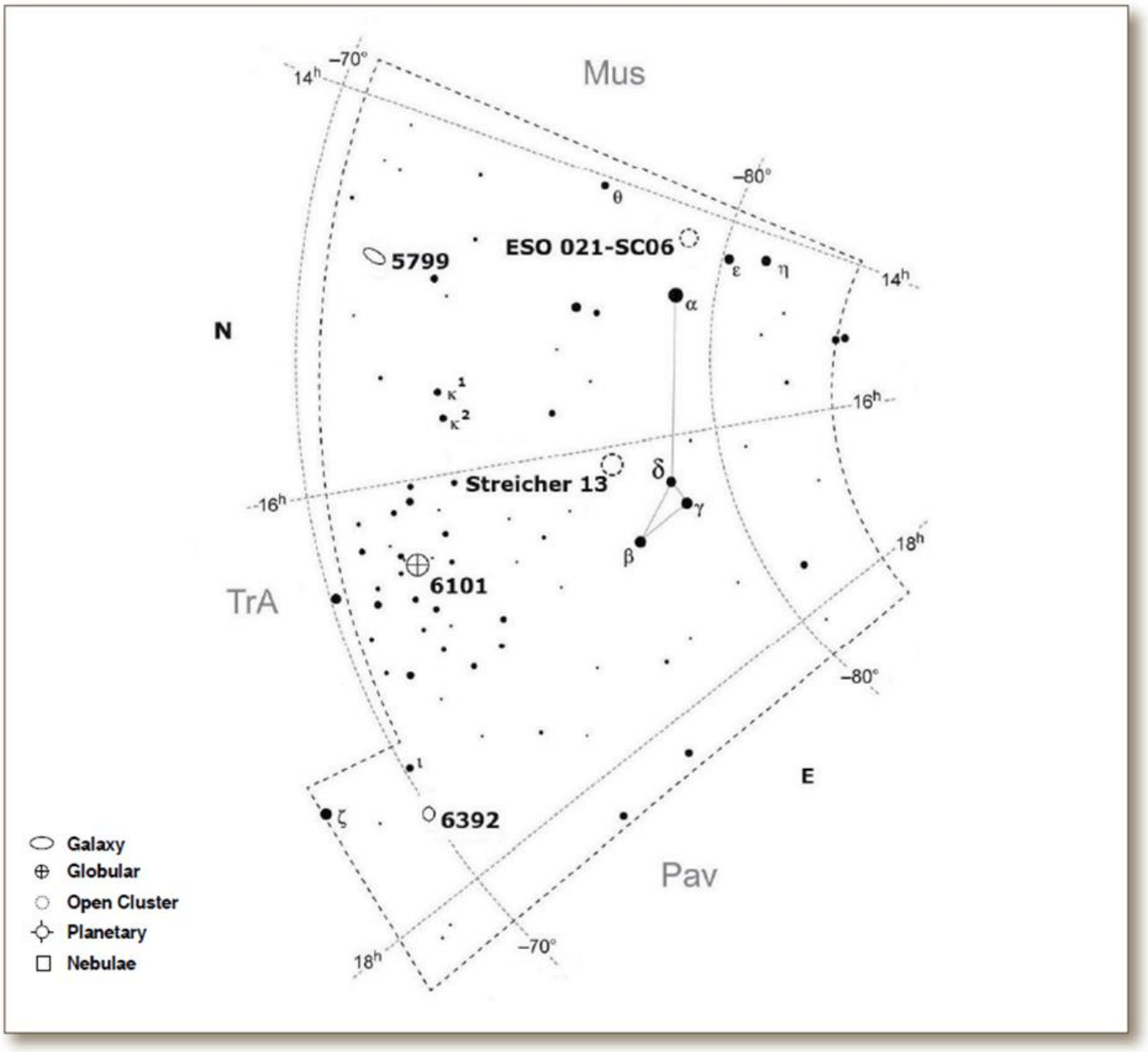
A slightly brighter open cluster **NGC 1520** displays a few stars of approximately magnitude 9 in brightness that appear close together as a group. A triangle of stars occupies the center with some fainter members stringing towards the north. Although it clearly stands out against the hazy field of view the area is scattered in faint starlight.

In the night shadow of Lacailles' great mountain I spend hours of solitude, searching for these small whispers of faint light, knowing that my love of astronomy is timeless.

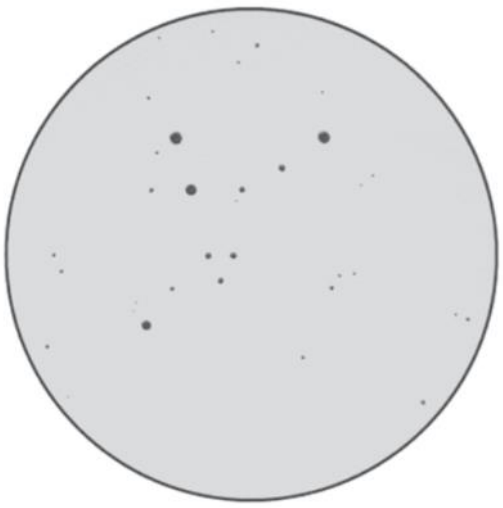
OBJECT	TYPE	RA	DEC	MAG	SIZE
NGC 1520	Open Cluster	03h57m.5	-76°50′.2	9	5′
STREICHER 29 DSH J0517.5-7507	Asterism	05h17m.5	-75°07′.0	8	14′
NGC 2103	Nebula	05h41m.7	-71°20′.1	11	3′
NGC 2122	Open Cluster	05h48m.8	-70°04′.2	10	4′

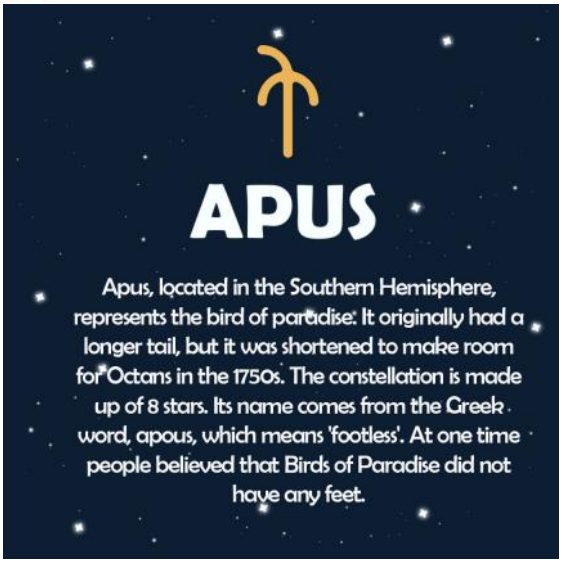
Astronomy Delights: Apus - The Swallow

By Magda Streicher



The constellation of Apus





...Apus - The Swallow

Apus, the bird of paradise or Apous as Caesius wrote it from the Greek, lies immediately below the Southern Triangle constellation just 1.3 degrees from the South Pole.

The grouping **ES0 021-SC06** is clearly visible against the background star field in a typical southern-cross shape, situated in the western part of the constellation. The cluster is elongated in an east-west direction, with the bulk of the fainter members to the south. The brightest magnitude 9.8 star is situated towards the northern edge.

NGC 5799 is a relatively medium sized galaxy combined in a framework of faint stars which shows an arrow figure pointing south. The galaxy displays a hazy glow, slightly brighter towards the nucleus.

The asterism **STREICHER 13** displays a dozen stars of various magnitudes create the shape of an arrow. This grouping fairly stands out against the background star field situated 1.5 degrees north of delta Apodis.

Globular cluster **NGC 6101** situated towards the northern brink of the constellation displays a relatively large, round haze of light that reveals a granular appearance. With higher magnification faint stars could be seen curling out in flimsy flares towards the edges. It gets more condensed towards the middle area with a few brighter stars on the northern edge. Within the heart of this object, two brighter stars appear to be double.

The oval shaped galaxy **NGC 6392** situated in the north-eastern corner of Apus is a considerably faint object barely seen and just slightly brighter towards the nucleus. A faint star can be seen on the south-western edge.

OBJECT	TYPE	RA	DEC	MAG	SIZE
ES0 021-SC06	Open Cluster	14h15m.9	-78°30′.0	9.2	9′
NGC 5799	Galaxy	15h05m.5	-72°26′.2	12.6	1.2′×1′
STREICHER 13 DSH J1607.4-7720	Asterism	16h07m.4	-77°20′.0	9.8	18′
NGC 6101	Globular Cluster	16h25m.8	-72°12′.1	9.2	10.7
NGC 6392	Galaxy	17h43m.5	-69°47′.1	12.3	1.3′×1.3′

At the Eyepiece

December 2021 by Ray Field

The Sun reaches the Summer Solstice for the southern hemisphere on the 21st December. The partial solar eclipse of the 4th is not visible from Durban. *(The summer solstice, also known as estival solstice or midsummer, occurs when one of Earth's poles has its maximum tilt toward the Sun. It happens twice yearly, once in each hemisphere)*

The Moon is new on the 4th, first quarter on 11th, full on the 19th and last quarter on the 27th. The Moon is near Venus on the 7th, Saturn on the 8th, Jupiter on the 9th, Pollux on the 21st, the Beehive cluster (Messier 44) on the 22nd, Regulus on the 24th, Spica on the 28th and Antares and Mars on the 31st.

Mercury in not suitably placed for observation most of this month, but is near Venus on the 29th, so it may be easier to be glimpsed then.

Venus, in Sagittarius, sets a few hours after sunset.

Mars is not suitably placed for observation in the morning sky, in Scorpius and Ophiuchus, as it has faded during the year to a faint object in the morning twilight.

Jupiter is a bright object in the evening sky in Aquarius. It sets at about 22:00.

Saturn, in Capricornus, sets at about 21:00. Jupiter and Saturn are fairly close in the sky. The Moon is near Saturn on the 8th and Jupiter on the 9th.

Uranus, in Aries, sets at about 01:00. It is a faint object and difficult to see with the naked eye. Binoculars will show it as a faint “star”.

Neptune, in Aquarius, is even fainter than Uranus and well below naked eye visibility.

The occultation of one major planet by another, as seen from Earth, is very rare. For example, in 1818 Venus occulted Jupiter. The next event like this will be in 2065, when Venus and Jupiter will be involved again. (see page 71 of Sky Guide 2021).

Meteor Showers. Three showers will be active this month.

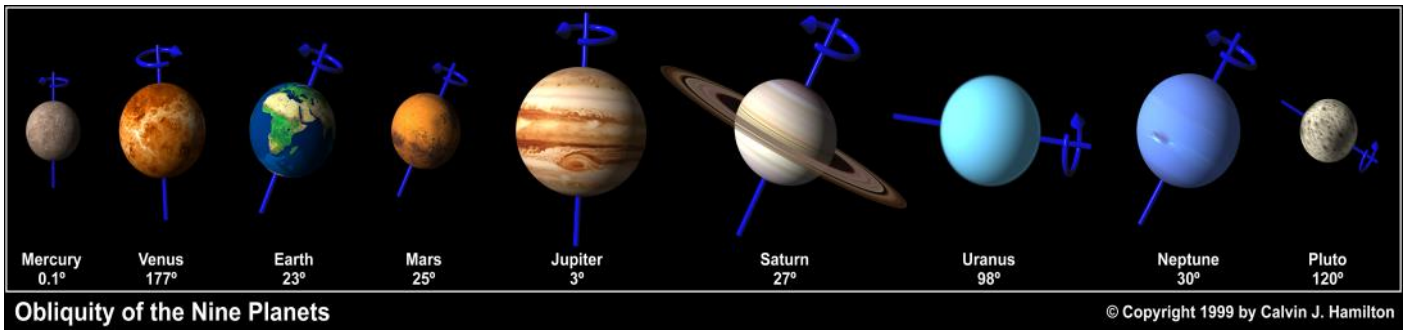
Shower	Date Max	Duration	ZHR	Start	End	Prospect
Dec Phoenicids	6 Dec	3 Dec - 9 Dec	5	20:30	02:00	Favourable
Geminids	14 Dec	4 Dec - 16 Dec	50	23:30	03:00	Good
Puppid-Velids	29 Dec	5 Dec - 7 Jan	5	20:30	03:30	Good

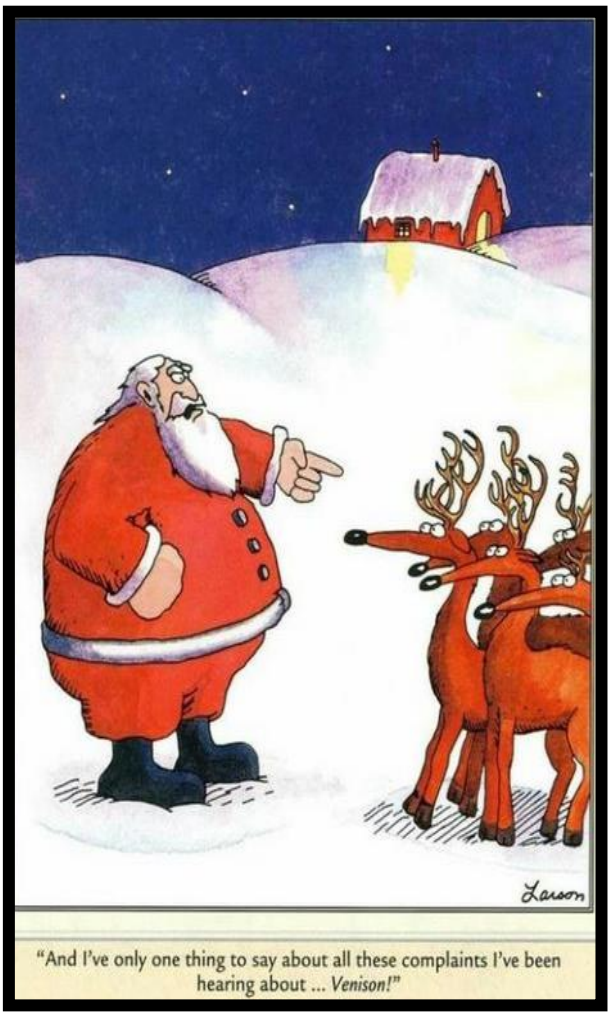
...At the Eyepiece

For deep sky observing, see page 95 – 97 of the ASSA Sky Guide 2021 for a list of the top 100 ASSA chosen Deep Sky Objects.

