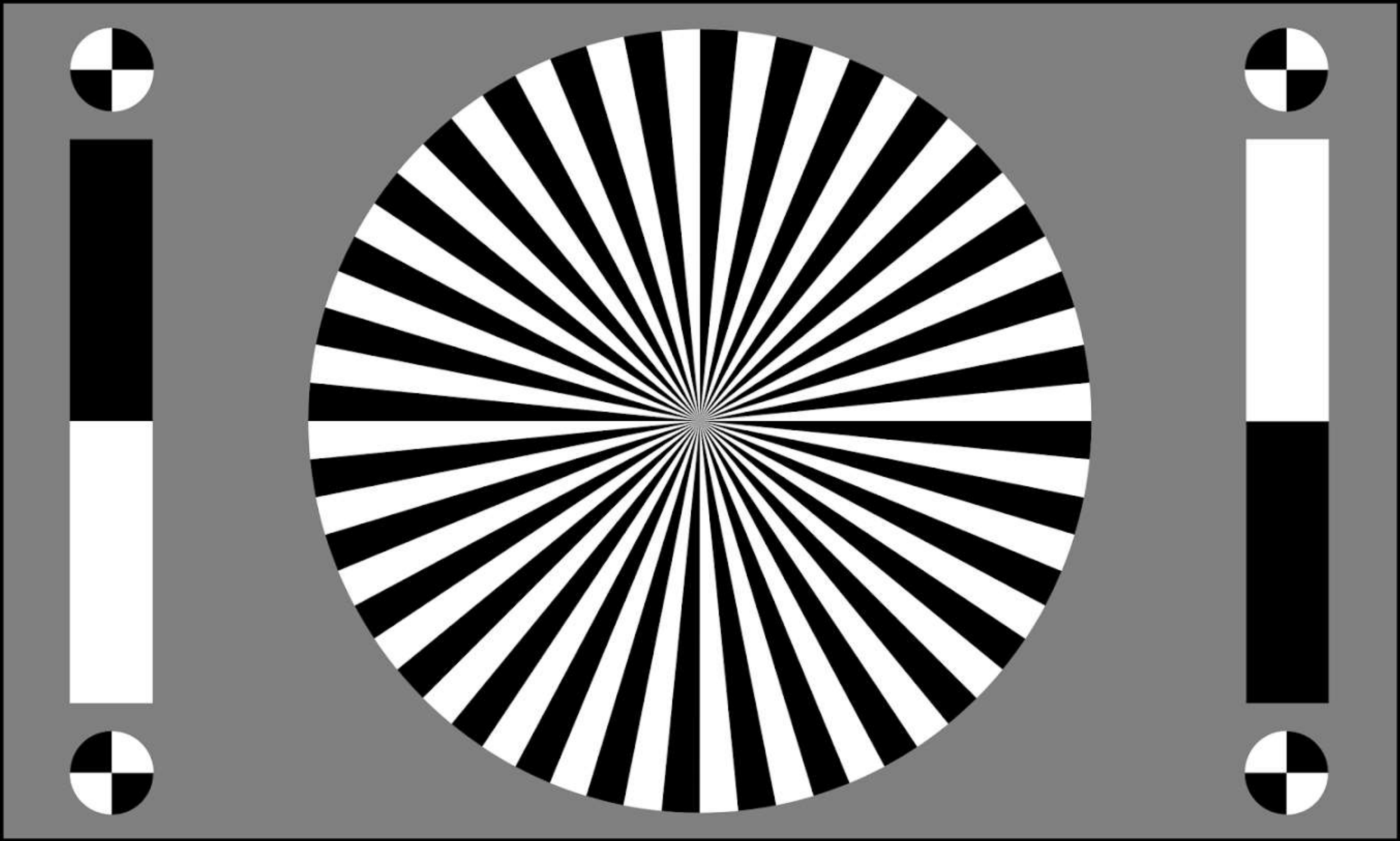


Focus Chart

For more film and photography related apps visit: **www.distantblue.at**

Kertausta ja päivitystä

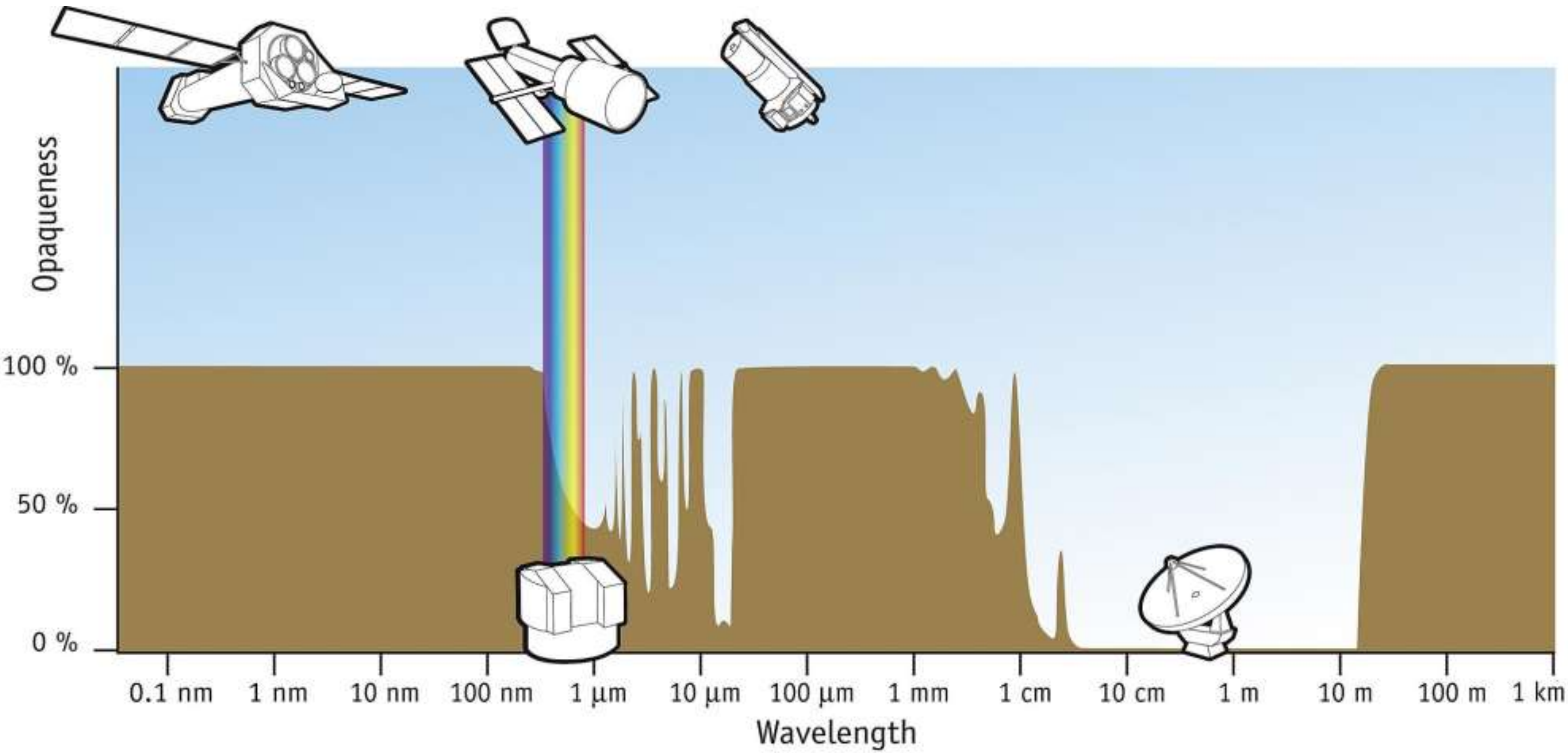
James Webb -teleskooppi

Ursan jäsenilta

Hannu Määttänen

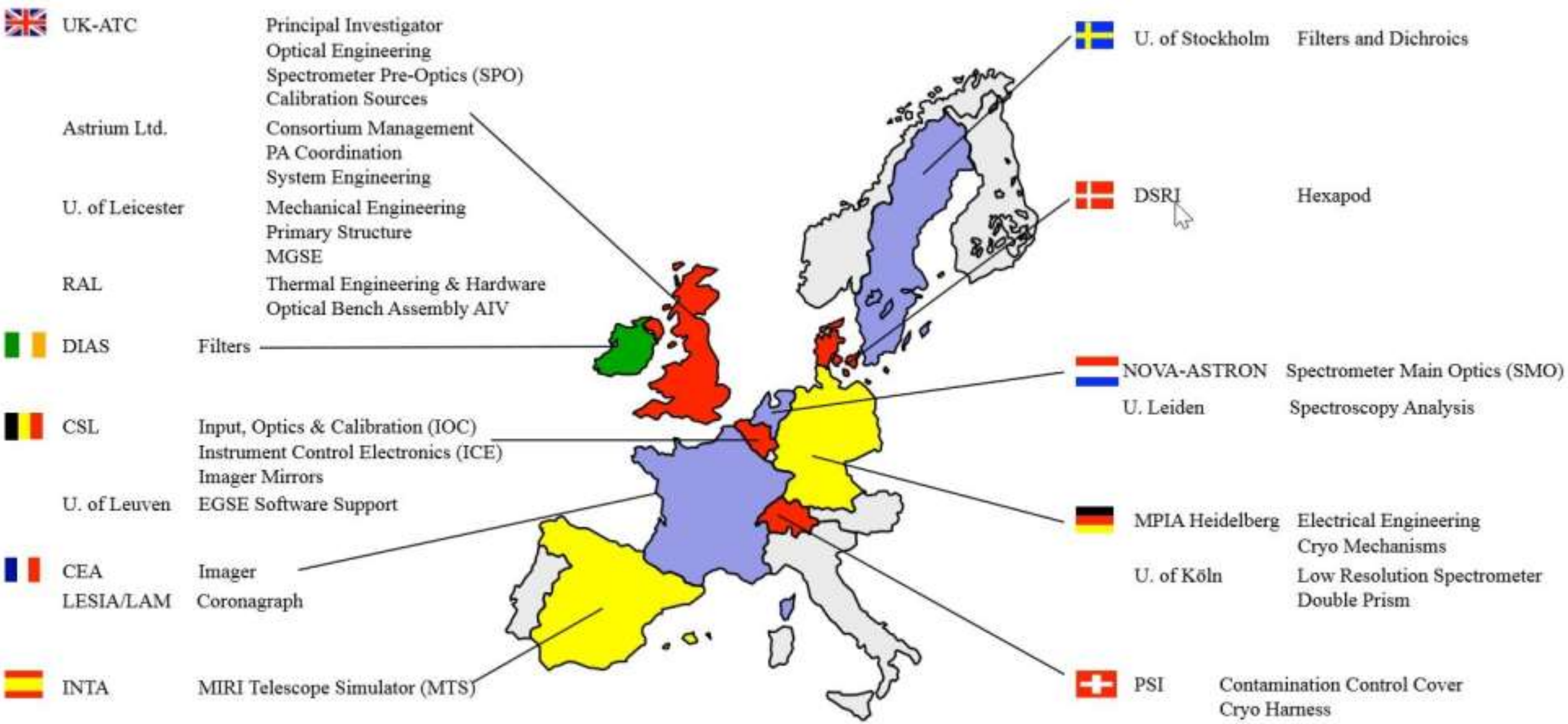
26.10.2022

Miten



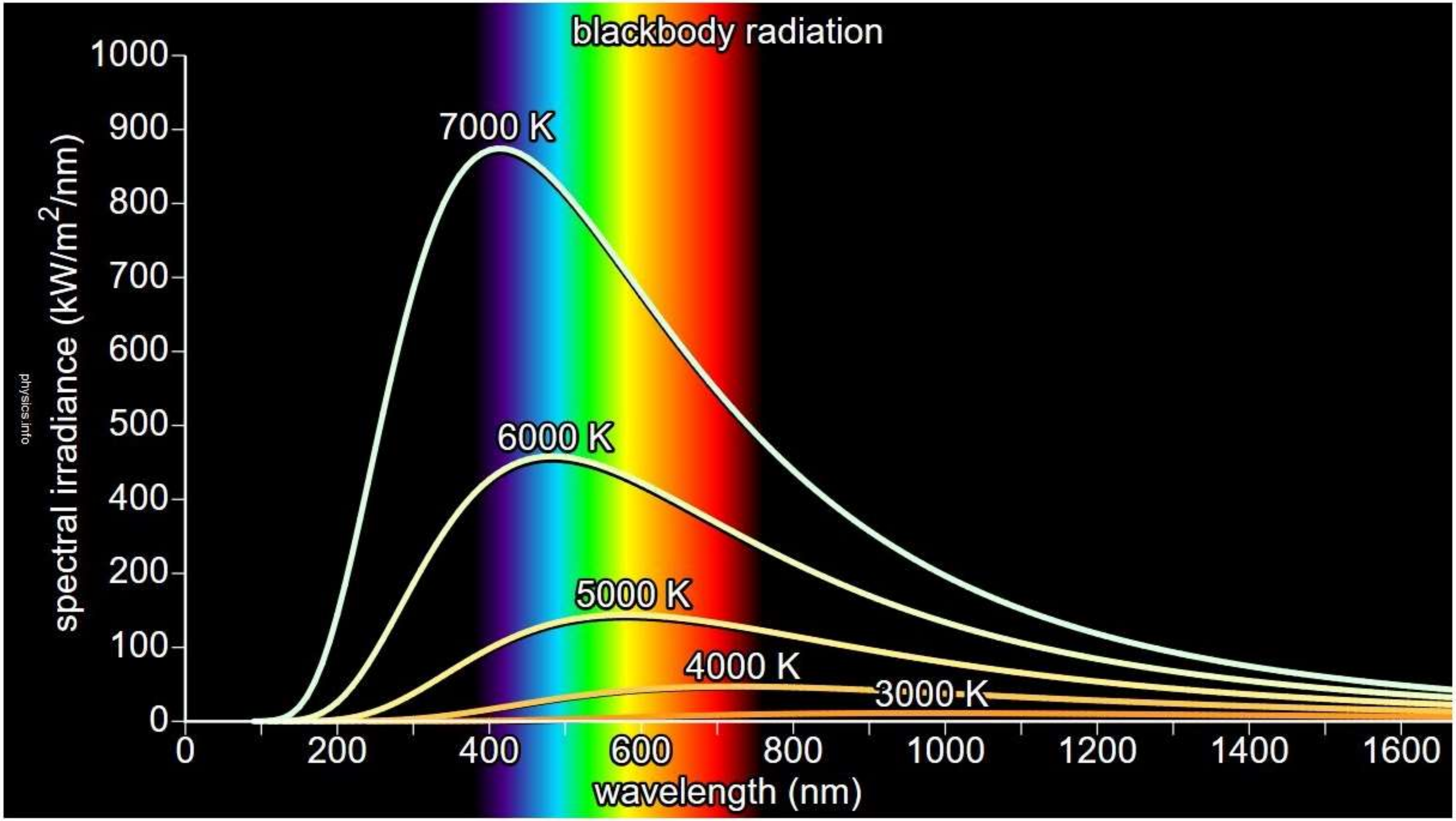
Opaqueness
100 %
50 %
0 %
0.1 nm
1 nm
10 nm
100 nm
1 µm
10 µm
100 µm
1 mm
1 cm
10 cm
1 m
10 m
100 m
1 km
Wavelength

Kuka



Over the duration of the mission, > 15% of the total JWST observing time goes to ESA member states applicants.

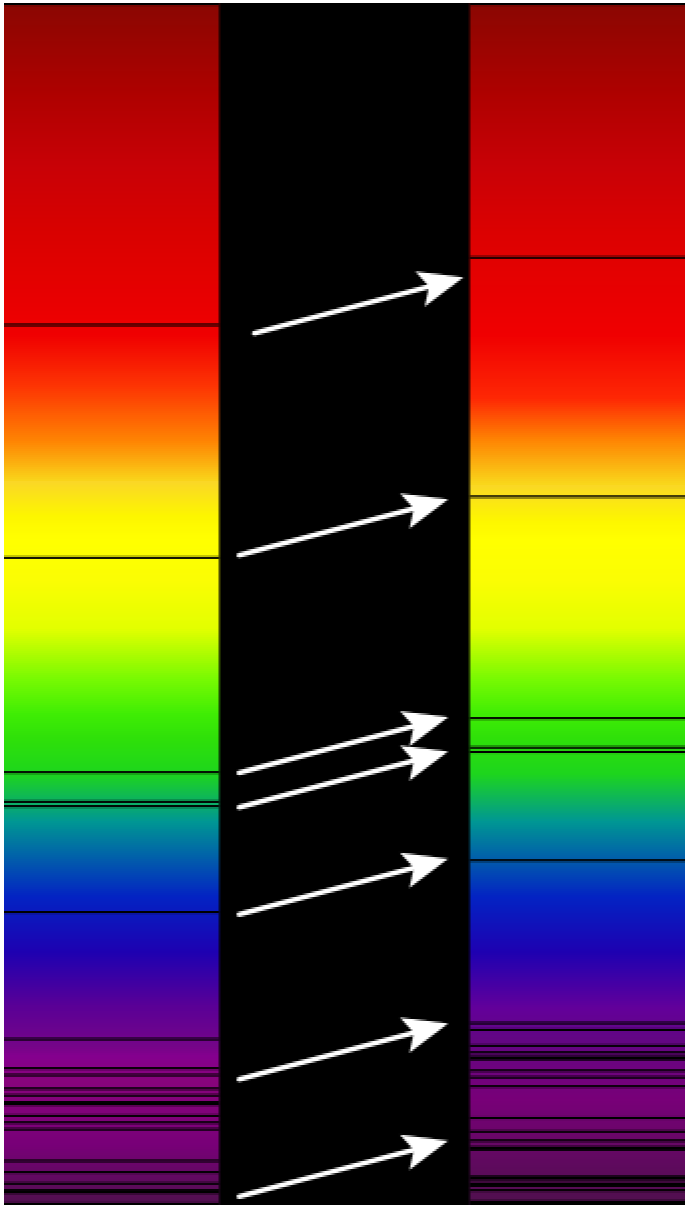
Katse kauemmaksi



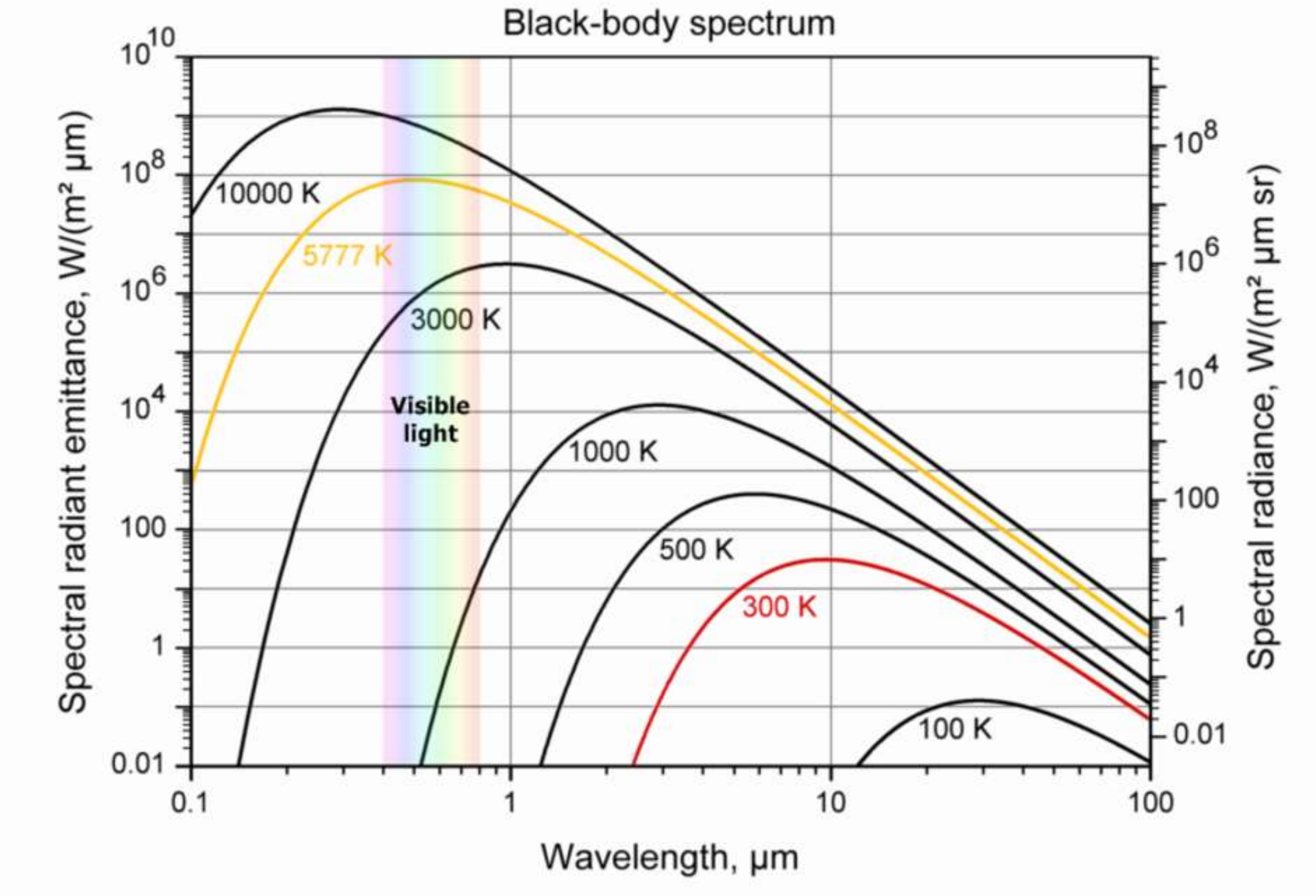
Katse kauemmaksi

$$f' = f\frac{1-\frac{v}{c}\cos\theta}{\sqrt{1-v^2/c^2}}$$

The most distant known quasar, ULAS J1342+0928, is at z = 7.54.



