nightwatch
Newsletter of the Pomona Valley Amateur Astronomers

Every answer given on principle of experience begets a fresh question.
Immanual Kant

VIRTUAL CLUB EVENTS
SEE WEBSITE FOR DETAILS

Volume 41 Number 11 *nightwatch* **November 2021**

Heart and Rose

Camping weekend at the dark site was Nov. 5-7 this month. Prior to heading out, I took some practice narrow-band shots from home with the intent to actually shoot the image in RGB, but I messed up. I was about a month early for the target, so I completed it from home and shot a different target from the dark site. By too early, I mean that the target crosses the meridian (the line running from north to south through the zenith, i.e. straight up) later after midnight than I wanted. Too late and I have to stay up late to flip the mount. I'll explain that at the end if you're interested in the details. The good news is that it's a two-image month!

First up is the Heart Nebula shot from home in the Hubble palette. The Heart Nebula, also known as IC 1805 and Sharpless 2-190, was discovered by William Herschel in 1787. It's located in the Perseus arm of the Milky Way in the constellation of Cassiopeia. It's about 7500 light years away and consists mainly of hydrogen which is red, but since it's narrow-band, the colors are mapped differently. I've framed the image rotated 180 degrees to better see the heart shape, although the nebula is too large (it covers an area of about 150×150 arcminutes) to fit on the camera chip so the upper lobe of the heart is cut off at the top. There are a couple notable areas within the Heart Nebula, including the Fish Head Nebula or NGC 896 in the lower left of the image, and star cluster Melotte 15 toward the Heart's center whose radiation causes the nebula's red glow in natural color. I debated whether to post this image or the HOO version, both have merits, but I think the Hubble palette version shows more detail.

At the dark site I imaged Arp 273 (Principle Galaxies Catalog (PGC) 8961 and 8970) or the Rose Galaxy in LRGB. In 1966, Halton Arp compiled the Atlas of Peculiar Galaxies, published by CalTech, and the Rose was first described there. Today, many of the galaxies that Arp listed are recognized as interacting galaxies. The two galaxies making up the Rose are about 300 million light years away in the constellation Andromeda. Both are distorted due to their interaction and it is thought that the "stem" galaxy actually passed through the "flower" part. The Rose is quite small, so the image is tightly cropped to better see the shape.

Now the technical details. The Heart was shot from home with the H-alpha (HA) data obtained October 1 as practice. Only 15 5-minute frames were used as the target is very bright in HA. 158 5-minute frames were taken through the O-III filter and 120 5-minute frames were taken through the S-II filter from October 26-29. All the frames were calibrated with 21 dark, 21 flat, and 21 flat dark frames before stacking in Deep Sky Stacker. Each of the narrow-band stacks was prestretched with FITS Liberator before processing in Photoshop. Recall that the Hubble palette maps the S-II data to red, HA to green, and O-III to blue which results in a very green image due to the strength of the HA signal, so the colors were adjusted somewhat to better color balance the image.

The Rose was imaged from the dark site from the valley just to the east of Mount Palomar on November 5 and 6. The first night I shot one hour of 5-minute frames through RGB filters and 74 3-minute frames through the luminance filter. It was a bad start for the night with a lot of software and hardware issues. I finally got things sorted out, but it was only when I changed to the luminance filter that I forgot to reacquire my target for the RGB frames. The second night went better and I captured the missing RGB frames before adding 97 luminance frames to the previous night's capture. All frames were shot binned 2x2, but I drizzled 2x when stacking to recover the lost resolution. The RGB frames were calibrated with 12 darks while the luminance frames were calibrated with 21 darks. All the frames were further calibrated with 21 flat and flat dark frames. After stacking, the frames were imported directly into Photoshop for recombination into an LRGB image. The final result was cropped tightly around the galaxies to better show the detail.

Now, if you've made it this far and don't know what I mean when I say I need to flip the mount and why I try to choose targets that cross the meridian around midnight, I'll try to explain. The mount sits on top of a pier (actually a tripod, but a pier will do) and it is angled toward the celestial north pole. The mount includes two axes, one that also points to the north pole (this is the RA axis) and another that is perpendicular to the RA axis (this is the DEC axis). The telescope itself is also aligned with the DEC axis. Think of the axes and telescope forming a capital T. To position the telescope east or west, the RA axis rotates (around the leg of the T), while to position the telescope north or south, the DEC axis rotates (the crosspiece of the T changes angle with respect to the leg). So as the mount tracks from east to west, the telescope actually is on the west side of the pier looking east. As the object crosses the meridian, the RA axis moves past horizontal and the telescope gets lower and closer to the pier. The problem with this set up is that if the telescope is too far below horizontal, it will hit the pier – very bad!! So when the object gets close to the meridian, you flip the mount, meaning you move the telescope from the west side of the pier looking east to the east side looking west. It's called flipping probably because you've flipped the scope to the other side of the pier and the image is actually rotated 180 degrees. I look for objects that cross the meridian near midnight to maximize the time I can image and so that I can flip the mount at a reasonable hour of the night. I'm not sure this is all clear; I know that I had a very hard time understanding it initially.

Hopefully you've enjoyed the pictures.