The starry sky from Durban 2021, Venus is very prominent over the West after sunset and is a very thin crescent as seen in a telescope, by the end of the year. See page 58 of Sky Guide 2021. Jupiter is also a bright object and sets at about 22:00. It is in Aquarius near Capricornus. In the evening sky, Scorpius is setting in the Southwest and Orion is rising over the East. The Southern Cross and its pointers is scraping the southern horizon and the bright star Achernar is high over the South, with the Small Magellanic Cloud (*Nubecula Minor*) between it and the South Celestial Pole (*The South Celestial Pole is the point in the sky about which all the stars seen from the Southern Hemisphere rotate*) The bright star Canopus is down to the left of Achernar, with Sirius rising to it left.

References: ASSA Sky Guide 2021, Norton's Star Atlas, Philips' Planisphere for 35°S, and Stars of the Southern Skies by Sir Patrick Moore.





For Sale - Astrophotography Filters

Baader 1.25 inch / 32 mm filters

Luminance (clear), Red, Green, Blue, and a UV/IR – Cut/L filters.

Narrowband Ha 7nm, Oiii 8.5nm and Sii 8.0nm.

Still in the original packaging. Never opened.

Originally Paid: R 12 000

Asking Price: **R 10 000**

CONTACT: **Johnny Visser**

Cell Number: **082 357 3091**

The Star of Good Fortune and Old Age

by Brian Ventrudo

The star Canopus, low in the sky and left of center in this image, lies well below the constellation Orion, at top center, and Canis Major (at upper left). As seen from the Winter Star Party, near Summerland Key, Florida, in 2017.

Canopus is located in the southern constellation Carina, the Keel, and it is by far the brightest star in the constellation. At a declination of about -52^{o}, Canopus never rises above the horizon for observers north of 38^{o}N latitude. Many northerners catch sight of it while travelling south for winter vacation. Almost directly south of Sirius, Canopus is just visible in the months of northern winter from southern Spain and Portugal, and from the southern United States. In the southern hemisphere, these two brightest stars are directly overhead in the evening summer sky.

Canopus, a grand star, shines with an apparent magnitude of -0.72, about half as bright as Sirius, which shines at magnitude -1.4. But Canopus is intrinsically far brighter. Canopus is 310 light years away, and if it were moved to the same distance as Sirius, about 8.6 light years, it would shine (if I did my math right) with an apparent magnitude of -8.5. That's easily bright enough to clearly see in daytime and cast shadows on moonless nights. Those who take the long view will be interested to know that in 480,000 years, Canopus will become the brightest star in the sky as Sirius recedes from the Sun.

Canopus is classified as an F0 II giant star, and is likely fusing helium into carbon in its core. It has swelled to about 9/10 of Mercury's orbit, and shines with the brightness of 13,000 suns. Despite its prominence, Canopus still defies complete understanding. As far as astronomers know, despite its immense luminosity, it isn't big enough to go supernova. Once it loses mass as a planetary nebula, the star will probably settle down for the next many billions of years as a slowly cooling white dwarf.

...Good Fortune and Old Age

The location of the star Canopus relative to Orion and Canis Major (from Stellarium)

Since it's a bright star off the ecliptic, away from the Sun and bright planets, Canopus often serves as a navigation star for many of NASA's deep-space probes. These probes orient themselves relative to Canopus and other guide stars using star-tracking cameras and control systems.
The star Canopus takes its name from the pilot of the sea ship that carried the legendary Menelaus from Greece to Troy in an attempt to reacquire his beautiful wife, Helen, from the feckless Trojan prince Paris. Much bloodshed and misery ensued for good men, on both sides, as readers of Homer's *Iliad* and *Odyssey* well know. In these tales, Canopus is a handsome young man who was loved by the Egyptian prophetess Theonoe, but who never reciprocated her feelings. While visiting the Egyptian coast, Canopus was bitten by a serpent and died. Menelaus built a monument to him near the mouth of the Nile. The ancient town of Canopus was later built around the monument.

The Chinese have a different legend for this star. In China, Canopus is only visible in the far southern reaches of the country, and even there it would be low on the horizon, shining with a reddened glow. But red is the color of happiness and long life in China and other eastern cultures. That's why Canopus is known as the "Star of the Old Man", or the "Star of Old Age". It's supposed to bring good fortune to those who wish to enjoy the privilege of a long and happy life.

May we all enjoy such a privilege, and an opportunity to observe the southern heavens.

The Cover Image - NGC 3614

Processed by John Gill

The image data was made available by AdamBlockStudios.com and acquired from the University of Arizona - SkyCenter - Schulman Telescope in 2015 February

Discovery of Stellar Streams around NGC 3614 by Adam Block

Published June 2021

Abstract

In the course of surveying spiral galaxies in the Local Volume, long exposures of NGC 3416 show two probable stellar streams with the possible remnant of a satellite galaxy. I captured the discovery image using the Schulman Telescope at Steward Observatory's Mount Lemmon Sky Center (University of Arizona). I acquired the wide bandpass data over three nights under photometric conditions in 2015 February. Prominent theories of galaxy formation hold that the creation of present-day galaxies are the aggregation of many past minor mergers. Stellar streams lend credence to the idea by presenting evidence of extended low surface brightness tidally created signatures. NGC 3614 appears to be a good example the for kind of extended features expected by these theories.

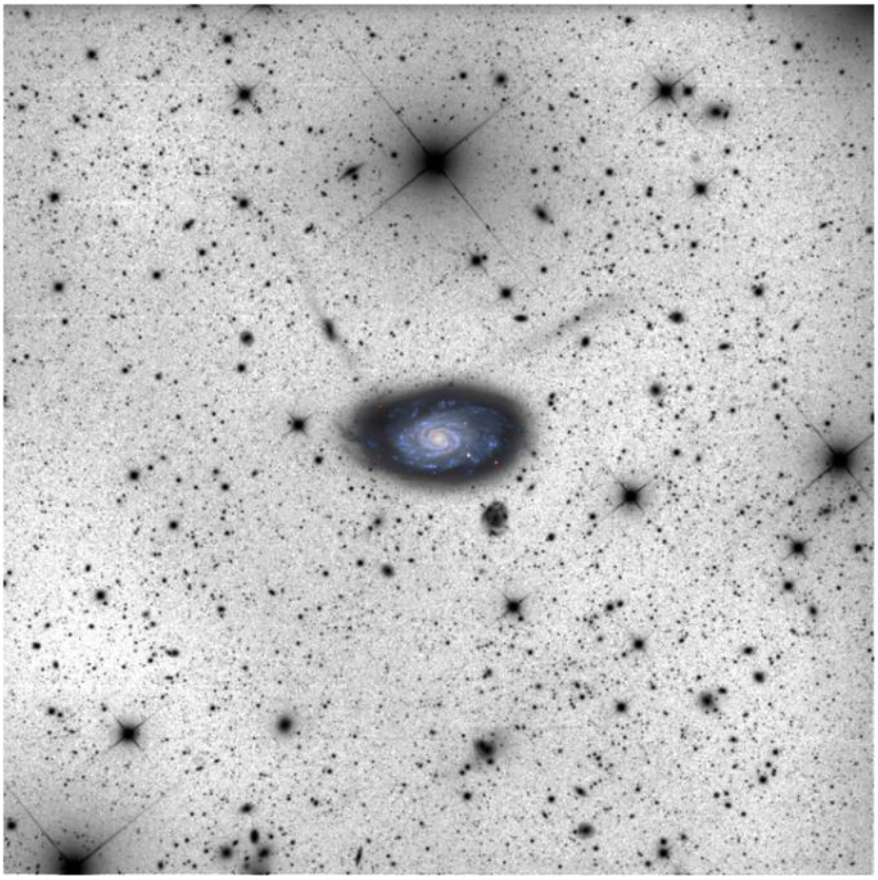
1. Star Stream Survey

Astronomers theorize that galaxy formation through the aggregation of smaller galaxy mergers plays an important role in the morphology, density and distribution of galaxies we see today (e.g., Cole et al. 1994 and Cooper et al. 2010). Subsequently, astronomers expect to find evidence of tidal debris, shells, and other remnant structures around otherwise kinematically quiescent typical disk galaxies (Martinez-Delgado et al. 2010). Although low surface brightness halos are detected in many "normal" disk galaxies, only recently are experts interpreting these structures to be tidal streams of stars not unlike the Milky Way's Sagittarius stream which circles our own galaxy (Deason et al. 2014). Observing analogues to the Sagittarius stream in other distant galaxies presents observational challenges due to its feeble apparent magnitude. Typically, the surface brightness of these features is on the order of 28.5 magnitudes per arcsecond2 (Morales et al. 2018) or fainter which requires a sensitivity modulated by either aperture or long integration times. Conversely the nearest galaxies, while offering better opportunities for detection in terms of surface brightness, have features spread across larger swathes of sky which might be missed by narrow fields of view (Martinez-Delgado et al. 2010). For these reasons surveys, such as those lead by David Martinez-Delgado, have utilized amateur astronomers that use wide-field of view telescopes and have unconstrained time to spend on achieving the best possible signal-to-noise ratio given their optical configurations and observing sites (Martinez-Delgado et al. 2010). These observations provide empirical support for the ΛcCDM prediction that tidally disrupted dwarf galaxies could be important contributors to the stellar halo formation in the Local Group spirals (Morales et al. 2018).

2. Observations

As a member of the Martinez-Delgado team I was aware of the current galaxies of interest and independently chose to image additional spiral disk galaxies that fit the criteria for the project and are likely candidates for stellar streams. The SkyCenter observatory enjoys seeing conditions that average 12 and an average zenith sky brightness of 21.3 magnitudes per arcsecond2 in the Johnson V band based on my work for Steward Observatory (University of Arizona) which includes long-term night sky brightness measurements of the site. I acquired the NGC 3614 data with the 0.8 m Schulman Telescope (f/7 Ritchey–Chrétien design) coupled with a SBIG STX16803 CCD camera. The sensor has a gain of 1.25 e-/ADU and a read noise of approximately 13 ADU. The 9 micron pixels of the sensor yield a plate scale of 033 per pixel and the array of 4096 × 4096 pixels create a field of view that is 225 × 225. The full observing campaign consisted of forty-five 20 minutes exposures (15 hr) through a wide bandpass, high throughput, clear optical filter with a near-IR cutoff ($3500 < \lambda < 8500$). I acquired additional color data through broadband RGB filters, though I binned the pixels 2 × 2 (06 per pixel) for the color acquisition. The integrated image has a resolution of 15 as measured from the FWHM of stars near the center of the field.

...NGC 3614



NGC 3614 with two stellar streams. The brightest optical part of the disk is shown as a color inset.

3. Data Reduction

Standard calibration and image integration of the data was sufficient to reveal the unknown tidal streams. Flat field images were bias subtracted and light frames were dark subtracted and then calibrated with the master flat field image. I combined 50 bias frames and 25 dark frames to create master files for bias correction and dark subtraction. I created flat field images each evening using an electroluminescent panel. During data acquisition the telescope dithered images by 8–10 pixels for each exposure. After image acquisition, registering the images using nearest neighbor resampling improved the rejection of cosmic rays and hot pixels in the processing that followed. I discarded all low-quality images with a threshold of 0.8 determined by normalizing the images based on signal strength measured via a small rectangular window defined within the disk of NGC 3614. I combined the remaining images with an aggressive sigma-clipping rejection threshold of 2.2. Modeling and correcting for small residual flat errors with the DynamicBackgroundExtraction method in PixInsight, a commercial image processing software, improved the apparent contrast of tidal streams against the background sky.

4. Results

NGC 3614 is a medium barred spiral galaxy with two main, knotty and filamentary branching arms (Sandage & Bedke 1994). As rendered in Figure 1 the galaxy's disk extends 54 in its major east–west axis and 3' along its minor north–south axis. The brighter stellar stream begins at the northern part of the galactic disk and extends 46 at a position angle of 314° with respect to the nucleus of NGC 3614 (in the direction of galaxy 2MASSX J11180157+4547453). The stream is uniform in its brightness and devoid of any discernable structure. The second stream appears to be associated with galaxy SDSS J111838+454721.7. The total length of this stream is approximately 38 at a position angle of 40°. The 9th magnitude star HD 98215 does not create any artifacts based on previous images of stars of the same brightness and position on the sensor. Galactic cirrus is thin in this direction and at the faint limit of the SDSS images no small-scale wisps are apparent within several degrees of this field.

5. Conclusion

I report the discovery of two stellar streams and likely progenitor galaxy around NGC 3614. Data was acquired from the University of Arizona SkyCenter Schulman Telescope in 2015 February .