Katse kauemmaksi



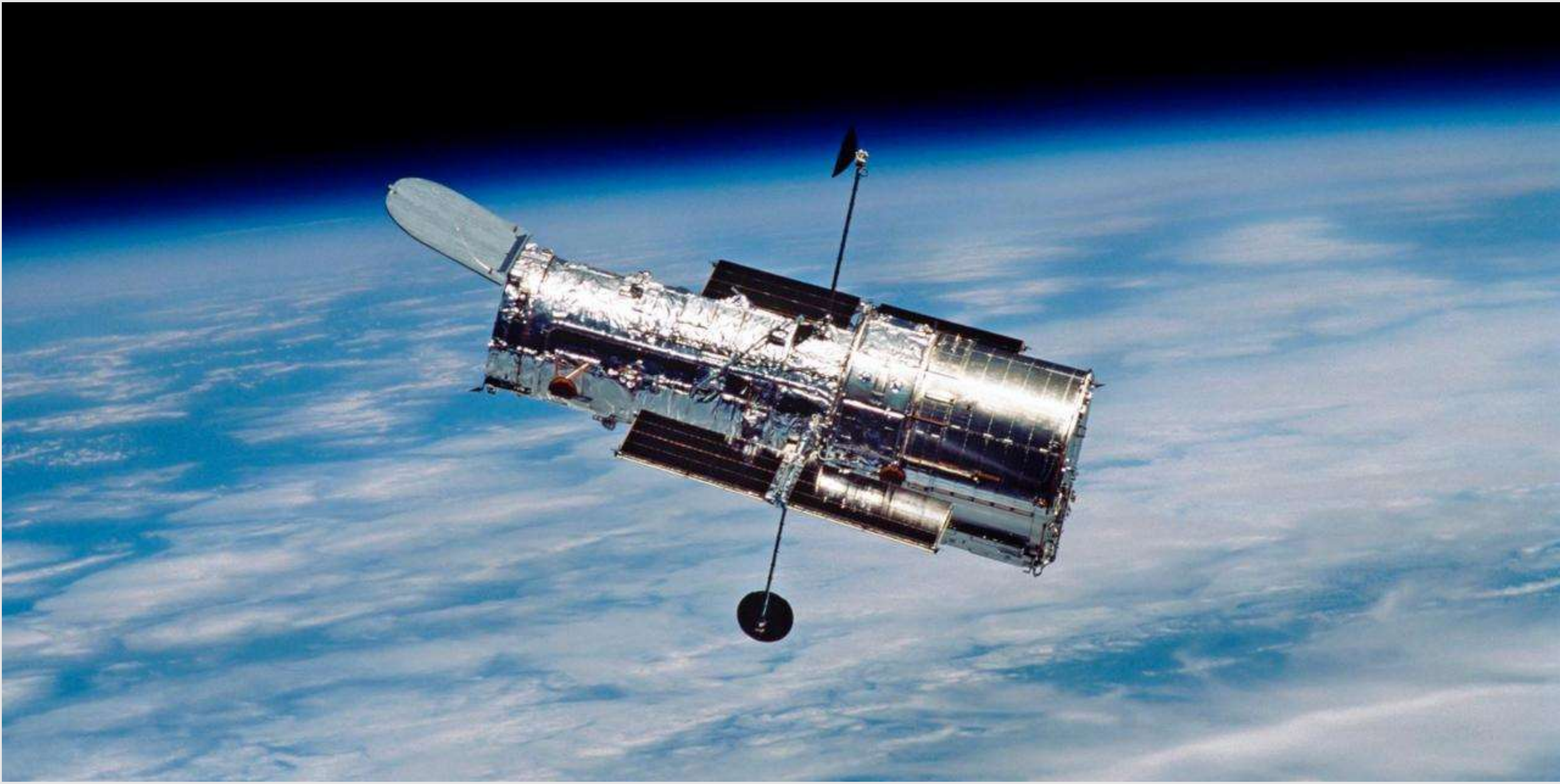
Katse kauemmaksi

Säteilyn maksimin aallonpituus saadaan Wienin siirtymälaista

lmax T = 0.0028978 Km /T

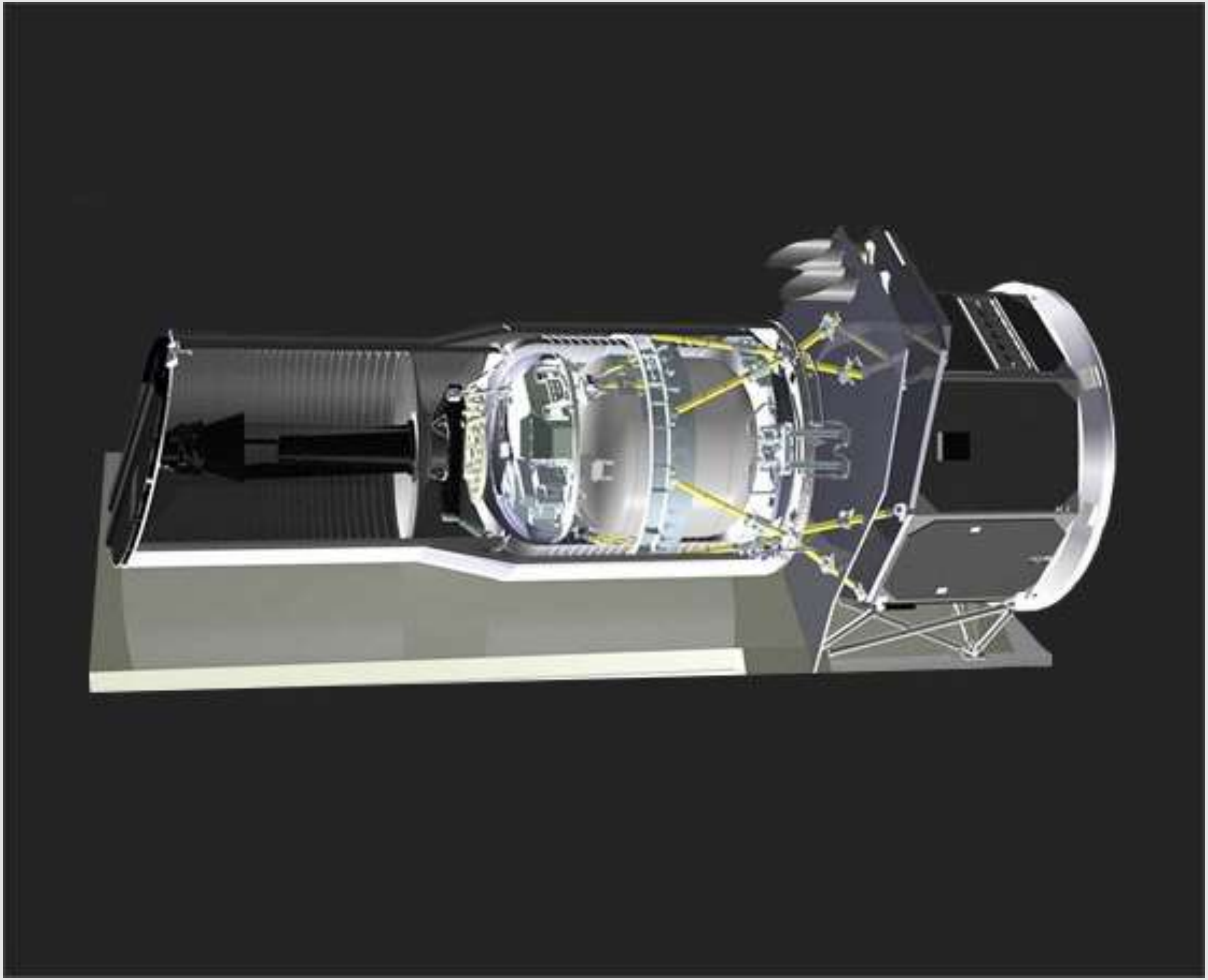
$$dI = \sigma T^4 \frac{\cos\theta}{\pi d^2} dA$$

Hubble-teleskooppi



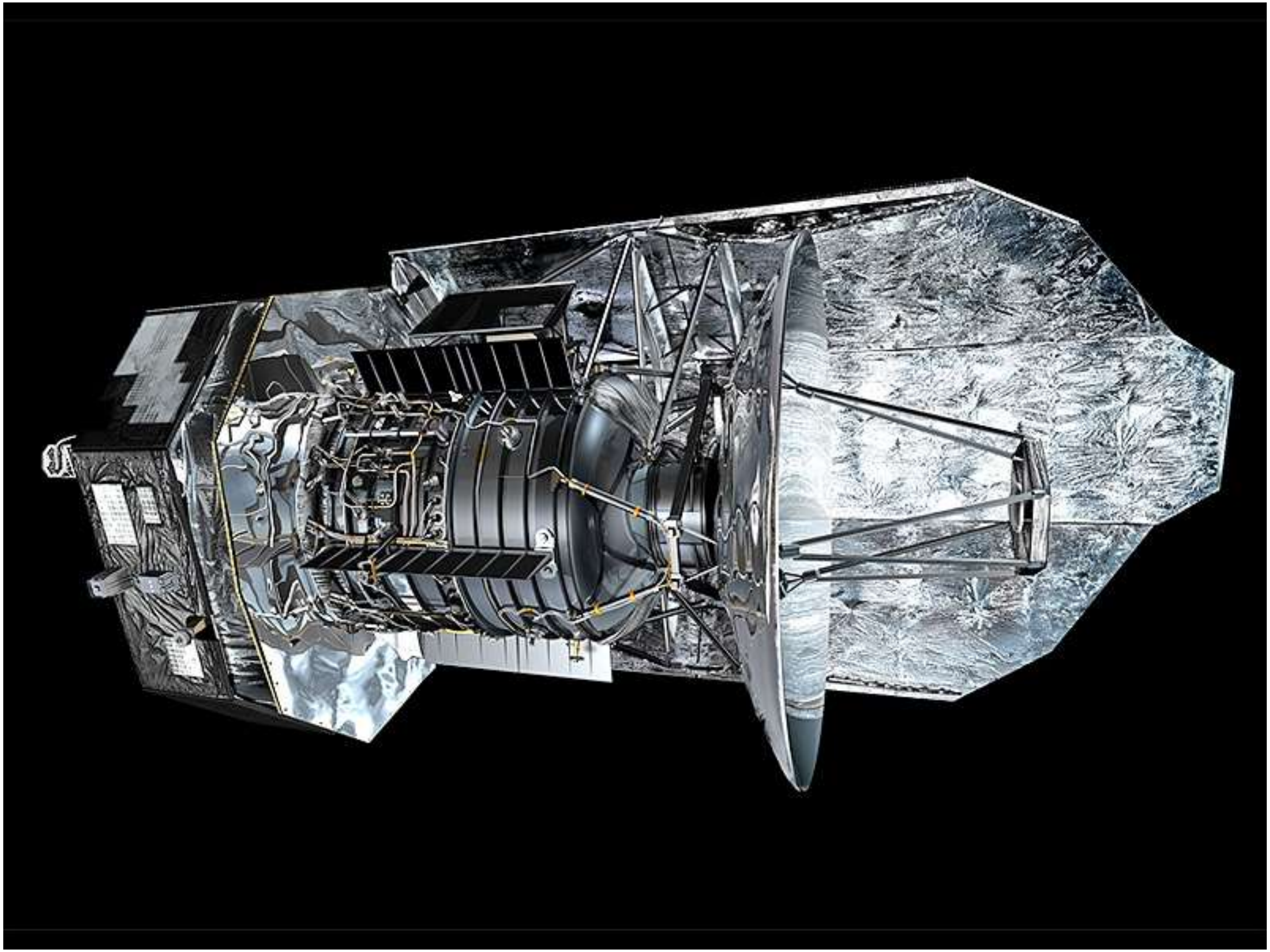
1990 -

Spitzer-teleskooppi



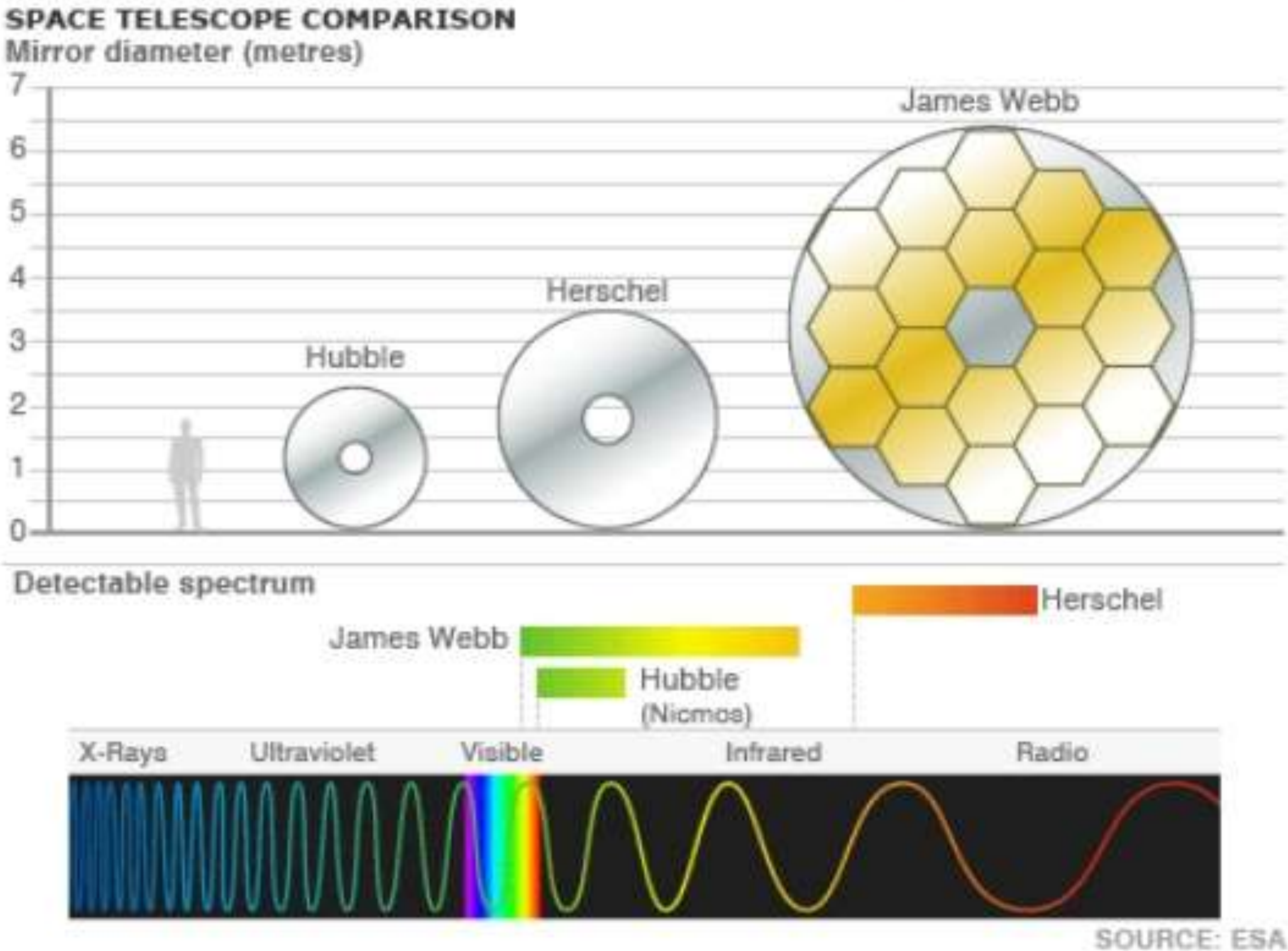
2003 -

Herschell-teleskooppi



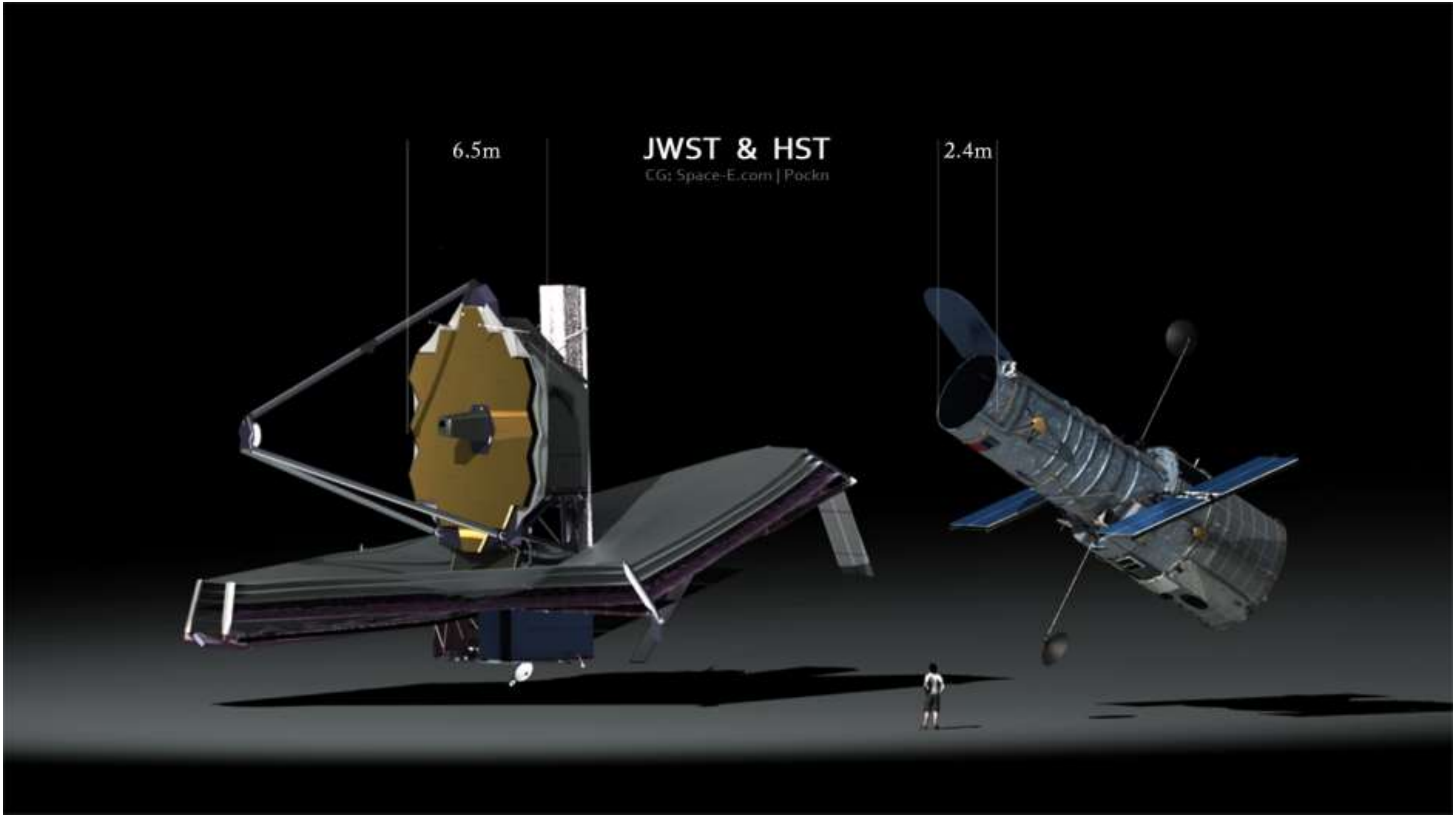
2009 - 2013

Another Reminder of How Big JWST Is



James Edwin Webb (7.10.1906 – 27.3.1992)

NASAn johtaja 1961–1968



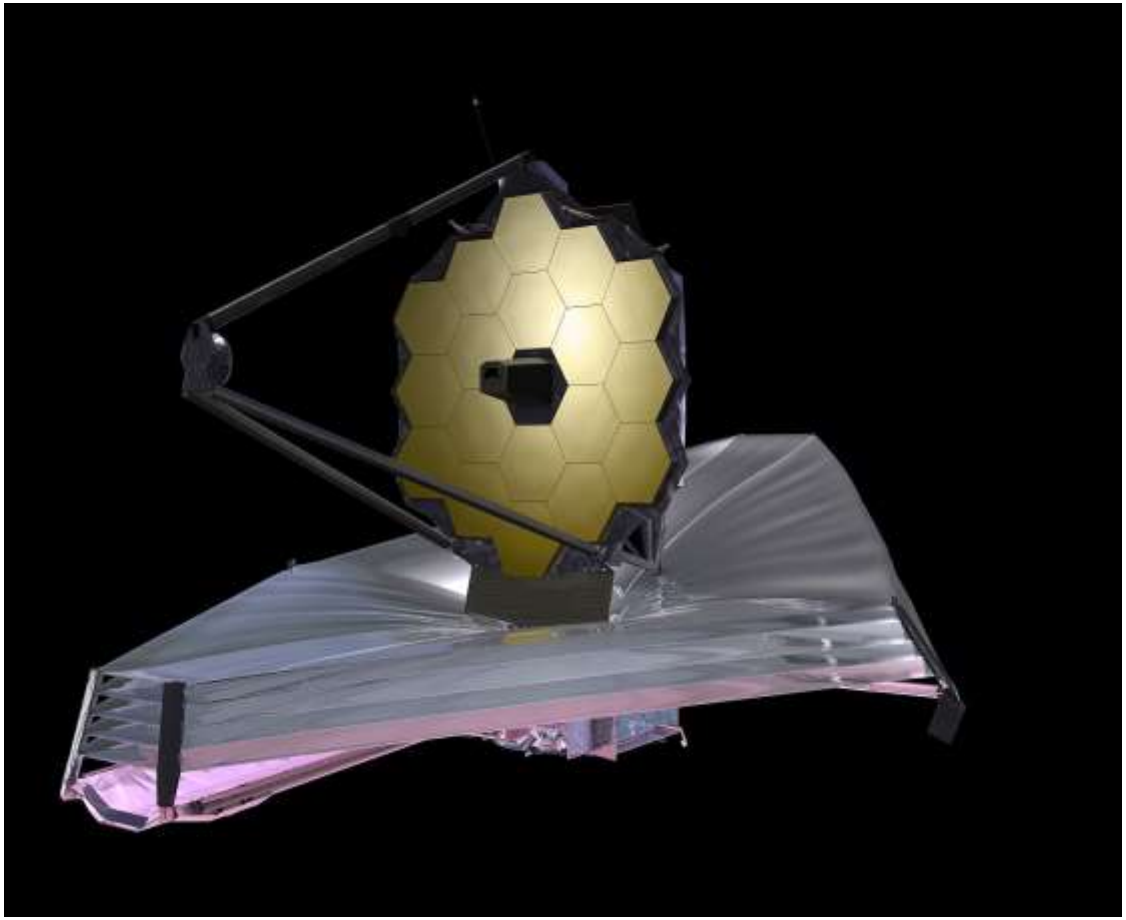
Alkurahoitus 2002

Suunnitelma valmis 2011

Kaukoputki valmis marraskuussa 2016

6 200 kg   (Hubble 11 110 kg)

Tavoitteet



?