Ron Ugolick

https://www.astrobin.com/users/ruccdu/

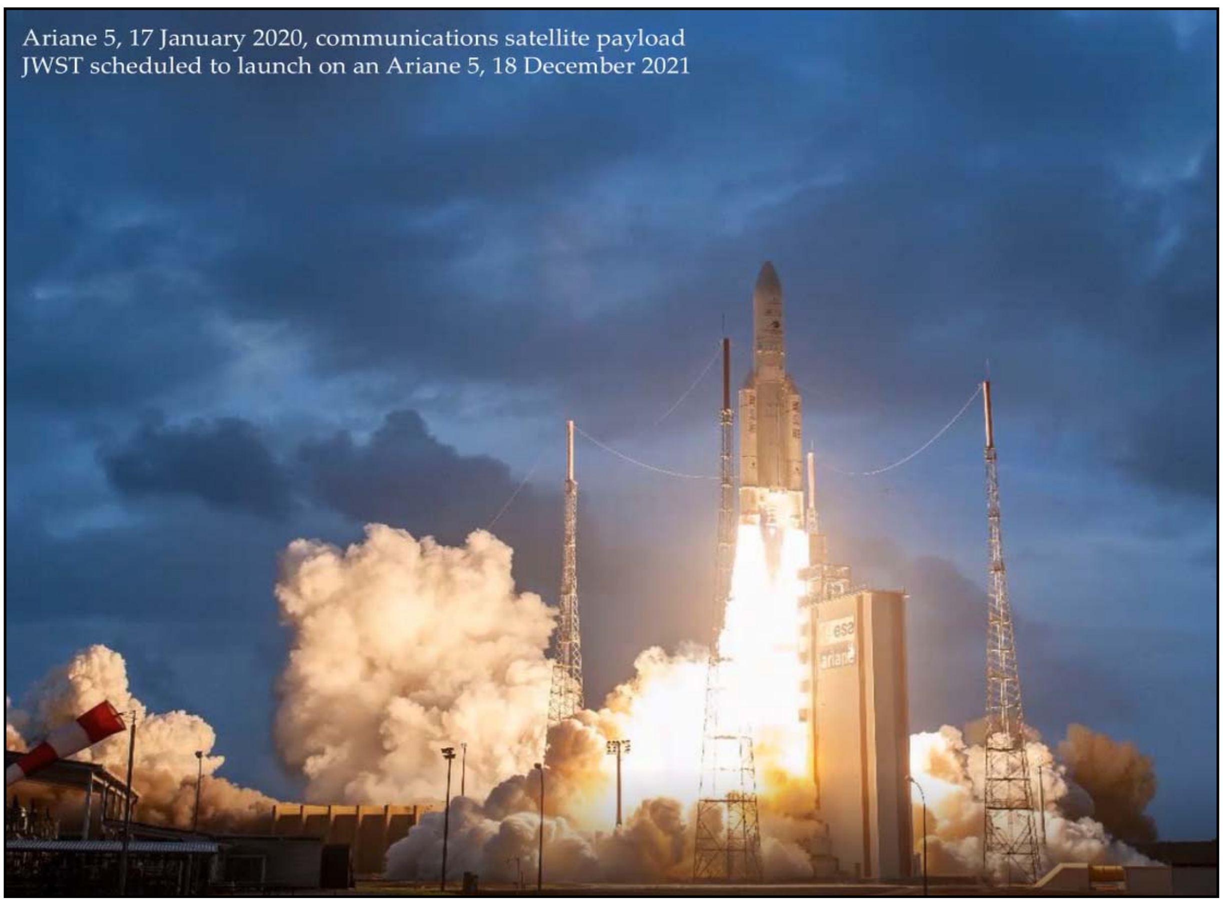
PVAA General Meeting 10/22/21

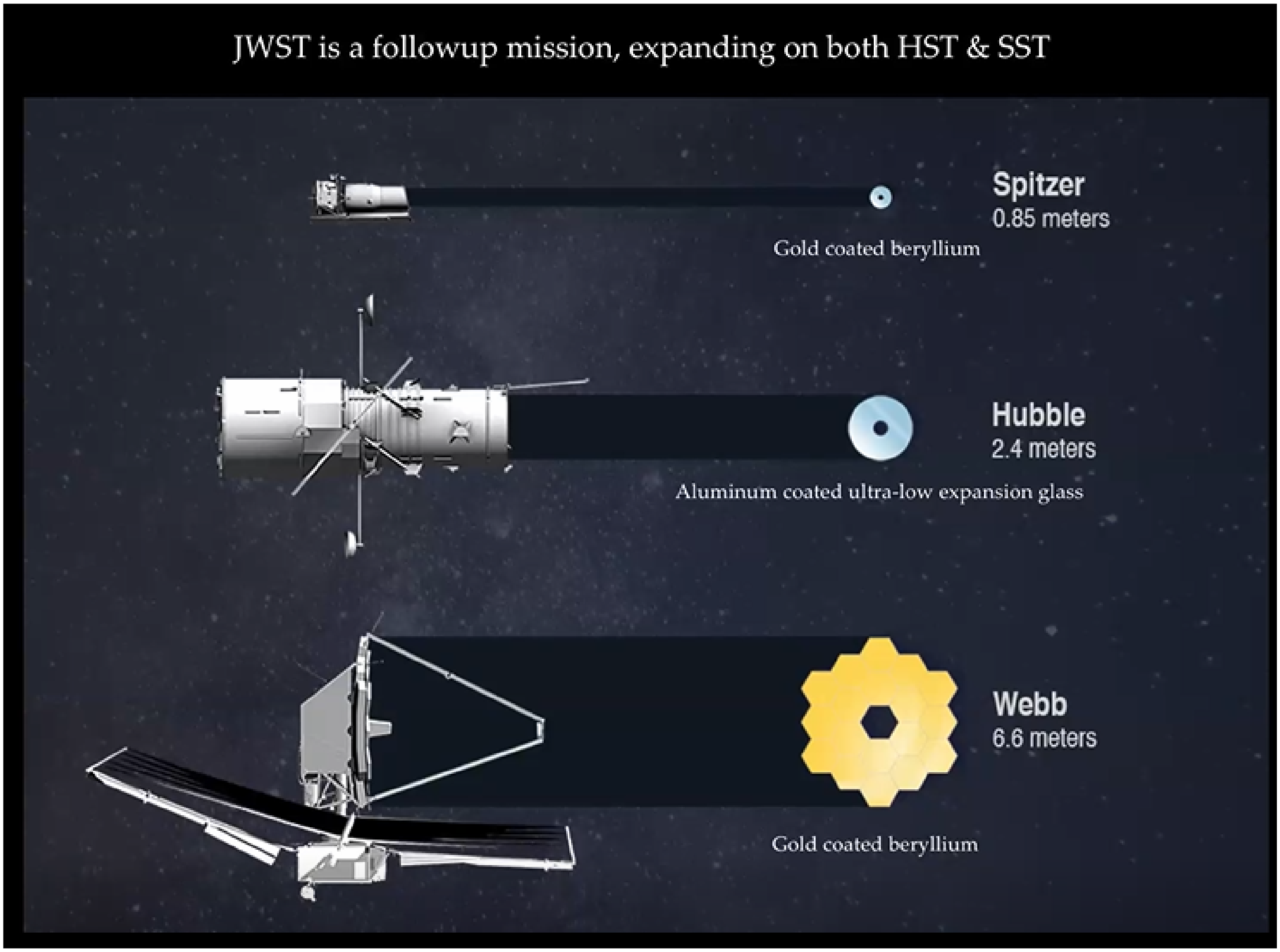
October's meeting was held on Zoom, and Timothy Thompson was our main speaker for the night. He did work on the Spitzer Space Telescope before retiring and for the meeting he spoke on the James Webb Space Telescope. James Webb was the 2nd NASA administrator and led NASA through the Mercury, Gemini, and the run-up to the Apollo program. The James Webb Space Telescope originally started out as the Next Generation Space Telescope in 1996, with a launch date of 2007, at a cost of half a billion dollars. The launch has been delayed 16 times, and the cost has grown to 9.7 billion dollars. It is currently scheduled for launch on December 18th, 2021. The European Space Agency (ESA) will launch the James Webb Space Telescope on an Ariane 5 from their Guiana Space Centre in French Guiana.