· RIGHT: University of Arizona SkyCenter Schulman Telescope

Space Suits - Part 2

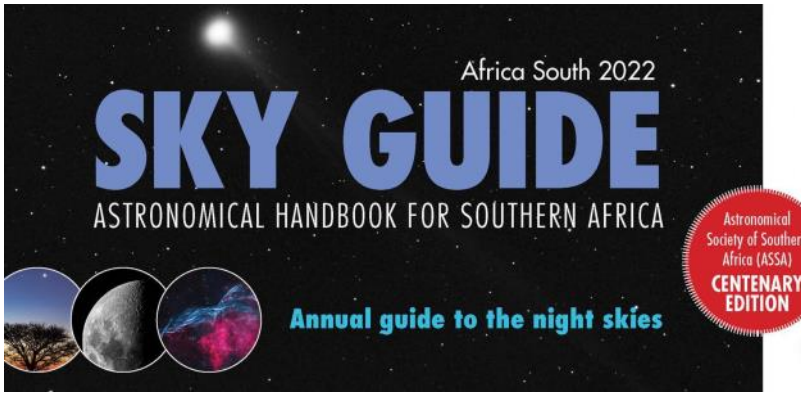
From Wikipedia, the free encyclopedia

List of space suit models

Soviet and Russian suit models

- **SK series (СК)**, the spacesuit used for the Vostok program (1961–1963). Worn by Yuri Gagarin on the first crewed space flight.
- No pressure suits were worn aboard Voskhod 1.
- **Berkut (Беркут = "golden eagle")**, the spacesuit was a modified SK-1 used by the crew of Voskhod 2 which included Alexei Leonov on the first spacewalk during (1965).
- From Soyuz 1 to Soyuz 11 (1967–1971) no pressure suits were worn during launch and reentry
- **Yastreb (Ястреб = "hawk")** extravehicular activity spacesuit used during a crew exchange between Soyuz 4 and Soyuz 5 (1969).
- **Krechet-94 (Кречет = "gyrfalcon")** spacesuit, designed for the canceled Soviet crewed Moon landing.
- **Strizh (Стриж = "swift (bird)")** spacesuit developed for pilots of *Buran*-class orbiters.
- **Sokol (Сокол = "falcon")** suits worn by Soyuz crew members during launch and re-entry They were first worn on Soyuz 12. They have been used from 1973 to present.
- **Orlan (Орлан = "sea-eagle" or "bald eagle")** suits for extravehicular activity, originally developed for the Soviet lunar program as a lunar orbit EVA suit. It is Russia's current EVA suit. Used from 1977 to present.

SK-1 space Suit | Berkut space suit | Yastreb space suit | Krehet space suit | Skol space suit | Sokol-KV2 space suit | Orlan-MK spacesuit



...Space Suits

United States suit models

- In the early 1950s, Siegfried Hansen and colleagues at Litton Industries designed and built a working hard-shell suit, which was used inside vacuum chambers and was the predecessor of space suits used in NASA missions.
- **Navy Mark IV** high-altitude/vacuum suit used for Project Mercury (1961–1963).
- **Gemini** space suits (1965–1966), there were three main variants developed: G3C designed for intra-vehicle use; G4C specially designed for EVA and intra-vehicle use; and a special G5C suit worn by the Gemini 7 crew for 14 days inside the spacecraft.
- **Manned Orbital Laboratory** MH-7 space suits for the canceled MOL program.
- **Apollo Block I A1C** suit (1966–1967) was a derivative of the Gemini suit, worn by primary and backup crews in training for two early Apollo missions. The nylon pressure garment melted and burned through in the Apollo 1 cabin fire. This suit became obsolete when crewed Block I Apollo flights were discontinued after the fire.
- **Apollo/Skylab A7L** EVA and Moon suits. The Block II Apollo suit was the primary pressure suit worn for eleven Apollo flights, three Skylab flights, and the US astronauts on the Apollo –Soyuz Test Project between 1968 and 1975. The pressure garment's nylon outer layer was replaced with fireproof Beta cloth after the Apollo 1 fire. This suit was the first to employ a liquid-cooled inner garment and outer micrometeroid garment. Beginning with the Apollo 13 mission, it also introduced "commander's stripes" so that a pair of space walkers will not appear identical on camera.
- **Shuttle Ejection Escape Suit** used from STS-1 (1981) to STS-4 (1982) by a two-man crew used in conjunction with the then-installed ejection seats. Derived from a USAF model. These were removed once the Shuttle became certified.
- From STS-5 (1982) to STS-51-L (1986) no pressure suits were worn during launch and re-entry. The crew would wear only a blue-flight suit with an oxygen helmet.
- **Launch Entry Suit** first used on STS-26 (1988), the first flight after the *Challenger* disaster. It was a partial pressure suit derived from a USAF model. It was used from 1988 to 1998.
- **Advanced Crew Escape Suit** used on the Space Shuttle starting in 1994. The Advanced Crew Escape Suit or ACES suit, is a full-pressure suit worn by all Space Shuttle crews for the ascent and entry portions of flight. The suit is a direct descendant of the United States Air Force high-altitude pressure suits worn by SR-71 Blackbird and U-2 spy plane pilots, North American X-15 and Gemini pilot-astronauts, and the Launch Entry Suits worn by NASA astronauts starting on the STS-26 flight. It is derived from a USAF model.
- **Extravehicular Mobility Unit (EMU)** used on both the Space Shuttle and International Space Station (ISS). The EMU is an independent anthropomorphic system that provides environmental protection, mobility, life support, and communications for a Space Shuttle or ISS crew member to perform an EVA in Earth orbit. Used from 1982 to present, but only available in limited sizing as of 2019.
- Aerospace company SpaceX developed an IVA suit which is worn by astronauts involved in Commercial Crew Program missions operated by SpaceX since the Demo-2 mission.
- **Orion Crew Survival System (OCSS)** will be used during launch and re-entry on the Orion MPCV. It is derived from the Advanced Crew Escape Suit but is able to operate at a higher pressure and has improved mobility in the shoulders.

...Space Suits

Shuttle Ejection Escape Suit

Shuttle Flight

Launch Entry

Advanced Crew Escape Suit

Extravehicular Mobility Unit

SpaceX IVA suit

SpaceX Suit ("Starman suit")

In February 2015, SpaceX began developing a space suit for astronauts to wear within the Dragon 2 space capsule. Its appearance was jointly designed by Jose Fernandez—a Hollywood costume designer known for his works for superhero and science fiction films—and SpaceX founder and CEO Elon Musk. The first images of the suit were revealed in September 2017. A mannequin, called "Starman" (after David Bowie's song of the same name), wore the SpaceX space suit during the maiden launch of the Falcon Heavy in February 2018. For this exhibition launch, the suit was not pressurized and carried no sensors.

The suit, which is suitable for vacuum, offers protection against cabin depressurization through a single tether at the astronaut's thigh that feeds air and electronic connections. The helmets, which are 3D-printed, contain microphones and speakers. As the suits need the tether connection and do not offer protection against radiation, they are not used for extra-vehicular activities.

In 2018, NASA commercial crew astronauts Bob Behnken, and Doug Hurley tested the spacesuit inside the Dragon 2 spacecraft in order to familiarize themselves with the suit. They wore it in the Crew Dragon Demo-2 flight launched on 30 May 2020. The suit is worn by astronauts involved in Commercial Crew Program missions involving SpaceX.

Chinese Suit Models

Shuguang Space Suit. First generation EVA space suit developed by China for the 1967 canceled *Project 714* crewed space program. With a mass of about 10 kilograms (20 lb), of orange colour, made of high-resistance multi-layers polyester fabric. The astronaut could use it inside the cabin and conduct an EVA as well.

Project 863 Space Suit. Cancelled project of second generation Chinese EVA space suit.

Shenzhou IVA Spacesuit. The suit was first worn by Yang Liewei on Shenzhou 5, the first crewed Chinese space flight, it closely resembles a Sokol-KV2 suit, but it is believed to be a Chinese-made version rather than an actual Russian suit. Pictures show that the suits on Shenzhou 6 differ in detail from the earlier suit, they are also reported to be lighter.

...Space Suits

Shenzhou Intra-Vehicular Activity Space Suit

Feitian space suit

Haiying EVA Space Suit. The imported Russian Orlan-M EVA suit is called *Haiying*. Used on Shenzhou 7.

Feitian EVA Space Suit. New generation indigenously developed Chinese-made EVA space suit also used for the Shenzhou 7 mission. The suit was designed for a spacewalk mission of up to seven hours. Chinese astronauts have been training in the out-of-capsule space suits since July 2007, and movements are seriously restricted in the suits, with a mass of more than 110 kilograms (240 lb) each.

Emerging technologies

Additive manufacturing

3D printing (additive manufacturing) can be used to reduce the mass of hard-shell space suits while retaining the high mobility they provide. This fabrication method also allows for the potential for in-situ fabrication and repair of suits, a capability which is not currently available, but will likely be necessary for Martian exploration.

The University of Maryland began development of a prototype 3D printed hard suit in 2016, based on the kinematics of the AX-5. The prototype arm segment is designed to be evaluated in the Space Systems Laboratory glovebox to compare mobility to traditional soft suits. Initial research has focused on the feasibility of printing rigid suit elements, bearing races, ball bearings, seals, and sealing surfaces.

Astronaut Glove Challenge

There are certain difficulties in designing a dexterous space suit glove and there are limitations to the current designs. For this reason, the Centennial Astronaut Glove Challenge was created to build a better glove. Competitions have been held in 2007 and 2009, and another is planned. The 2009 contest required the glove to be covered with a micro-meteorite layer.

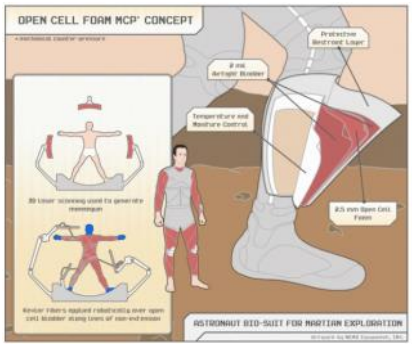
...Space Suits

Aouda.X

Since 2009, the Austrian Space Forum has been developing "Aouda.X", an experimental Mars analogue space suit focusing on an advanced human-machine interface and on-board computing network to increase situational awareness. The suit is designed to study contamination vectors in planetary exploration analogue environments and create limitations depending on the pressure regime chosen for a simulation.

Since 2012, for the Mars2013 analogue mission by the Austrian Space Forum to Erfoud, Morocco, the Aouda.X analogue space suit has a sister in the form of Aouda.S. This is a slightly less sophisticated suit meant primarily to assist Aouda.X operations and be able to study the interactions between two (analogue) astronauts in similar suits.

The Aouda.X and Aouda.S space suits have been named after the fictional princess from the Jules Verne's 1873 novel *Around the World in Eighty Days* and can be followed on Facebook. A public display mock-up of Aouda.X (called Aouda.D) is currently on display at the Dachstein Ice Cave in Obertraun, Austria, after the experiments done there in 2012.



Bio-Suit

Bio-Suit is a space activity suit under development at the Massachusetts Institute of Technology, which as of 2006 consisted of several lower leg prototypes. Bio-suit is custom fit to each wearer, using laser body scanning.

Constellation Space Suit System

On August 2, 2006, NASA indicated plans to issue a Request for Proposal (RFP) for the design, development, certification, production, and sustaining engineering of the Constellation Space Suit to meet the needs of the Constellation Program. NASA foresaw a single suit capable of supporting: survivability during launch, entry and abort; zero-gravity EVA; lunar surface EVA; and Mars surface EVA.

On June 11, 2008, NASA awarded a US$745 million contract to Oceaneering International to create the new space suit.

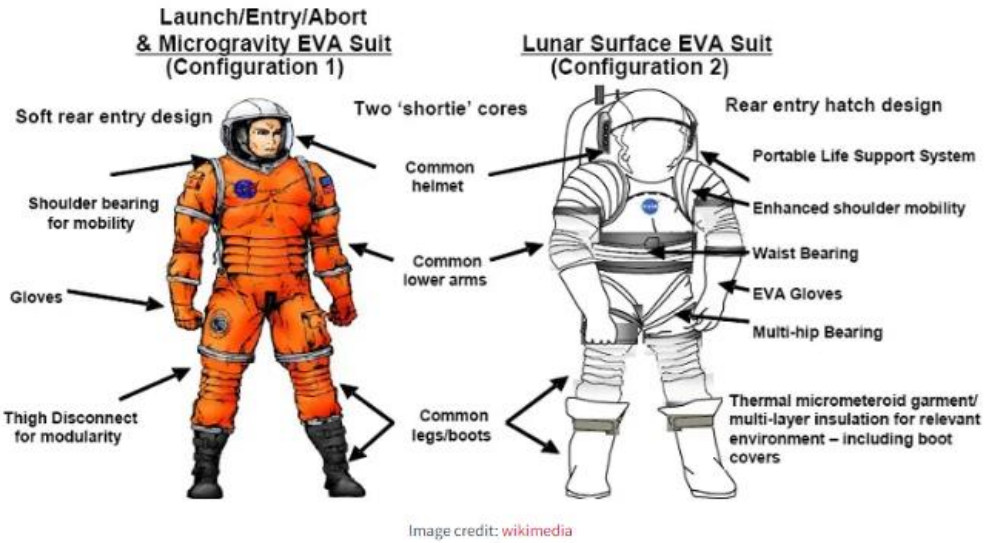


Image credit: wikimedia

...Space Suits

Final Frontier Design IVA Space Suit

Final Frontier Design IVA Space Suit

Final Frontier Design (FFD) is developing a commercial full IVA space suit, with their first suit completed in 2010. FFD's suits are intended as a light-weight, highly mobile, and inexpensive commercial space suits. Since 2011, FFD has upgraded IVA suit's designs, hardware, processes, and capabilities. FFD has built a total of 7 IVA space suit (2016) assemblies for various institutions and customers since founding, and has conducted high fidelity human testing in simulators, aircraft, microgravity, and hypobaric chambers. FFD has a Space Act Agreement with NASA's Commercial Space Capabilities Office to develop and execute a Human Rating Plan for FFD IVA suit. FFD categorizes their IVA suits according to their mission: Terra for Earth-based testing, Stratos for high altitude flights, and Exos for orbital space flights. Each suit category has different requirements for manufacturing controls, validations, and materials, but are of a similar architecture.

I-Suit

The I-Suit is a space suit prototype also constructed by ILC Dover, which incorporates several design improvements over the EMU, including a weight-saving soft upper torso. Both the Mark III and the I-Suit have taken part in NASA's annual Desert Research and Technology Studies (D-RATS) field trials, during which suit occupants interact with one another, and with rovers and other equipment.