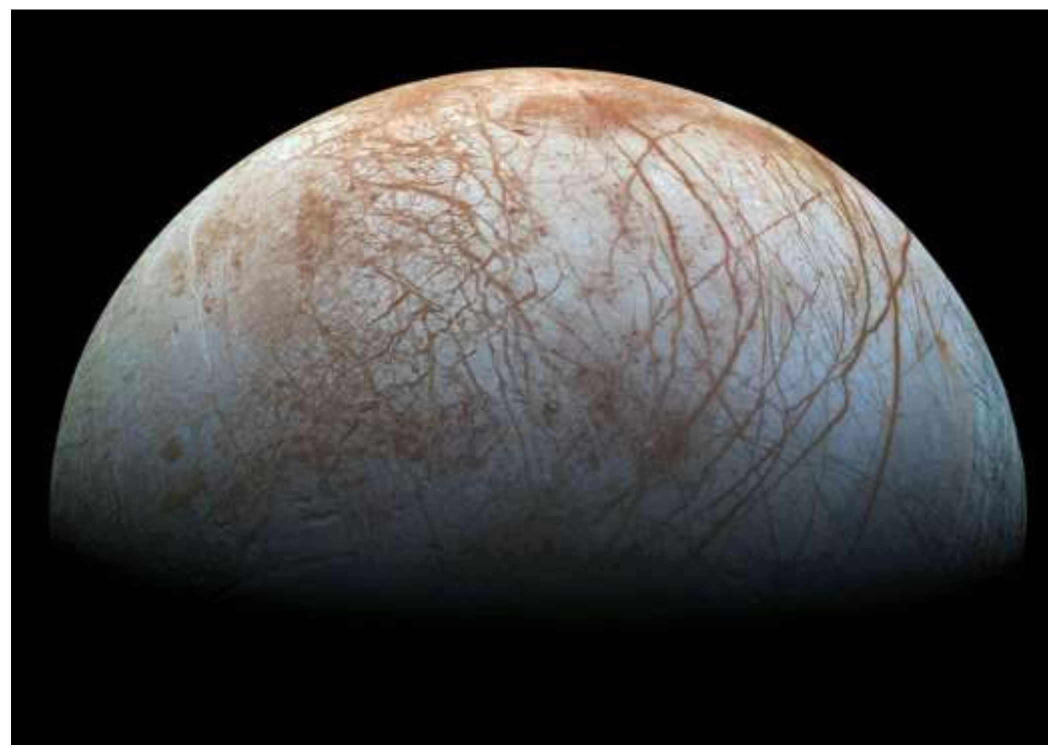
Webb is designed to discover and study the first stars and galaxies that formed in the early Universe. To see these faint objects, it must be able to detect things that are ten billion times as faint as the faintest stars visible without a telescope. This is 10 to 100 times fainter than Hubble can see.

Tavoitteet

One of the main goals of Webb is to detect some of the very first star formation in the Universe. This is thought to happen somewhere between redshift 15 and 30. At those redshifts, the Universe was only one or two percent of its current age.

The Universe is now 13.7 billion years old, and these redshifts correspond to 100 to 250 million years after the Big Bang. The light from the first galaxies has traveled for about 13.5 billion years.

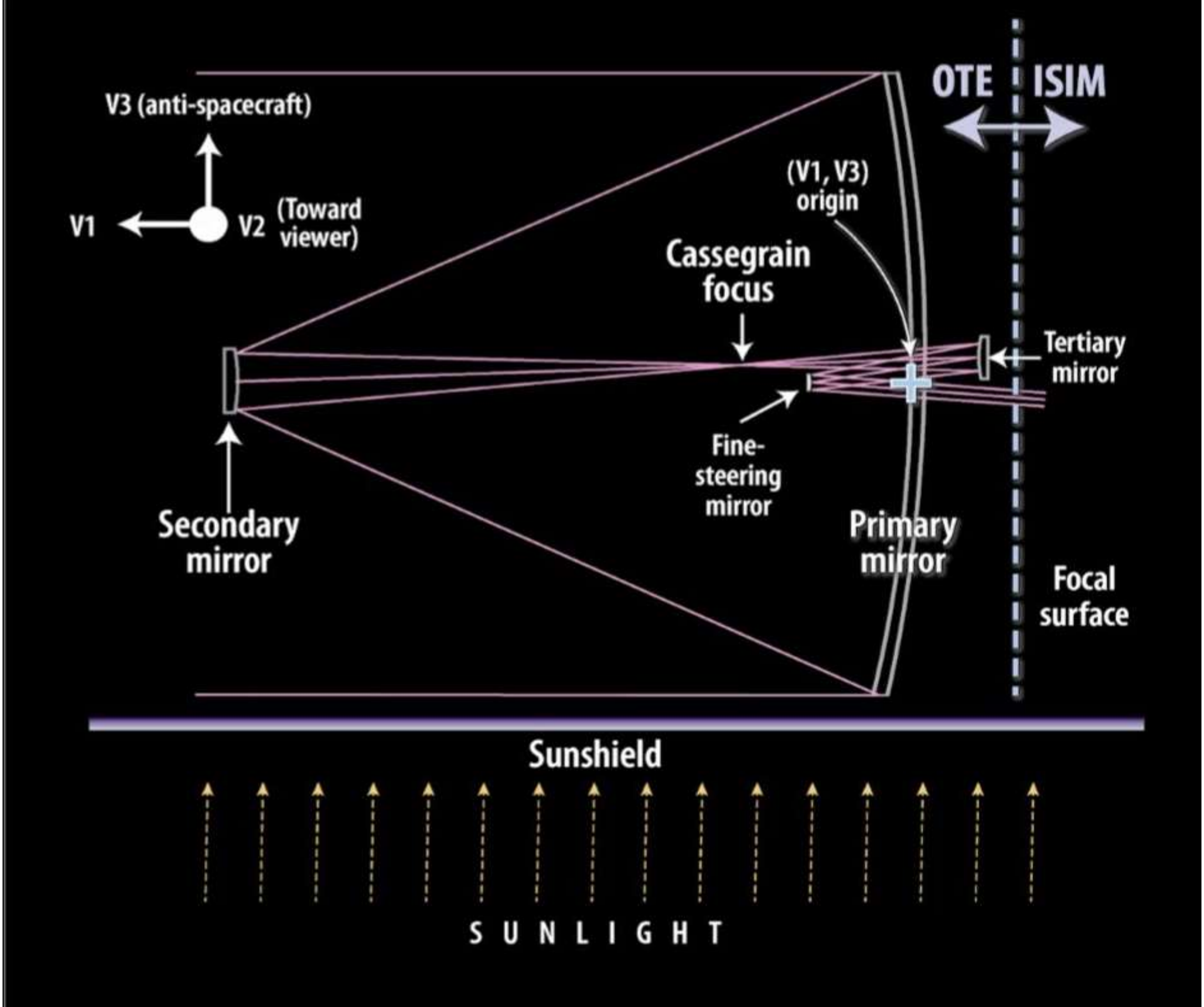
Webb telescope's observations might be particularly telling for the plumes on Europa, the composition of which largely remains a mystery. "Are they made of water ice? Is hot water vapor being released? What is the temperature of the active regions and the emitted water?" Webb telescope's measurements will allow us to address these questions with unpredented accuracy and precision.



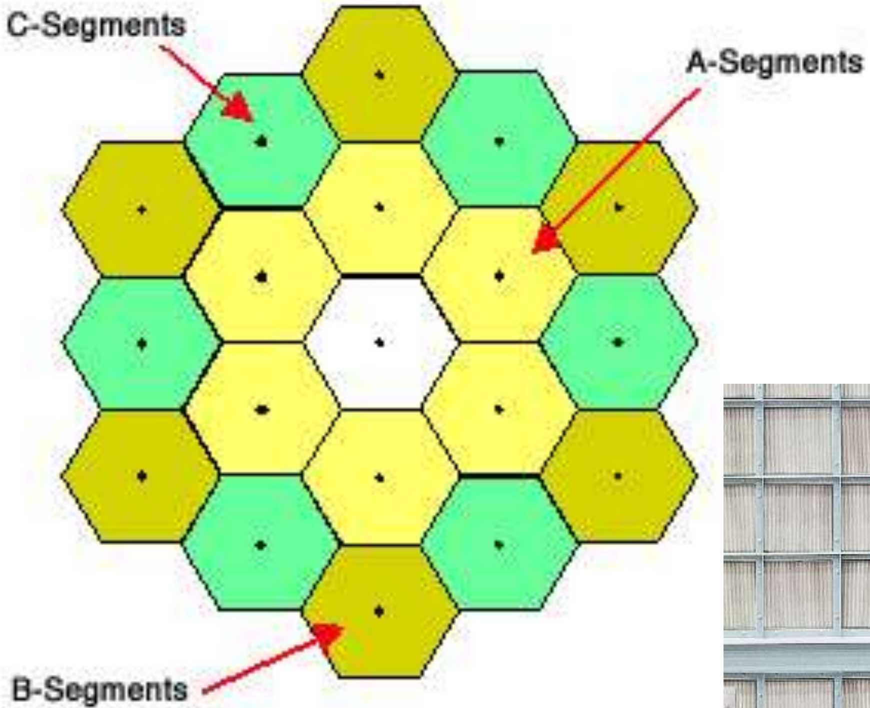
Aurinkokunnan kohteita

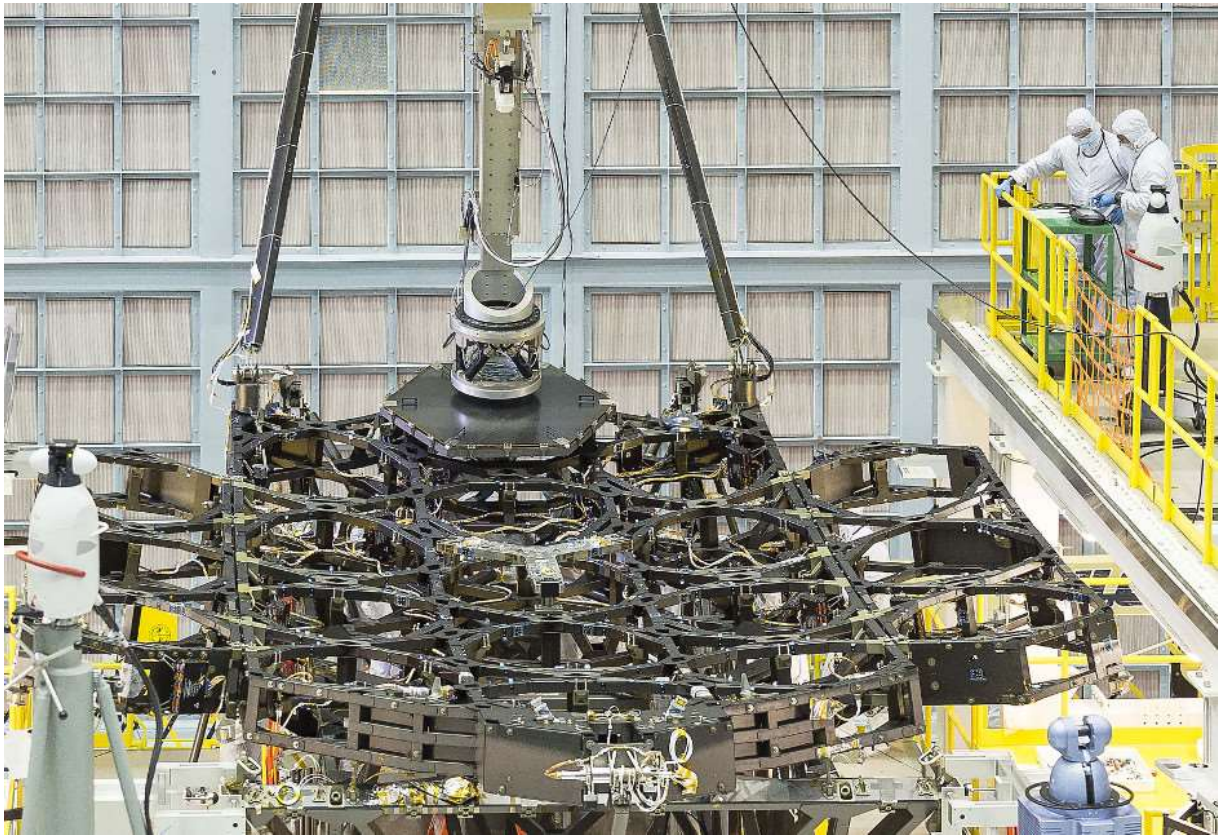
Near-simultaneous mapping and spectroscopy of cometary gas and dust from 0.6 – ~ 28.5 μm.

Varjo

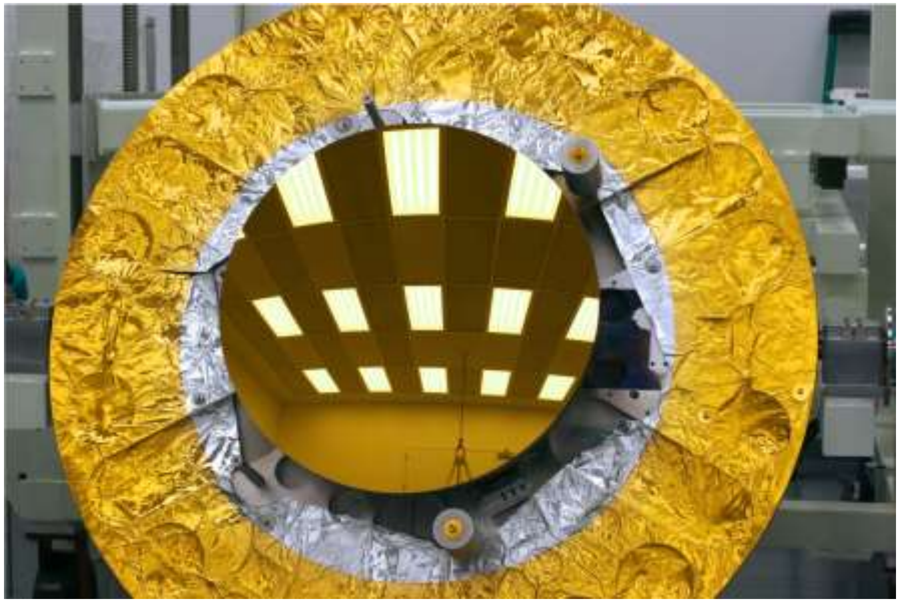

OTE
ISIM
V3 (anti-spacecraft)
V1
V2
(Toward viewer)
(V1, V3) origin
Cassegrain focus
Tertiary mirror
Fine-steering mirror
Secondary mirror
Primary mirror
Focal surface
Sunshield
SUNLIGHT

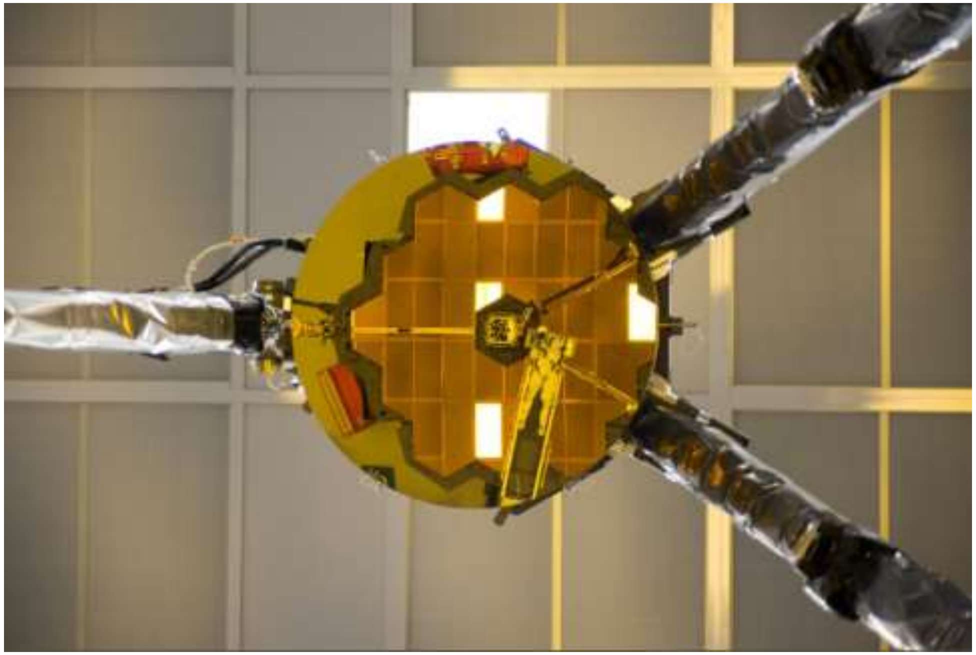
Kaukoputki





Peilit





Optiset laitteet

The James Webb Space Telescope includes four scientific instruments:

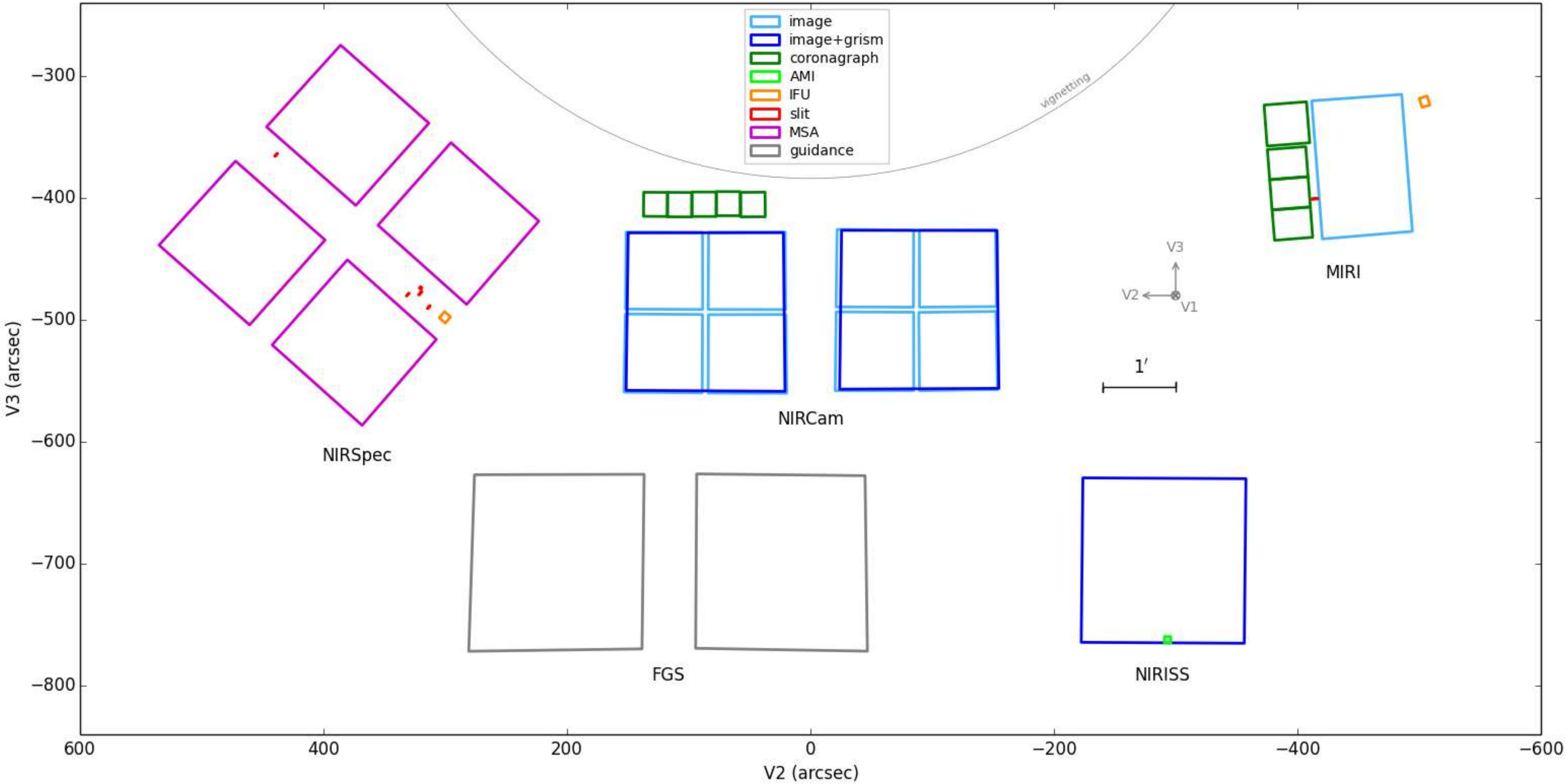
the Near Infrared Camera (NIRCam),

the Near-Infrared Spectrograph (NIRSpec),

the Mid-Infrared Instrument (MIRI),

and the Fine Guidance Sensor/ Near InfraRed Imager and Slitless Spectrograph (FGS-NIRISS).