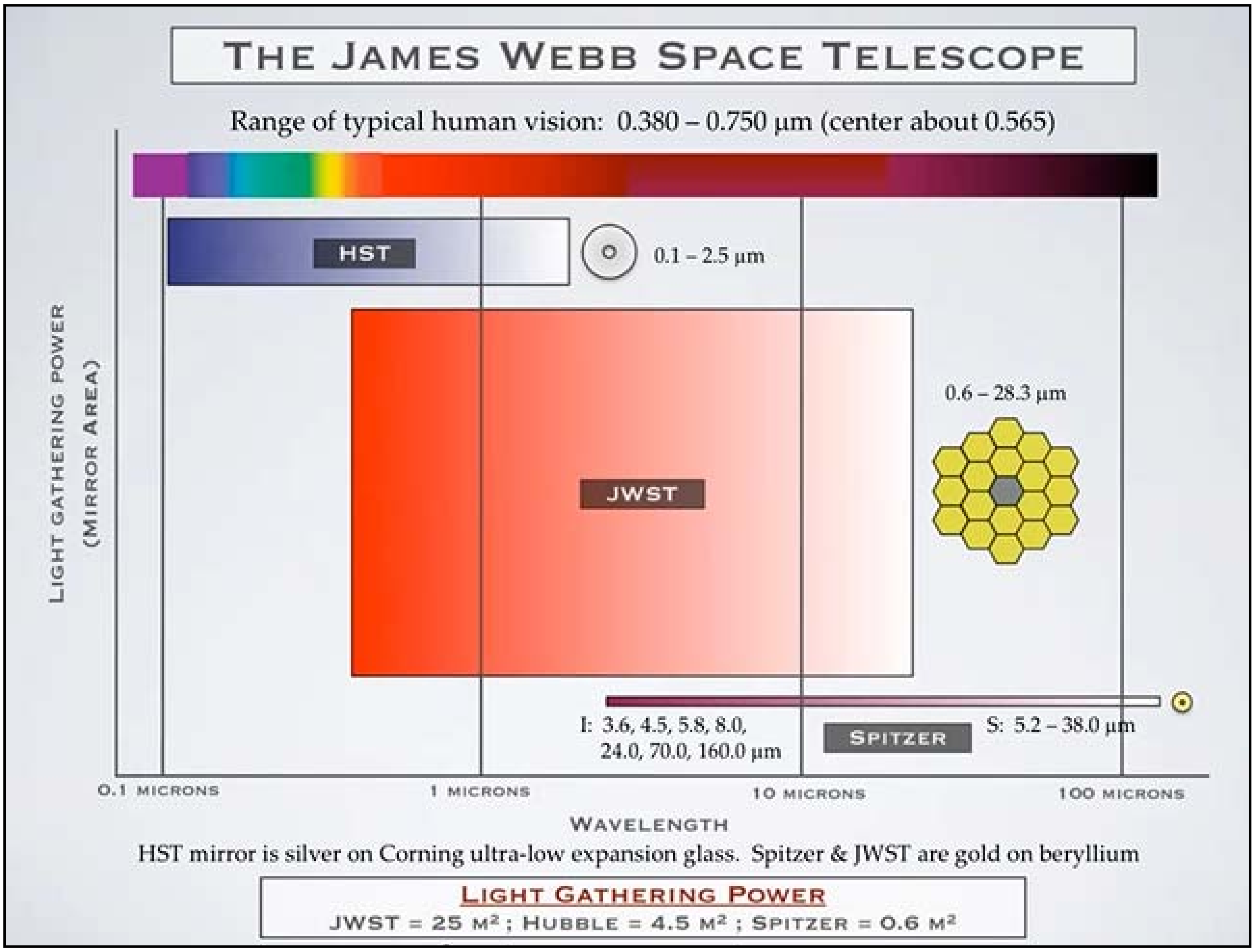
The main mirror is made up of 18 hexagonal segments 1.32 meters (52 inches) across. Each segment weighs ~20 kg, or 46 pounds. Fully assembled with each segment's actuator, the weight doubles. Each actuator will adjust/bend the segment to put all the segments into focus. Webb uses a three-mirror, followed by a steering mirror, f/20 design. It has a 5-layer sun shield. The cold side of the shield is -235 Celsius or -391 Fahrenheit. The hot side is 125 Celsius or 257 Fahrenheit.