Mark III

The Mark III is a NASA prototype, constructed by ILC Dover, which incorporates a hard lower torso section and a mix of soft and hard components. The Mark III is markedly more mobile than previous suits, despite its high operating pressure (57 kPa or 8.3 psi), which makes it a "zero-prebreathe" suit, meaning that astronauts would be able to transition directly from a one atmosphere, mixed-gas space station environment, such as that on the International Space Station, to the suit, without risking decompression sickness, which can occur with rapid depressurization from an atmosphere containing nitrogen or another inert gas.

MX-2

The MX-2 is a space suit analogue constructed at the University of Maryland's Space Systems Laboratory. The MX-2 is used[] for crewed neutral buoyancy testing at the Space Systems Lab's Neutral Buoyancy Research Facility. By approximating the work envelope of a real EVA suit, without meeting the requirements of a flight-rated suit, the MX-2 provides an inexpensive platform for EVA research, compared to using EMU suits at facilities like NASA's Neutral Buoyancy Laboratory.

The MX-2 has an operating pressure of 2.5–4 psi. It is a rear-entry suit, featuring a fiberglass HUT. Air, LCVG cooling water, and power are open loop systems, provided through an umbilical. The suit contains a Mac mini computer to capture sensor data, such as suit pressure, inlet and outlet air temperatures, and heart rate. Resizable suit elements and adjustable ballast allow the suit to accommodate subjects ranging in height from 68 to 75 inches (170–190 cm), and with a weight range of 120 lb (54 kg).

...Space Suits

North Dakota suit

Beginning in May 2006, five North Dakota colleges collaborated on a new space suit prototype, funded by a US$100,000 grant from NASA, to demonstrate technologies which could be incorporated into a planetary suit. The suit was tested in the Theodore Roosevelt National Park badlands of western North Dakota. The suit has a mass of 47 pounds (21 kg) without a life support backpack, and costs only a fraction of the standard US$12,000,000 cost for a flight-rated NASA space suit. The suit was developed in just over a year by students from the University of North Dakota, North Dakota State, Dickinson State, the state College of Science and Turtle Mountain Community College. The mobility of the North Dakota suit can be attributed to its low operating pressure; while the North Dakota suit was field tested at a pressure of 1 psi (6.9 kPa; 52 Torr) differential, NASA's EMU suit operates at a pressure of 4.7 psi (32 kPa; 240 Torr), a pressure designed to supply approximately sea-level oxygen partial pressure for respiration.

PXS

NASA's Prototype eXploration Suit (PXS), like the Z-series, is a rear-entry suit compatible with suitports. The suit has components which could be 3D printed during missions to a range of specifications, to fit different individuals or changing mobility requirements.

Suitports

A suitport is a theoretical alternative to an airlock, designed for use in hazardous environments and in human spaceflight, especially planetary surface exploration. In a suitport system, a rear-entry space suit is attached and sealed against the outside of a spacecraft, such that an astronaut can enter and seal up the suit, then go on EVA, without the need for an airlock or depressurizing the spacecraft cabin. Suitports require less mass and volume than airlocks, provide dust mitigation, and prevent cross-contamination of the inside and outside environments. Patents for suitport designs were filed in 1996 by Philip Culbertson Jr. of NASA's Ames Research Center and in 2003 by Joerg Boettcher, Stephen Ransom, and Frank Steinsiek.

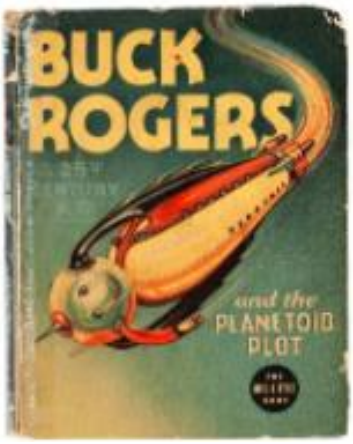
Z-series

Z-1 Series Suit

In 2012, NASA introduced the Z-1 space suit, the first in the Z-series of space suit prototypes designed by NASA specifically for planetary extravehicular activity. The Z-1 space suit includes an emphasis on mobility and protection for space missions. It features a soft torso versus the hard torsos seen in previous NASA EVA space suits, which provides reduced mass. It has been labeled the "Buzz Lightyear suit" due to its green streaks for a design.

In 2014, NASA released the design for the Z-2 prototype, the next model in the Z-series. NASA conducted a poll asking the public to decide on a design for the Z-2 space suit. The designs, created by fashion students from Philadelphia University, were "Technology", "Trends in Society", and "Biomimicry." The design "Technology" won, and the prototype is built with technologies like 3D printing. The Z-2 suit will also differ from the Z-1 suit in that the torso reverts to the hard shell, as seen in NASA's EMU suit.

...Space Suits



In fiction

The earliest space fiction ignored the problems of traveling through a vacuum, and launched its heroes through space without any special protection. In the later 19th century, however, a more realistic brand of space fiction emerged, in which authors have tried to describe or depict the space suits worn by their characters. These fictional suits vary in appearance and technology, and range from the highly authentic to the utterly improbable.

A very early fictional account of space suits can be seen in Garrett P. Serviss' novel *Edison's Conquest of Mars* (1898). Later comic book series such as Buck Rogers (1930s) and Dan Dare (1950s) also featured their own takes on space suit design. Science fiction authors such as Robert A. Heinlein contributed to the development of fictional space suit concepts.

“Irresponsible” Russian Anti-Satellite Test Creates Orbital Debris Field, Endangering the Space Station and Crew

By Nancy Atkinson

Early Monday, November 15, 2021, the International Space Station Flight Control team in Houston told the crew that due to a to satellite breakup, a debris field was created near the station’s orbital path. The astronauts and cosmonauts were told to “shelter in place” on board the Soyuz and SpaceX capsules attached to the ISS.

What became apparent as the day wore on is that the debris field was the result of a “destructive” test by Russia of an anti-satellite missile system against one of their own satellites. Experts from the US Space Command say the test resulted in “over fifteen hundred pieces of trackable orbital debris” which could stay in orbit for several years.

The debris not only endangered the crew and the ISS today, but could continue to cause problems for the ISS – as well as other satellites and launches – for at least five years.

Artist’s impression of the orbital debris problem. Credit: UC3M

“Russia’s dangerous and irresponsible behavior jeopardizes the long-term sustainability of … outer space and clearly demonstrates that Russia’s (claims) to oppose the weaponization of space are disingenuous and hypocritical,” State Department spokesman Ned Price told reporters at a briefing today.

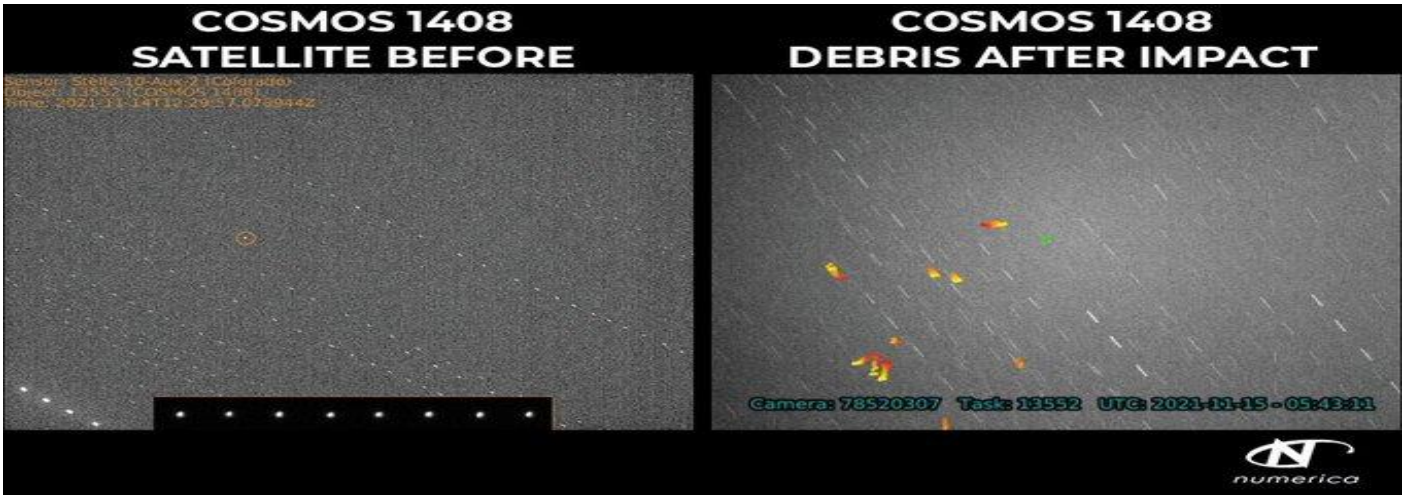
In a statement, NASA Administrator Bill Nelson said, “I’m outraged by this irresponsible and destabilizing action. With its long and storied history in human spaceflight, it is unthinkable that Russia would endanger not only the American and international partner astronauts on the ISS, but also their own cosmonauts. Their actions are reckless and dangerous, threatening as well the Chinese space station and the taikonauts on board.”

The destroyed satellite, Kosmos-1408, appears to have broken up either late Nov. 14 or early Nov. 15, based on government and commercial tracking data. The satellite has been in orbit since 1982 and is no longer operational. Sources said the satellite weighed about 2,000 kilograms (4,400 lbs) and was last tracked in an orbit about 485 kilometers high.

...Orbital Debris

The crew was awakened and directed to close the hatches on several outward modules on the station, including Columbus, Kibo, the Permanent Multipurpose Module, Bigelow Expandable Activity Module, and Quest Joint Airlock.

NASA said an additional precautionary measure of sheltering the crew was executed for two passes through or near the vicinity of the debris cloud. The crew members made their way into their spacecraft shortly before 2 a.m. EST and remained there until about 4 a.m. The space station is passing through or near the cloud every 90 minutes, but the need to shelter for only the second and third passes of the event was based on a risk assessment made by the debris office and ballistics specialists at NASA's Johnson Space Center in Houston.



The crew was also directed to move any sleeping quarters to the interior parts of the space station until further notice. Hatches between the U.S. and Russian segments remain open.

NASA astronauts Tom Marshburn, Kayla Barron, Raja Chari and European Space Agency astronaut Matthias Maurer took shelter in their SpaceX Crew Dragon spacecraft, while Russian cosmonauts Anton Shkaplerov and Pyotr Dubrov, as well as NASA astronaut Mark Vande Hei, boarded the Soyuz spacecraft. While those spacecraft brought the crew on board and will be used to bring them back to Earth again, both spacecraft can be used as lifeboats in any emergency situation.

An approach of debris is considered "close" only when it enters an imaginary "pizza box" shaped region around the station, measuring 0.75 kilometers above and below the station and 25 kilometers on each side (2,460 feet above and below and 15.6 by 15.6 miles). Thrusters on the ISS can move the station out of the way of orbital debris, if the debris has been tracked or is known about with enough lead time.

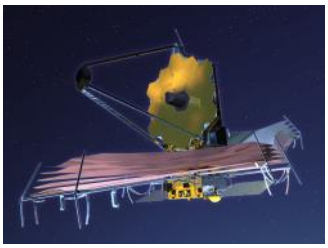
Dedicated debris shields on the ISS can withstand particles as large as 1 cm in diameter. It is known that small pieces of debris have already collided with ISS on many occasions, but no collisions to date have affected the safety of the crew or the operation of the mission.

For the latest regarding this event, orbital debris specialist and Harvard astronomer Jonathan McDowell is providing updates on Twitter regarding the debris field and how it will affect objects in low Earth orbit.

RIGHT: This is what happens to a block of solid aluminum when hit by a 1/2 oz (~14g) piece of plastic going 15,000 mph (~24000 km/h) in space, leaving a crater of 5 inches (12.7cm deep).

James Webb Space Telescope

Collated by Corinne Gill



Exploring strange new worlds. Understanding the origins of the universe. Searching for life in the galaxy. These are not the plot of a new science fiction movie, but the mission objectives of the James Webb Space Telescope, the long-awaited successor to the Hubble Space Telescope. NASA is building and launching the James Webb Space Telescope in partnership with the European Space Agency and Canada.

When you look up at the night sky, you're only seeing a tiny fraction of the estimated septillion stars out there in the universe…even astronomers have a hard time. But now the James Webb Space Telescope may just make things a lot easier and push the very limits of infrared light observation to travel back over 13 billion years ago for a glimpse of our universe's first light. The James Webb Space Telescope will be 100 times as powerful as the Hubble. It will change how we see the universe.

The James Webb Space Telescope was originally called the "Next Generation Space Telescope," or NGST. It was called "Next Generation" because Webb will build on and continue the science exploration started by the Hubble Space Telescope.

The telescope was re-named after James E. Webb, a former administrator of NASA from 1961 to 1968 and played an integral role in the Apollo program. James Webb was NASA's second administrator, leading the space agency from 1961 to 1968, a period including the Apollo moon program, and NASA profiles of Webb describing him as a skilled manager who balanced the political and scientific missions of the agency with aplomb.

Delays

Development began in 1996 for a launch that was initially planned for 2007 and a US$500 million budget, but the project had numerous delays and cost overruns and the programme underwent a major redesign in 2005. The JWST's construction was completed in late 2016, after which its extensive testing phase began. In March 2018, NASA further delayed the launch after the telescope's sunshield ripped during a practice deployment. Launch was delayed again in June 2018 following recommendations from an independent review board. Work on integration and testing of the telescope was suspended in March 2020 due to the COVID-19 pandemic, adding further delays. Following work resumption, the launch date was delayed to 31 October 2021. However problems with the Ariane 5 launch vehicle subsequently pushed the launch date back.

The launch, is now officially scheduled for December 22 at 7:20 a.m. EST.