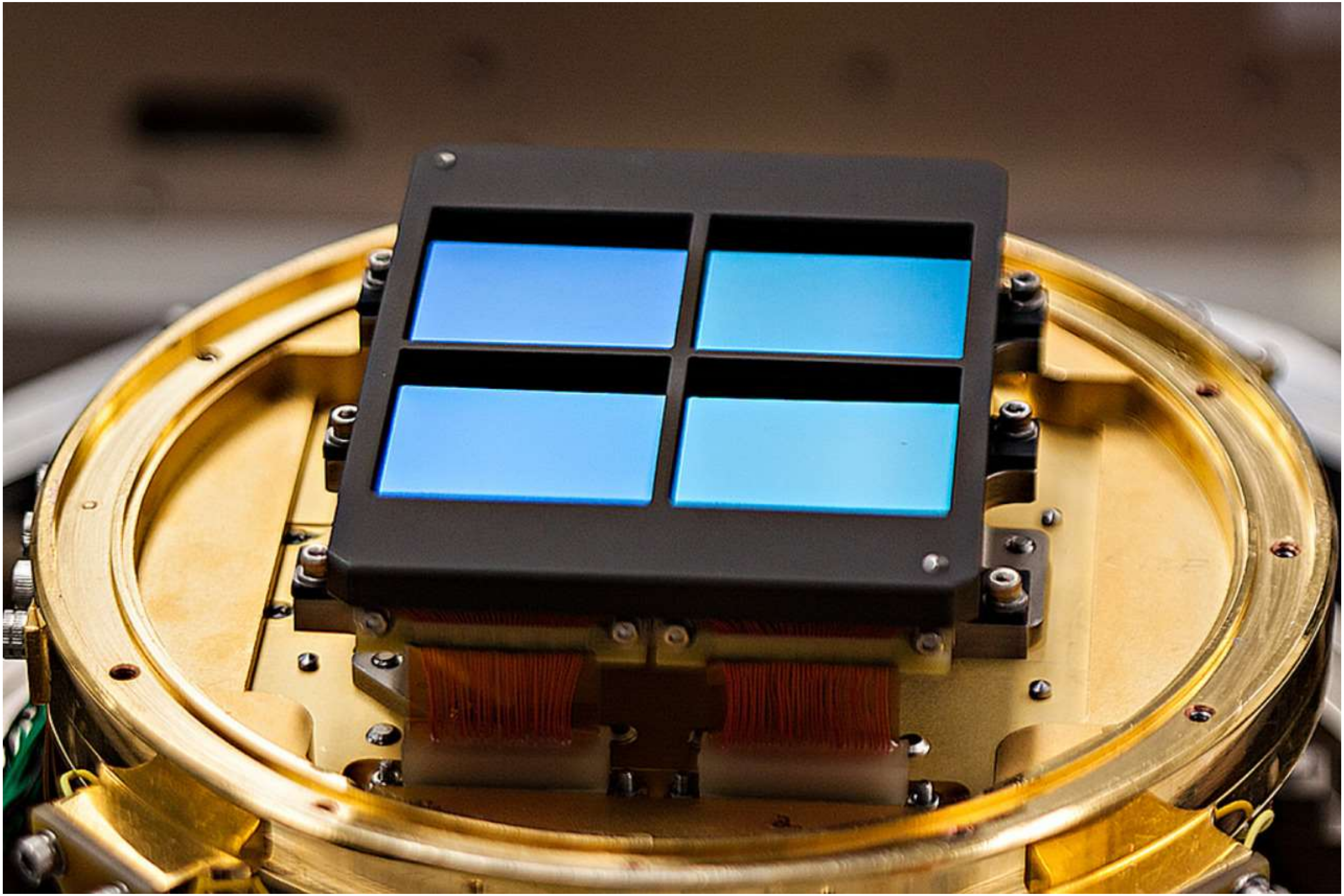
Kuvataso



The ISIM instruments are located in an off-axis position, which yield excellent image quality over the 9.4 arcminute field

Near Infrared Camera (NIRCam)

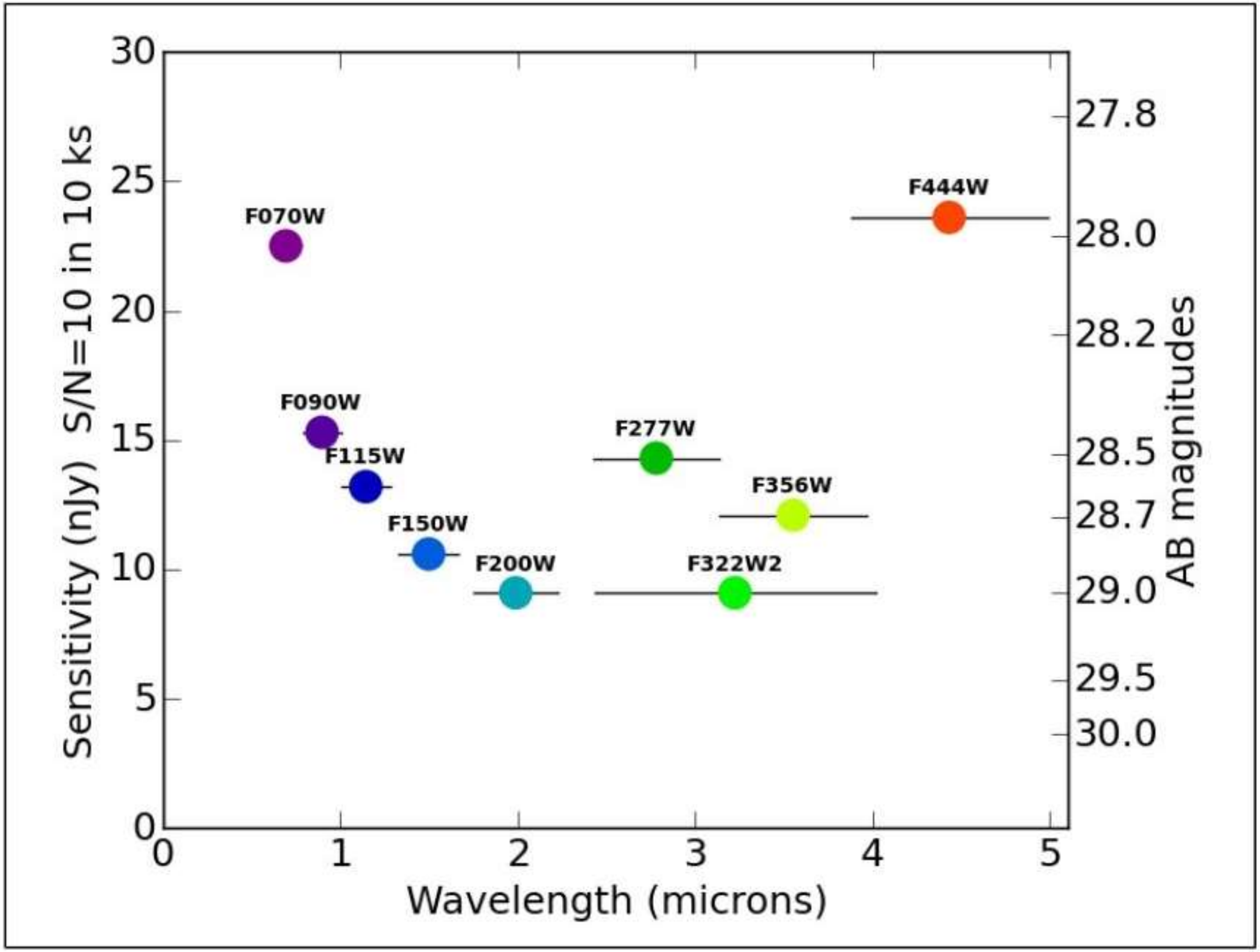
Near Infrared Camera (NIRCam)



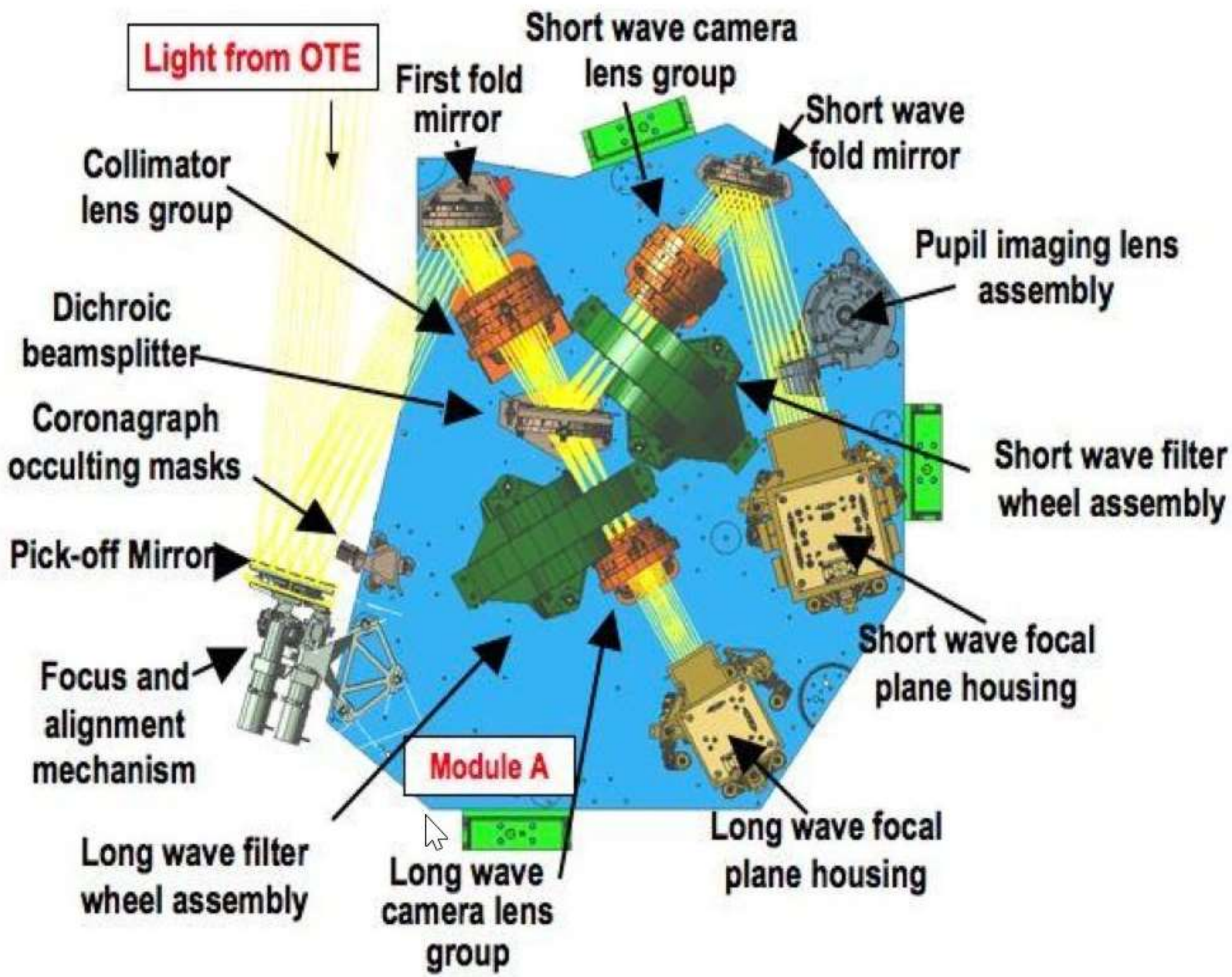
Near Infrared Camera (NIRCam)

NIRCam is the primary wavefront sensor for JWST and contains several components in its pupil wheels that are used to measure wavefront information. Because of its importance to overall observatory operations, NIRCam is comprised of two fully redundant modules. Weak lenses in the NIRCam filter wheels defocus the images to provide wavefront information.

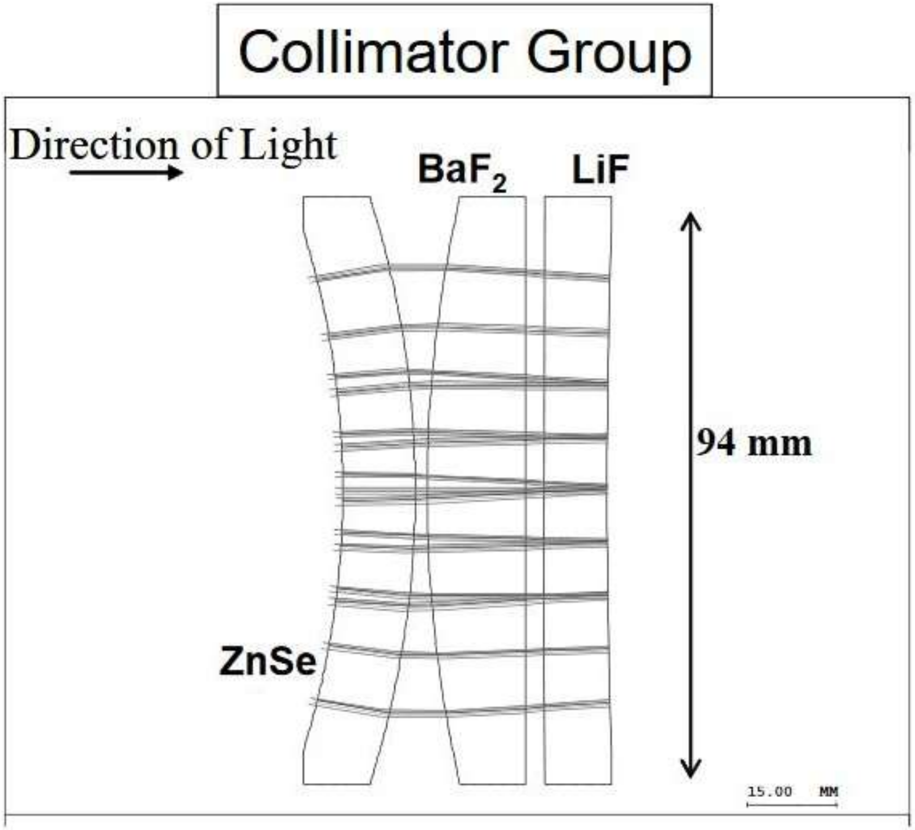
Near Infrared Camera (NIRCam)

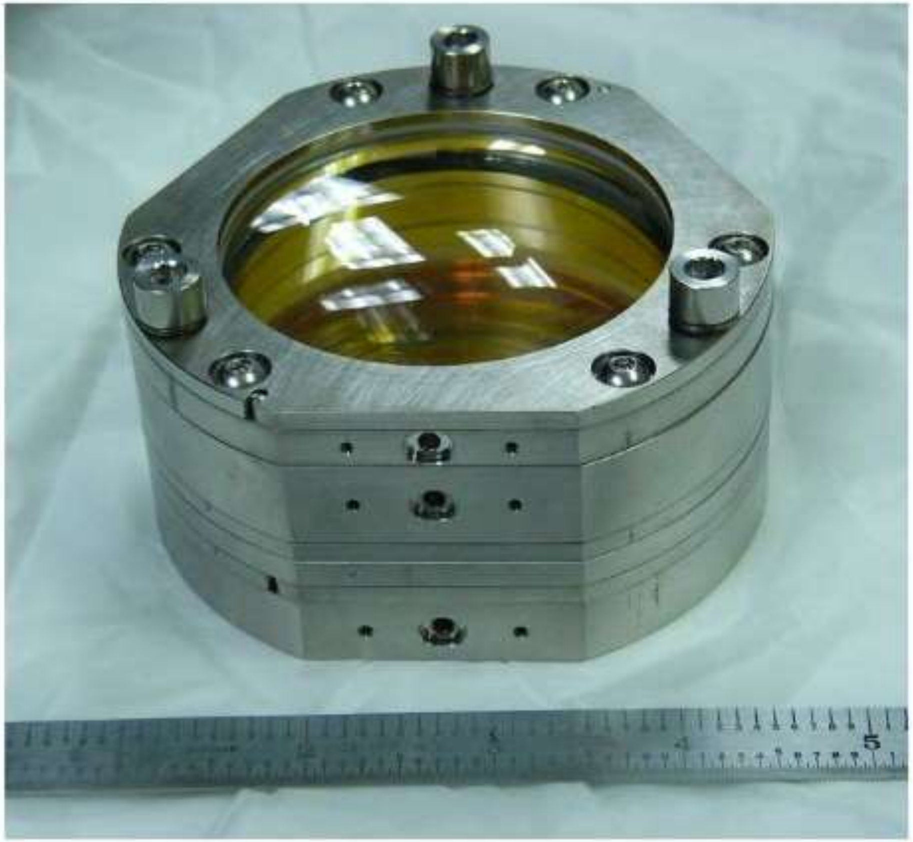


Near Infrared Camera (NIRCam)

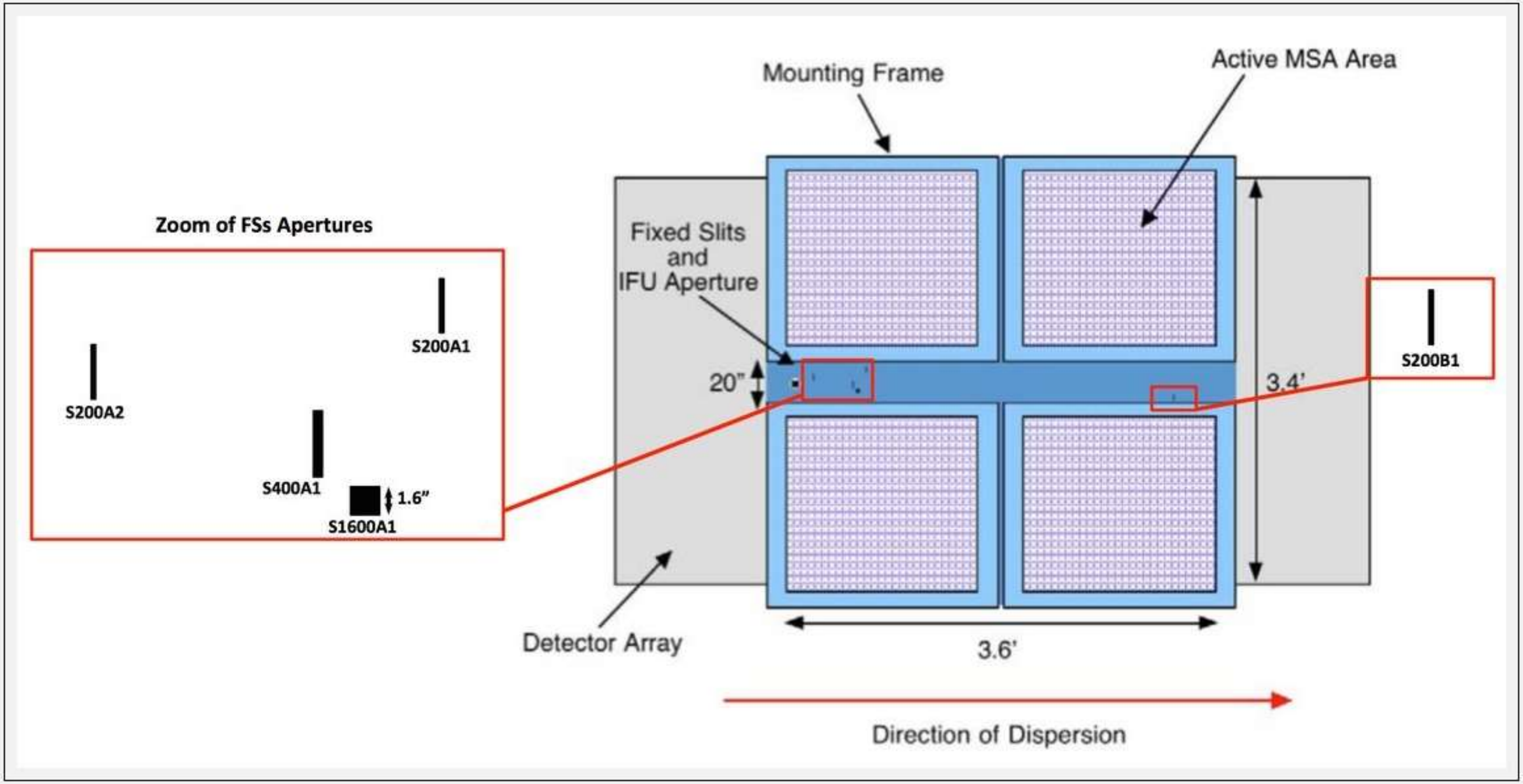


Near Infrared Camera (NIRCam)



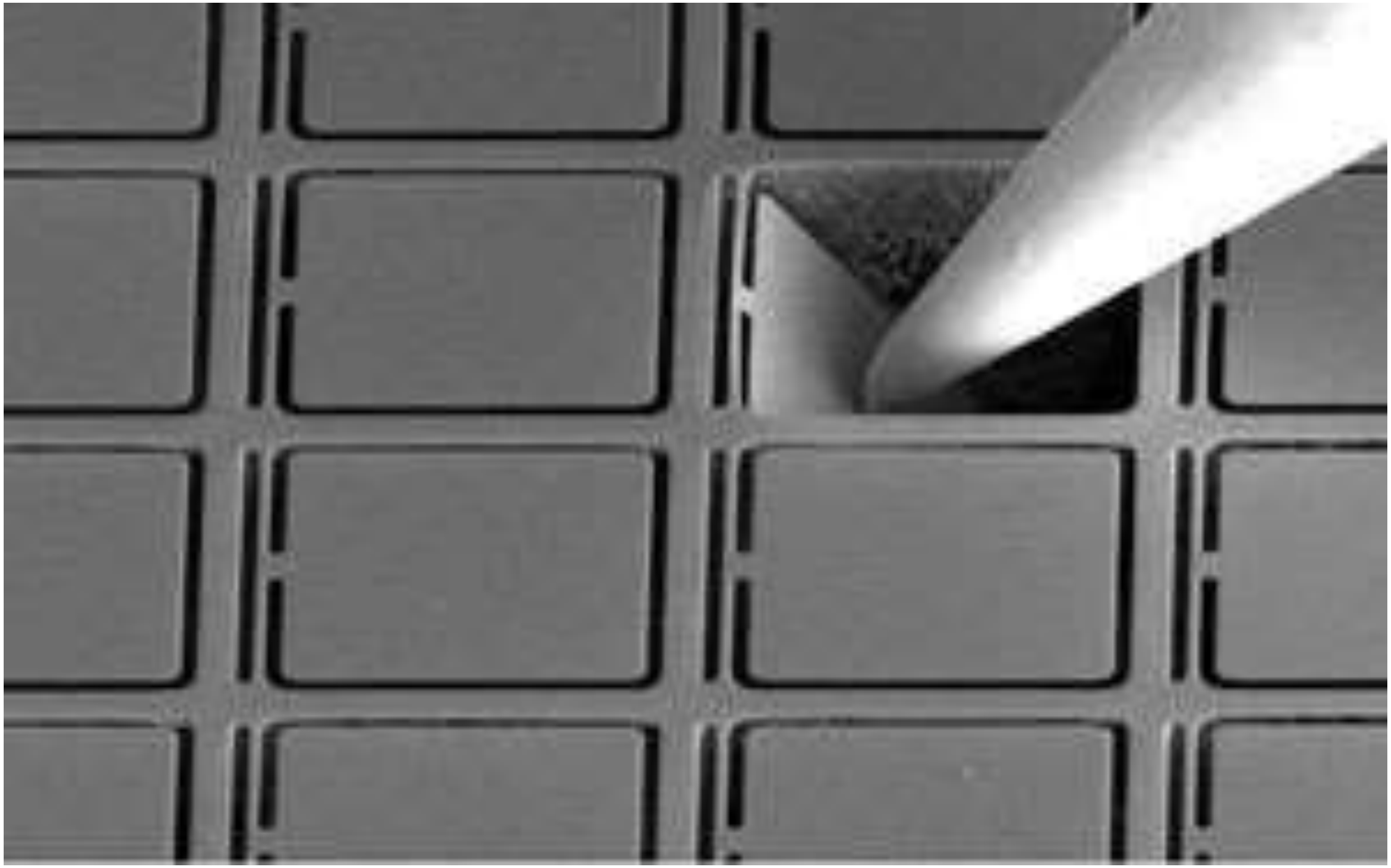


Near-Infrared Spectrograph (NIRSpec)



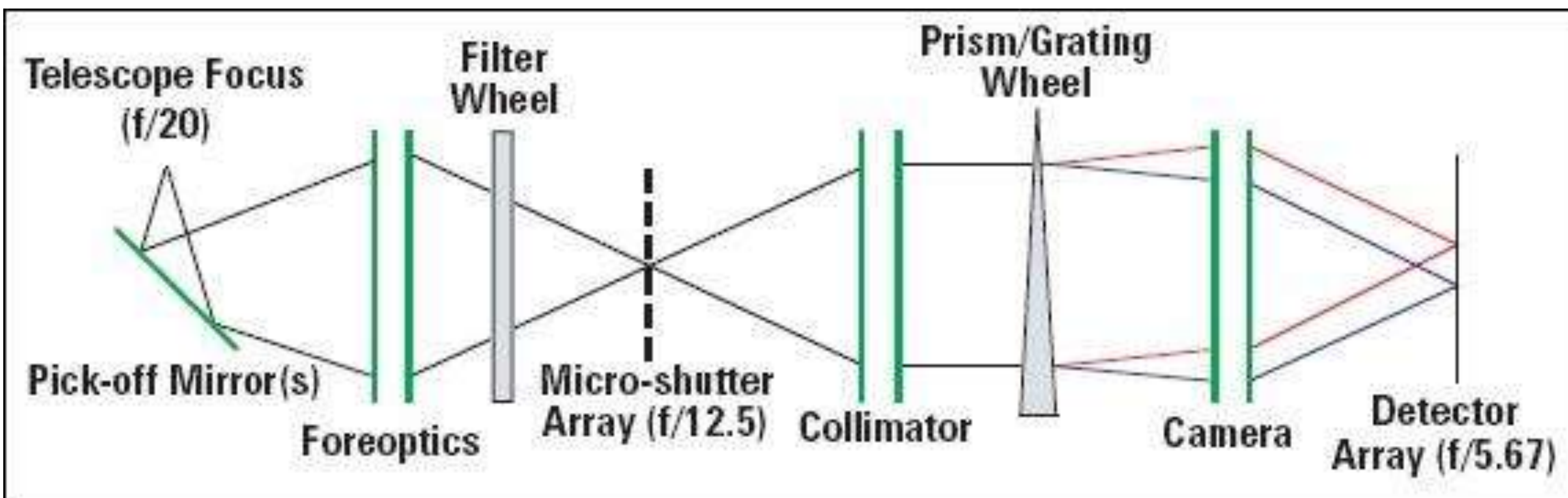
Because Webb will observe faint, far-away objects, it will take as long as a week for NIRSpec to gather enough light to obtain good spectra.