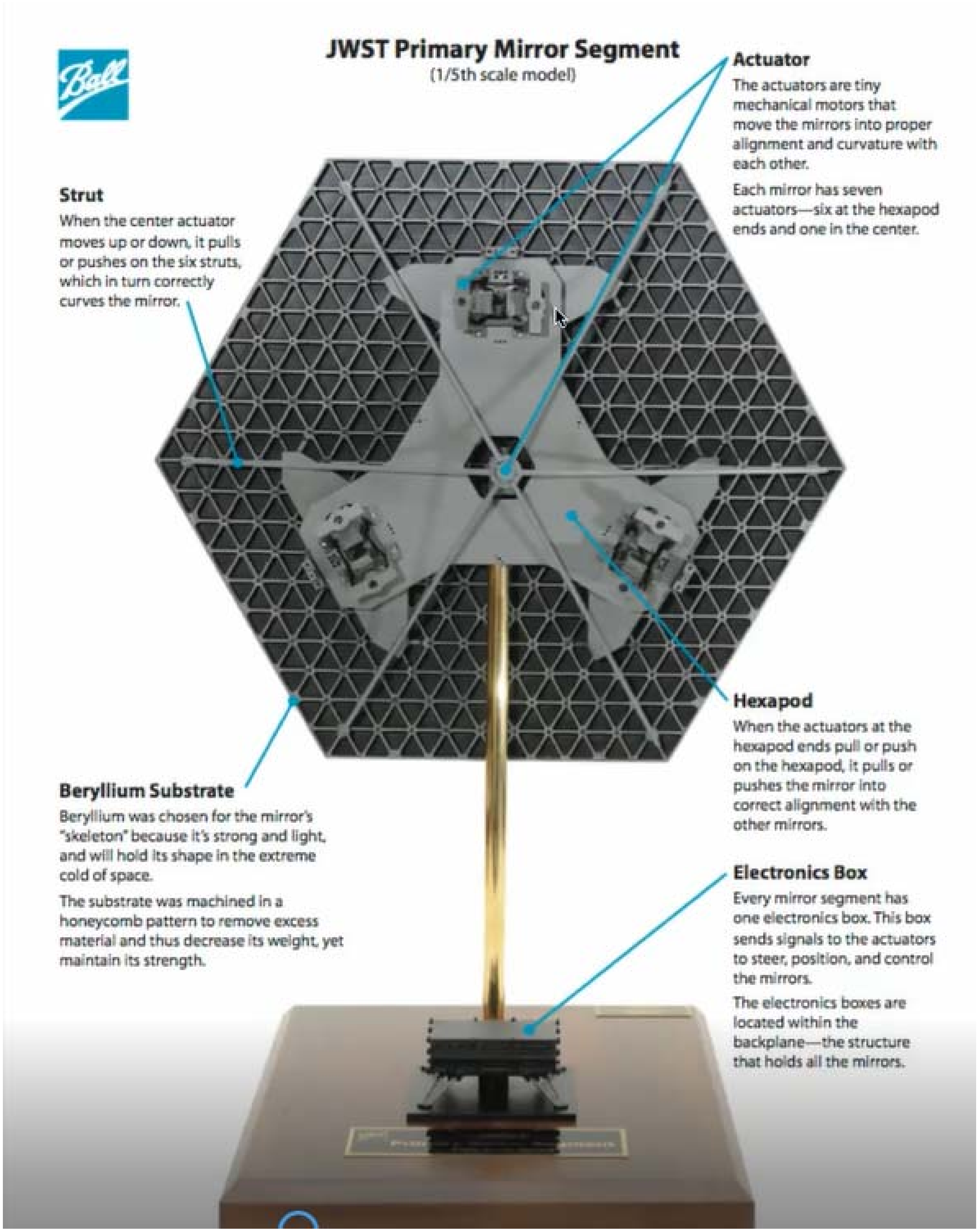
Tim then showed some slides on the wavelengths in the spectrum Webb will be viewing, and then a couple of short videos on the early filaments and galaxy formation of the cosmic web. We now believe that galaxies formed a lot sooner than previous estimates. Tim recommends that you visit the NASA website for James Webb.