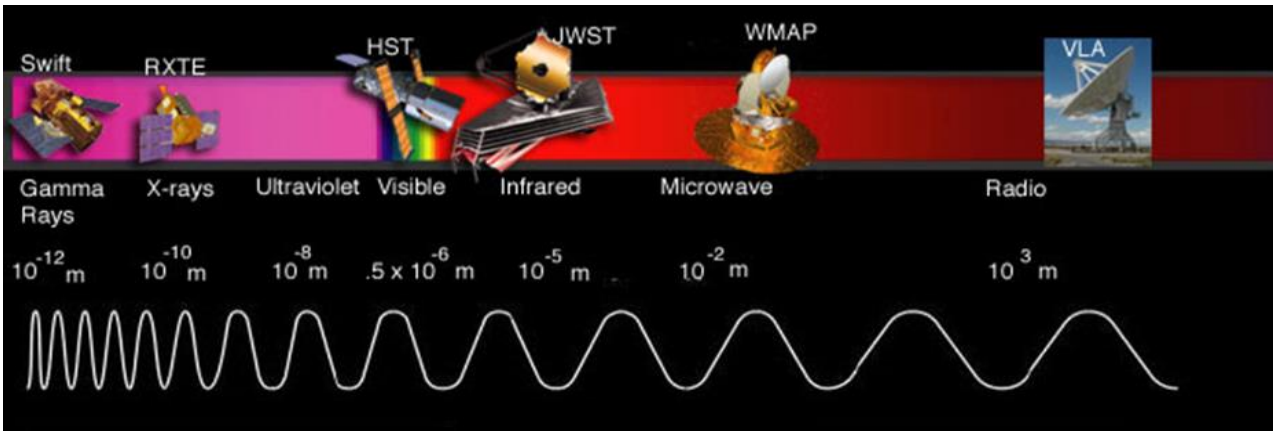
Overview

Webb often gets called the replacement for Hubble, but it actually it's successor. After all, Webb is the scientific successor to Hubble; its science goals were motivated by results from Hubble. Hubble's science pushed us to look to longer wavelengths to "go beyond" what Hubble has already done. In particular, more distant objects are more highly redshifted, and their light is pushed from the UV and optical into the near-infrared. Thus observations of these distant objects (like the first galaxies formed in the Universe, for example) requires an infrared telescope.

This is the other reason that Webb is not a replacement for Hubble; its capabilities are not identical. Webb will primarily look at the Universe in the infrared, while Hubble studies it primarily at optical and ultraviolet wavelengths (though it has some infrared capability). Webb also has a much bigger mirror than Hubble. This larger light collecting area means that Webb can peer farther back into time than Hubble is capable of doing. Hubble is in a very close orbit around the earth, while Webb will be 1.5 million kilometers (km) away at the second Lagrange (L2) point.

...JWST

Wavelength



ABOVE: EM Spectrum and satellites

The JWST will observe primarily in the infrared and will have four science instruments to capture images and spectra of astronomical objects. These instruments will provide wavelength coverage from 0.6 to 28 micrometers (or "microns"; 1 micron is 1.0 x 10^{-6} meters). The infrared part of the electromagnetic spectrum goes from about 0.75 microns to a few hundred microns. This means that Webb's instruments will work primarily in the infrared range of the electromagnetic spectrum, with some capability in the visible range (in particular in the red and up to the yellow part of the visible spectrum).

The instruments on Hubble can observe a small portion of the infrared spectrum from 0.8 to 2.5 microns, but its primary capabilities are in the ultra-violet and visible parts of the spectrum from 0.1 to 0.8 microns.

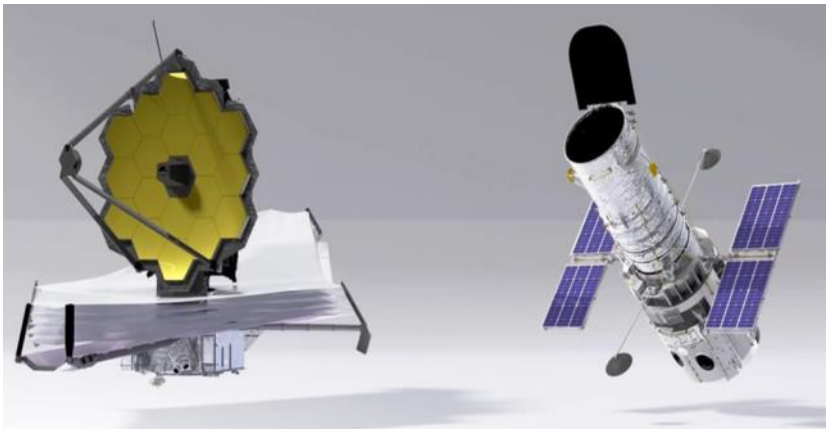
Why are infrared observations important to astronomy? Stars and planets that are just forming lie hidden behind cocoons of dust that absorb visible light. (The same is true for the very center of our galaxy.) However, infrared light emitted by these regions can penetrate this dusty shroud and reveal what is inside. Above left are infrared and visible light images from the Hubble Space Telescope of the Monkey Head Nebula, a star-forming region. A jet of material from a newly forming star is visible in one of the pillars, just above and left of center in the right-hand image. Several galaxies are seen in the infrared view, much more distant than the columns of dust & gas.

LEFT: Are infrared and visible light images from the Hubble Space Telescope of the Monkey Head Nebula, a star forming region. A jet of material from a newly forming star is visible in one of the pillars, just above and left of center in the right-hand image. Several galaxies are seen in the infrared view, much more distant than the columns of dust and gas.

ABOVE: Hubble's visible and infrared views of the Monkey Head Nebula.
Credit: NASA and ESA Acknowledgment: the Hubble Heritage Team (STScI/AURA), and J. Hester

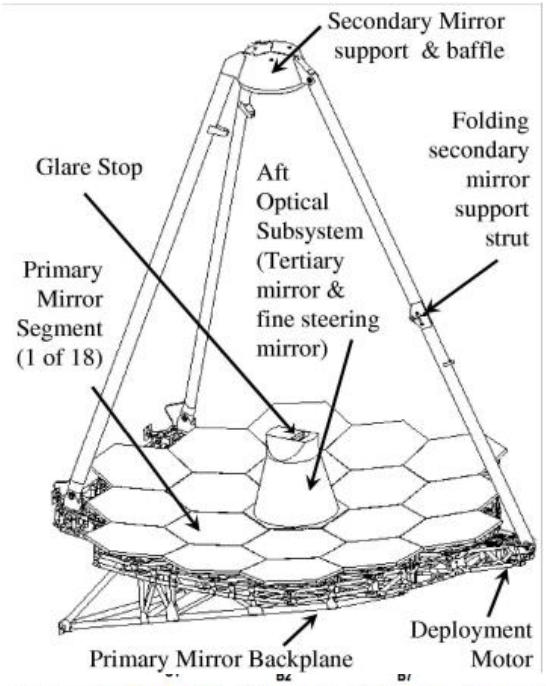
...JWST

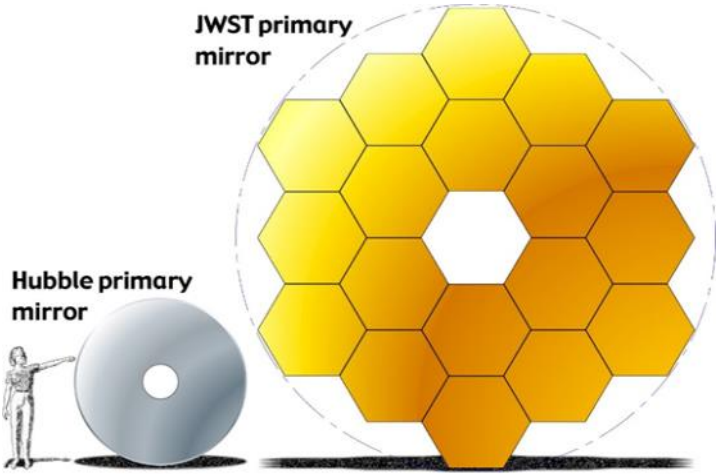
Size Comparisons



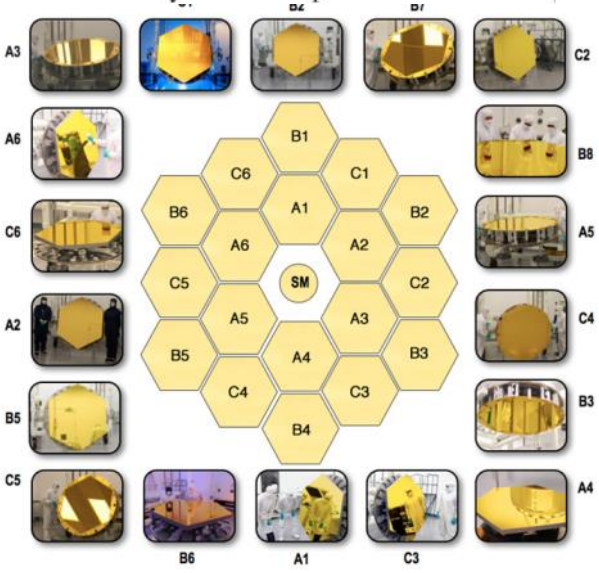
ABOVE & RIGHT: Overall size comparison of Webb and Hubble. Credit: GSFC

The Webb's primary mirror is made of 18 segments will have a diameter of approximately 6.5 meters, which would give it a significantly larger collecting area than the mirrors available on the current generation of space telescopes. It's area of slightly more than 25 square meters and it's diffraction-limited resolution are approx. equivalent to a 6.0 meter conventional round mirror. At 2 microns, the FWHM of the image will be about 70 milli-arcsec.





The 18 hexagonal segments are arranged in a large hexagon, with the central segment removed to allow the light to reach the instruments. Each segment is 1.32 m, measured flat to flat. Beginning with a geometric area of 1.50 m^2; after cryogenic shrinking and edge removal, the average projected segment area is 1.46 m^2. With obscuration by the secondary mirror support system of no more than 0.86 m^2, the total polished area equals 25.37 m^2, and vignetting by the pupil stops is minimized so that it meets the discussed >25 m^2 requirement of the total unobscured collecting area for the telescope.



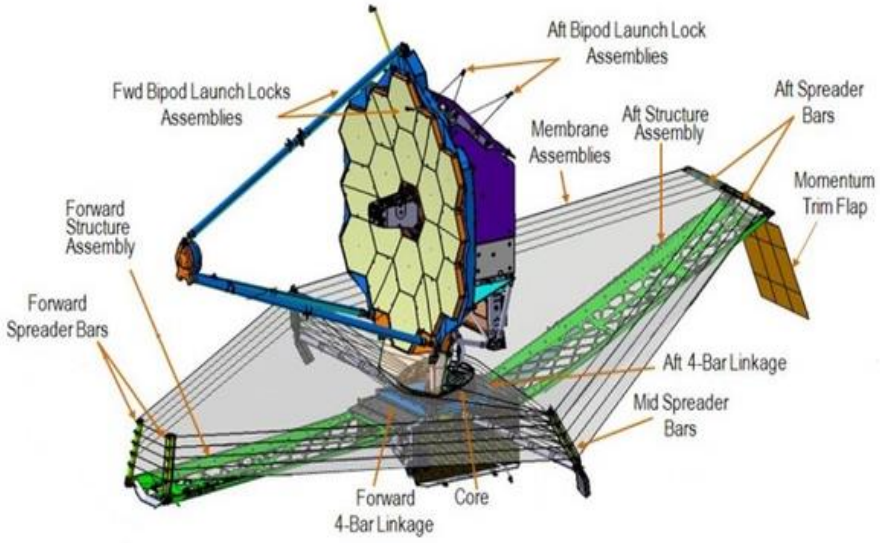
The outer diameter, measured along the mirror, point to point on the larger hexagon, but flat to flat on the individual segments, is 5 times the 1.32 m segment size, or 6.6 m (see figure). The secondary mirror is circular, 0.74 m in diameter and has a convex aspheric prescription. There are three different primary mirror segment prescriptions, with 6 flight segments and 1 spare segment of each prescription. The telescope is a three-mirror anastigmat, so it has primary, secondary and tertiary mirrors, a fine steering mirror, and each instrument has one or more pick-off mirrors.

...JWST

Hubble's mirror has a much smaller 2.4 meters diameter round primary mirror and its corresponding collecting area is 4.5 m^2, thus giving the JWT around 6.25 times more collecting area! Webb will have significantly larger field of view than the NICMOS camera on Hubble (covering more than ~15 times the area) and significantly better spatial resolution than is available with the infrared Spitzer Space Telescope.

Solar Shield - Keeping it Cool

The James Webb Space Telescope will observe primarily the infrared light from faint and very distant objects. In order to be able to detect those faint heat signals, the telescope itself must be kept extremely cold. To protect the telescope from external sources of light and heat (like the Sun, Earth, and Moon) as well as from heat emitted by the observatory itself, Webb has a 5-layer, tennis court-sized sunshield that acts like a parasol providing shade. Dimensions: 21.197 m x 14.162 m (69.5 ft x 46.5 ft).



This sunshield will always be between the Sun/Earth/Moon and the telescope. It's able to be positioned this way because JWST will be orbiting the Sun 1.5 million kilometers away from (but approximately in line with) the Earth.

The sunshield will allow the telescope to cool down to a temperature below 50 Kelvin (-370°F, or -223°C) by passively radiating its heat into space. The near-infrared instruments will work at about 39 K (-389°F, -234°C) through a passive cooling system. The mid-infrared instrument will work at a temperature of 7 K (-447°F, -266°C), using a helium refrigerator, or cryocooler system .

In addition to providing a cold environment, the sunshield provides a thermally stable environment. This is essential to maintaining proper alignment of the primary mirror segments as the telescope changes its orientation to the Sun. The Sunshield made of five thin layers of Kapton, each as thin as a human hair, with aluminum and doped-silicon coatings to reflect the sun's heat back into space.

The reason for 5 layers instead of one thick one is that each successive layer of the sunshield is cooler than the one below. The heat radiates out from between the layers, and the vacuum between the layers is a very good insulator. One big thick sunshield would conduct the heat from the bottom to the top more than five layers separated by vacuum.