Near-Infrared Spectrograph (NIRSpec)



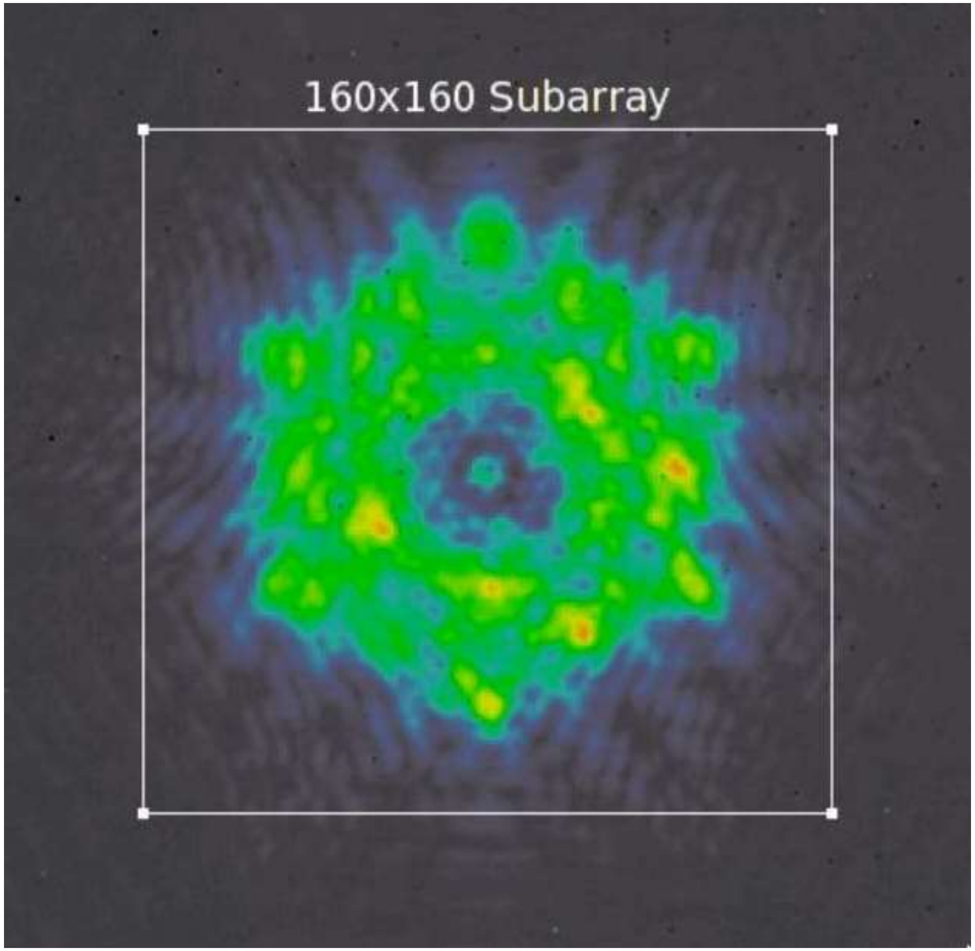
Each microshutter has a FOV of 0.2 x 0.4 arcsec

Multi-object spectroscopy obtains simultaneous spectroscopy of multiple science targets within a 3.6 × 3.4' field of view using the micro-shutter assembly (MSA)



Near Infrared Camera (NIRCam)

Analysis and determination of the wavefront error is performed on the ground using downlinked image data, and the necessary mirror commands are then uplinked to JWST to correct the alignments.



In a 10 ks image, NIRCam will obtain S/N = 10 detections of point sources as faint as ~10 nJy (AB mag 28.9) in some filters, and S/N = 5 detections of 5 nJy (AB mag 29.65) point source.

Mid-Infrared Instrument (MIRI)

MIRI provides imaging and spectroscopic observing modes from 4.9 to 28.8 μm. These wavelengths can be utilized for: direct imaging of young warm exoplanets and spectroscopy of their atmospheres; identification and characterization of the first galaxies at redshifts $z > 7$; and analysis of warm dust and molecular gas in young stars and proto-planetary disks.

Mid-Infrared Instrument (MIRI)

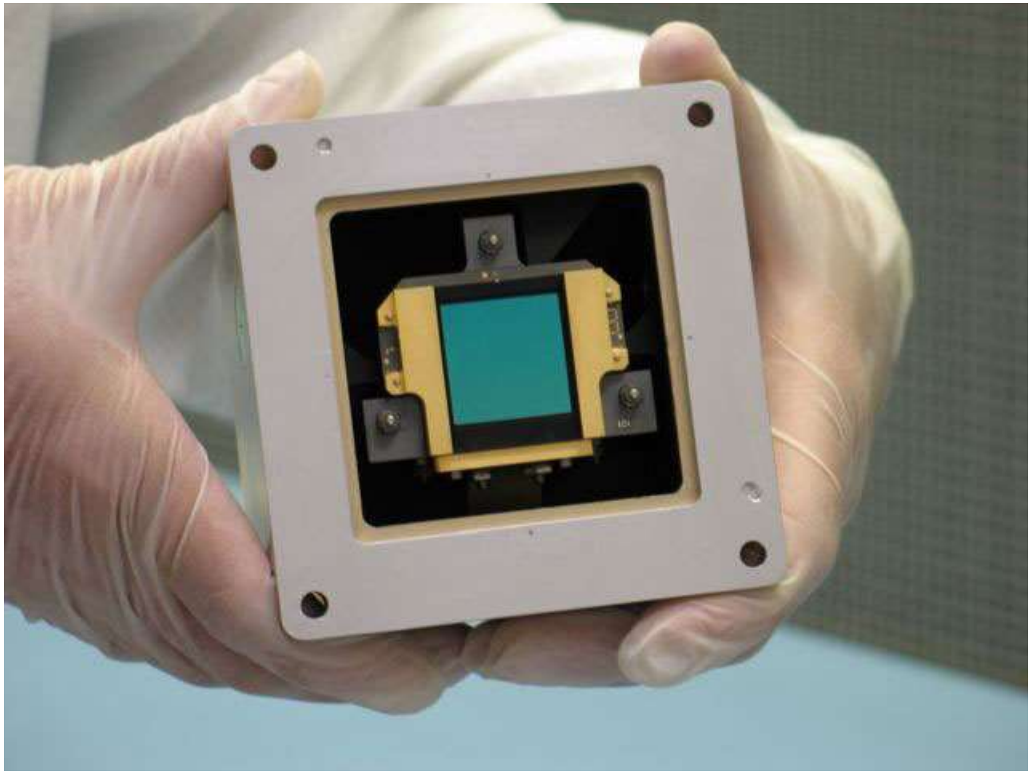
First JWST instrument MIRI
Delivered to NASA

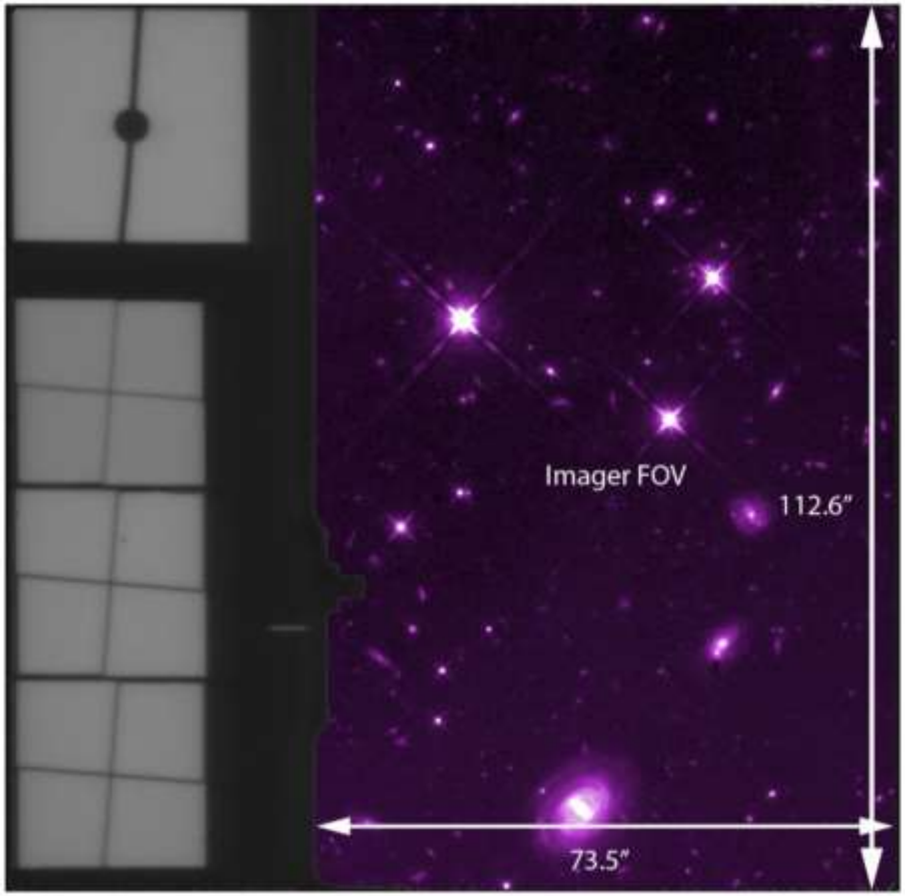
On May 9, 2012.

Mid-Infrared Instrument (MIRI)

MIRI covers the wavelength range of 5 to 28 microns.

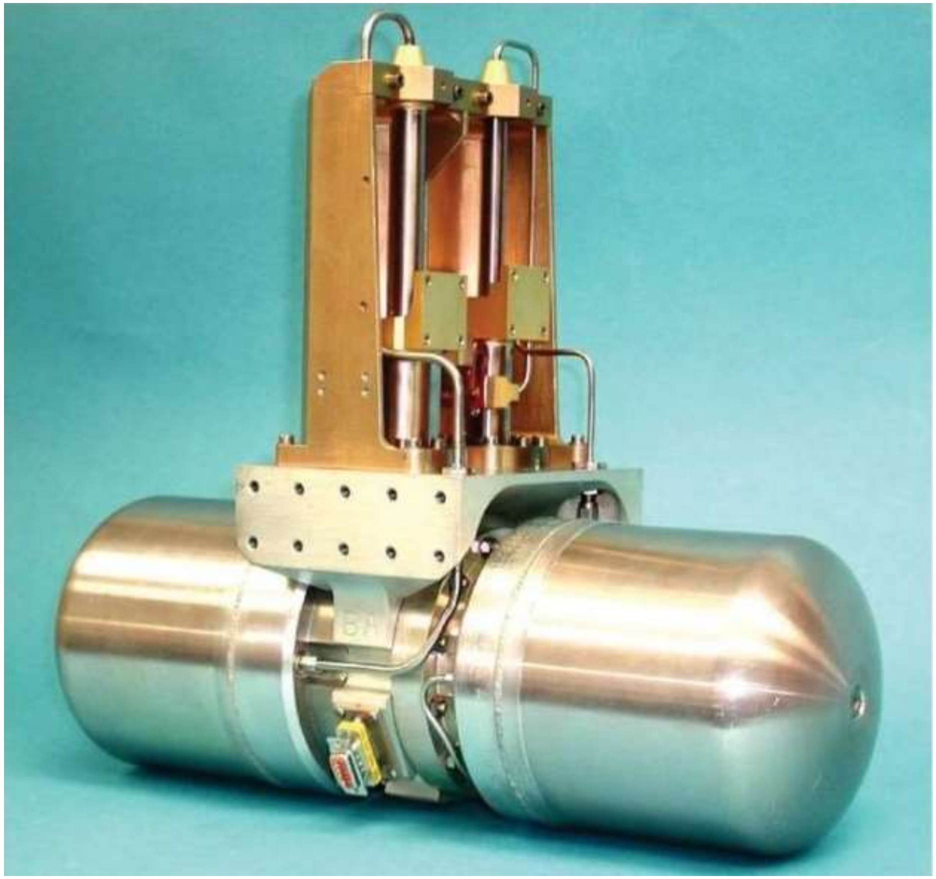
Mid-Infrared Instrument (MIRI)





The imager has a plate scale of 0.11 arcseconds/pixel and a field of view of 74 by 113 arcseconds with filters ranging from 5.6 to 25.5 μm. It has a 1024x1024 pixel array of arsenic doped silicon pixels.

Mid-Infrared Instrument (MIRI)



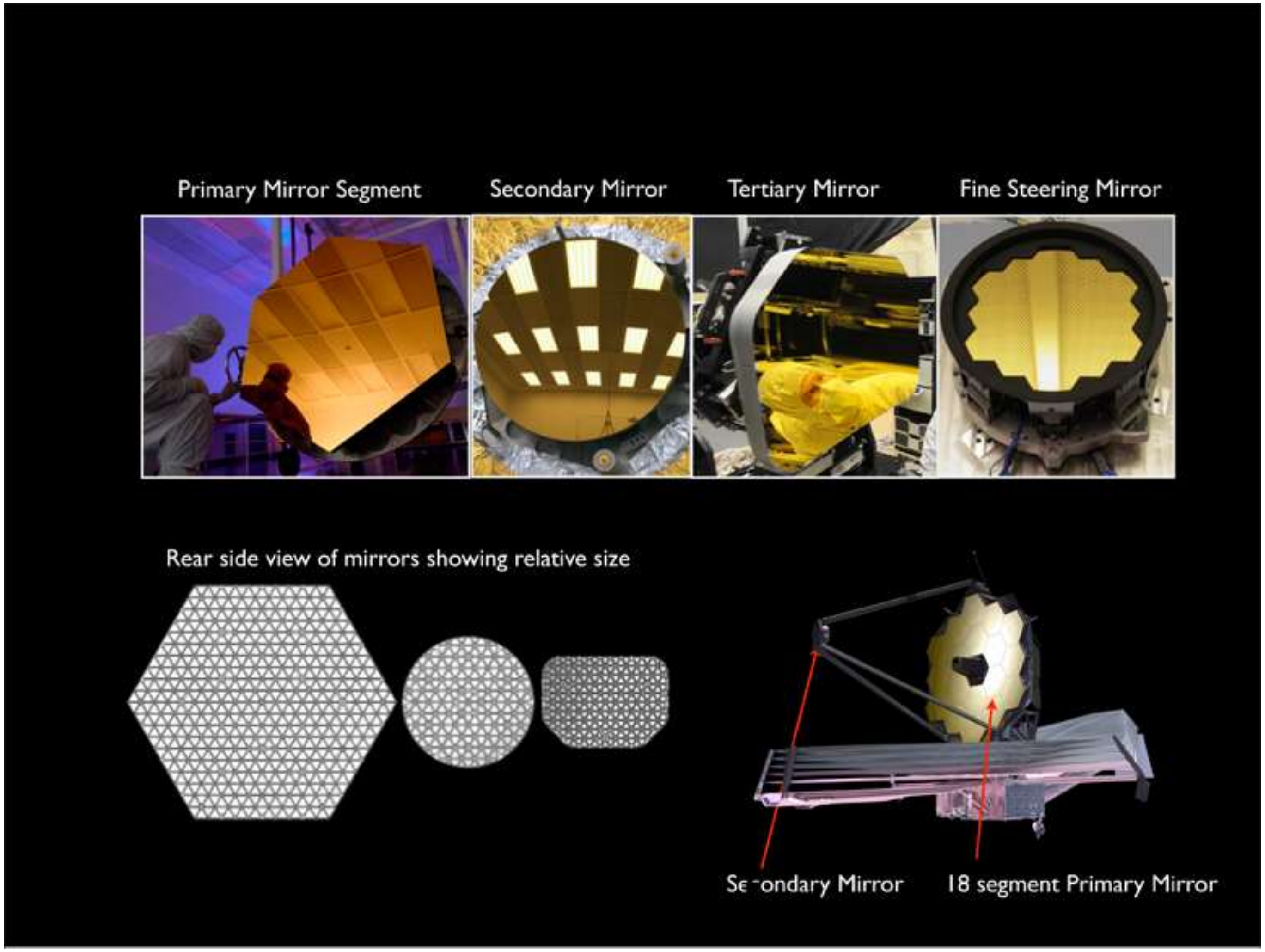
The MIRI instrument. MIRI's operates at temperatures of no more than 6.7 degrees above absolute zero.

Mid-Infrared Instrument (MIRI)

The large telescope aperture places this limit at about 5 AU at 10 pc for the coronagraph channels at 11–16 μm, and the sensitivity allows detection of low-mass planets . MIRI detects the thermal radiation (rather than reflected light) and hence is most sensitive to young exoplanets.

The MIRI imager spectral bands at 11.3 and 15 μm. The depth of the CO2 absorption indicates whether the planetary atmosphere is hydrogen poor or hydrogen rich (in which case there is virtually no absorption)

Fine Steering Mirror



Fine steering mirror (FSM) with line-of-sight (LOS) stabilization < 7.3 marcsec (or mas).

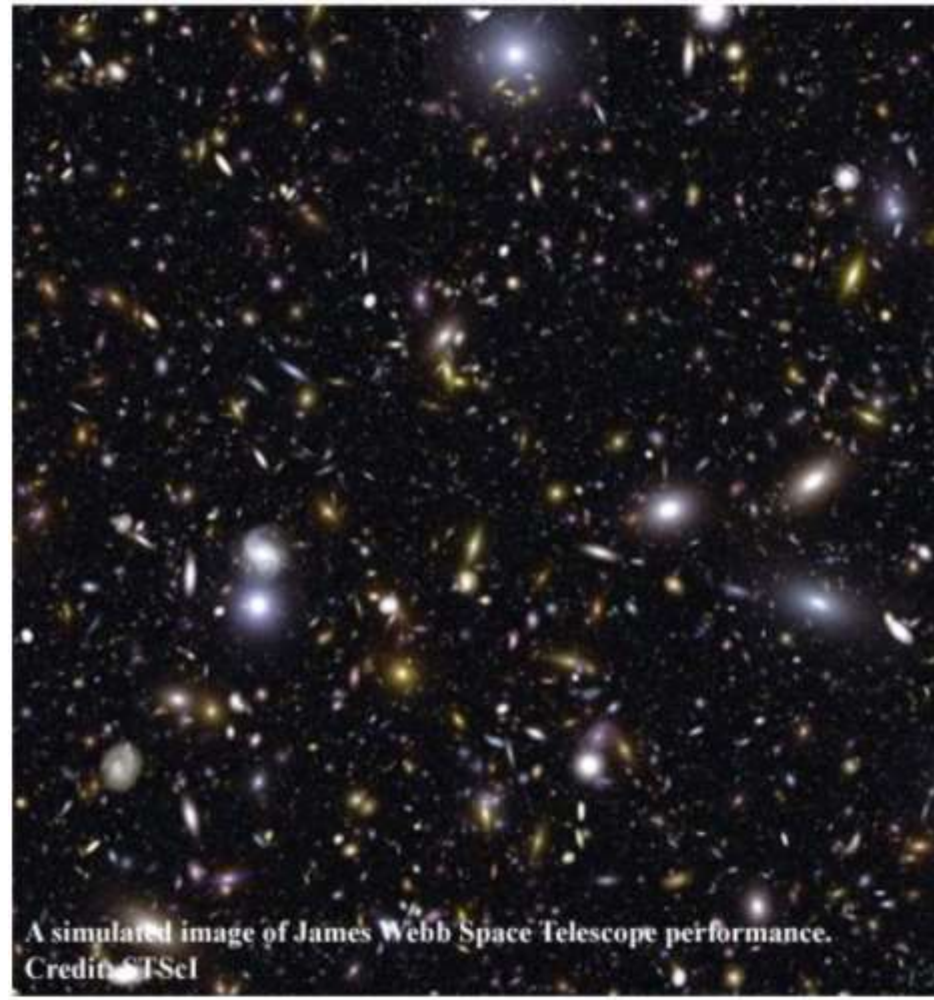
Detektorit

Webb will have two types of detector arrays (SCA): visible to near-infrared arrays with 2,048 x 2,048 pixels, and mid-infrared arrays with about 1,024 x 1,024 pixels. Several detectors will be built into mosaics to give a larger field of view. NIRCam, NIRSpec and FGS-NIRISS will use Mercury Cadmium Telluride (HgCdTe) detectors made by Teledyne Scientific & Imaging.

MIRI will employ arsenic doped silicon (Si:As) detectors produced by Raytheon.