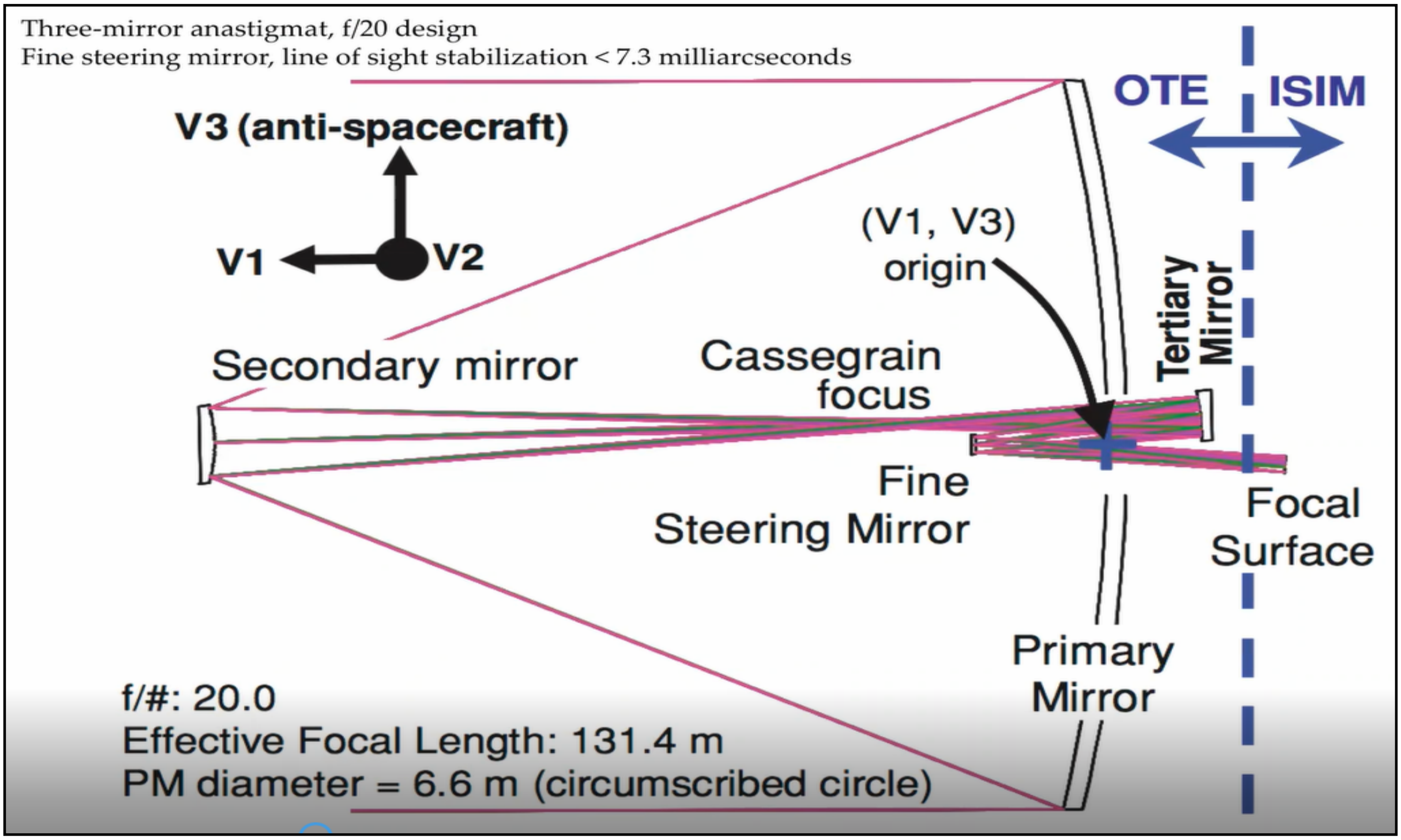
Gary Thompson



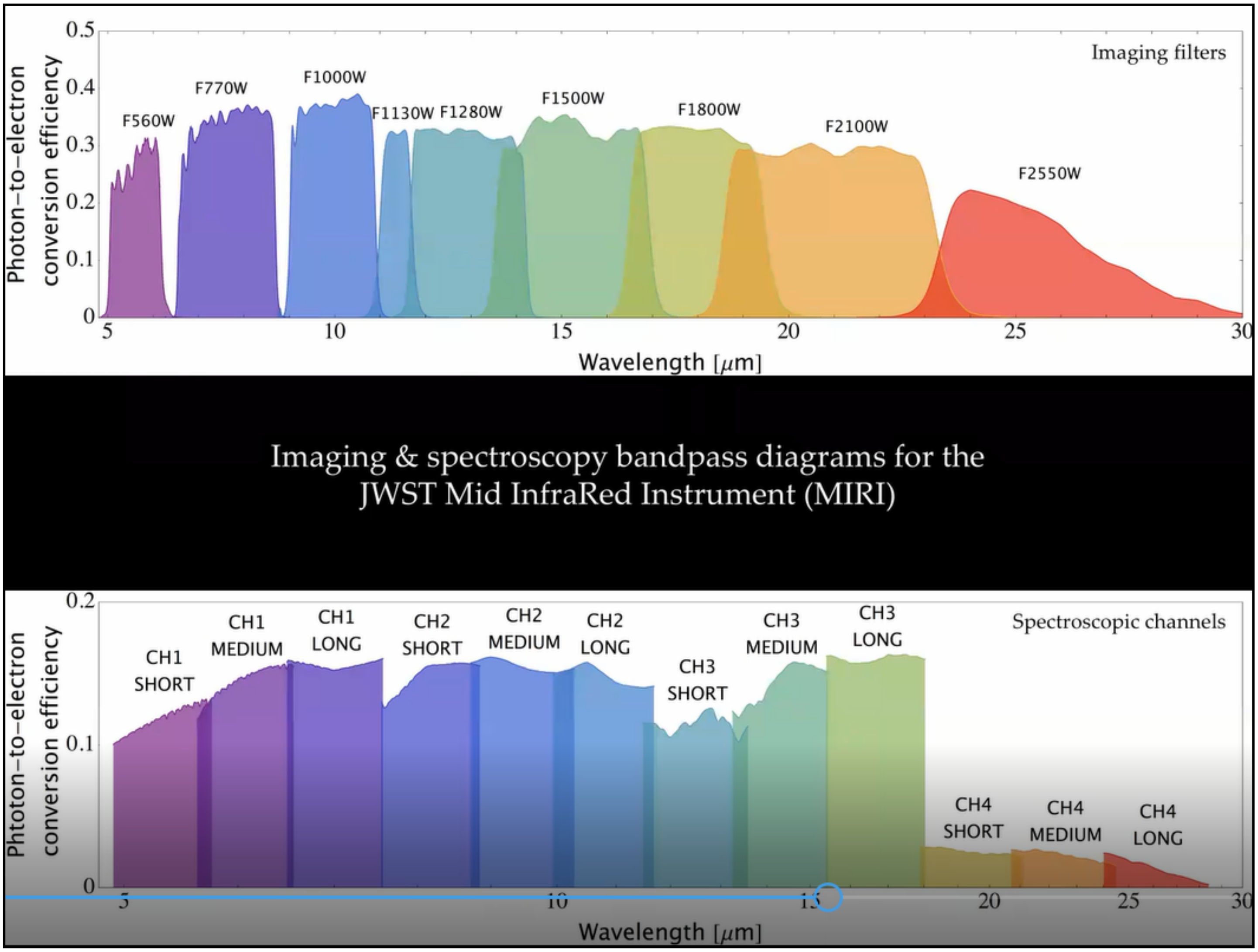

JWST is a followup mission, expanding on both HST & SST
Spitzer
0.85 meters
Gold coated beryllium
Hubble
2.4 meters
Aluminum coated ultra-low expansion glass
Webb
6.6 meters
Gold coated beryllium