The sunshield is made of a lightweight material with special thermal properties, called Kapton. It has high heat-resistance and remains stable across a wide range of temperatures from minus 269 to plus 400 Celsius (minus 452 to plus 752 degrees Fahrenheit). It does not melt or burn at the highest of these temperatures. .

...JWST

The Engineers working on NASA's JWST have successfully folded and packed its sunshield for its upcoming million-mile (roughly 1.5 million kilometer) journey, on 22 December 2021.

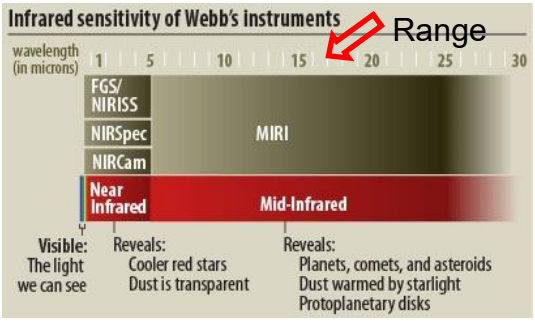
The JWST folds the mirrors in onto themselves, like origami figure, to be compact enough to fit inside the head of the rocket. The Engineers working on NASA's James Webb Space Telescope have successfully folded and packed its sunshield for its upcoming million-mile (roughly 1.5 million kilometer) journey, on 22 December.

The most intricate aspects of the folding process involved aligning the membrane stacks. Each of the sunshield's layers has hundreds of intentional holes, which are deliberately arranged to avoid light and heat from passing to the optical elements of the telescope when the sunshield is fully deployed. These holes must be lined up during folding so that Webb technicians can insert "pins" through the holes in each membrane stack. The 107 "pins," or membrane release devices, will help restrain the layers for launch, but release to unfold the sunshield once the telescope is in space..

The sunshield was specially engineered to fold up around the two sides of the telescope and fit within the confines of its launch vehicle, the Ariane 5 rocket. Now that folding has been completed at Northrop Grumman in Redondo Beach, California, the sunshield will remain in this compact form through launch and the first few days the observatory will spend in space.

Once in space at it's L2 position—it will be on its own. There is no ability to repair the James Webb Space Telescope should something go wrong!

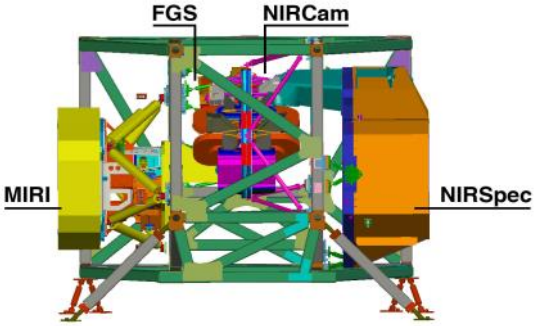
Near Infrared Camer (NIRCam)



The Near Infrared Camera (NIRCam) is Webb's primary imager that will cover the infrared wavelength range 0.6 to 5 microns. NIRCam will detect light from: the earliest stars and galaxies in the process of formation, the population of stars in nearby galaxies, as well as young stars in the Milky Way and Kuiper Belt objects. NIRCam is equipped with coronagraphs, instruments that allow astronomers to take pictures of very faint objects around a central bright object, like stellar systems. NIRCam's coronagraphs work by blocking a brighter object's light, making it possible to view the dimmer object nearby - just like shielding the sun from your eyes with an upraised hand can allow you to focus on the view in front of you. With the coronagraphs, astronomers hope to determine the characteristics of planets orbiting nearby stars. The NIRCAM is included in the ISIM.

Integrated Science Instrument Module

The Integrated Science Instrument Module (ISIM) is the part of JWST that contains 4 science instruments, the Fine Guidance Sensor, and the data-handling computer.



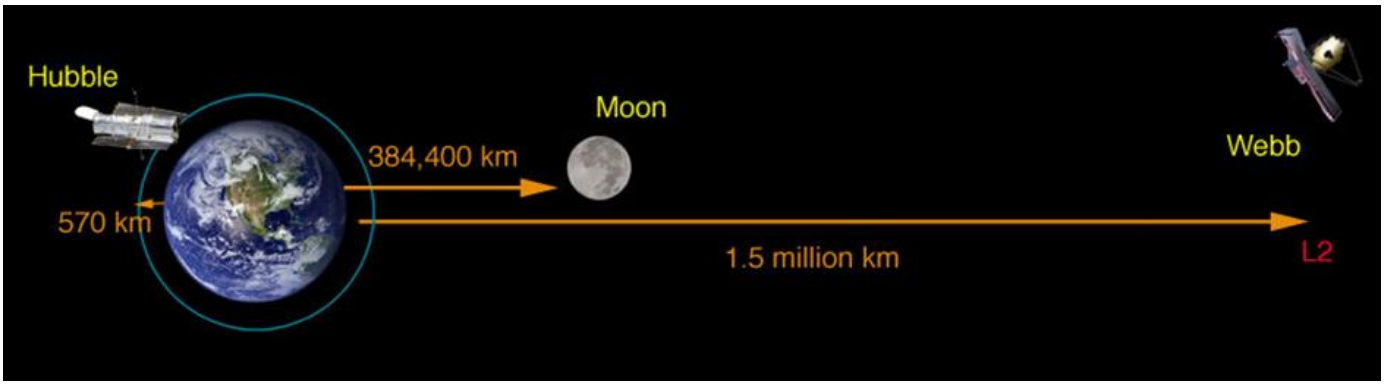
The ISIM includes the following instruments:

- Near-Infrared Camera, or NIRCam
- Near-Infrared Spectrograph, or NIRSpec
- Mid-Infrared Instrument, or MIRI
- Fine Guidance System/Near-InfraRed Imager and Slitless Spectrograph (FGS/NIRISS)

...JWST

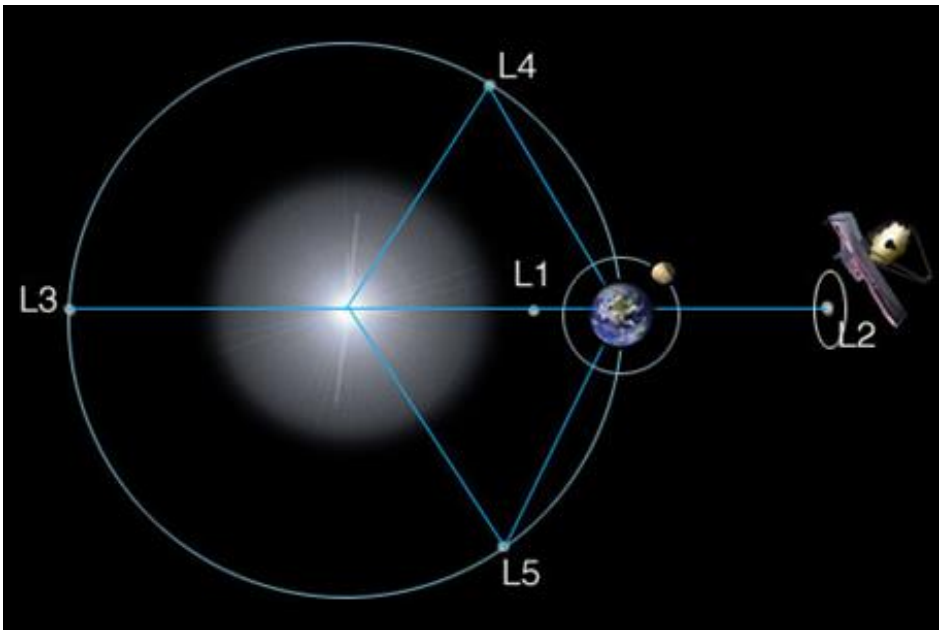
Orbit

The Earth is 150 million km from the Sun and the moon orbits the earth at a distance of approximately 384,500 km. The Hubble Space Telescope orbits around the Earth at an altitude of ~570 km above it. Webb will not actually orbit the Earth - instead it will sit at the Earth-Sun L2 Lagrange point, 1.5 million km away!



ABOVE: Webb will orbit the sun 1.5 million kilometers (1 million miles) away from the Earth at what is called, the second Lagrange point or L2. (Note that these graphics are not to scale.)

Because Hubble is in Earth orbit, it was able to be launched into space by the space shuttle. Webb will be launched on an Ariane 5 rocket and because it won't be in Earth orbit, it is not designed to be serviced by the space shuttle.



As the Earth orbits the Sun, Webb will orbit with it - but stay fixed in the same spot with relation to the Earth and the Sun, as shown in the diagram to the left. Actually, satellites orbit around the L2 point, as you can see in the diagram - they don't stay completely motionless at a fixed spot.

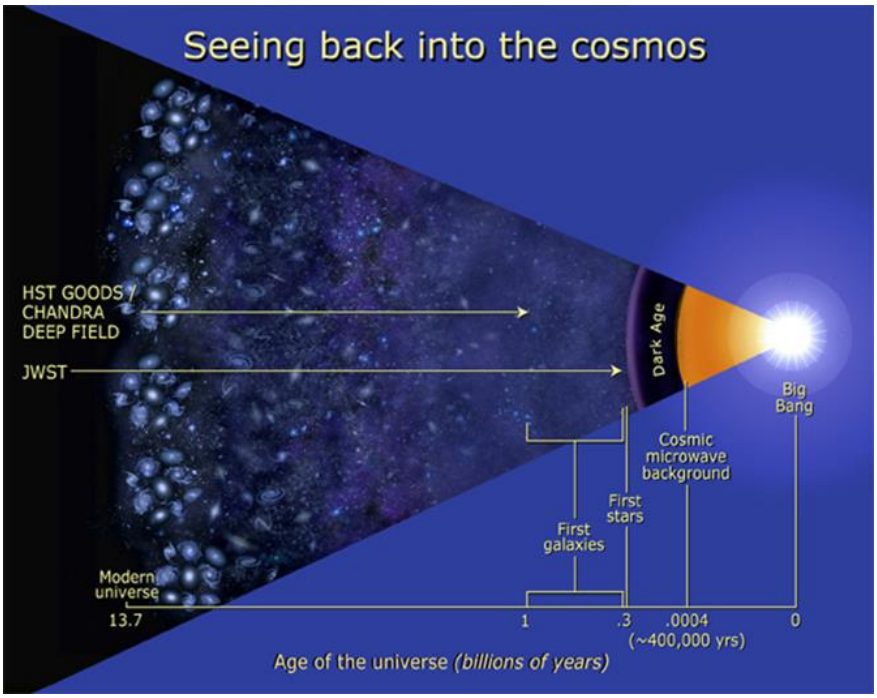
At the L2 point Webb's solar shield will block the light from the Sun, Earth, and Moon. This will help Webb stay cool, which is very important for an infrared telescope.

ABOVE: Diagram indicating Lagrange Points.

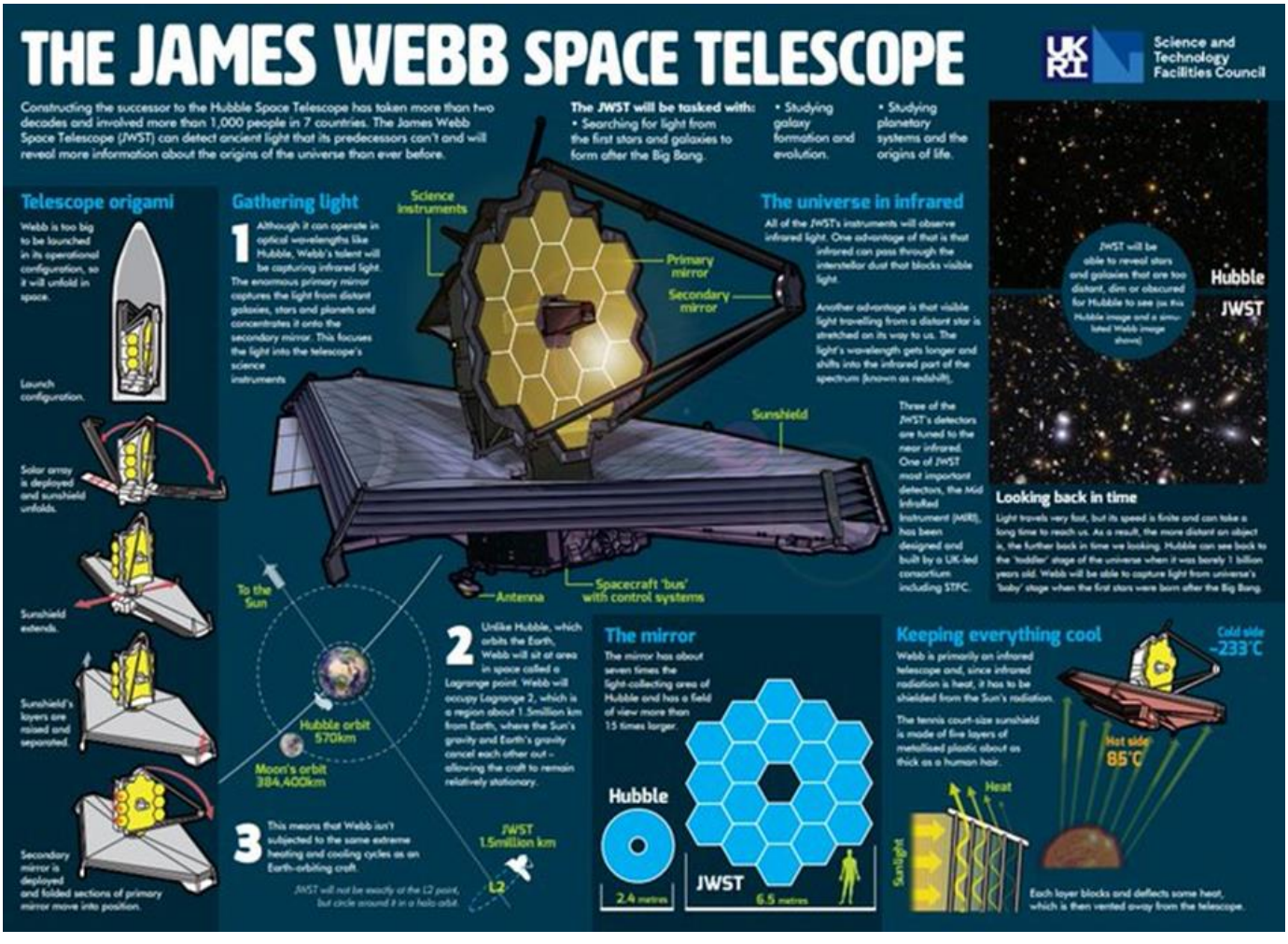
...JWST

How Far Will the JWST See?