Hubble vs. JWST

Distant galaxies in deep space in the Hubble Ultra Deep Field photograph.
Credit: NASA/ESA

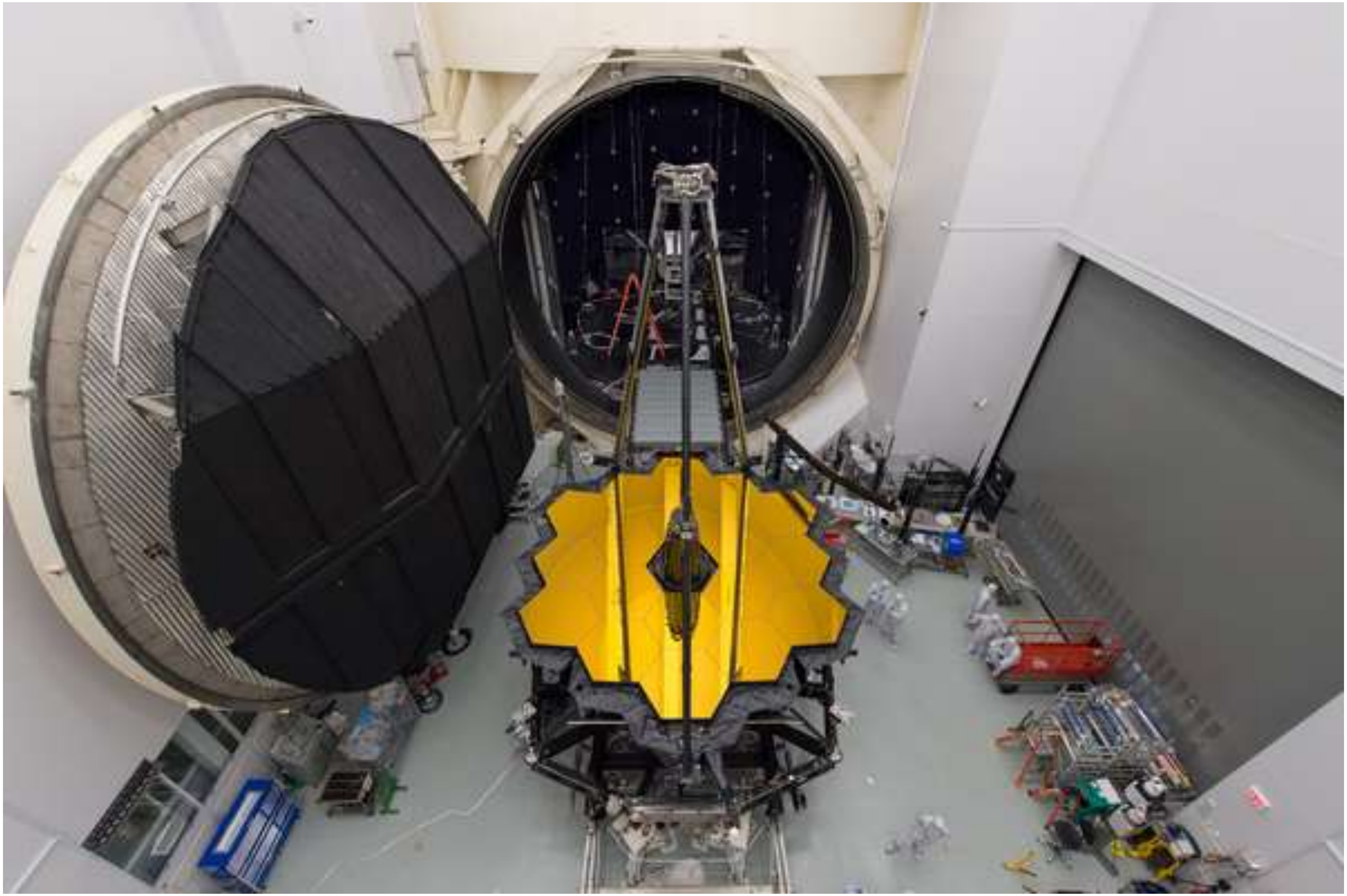


A simulated image of James Webb Space Telescope performance.
Credit: STScI

Webb's ground control system

Johns Hopkins University in Baltimore.

Rakentaminen, testaus



Suuntaus

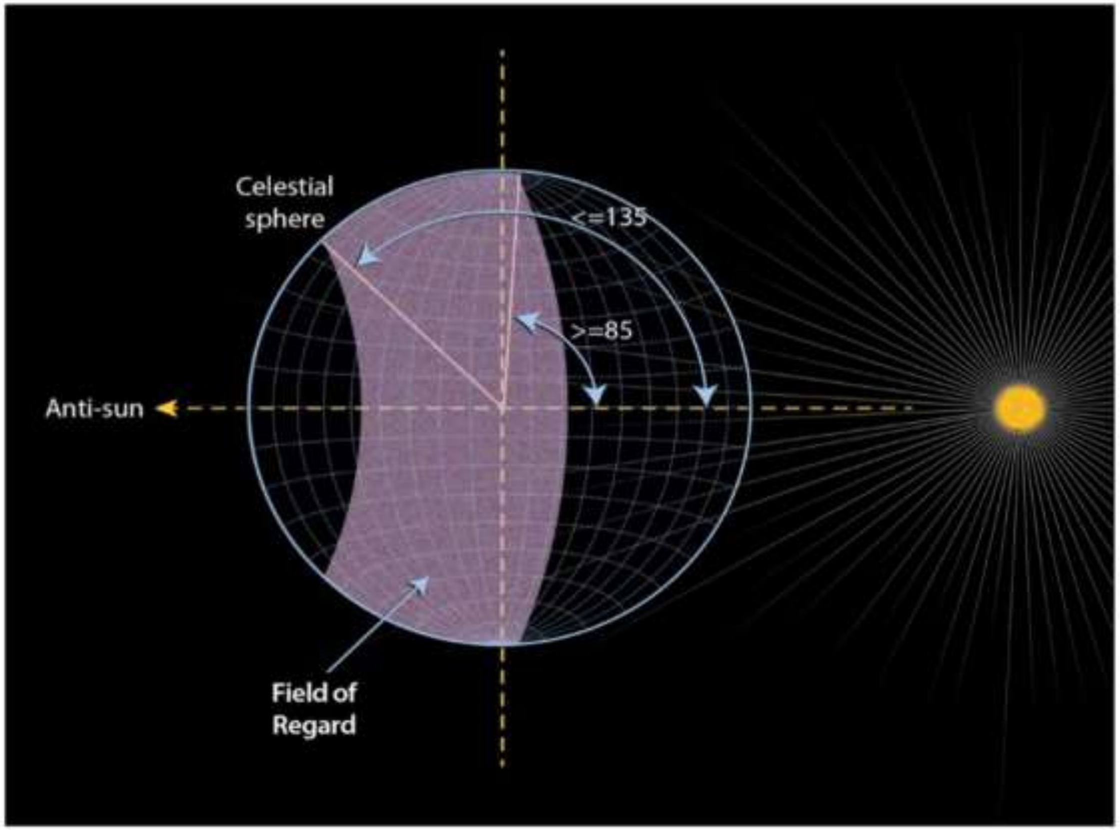
The FOR (Field of Regard) is the region of the sky in which observations can be conducted safely at a given time. For JWST, the FOR is a large annulus that moves with the position of the Sun and covers about 40% of the sky at any time. This coverage is lower than the ~80% that is accessible by Hubble. The FOR allows one to observe targets from 85º to 135º of the Sun. Most astronomical targets are observable for two periods separated by 6 months during each year. The length of the observing window varies with ecliptic latitude, and targets within 5º of the ecliptic poles are visible continuously, and provides 100% accessibility of the sky during a year period. The sunshield permits the observatory to pitch toward and away from the sun by approximately 68º, while still keeping the telescope in the shade. The continuous viewing zone is important for some science programs that involve monitoring throughout the year and will also be useful for calibration purposes. Outside the continuous viewing zone every area in the sky is observable for at least 100 days per year. The maximum time on target at a given orientation is 10 days

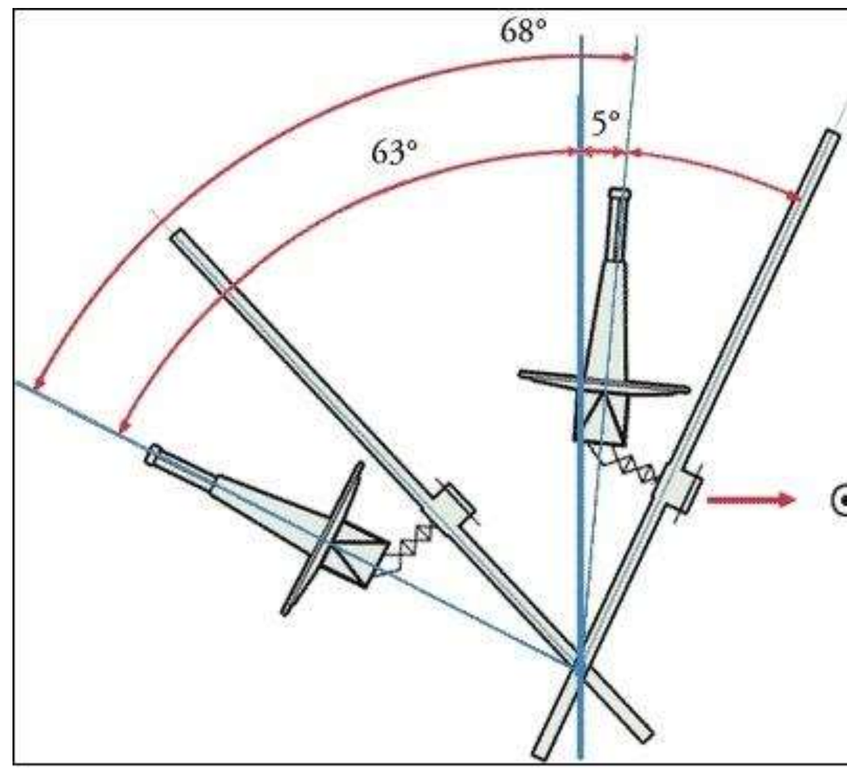
Suuntaus

The Hemispherical Resonator Gyroscope (HRG),

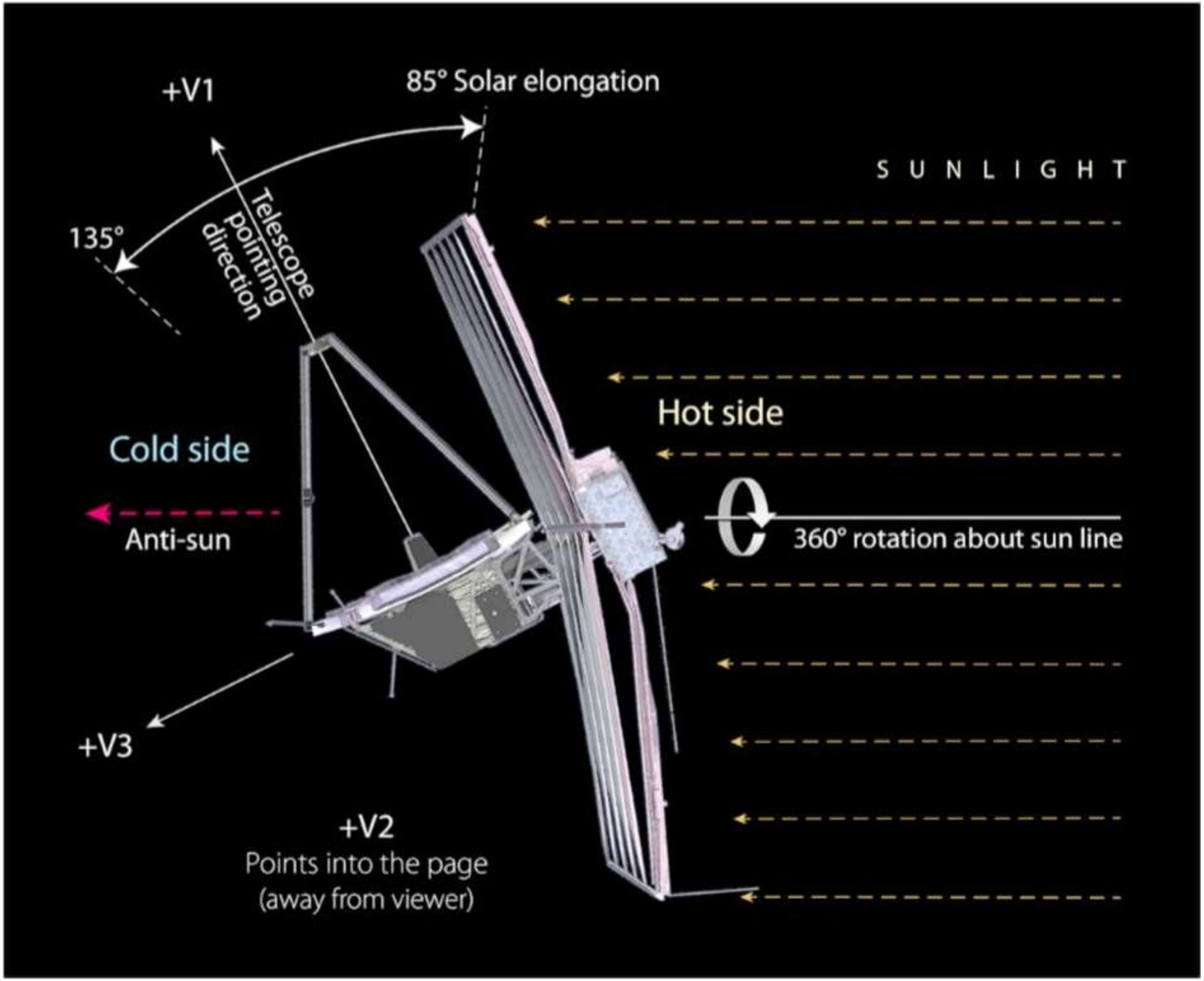
also called wine-glass gyroscope or mushroom gyro, is made using a thin solid-state hemispherical shell, anchored by a thick stem. This shell is driven to a flexural resonance by electrostatic forces generated by electrodes which are deposited directly onto separate fused-quartz structures that surround the shell. Gyroscopic effect is obtained from the inertial property of the flexural standing waves. HRG has no moving parts, is very compact, is extremely reliable and very accurate.

Suuntaus





Suuntaus



+V1
85° Solar elongation
SUNLIGHT
135°
Telescope pointing direction
Hot side
Cold side
Anti-sun
360° rotation about sun line
+V3
+V2
Points into the page
(away from viewer)

Suuntaus

The spacecraft bus has two star trackers, six reaction wheels. Control of the roll orientation about the telescope's optical axis is provided by input from the spacecraft's two star trackers. The star trackers each have a ~16° diameter FOV, projected on to a 512 × 512 pixel CCD detector.

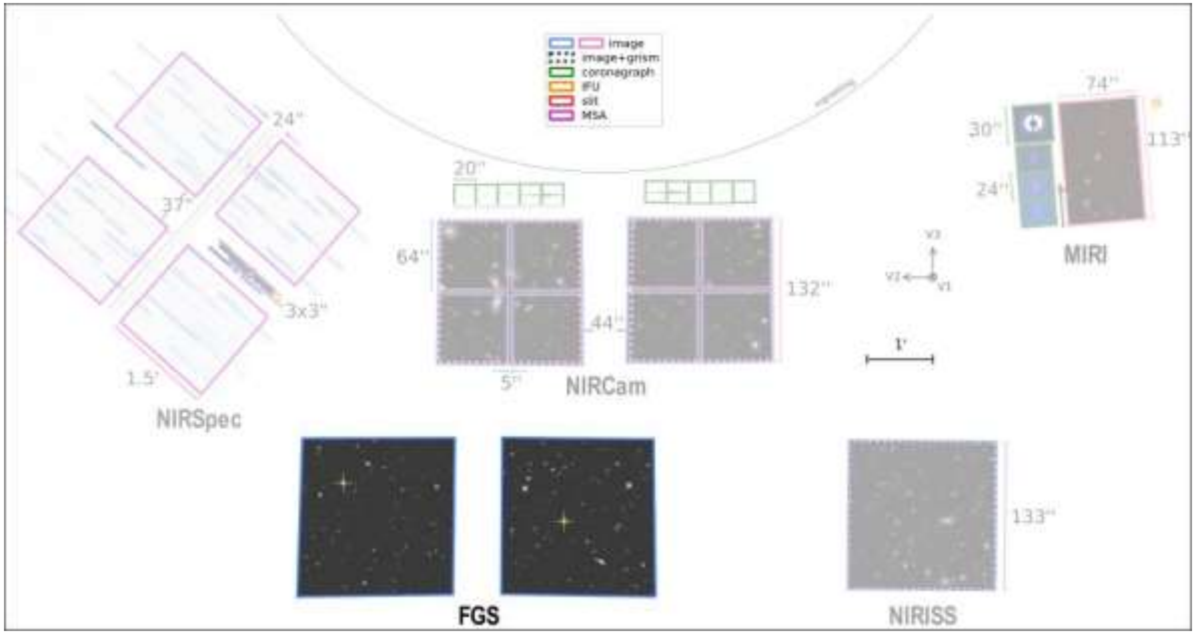
The JWST pointing control system will track objects moving at rates of up to 30 mas/sec (adequate to follow Mars and even most near-Earth objects).

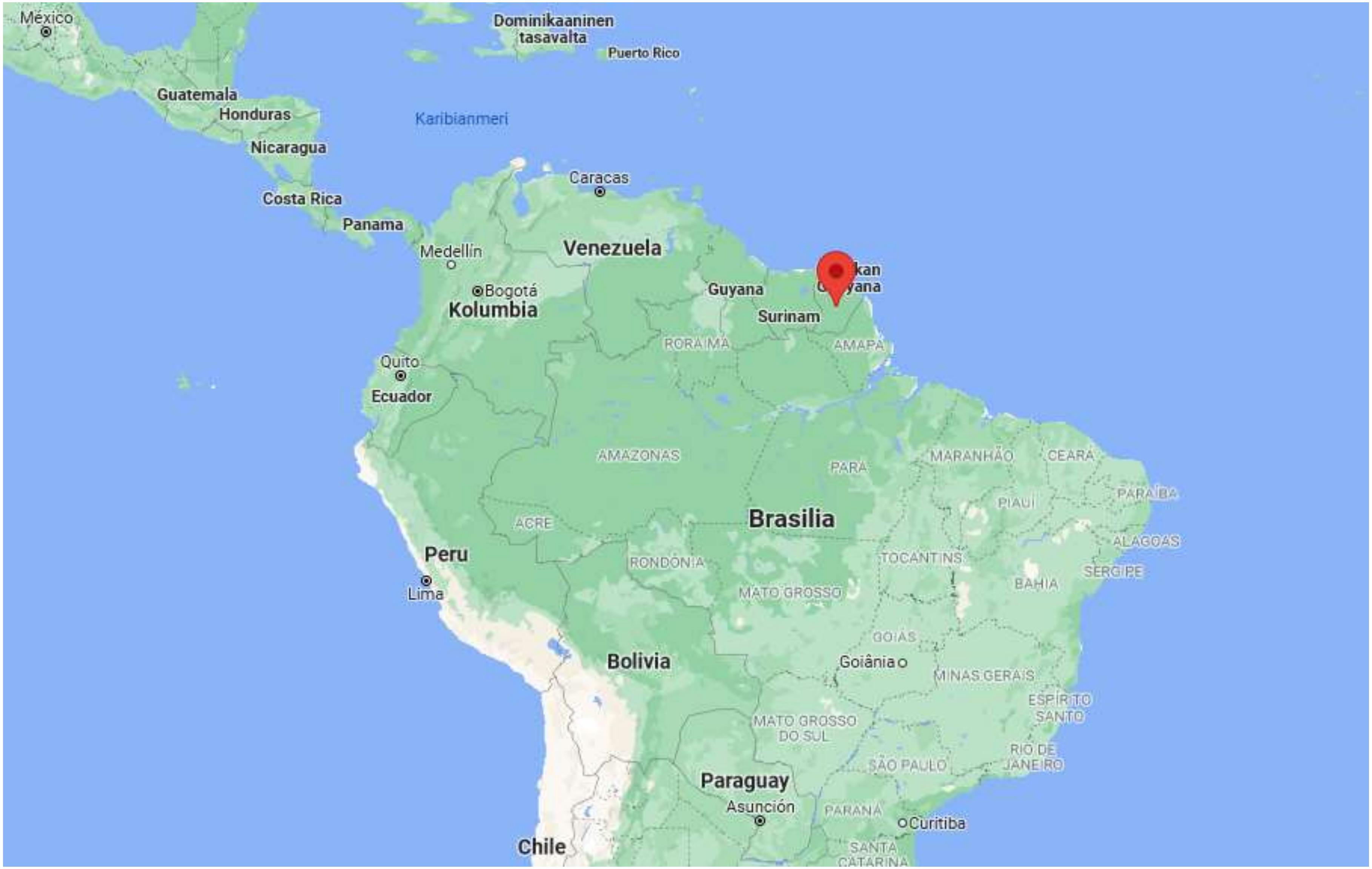
Suuntaus

Slew distance	Slew time (s)
0"–0.06"	0
>0.06" to 15"	20.48
>25" to 3°	109.312–825.6
>3° to 180°	521.216–3840.512

Suuntaus

The FGS makes measurements of the guide star position in the plane of the sky and sends these to the ACS every 64 ms. Using the FGS data, the ACS determines the telescope pointing error to be removed, using a combination of the fine steering mirror (FSM) and the spacecraft's reaction wheels.
(ACS) = Attitude control subsystem