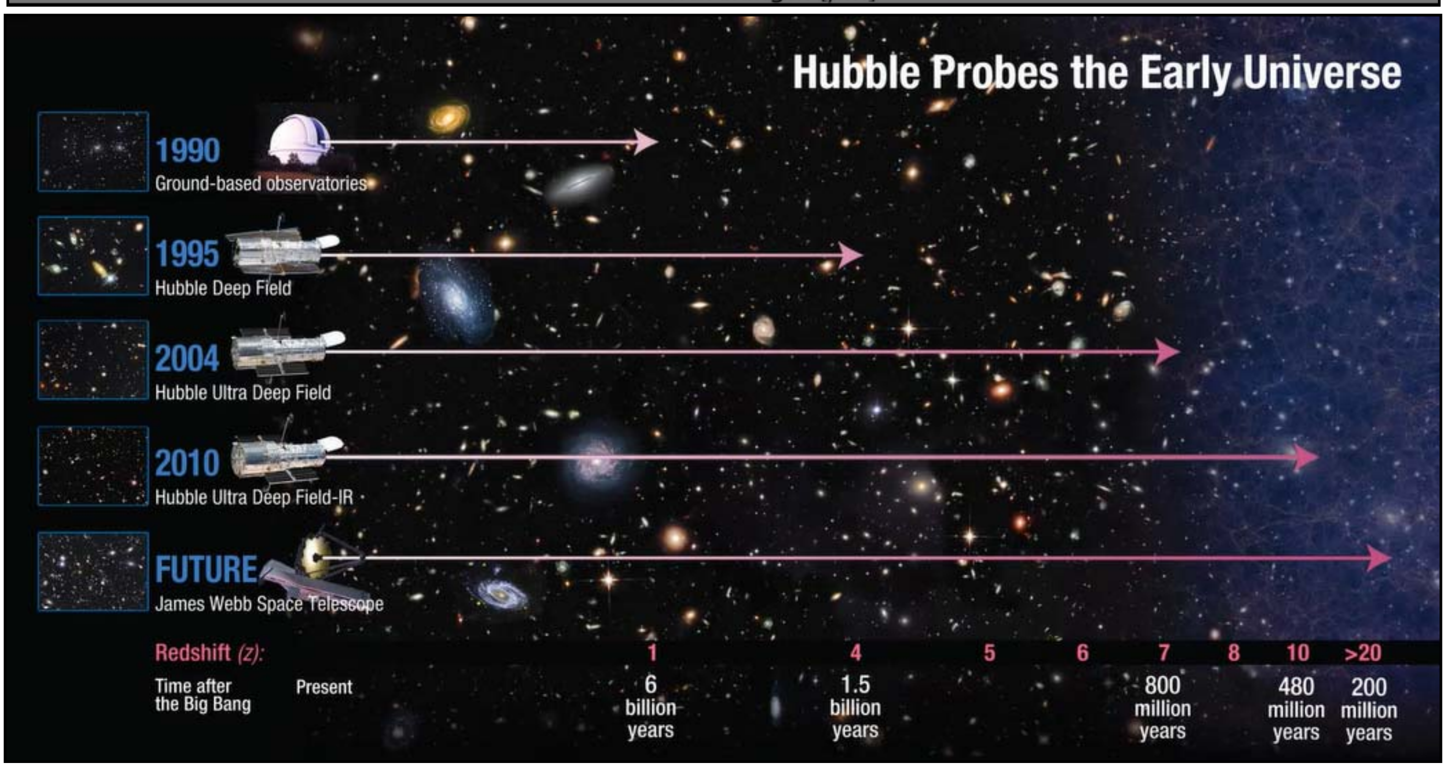

THE JAMES WEBB SPACE TELESCOPE
Range of typical human vision: 0.380 – 0.750 µm (center about 0.565)
HST
0.1 – 2.5 µm
JWST
0.6 – 28.3 µm
I: 3.6, 4.5, 5.8, 8.0, 24.0, 70.0, 160.0 µm
SPITZER
S: 5.2 – 38.0 µm
LIGHT GATHERING POWER (MIRROR AREA)
0.1 MICRONS
1 MICRONS
10 MICRONS
100 MICRONS
WAVELENGTH
HST mirror is silver on Corning ultra-low expansion glass. Spitzer & JWST are gold on beryllium
LIGHT GATHERING POWER
JWST = 25 M²; HUBBLE = 4.5 M²; SPITZER = 0.6 M²

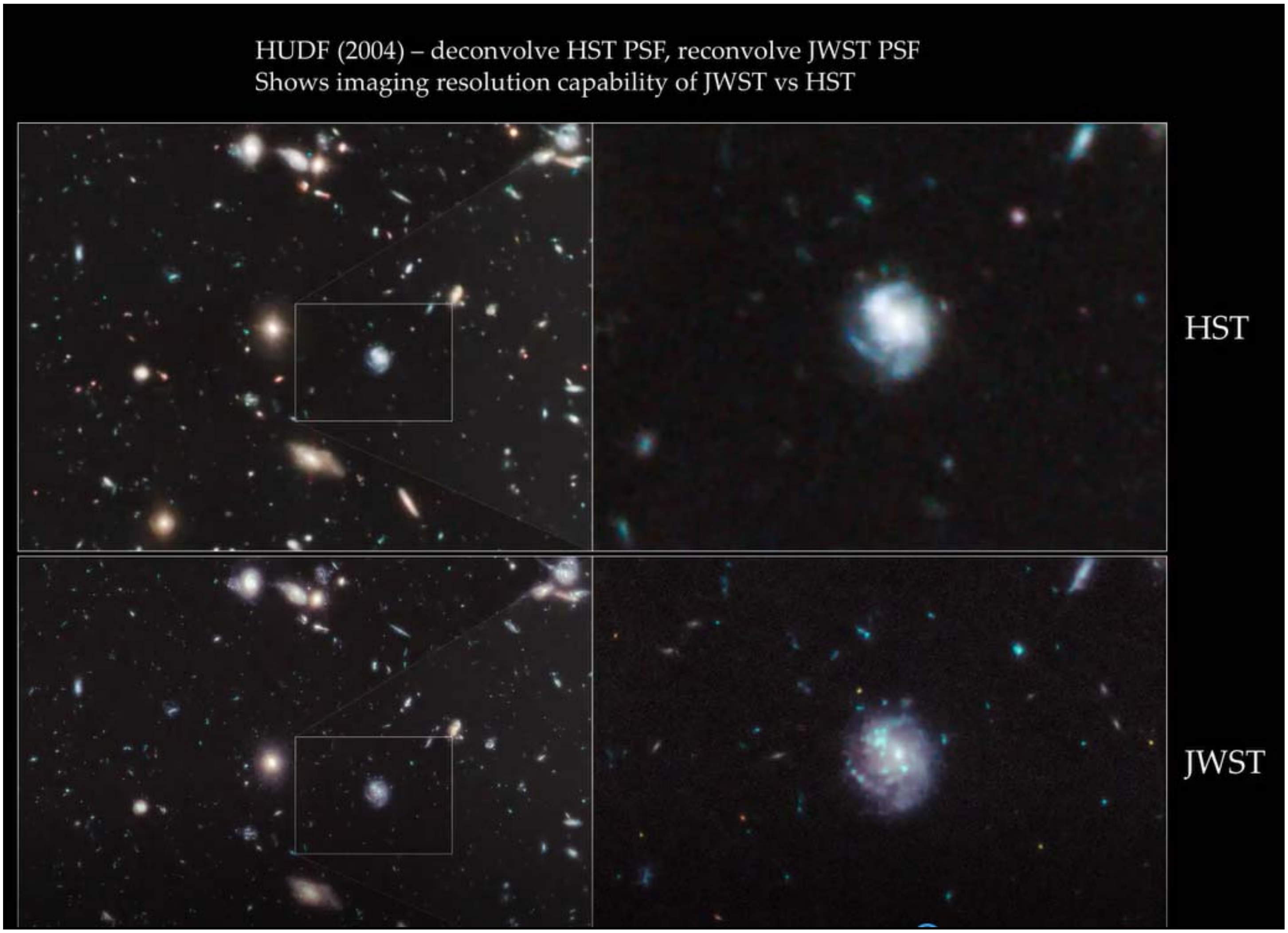

JWST Primary Mirror Segment
(1/5th scale model)
Actuator
The actuators are tiny mechanical motors that move the mirrors into proper alignment and curvature with each other.
Each mirror has seven actuators—six at the hexapod ends and one in the center.
Strut
When the center actuator moves up or down, it pulls or pushes on the six struts, which in turn correctly curves the mirror.
Hexapod
When the actuators at the hexapod ends pull or push on the hexapod, it pulls or pushes the mirror into correct alignment with the other mirrors.
Beryllium Substrate
Beryllium was chosen for the mirror's "skeleton" because it's strong and light, and will hold its shape in the extreme cold of space.
The substrate was machined in a honeycomb pattern to remove excess material and thus decrease its weight, yet maintain its strength.
Electronics Box
Every mirror segment has one electronics box. This box sends signals to the actuators to steer, position, and control the mirrors.
The electronics boxes are located within the backplane—the structure that holds all the mirrors.