Because of the time it takes light to travel, the farther away an object is, the farther back in time we are looking.

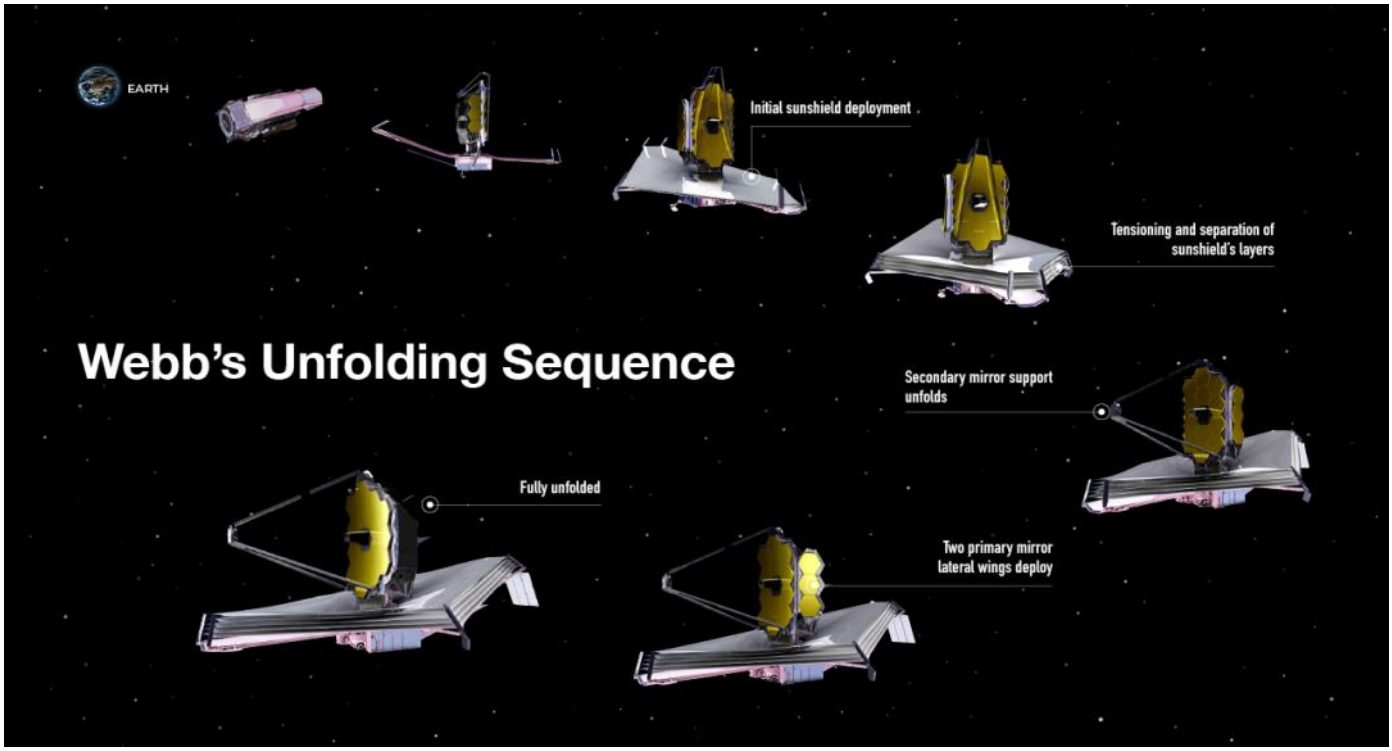


This illustration compares various telescopes and how far back they are able to see. Essentially, Hubble can see the equivalent of "toddler galaxies" and Webb Telescope will be able to see "baby galaxies". One reason Webb will be able to see the first galaxies is because it is an infrared telescope. The universe (and thus the galaxies in it) is expanding. When we talk about the most distant objects, Einstein's General Relativity actually comes into play. It tells us that the expansion of the universe means it is the space between objects that actually stretches, causing objects (galaxies) to move away from each other. Furthermore, any light in that space will also stretch, shifting that light's wavelength to longer wavelengths. This can make distant objects very dim (or invisible) at visible wavelengths of light, because that light reaches us as infrared light. Infrared telescopes, like Webb, are ideal for observing these early galaxies.



...JWST

Launch Relay



Deploying, tensioning, and separating Webb's sunshield, a five-layer, diamond-shaped structure the size of a tennis court; extending its secondary mirror support structure; and unfolding its primary mirror, which has a honeycomb-like pattern of 18 hexagonal, gold-coated mirror segments.

Deployment and commissioning will take time - at least six months. Engineers and scientists will carefully activate and confirm each and every instrument is working properly before the first - but still unfocused - images of a star field will be delivered about two months after it launches.

In the fourth month after launch, Webb will complete its first orbit around L2 - and take the first focused image. This will show that the mirrors are aligned.

After the six-month mark, Webb will begin its science mission and start to conduct routine science operations.

Watch live video presentation to be held on the 7th December: Link: https://www.youtube.com/watch?v=_8mA4wVBvBc

Sources:
https://fossbytes.com/reasons-why-nasa-james-webb-space-telescope-hubbles-successor-jwst/
https://mobile.twitter.com/STFC_Matters/status/1401844768393531393/photo/1
https://www.forbes.com/sites/startswithabang/2018/01/26/how-the-james-webb-space-telescope-will-deploy-in-an-ideal-world/?sh=4e51a2006791
https://facebook.com/events/s/free-lecture-the-webb-space-te/934236044141879/
https://www.theverge.com/2021/9/8/22663027/nasa-james-webb-space-telescope-launch-date
https://www.nasaspaceflight.com/2021/11/commissioning-jwst-1/
https://jwst.nasa.gov/content/about/launch.html#webbLaunchConfiguration
https://www.nasa.gov/feature/goddard/2021/nasa-s-webb-telescope-packs-its-sunshield-for-a-million-mile-trip
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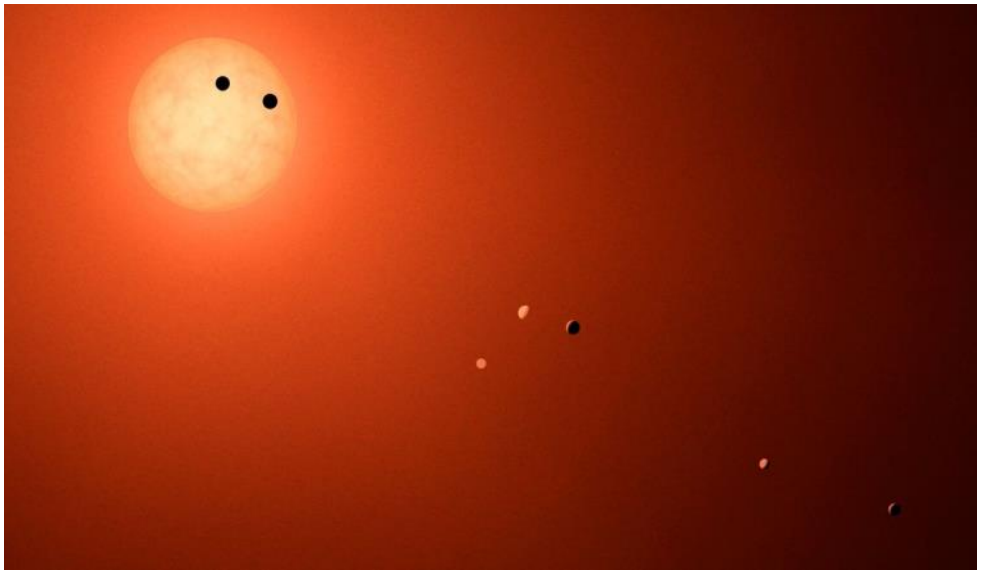
https://www.vox.com/science-and-health/22664709/james-webb-space-telescope-launch-date-december-science-hubble
https://www.jwst.nasa.gov/content/about/comparisonWebbVsHubble.html
https://en.wikipedia.org/wiki/James_Webb_Space_Telescope
https://www.nasa.gov/mission_pages/webb/about/index.html

ExoMiner Adds 301 Planets to Kepler's Total Count

By NASA Jet Propulsion Laboratory

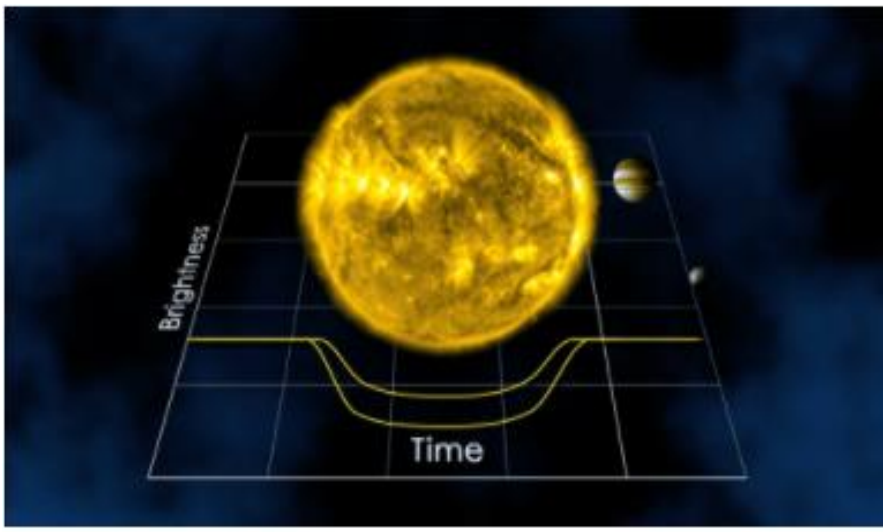
Scientists have added a whopping 301 newly confirmed exoplanets to the total exoplanet tally.

Scientists recently added a whopping 301 newly validated exoplanets to the total exoplanet tally. The throng of planets is the latest to join the 4,569 already validated planets orbiting a multitude of distant stars. How did scientists discover such a huge number of planets, seemingly all at once? The answer lies with a new deep neural network called ExoMiner.



Over 4,5000 planets have been found around other stars, but scientists expect that our galaxy contains millions of planets. There are multiple methods for detecting these small, faint bodies around much larger, bright stars. Credit: NASA/ JPL-Caltech

Deep neural networks are machine learning methods that automatically learn a task when provided with enough data. ExoMiner is a new deep neural network that leverages NASA's Supercomputer, Pleiades, and can distinguish real exoplanets from different types of imposters, or "false positives." Its design is inspired by various tests and properties human experts use to confirm new exoplanets. And it learns by using past confirmed exoplanets and false positive cases.



When a planet crosses directly between us and its star, we see the star dim slightly because the planet is blocking out a portion of the light. This is one method scientists use to find exoplanets. They make a plot called a light curve with the brightness of the star versus time. Using this plot, scientists can see what percentage of the star's light the planet blocks and how long it takes the planet to cross the disk of the star.

Photo Credit: NASA's Goddard Space Flight Centre

ExoMiner supplements people who are pros at combing through data and deciphering what is and isn't a planet. Specifically, data gathered by NASA's Kepler spacecraft and K2, its follow-on mission. For missions like Kepler, with thousands of stars in its field of view, each holding the possibility to host multiple potential exoplanets, it's a hugely time-consuming task to pore over massive datasets. ExoMiner solves this dilemma.

...Kepler's Planet Count Increases

"Unlike other exoplanet-detecting machine learning programs, ExoMiner isn't a black box – there is no mystery as to why it decides something is a planet or not," said Jon Jenkins, exoplanet scientist at NASA's Ames Research Center in California's Silicon Valley. "We can easily explain which features in the data lead ExoMiner to reject or confirm a planet."

What is the difference between a confirmed and validated exoplanet? A planet is "confirmed," when different observation techniques reveal features that can only be explained by a planet. A planet is "validated" using statistics – meaning how likely or unlikely it is to be a planet based on the data.

In a paper published in the Astrophysical Journal, the team at Ames shows how ExoMiner discovered the 301 planets using data from the remaining set of possible planets – or candidates – in the Kepler Archive. All 301 machine-validated planets were originally detected by the Kepler Science Operations Center pipeline and promoted to planet candidate status by the Kepler Science Office. But until ExoMiner, no one was able to validate them as planets.

The paper also demonstrates how ExoMiner is more precise and consistent in ruling out false positives and better able to reveal the genuine signatures of planets orbiting their parent stars – all while giving scientists the ability to see in detail what led ExoMiner to its conclusion.

"When ExoMiner says something is a planet, you can be sure it's a planet," added Hamed Valizadegan, ExoMiner project lead and machine learning manager with the Universities Space Research Association at Ames. "ExoMiner is highly accurate and in some ways more reliable than both existing machine classifiers and the human experts it's meant to emulate because of the biases that come with human labeling."

None of the newly confirmed planets are believed to be Earth-like or in the habitable zone of their parent stars. But they do share similar characteristics to the overall population of confirmed exoplanets in our galactic neighborhood.

"These 301 discoveries help us better understand planets and solar systems beyond our own, and what makes ours so unique," said Jenkins.

As the search for more exoplanets continues – with missions using transit photometry such as NASA's Transiting Exoplanet Survey Satellite, or TESS, and the European Space Agency's upcoming PLAnetary Transits and Oscillations of stars, or PLATO, mission – ExoMiner will have more opportunities to prove it's up to the task.