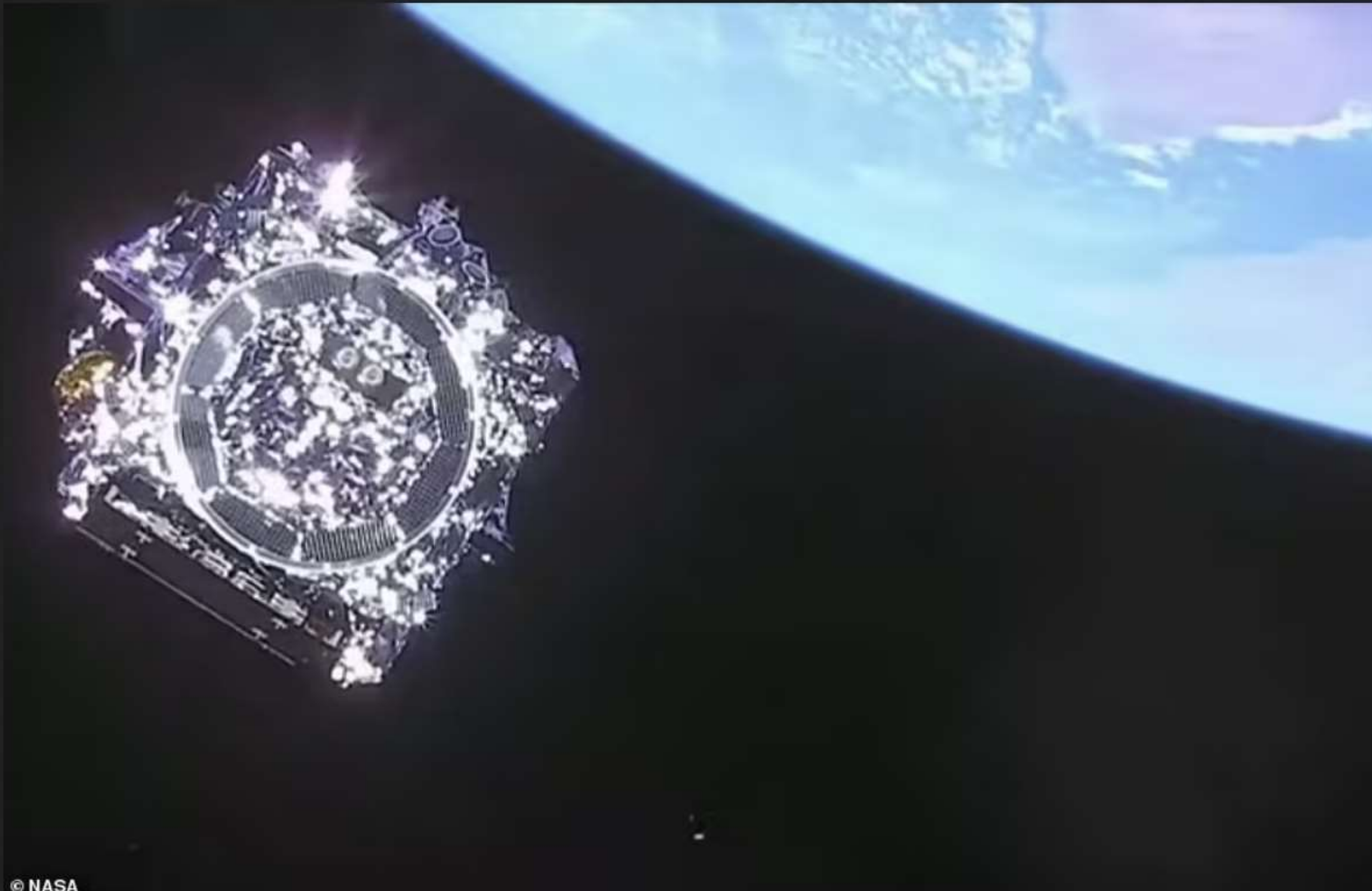


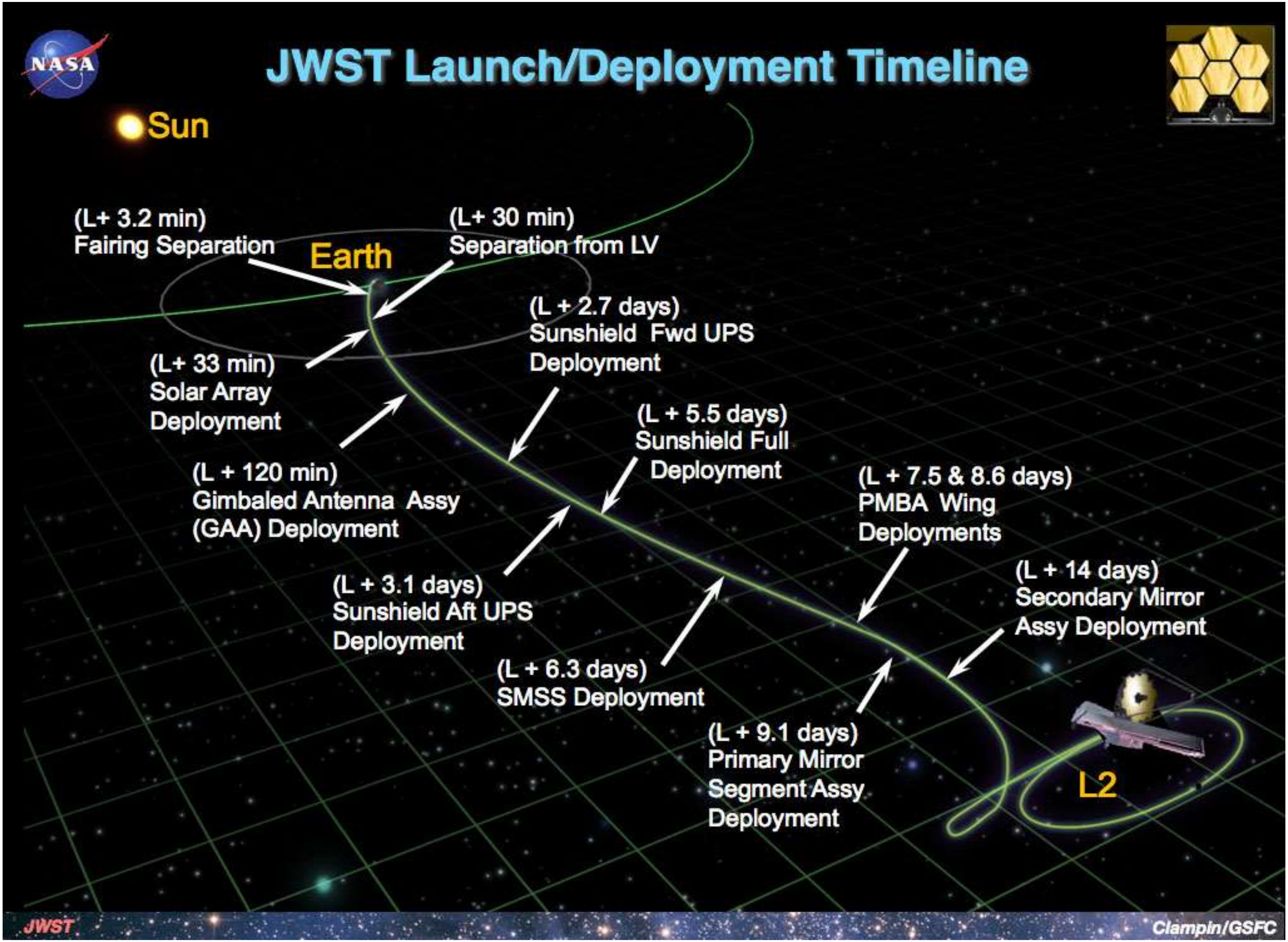


Ranskan Guayana, viralliselta nimeltään Guayanan merentakainen departementti, on Ranskan merentakainen departementti ja hallintoalue Etelä-Amerikassa, Karibianmeren rannalla Surinamen ja Brasilian välissä. Osana Ranskaa se on myös osa Euroopan unionia ja euroaluetta.


esa
ariane


esa

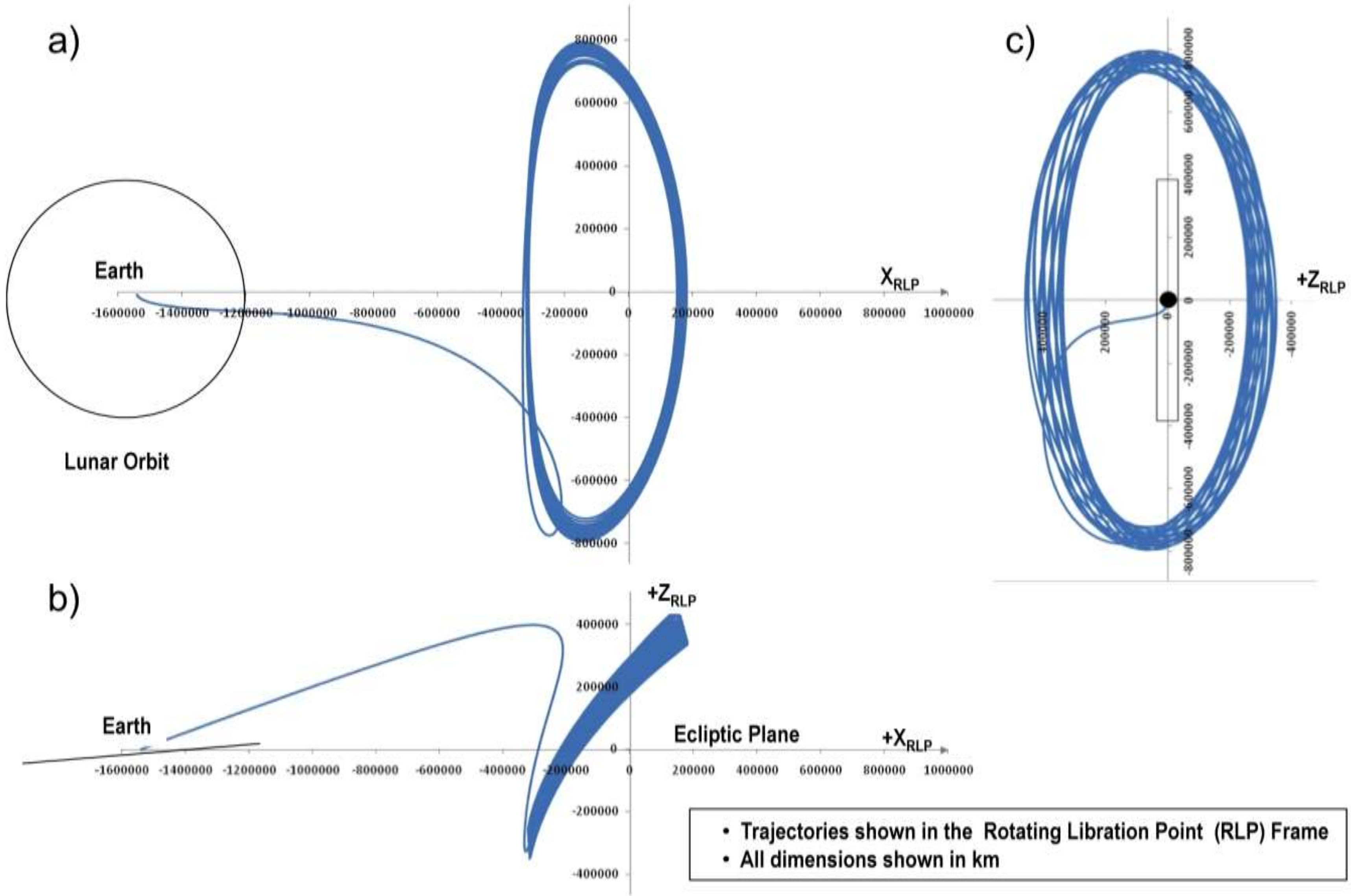

© NASA


JWST Launch/Deployment Timeline
Sun
Earth
(L+ 3.2 min)
Fairing Separation
(L+ 30 min)
Separation from LV
(L+ 33 min)
Solar Array
Deployment
(L + 120 min)
Gimbaled Antenna Assy
(GAA) Deployment
(L + 2.7 days)
Sunshield Fwd UPS
Deployment
(L + 3.1 days)
Sunshield Aft UPS
Deployment
(L + 5.5 days)
Sunshield Full
Deployment
(L + 6.3 days)
SMSS Deployment
(L + 7.5 & 8.6 days)
PMBA Wing
Deployments
(L + 9.1 days)
Primary Mirror
Segment Assy
Deployment
(L + 14 days)
Secondary Mirror
Assy Deployment
L2
JWST
Clampin/GSFC

L2

The distance of JWST from the L2 point varies between 250,000 to 832,000 km. The period of the orbit is about six months. The maximum excursion above or below the ecliptic plane is 520,000 km. The maximum distance from the Earth is 1.8 million km, and the maximum Earth-Sun angle is <33° .

L2 is a saddle point in the gravitational potential of the Solar System. Because saddle points are not stable, JWST will need to regularly fire onboard thrusters to maintain its orbit around L2. These station-keeping maneuvers will be performed every 21 days.


a)
Earth
Lunar Orbit
XRLP
-1600000 -1400000 -1200000 -1000000 -800000 -600000 -400000 -200000 0 200000 400000 600000 800000 1000000
800000 600000 400000 200000 0 -200000 -400000 -600000 -800000
b)
+ZRLP
Earth
Ecliptic Plane
+XRLP
400000 200000 0 -200000 -400000
c)
+ZRLP
• Trajectories shown in the Rotating Libration Point (RLP) Frame
• All dimensions shown in km

Rakentaminen, aikataulu, hinta

… It is currently planned to be launched in 2013 from French Guiana aboard an Ariane 5 launch vehicle...

... It will be the closest simulation of the space environment before the actual launch, which may not occur until 2018...

… James Webb Space Telescope, scheduled to launch in 2018...

… a new launch date of October 2018...

… in a launch window between March and June 2019...

… the launch window is now targeted for about May 2020...

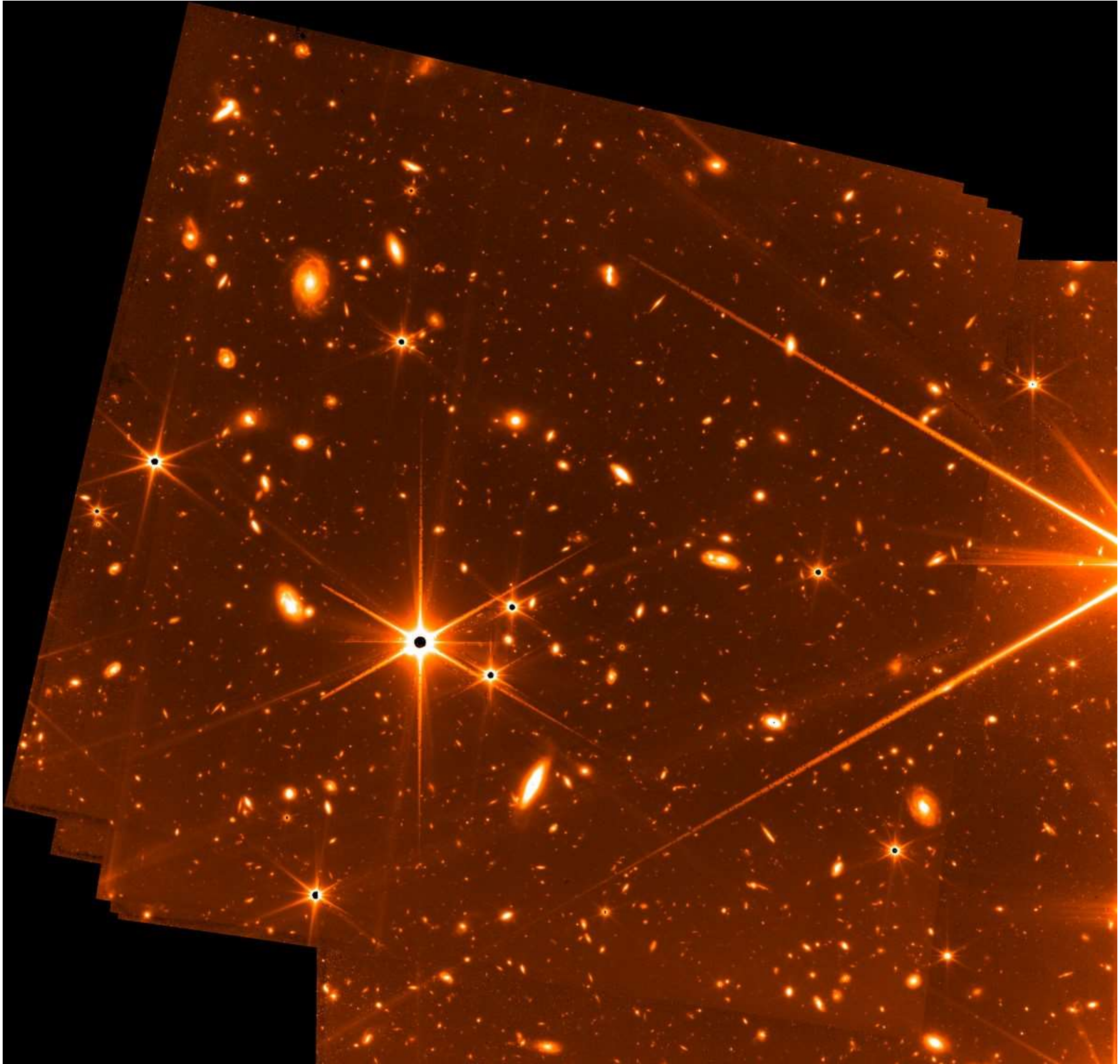
… Uusi ajankohta on näillä näkymin maaliskuu 2021.

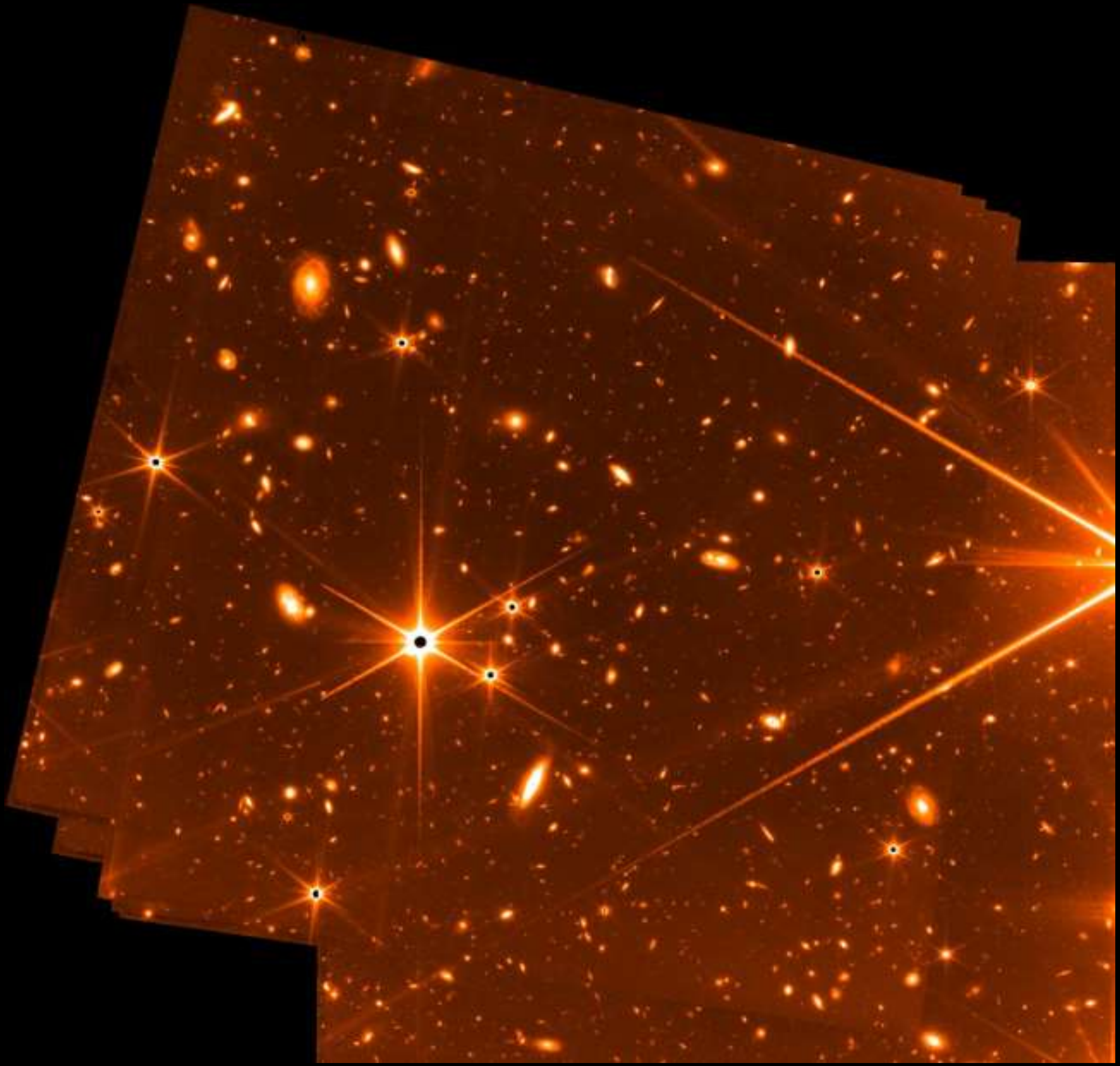
… NASA's Webb telescope delayed, may exceed $8 billion price tag.

… more money from Congress...

The Henry Draper Catalogue (HD) is an astronomical star catalogue published between 1918 and 1924, giving spectroscopic classifications for 225,300 stars

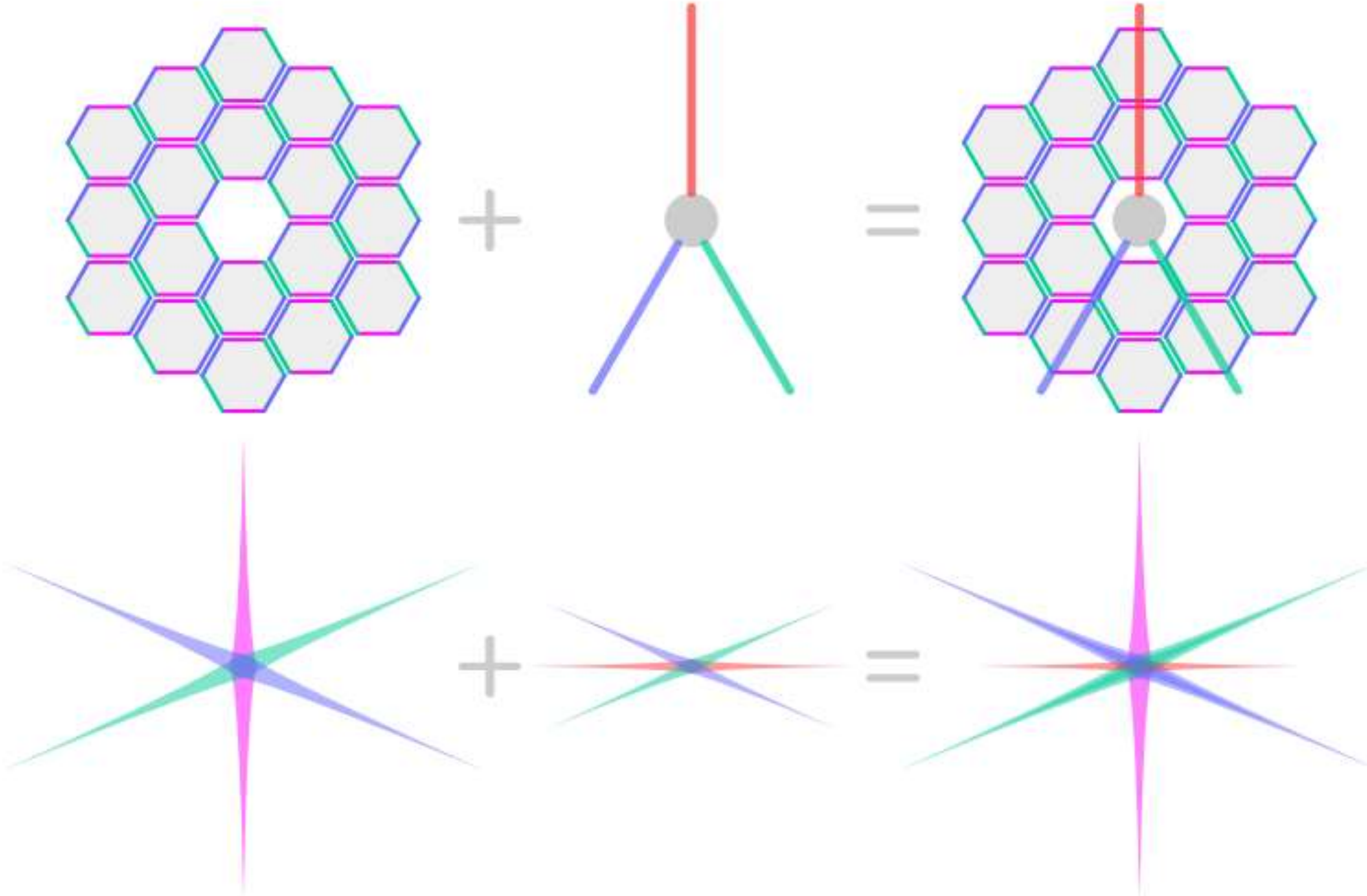
2.2.2022 ensimmäinen kuva ennen peilien suuntausta