Three-mirror anastigmat, f/20 design
Fine steering mirror, line of sight stabilization < 7.3 milliarcseconds
V3 (anti-spacecraft)
V1
V2
(V1, V3)
origin
OTE
ISIM
Tertiary Mirror
Secondary mirror
Cassegrain focus
Fine Steering Mirror
Focal Surface
Primary Mirror
f/#: 20.0
Effective Focal Length: 131.4 m
PM diameter = 6.6 m (circumscribed circle)


Five-layer V-groove radiator design
Sized & shaped to limit solar radiation induced momentum buildup
Kapton-E polyimide film. Both sides aluminum coated, with doped silicon on two first sun-facing layers (makes it look pink)
29.197 x 14.162 meters (69.5 x 46.5 ft)
Sun facing layer 0.05 mm thick, all other layers 0.025 mm thick


Photon-to-electron conversion efficiency
Imaging filters
F560W
F770W
F1000W
F1130W
F1280W
F1500W
F1800W
F2100W
F2550W
Wavelength [μm]
Imaging & spectroscopy bandpass diagrams for the JWST Mid InfraRed Instrument (MIRI)
Phtoton-to-electron conversion efficiency
Spectroscopic channels
CH1 SHORT
CH1 MEDIUM
CH1 LONG
CH2 SHORT
CH2 MEDIUM
CH2 LONG
CH3 SHORT
CH3 MEDIUM
CH3 LONG
CH4 SHORT
CH4 MEDIUM
CH4 LONG
Wavelength [μm]


Hubble Probes the Early Universe
1990
Ground-based observatories
1995
Hubble Deep Field
2004
Hubble Ultra Deep Field
2010
Hubble Ultra Deep Field-IR
FUTURE
James Webb Space Telescope
Redshift (z): 1 4 5 6 7 8 10 >20
Time after the Big Bang
Present
6 billion years
1.5 billion years
800 million years
480 million years
200 million years



Club Events Calendar

Nov 19 — **General Meeting –**
Citrus College Astronomy Professor Dave Kary on "The Race to Find Life in the Universe"

Dec 11 — **Christmas Party**

2022

Jan 14 — **General Meeting - (presentation: TBD)**

Feb 18 — **General Meeting - (presentation: TBD)**

Mar 18 — **General Meeting - (presentation: TBD)**

Apr 15 — **General Meeting - (presentation: TBD)**

NASA Night Sky Notes December 2021

This article is distributed by NASA Night Sky Network

The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit nightsky.jpl.nasa.gov to find local clubs, events, and more!

The James Webb Space Telescope: Ready for Launch!

David Prosper

NASA's James Webb Space Telescope is ready for lift-off! As of this writing (November 15), the much-anticipated next-generation space telescope is being carefully prepared for launch on December 18, 2021, and will begin its mission to investigate some of the deepest mysteries of our universe.

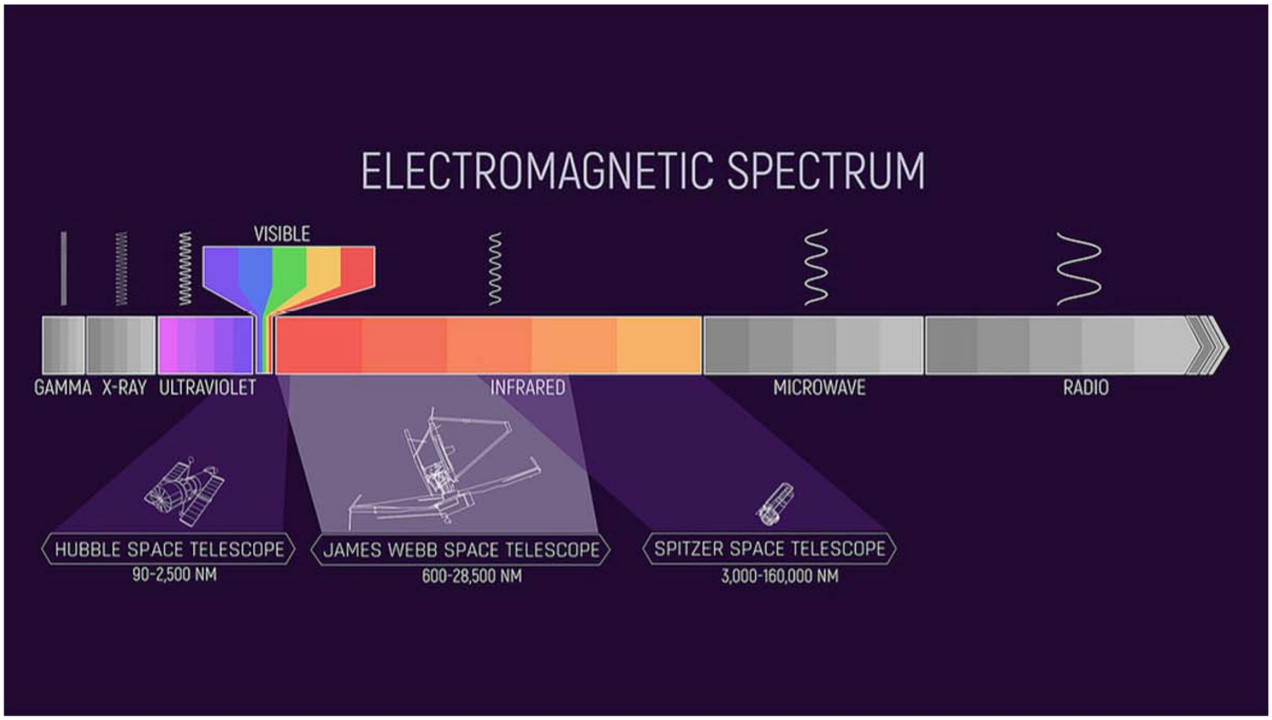
The development of the Webb began earlier than you might expect – the concept that would develop into Webb was proposed even before the launch of the Hubble in the late 1980s! Since then, its design underwent many refinements, and the telescope experienced a series of delays during construction and testing. While frustrating, the team needs to ensure that this extremely complex and advanced scientific instrument is successfully launched and deployed. The Webb team can't take any chances; unlike the Hubble, orbiting at an astronaut-serviceable 340 miles (347 km) above Earth, the Webb will orbit about one million miles away (or 1.6 million km), at Lagrange Point 2. Lagrange Points are special positions where the gravitational influence between two different bodies, like the Sun and Earth, "balance out," allowing objects like space telescopes to be placed into stable long-term orbits, requiring only minor adjustments - saving Webb a good deal of fuel.