"Now that we've trained ExoMiner using Kepler data, with a little fine-tuning, we can transfer that learning to other missions, including TESS, which we're currently working on," said Valizadegan. "There's room to grow."

The Exominer new deep neural network program which is highly accurate and explainable deep learning classifier that validates new Exoplanets. It was trained and fed with data from **NASA's Kepler spacecraft** to identify new exoplanets. It scoured through data from NASA's Pleiades supercomputer to identify the 301 unknown exoplanets The machine learning method is also capable enough to distinguish between real exoplanets and imposters which are also called "false positives.

Although NASA ended the Kepler mission in 2018, there is still a lot of data for scientists to read through and discover new exoplanets. This is humanly possible but it's a tedious task, and this is where ExoMiner comes in.

https://www.businessinsider.in/science/space/news/exominer-machine
https://www.jpl.nasa.gov/news/new-deep-learning-method-adds-301-planets-to-keplers-total-count

ASSA Durban Minutes of General Meeting

10 November 2021 - 19:30 via Zoom

Attendees:

Speaker:	Francois Malan (PhD)		
Present	Francois Zinserling	Michael Caine	Chris Stewart
Gerald & Linda	Michel Benet	John Gill	Graham Alston
Amith Rajpal	Mike Hadlow	Corinne Gill	Peter Dormehl
Pieter Strauss	Etsuo Takayanagi	Alison Coulter	John Lindsay-Smith
Andy Overbeek	Ooma Rambilass	Roger Bond	Carmel Ives
Tessa Collins	Laurienne Alder	Hazel Hall	Brendon
Michael Watkeys	Johan Viljoen	Paul Ludick	Dave Blane
Carmen Brunette	Jean Senogles	Sheldon Seymour	Moya O'Donoghue
ShaunO	Claire Odhav	Don Orsmond	Michelle
Giljen Jacobs	Yesen Govender	Dylan Evans	R Abboo
Apologies:	Sheryl Venter	Alan Marnit	MaryAnne Jackson

1. **Welcome (Durban meeting):**
   - The Chairman, Amith Rajpal, welcomed all attendees, and visitors.

2. **Guest Speaker**
   - Amith introduced the speaker. Francois Malan, who spoke about the “South African space industry and some interesting projects”

3. **Present and Apologies**
   - See above

4. **Previous meeting minutes:**
   - Minutes approved by John Gill and seconded by Corinne Gill.
   - There were no matters arising from previous minutes

5. **Finance:**

   - Corinne sent detail of financials by email during the meeting

Finances	Month	Current	Investment	Cash
General Meeting	**2021-11-10**	**R 24,565.27**	**R 60,652.84**	**R 1,204.00**

ASSA DURBAN - MEMBERS

Date	No off	Paid Members	Honoury	Removed
2021-11-10	**118**	**105**	**3**	**2**

   - Treasurer’s report was presented by Corinne Gill

…General Meeting Minutes

6. Year-end function

- Corinne says venue has certain requirements
- Venue has already been paid for (~R 2000:00).
- Additional R 50:00 for cleaner and R 150:00 for car-guard to be paid.
- Alcohol or drinks must be bought from the venue. It may not be brought in from outside
- We need to provide a list of drinks that is required. They will buy and sell back to us
- Corinne will find out price details or mark-up of drinks prices
- Venue is self-catering
- No chef trays available but plug points are available
- Thursday 9 December has been confirmed
- Need to send out info to find out who will attend

7. ASSA 100

- Compiling history page to submit to ASSA National.
- If anyone has a contribution, please contact Amith

8. Events:

8.1 Sutherland Trip:

- Piet spoke to travel agent to raise a legal letter to Mango and find out status of bookings
- Deposits are supposedly still secure
- Piet asked to investigate alternative mode of flights
- All correspondence in this regard to be sent to piet@astronomydurban.co.za

8.2 Viewing evenings

- 3rd December is next viewing evening
- 5th November viewing had no attendees
- Mike needs people to assist on viewing days
- Telescope collimation must be attended to

9. General:

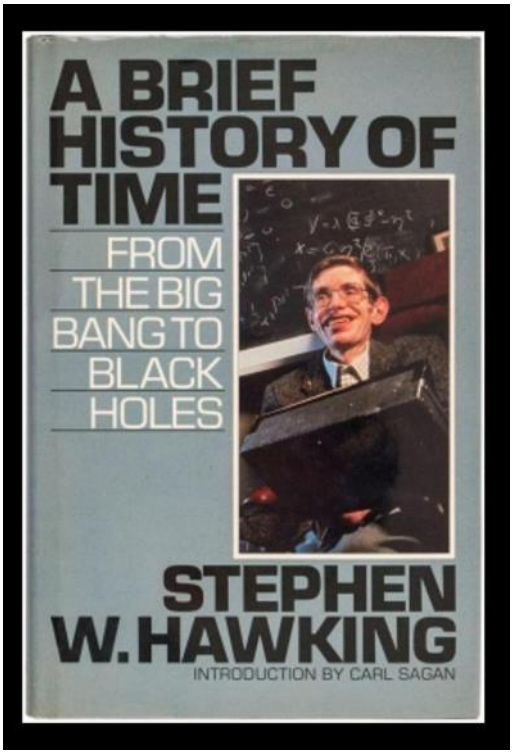
- No further items were discussed
- The next General Meeting will be held at the year-end event on **9th December 2021**
- Times and venue details will be sent via email and WhatsApp

10. Meeting closed

- The Chairman closed the meeting at 22:10

Library News

By Claire Odhav



Book review " A Brief History of Time." By Stephen Hawking

From the Big Bang to Black Holes is a book on theoretical cosmology by English physicist Stephen Hawking. It was first published in 1988. Hawking wrote the book for readers who had no prior knowledge of physics and people who are interested in learning something new about interesting subjects.

In A Brief History of Time, Hawking writes in non-technical terms about the structure, origin, development and eventual fate of the Universe, which is the object of study of astronomy and modern physics. He talks about basic concepts like space and time, basic building blocks that make up the Universe (such as quarks) and the fundamental forces that govern it (such as gravity). He writes about cosmological phenomena such as the Big Bang and black holes. He discusses two major theories, general relativity and quantum mechanics, that modern scientists use to describe the Universe. Finally, he talks about the search for a unifying theory that describes everything in the Universe in a coherent manner.

The book became a bestseller and sold more than 25 million copies. This book is available from our library and is a must read!

Here are some great stocking stuffers and Christmas gifts for the young space enthusiasts

1. R 60 - Sun, Moon, Stars. (Usborne, Hardcover)
2. R 50 - Inside Space Machines - Miles Kelly
3. R 75 - Astronaut Activity Book - make and play:
4. R 35 - Space adventures Dot to dot
5. R 75 - Let's learn with Space. (write & wipe)
6. R 150 - Space IQ activity kit (book, poster, diy 3D model)
7. R 200 - Professor Noggins Outer Space card game.

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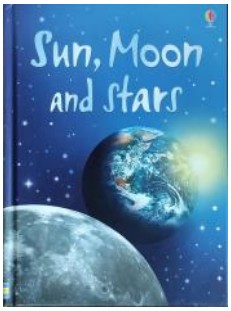

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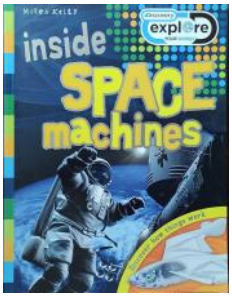

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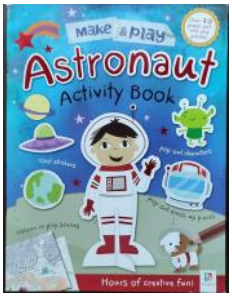

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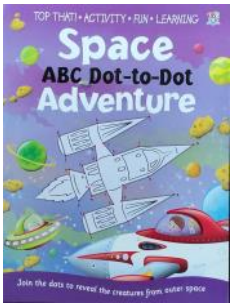

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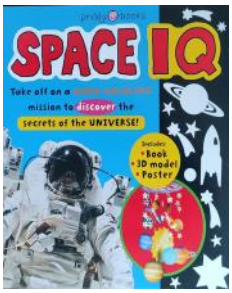


Message me, Claire, for more info and orders

Claire@astronomydurban.co.za 083 395 5160

Public Viewing Roster ASSA Durban

Dome Master	Phone	Telescope Volunteer	Assistant	New Moon	Public Viewing
John Gill	083 378 8797	Sihle Kunene	Alan Marnitz	4 December 2021	3 December 2021
Mike Hadlow	083 326 4085	Alan Marnitz	Debbie Abel	2 January 2022	TBC

PUBLIC VIEWING RESUMED:

Public viewing is allowed back on site at the school in the dome and around the pool; due to revised lockdown level 1. This may change according to any revised lockdown conditions.

Please note there is a roster with a booking system. Once the number of telescopes are confirmed, Individuals will be contacted to confirm dates and times. Please book your place !

Kindly note, everyone will be required to adhere to the Covid & social distancing regulations of 1.5m and all will need to sign the attached mandatory questionnaire. Temperatures will also be taken on site.

NOTIFY OBSERVATORY MANAGER:

Members interested in attending the above viewing evenings and/or becoming involved in assisting with the viewing evenings, please send your names to Mike Hadlow at the following address: mike@astronomydurban.co.za

Volunteers to please identify which role you are willing to assist with, Dome Master, Viewing Assistant or a Telescope Volunteer.

After which, attendance will be confirmed and viewing dates will be announced.

VOLUNTEERS REQUIRED:

Dome Master - Taking responsibility for the viewing evenings and learning how to set up, manage and use the new telescope.

Viewing Assistant - Learning about the new telescope, assisting with the viewing evenings, assisting viewing members as required.

Telescope Volunteers - Members willing to bring their telescopes to the viewing evenings to set up around the pool for public viewing. **VOLUNTEERS REQUIRED:**

Viewing Contacts:	Phone	Email
Mike Hadlow	083 326 4085	mike@astronomydurban.co.za
Alan Marnitz		alan@astronomydurban.co.za
John Gill	083 3788 797	john@astronomydurban.co.za

2022 ASSA Sky Guide
Now available to members for only
R 100:00
Please deposit into the ASSA bank
Details on Noticeboard page.
Use your personal reference
SG - Surname & First Name
E-mail proof of payment to
treasurer@astronomydurban.co.za

Notice Board

MEETINGS:

- END OF YEAR FUNCTION being held on **THURSDAY 9th DECEMBER @ 19:00.** in lieu of the GENERAL MEETING
- PUBLIC VIEWING MEETINGS - please refer to website under the tab "Viewing and Events" for any updates with regards dates & public viewing under the current Covid restrictions; or click here: https://astronomydurban.co.za/events-viewing/

MNASSA:

- Monthly Notes of the Astronomical Society of Southern Africa.
- Available at www.mnassa.org.za to download your free monthly copy.

NIGHTFALL:

- Fantastic astronomy magazine. Check it out.
- Available from the ASSA website assa.saao.ac.za/about/publications/nightfall/

MEMBERSHIP FEES & BANKING:

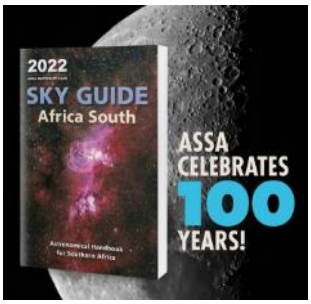
- Many thanks to all the members who have paid their Membership fees for the 2021-07-01 to 2022-06-30 financial year.
- There are 3 family members with outstanding payments. Please members, kindly ensure payment is made by 15th December or your resignation will be noted !!!

Membership fees are indicated below:

- Single Members: R 170:00
- Family Membership: R 200:00 for parents
- Under 18 members: Free
- Cash/Cheques: Please note: NO cheques or cash will be accepted

Pay Fees Online

- Account Name: **ASSA Natal Centre**
- Bank: **Nedbank**
- Account No. **1352 027 674**
- Branch: **Nedbank Durban North**
- Code: **135 226**
- Reference: **SUBS - SURNAME and FIRST NAME**
- Proof of Payment: treasurer@astronomydurban.co.za



SKY GUIDE 2022 and ASSA MASKS - Limited number available !!!

- Sky Guides: R 100:00 each with payment reference: SG - SURNAME and FIRST NAME
- Masks: R 50:00 each with payment reference: MK - SURNAME and FIRST NAME

Please ensure proof of payment is sent to treasurer@astronomydurban.co.za

RESIGNATIONS from ASSA:

Please send an email immediately notifying the Secretary of your wish to resign from the society to : secretary@astronomydurban.co.za

NEW COMMITTEE POSITIONS & CONTACTS:

Chairman	Amith Rajpal	Amith@astronomydurban.co.za	
Vice Chair	Debbie Abel	Debbie@astronomydurban.co.za	
Secretary	Francois Zinserling	Secretary@astronomydurban.co.za	
Treasurer	Corinne Gill	Treasurer@astronomydurban.co.za	
Guest Speaker Liaison	Piet Strauss	Piet@astronomydurban.co.za	
Observatory & Equipment	Mike Hadlow	Mike@astronomydurban.co.za	083 326 4085
Observatory Assistant	Alan Marnitz	Alan@astronomydurban.co.za	
Publicity & Librarian	Claire Odhav	Claire@astronomydurban.co.za	083 395 5160
Out-Reach - Public	Sheryl Venter	Sheryl@astronomydurban.co.za	082 202 2874
Out-Reach - Schools	Sihle Kunene	Sihle@astronomydurban.co.za	
St. Henry's Marist College Liaison	Moya O`Donoghue	Moya@astronomydurban.co.za	
'nDaba Editor, Website & Facebook	John Gill	John@astronomydurban.co.za	083 378 8797

ELECTRONIC DETAILS:

- Website: www.astronomydurban.co.za
- Emails : AstronomyDurban@gmail.com
- Instagram: https://www.instagram.com/astronomydurban/
- Facebook: https://www.facebook.com/groups/376497599210326