Since this position is also several times further than the Moon, Webb's sunshield will safely cover the Moon, Earth, and Sun and block any potential interference from their own infrared radiation. Even the seemingly small amount of heat from the surfaces of the Earth and Moon would interfere with Webb's extraordinarily sensitive infrared observations of our universe if left unblocked. More detailed information about Webb's orbit can be found at bit.ly/webborbitinfo, and a video showing its movement at bit.ly/webborbitvideo.

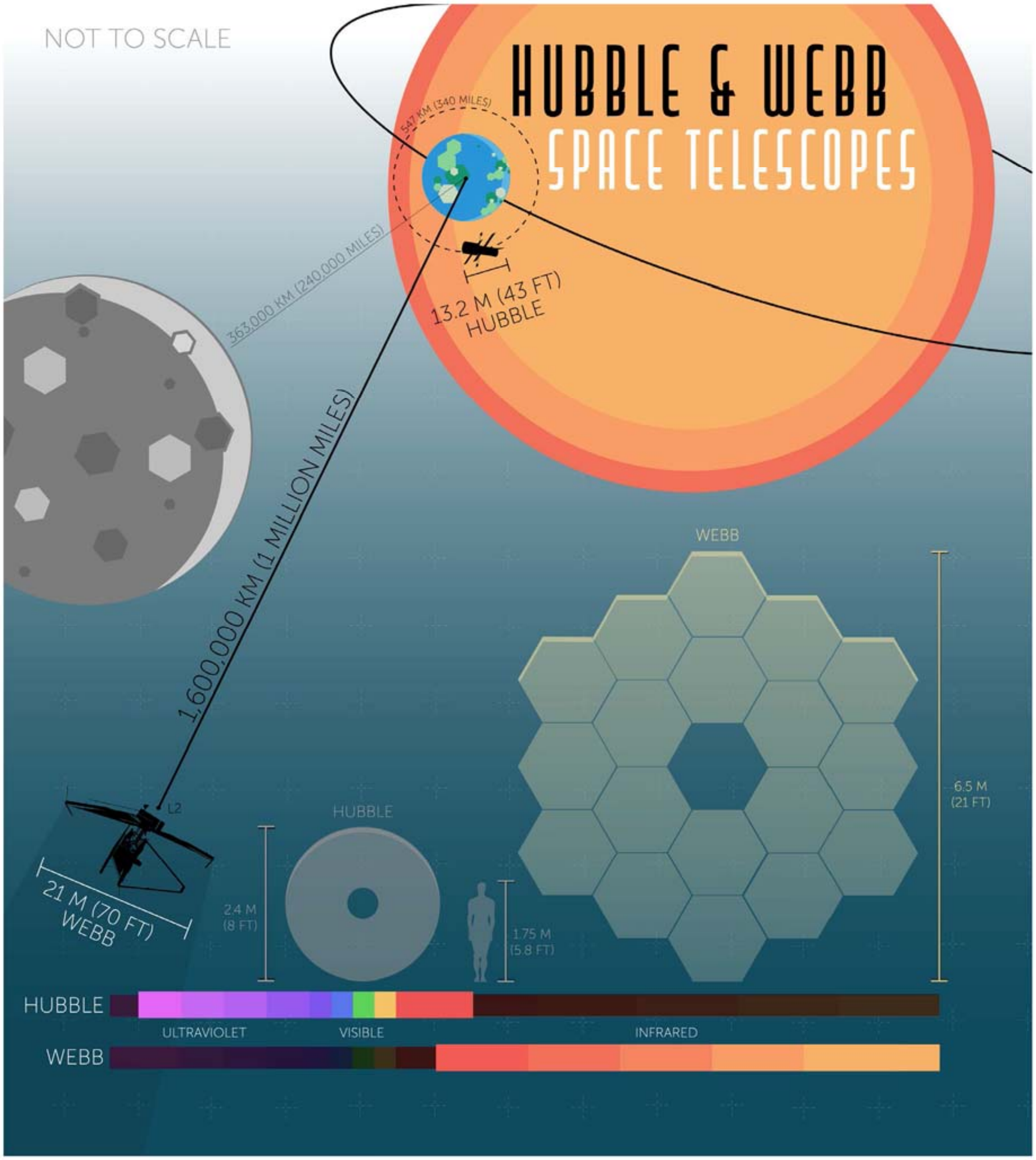
Once in its final position, its sunshield and mirror fully deployed and instruments checked out, Webb will begin observing! Webb's 21-foot segmented mirror will be trained on targets as fine and varied as planets, moons, and distant objects in our outer Solar System, active centers of galaxies, and some of the most distant stars and galaxies in our universe: objects that may be some of the first luminous objects formed after the Big Bang! Webb will join with other observatories to study black holes - including the one lurking in the center of our galaxy, and will study solar systems around other stars, including planetary atmospheres, to investigate their potential for hosting life.

Wondering how Webb's infrared observations can reveal what visible light cannot? The "Universe in a Different Light" Night Sky Network activity can help - find it at bit.ly/different-light-nsn. Find the latest news from NASA and Webb team as it begins its mission by following #UnfoldTheUniverse on social media, and on the web at nasa.gov/webb.

NASA Night Sky Notes December 2021



Webb will observe a wide band of the infrared spectrum, including parts observed by the Hubble - which also observes in a bit of ultraviolet light as well as visible - and the recently retired Spitzer Space Telescope. Webb will even observe parts of the infrared spectrum not seen by either of these missions! Credits: NASA and J. Olmstead (STScI)



Webb will follow up on many of Hubble's observations and continue its mission to study the most distant galaxies and stars it can - and as you can see in this comparison, its mirror and orbit are both huge in comparison, in order to continue these studies in an even deeper fashion! Credits: NASA, J. Olmsted (STScI)