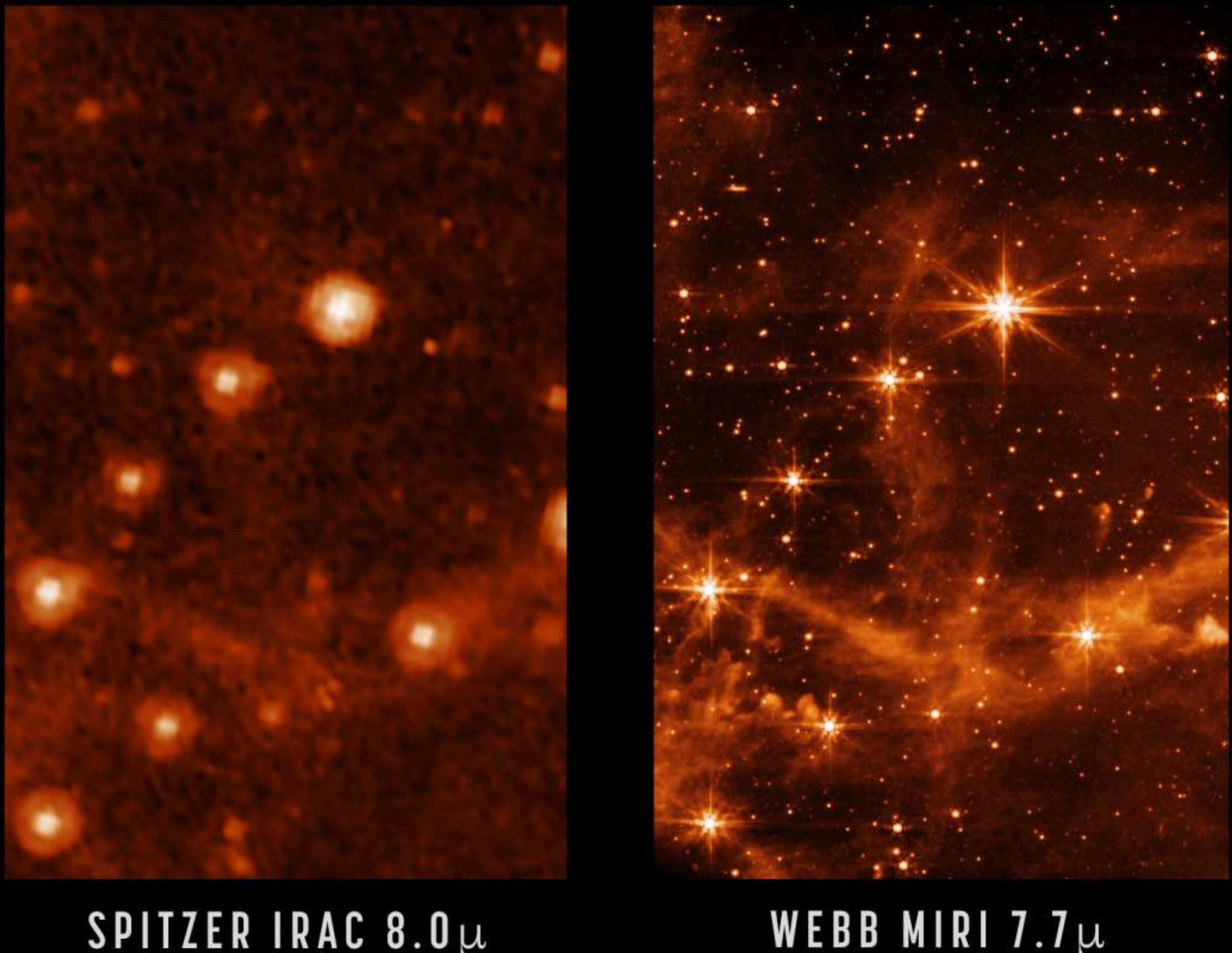




72 exposures over 32 hours. In this image, the FGS image was acquired in parallel with NIRCam imaging of the star HD147980 over a period of 8 days at the beginning of May.

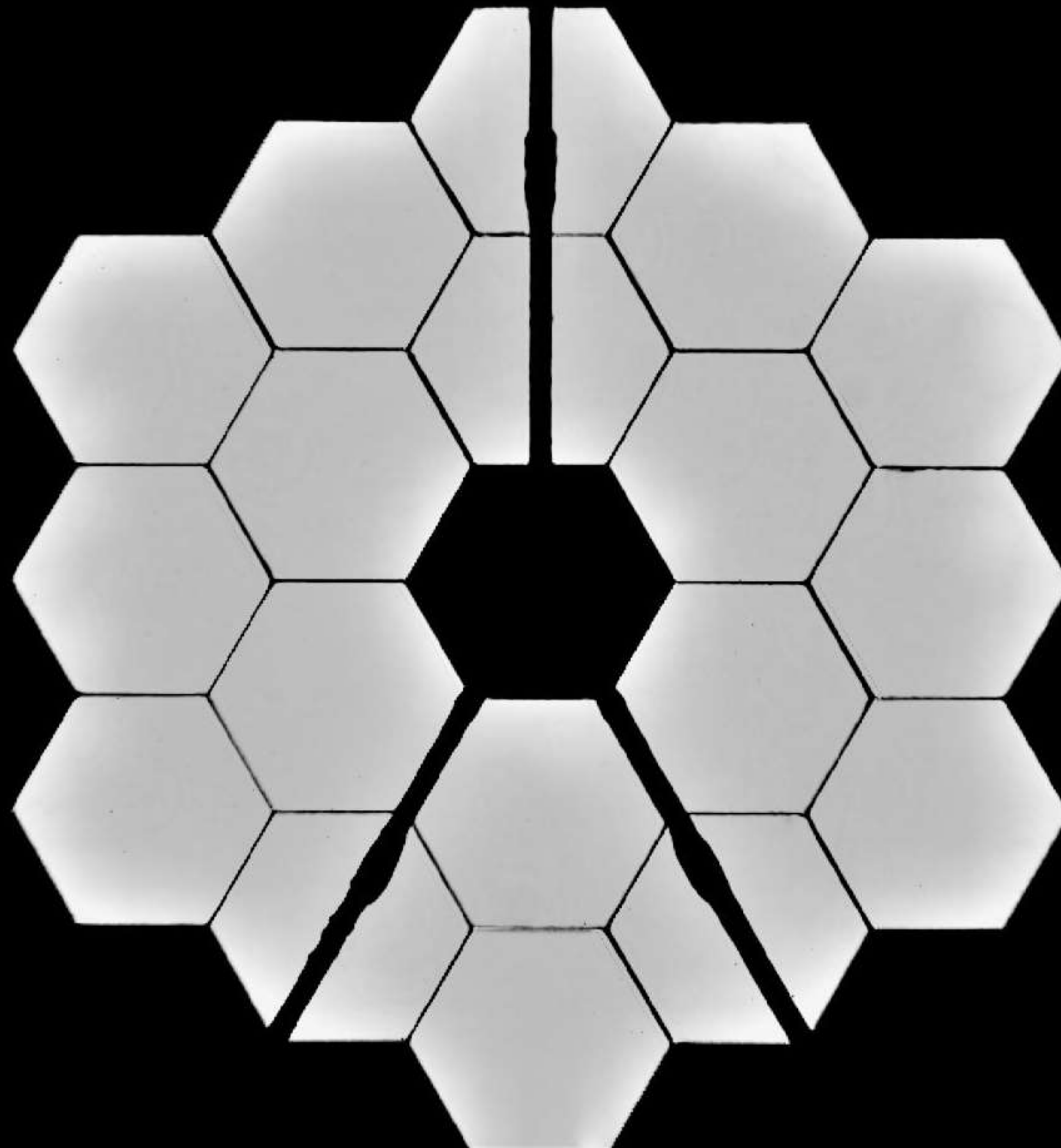

TELESCOPE ALIGNMENT EVALUATION IMAGE

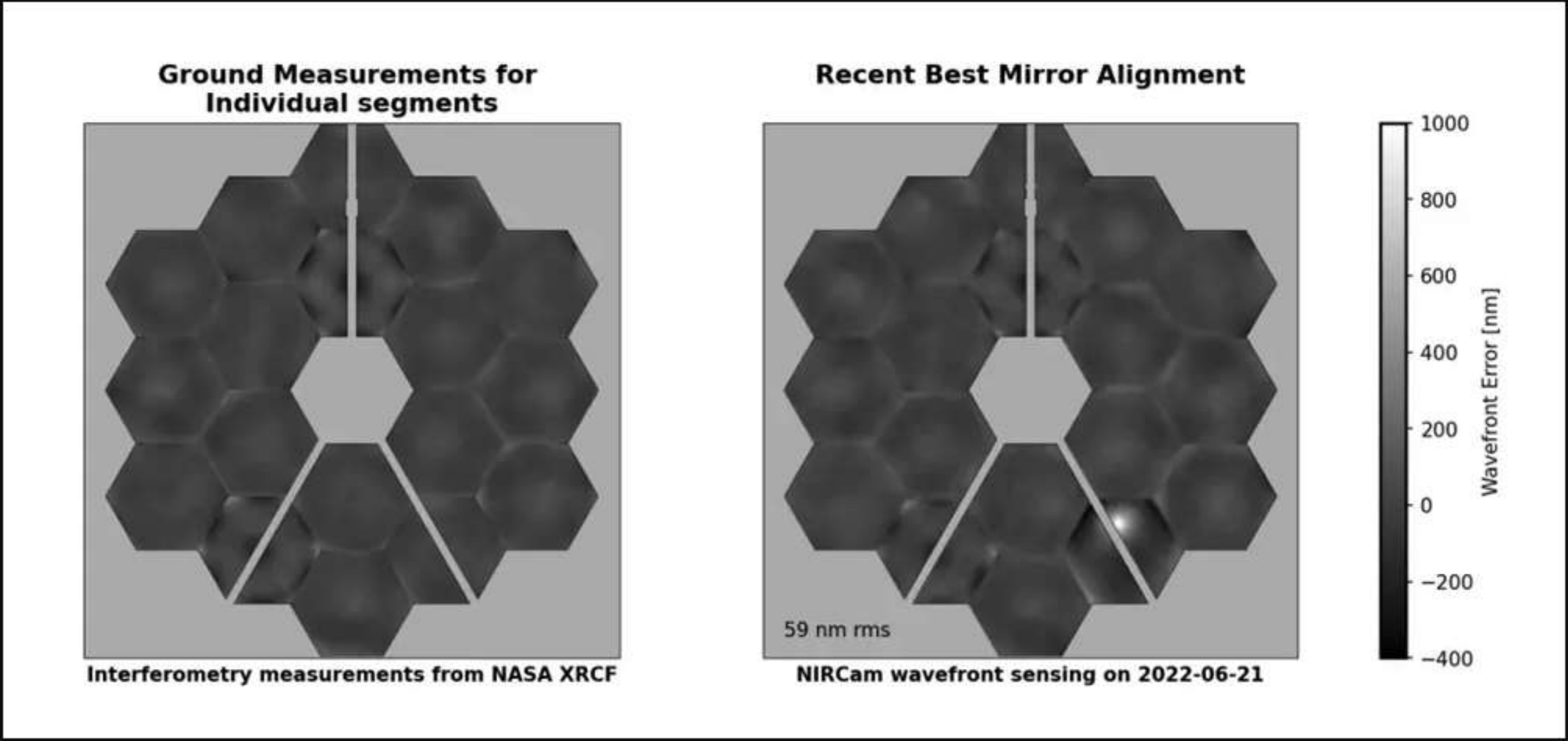




James Webb Space Telescope’s MIRI instrument captures an incredible, sharp photo of Large Magellanic Cloud. Toukokuu 2022.

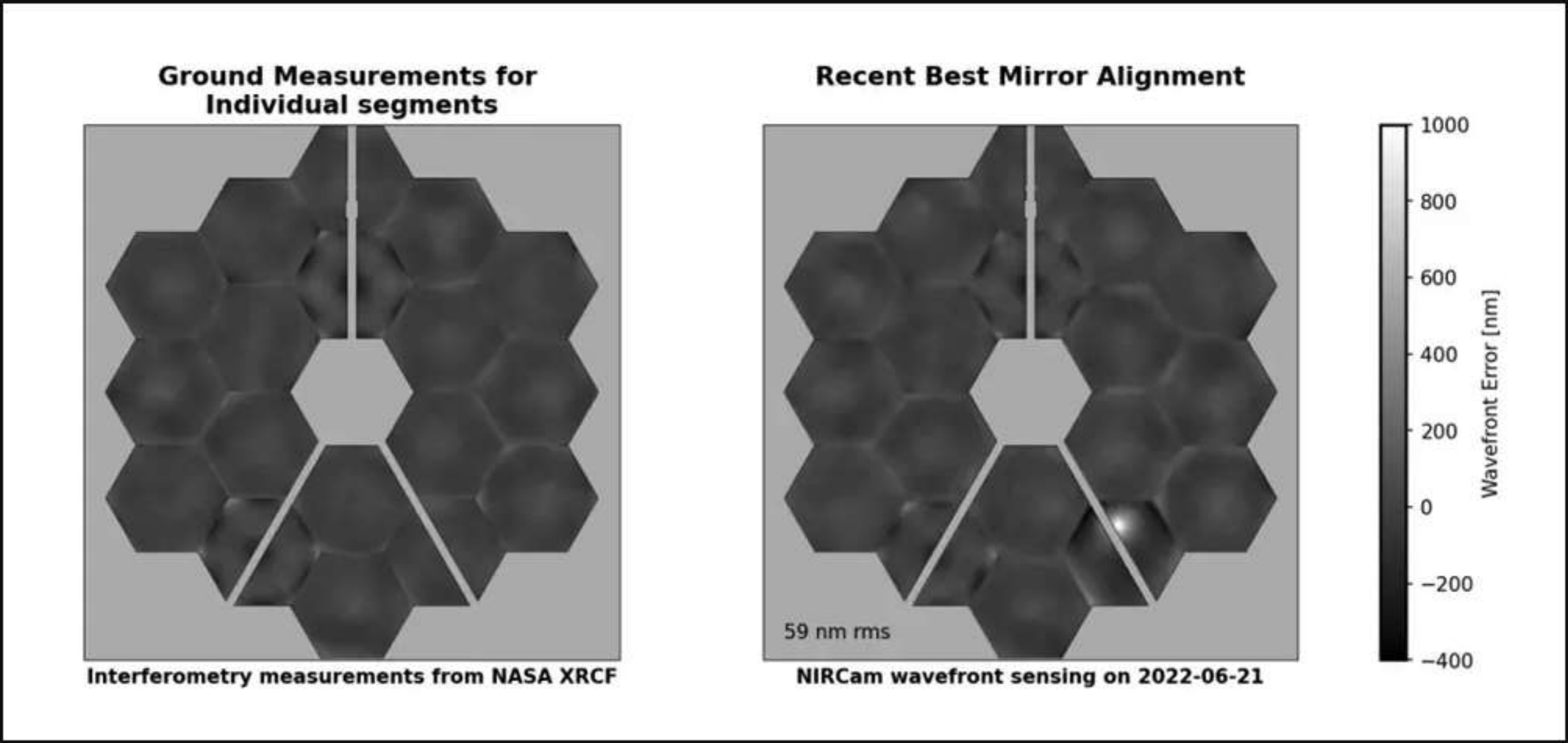
NIRCAM ALIGNMENT SELFIE





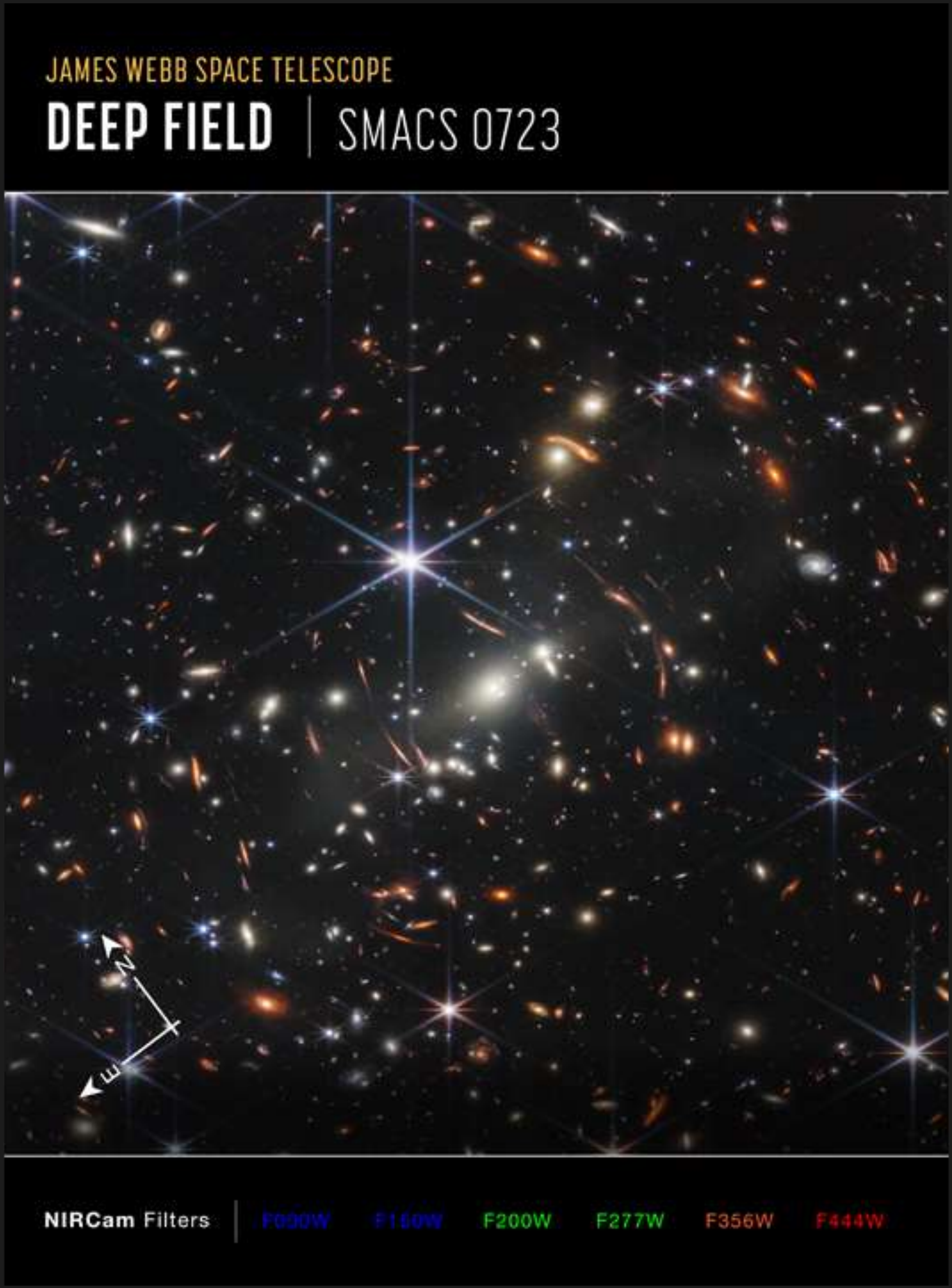
23.-25. toukokuuta

For now, engineers are keeping an eye on potential future dust-generating events such as in 2023 and 2024, when Webb is expected to fly through particles left behind by Halley's Comet.

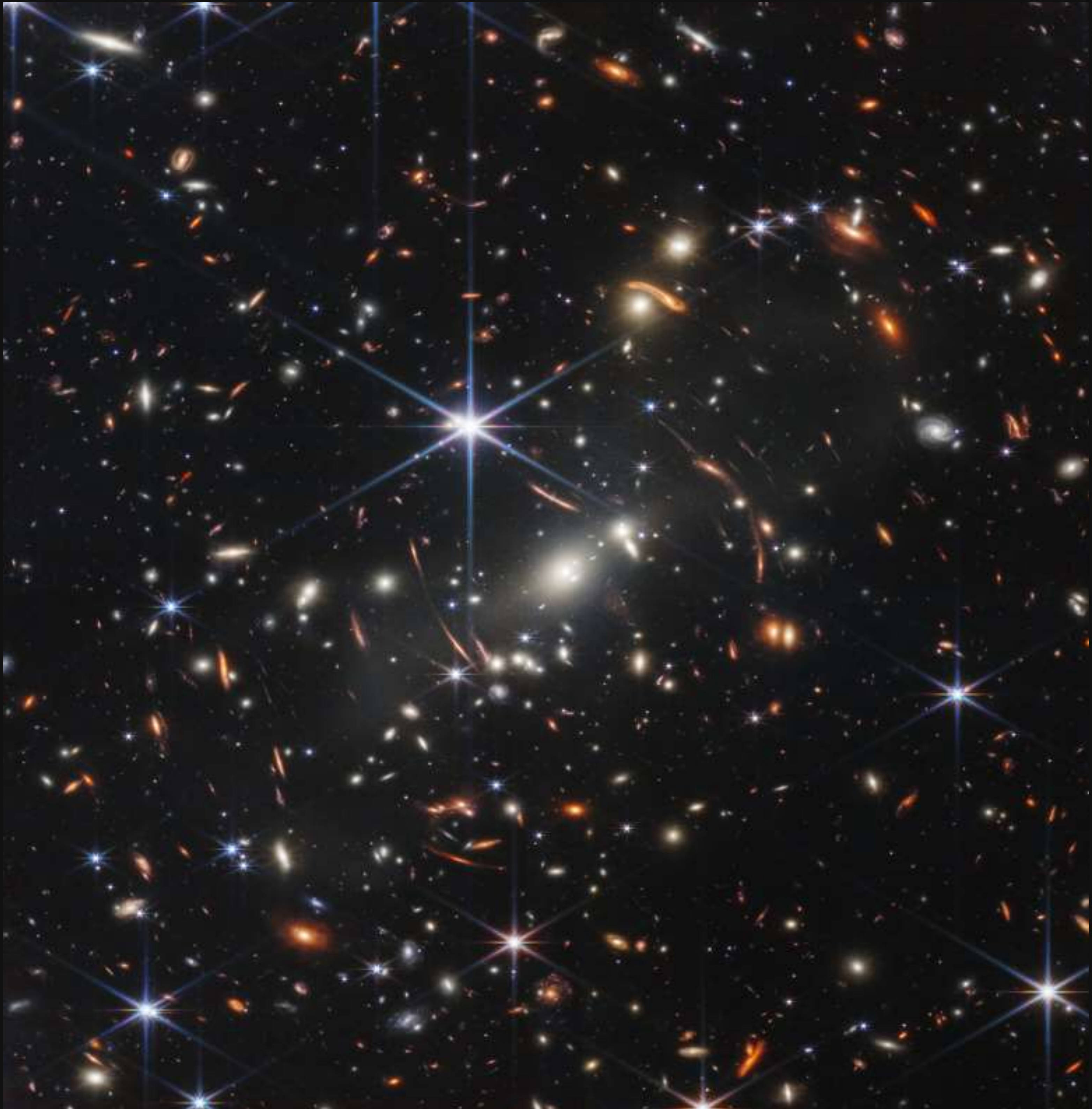


At the beginning the mission, the C3 segment had a wavefront error of 56 nanometers rms, a level similar to the main mirror's other 17 segments. The impact increased C3's wavefront error to 258 nm rms.

Spacecraft engineers can change the position and curvature of each segment and in this way were able to reduce the error to 178 nm rms.

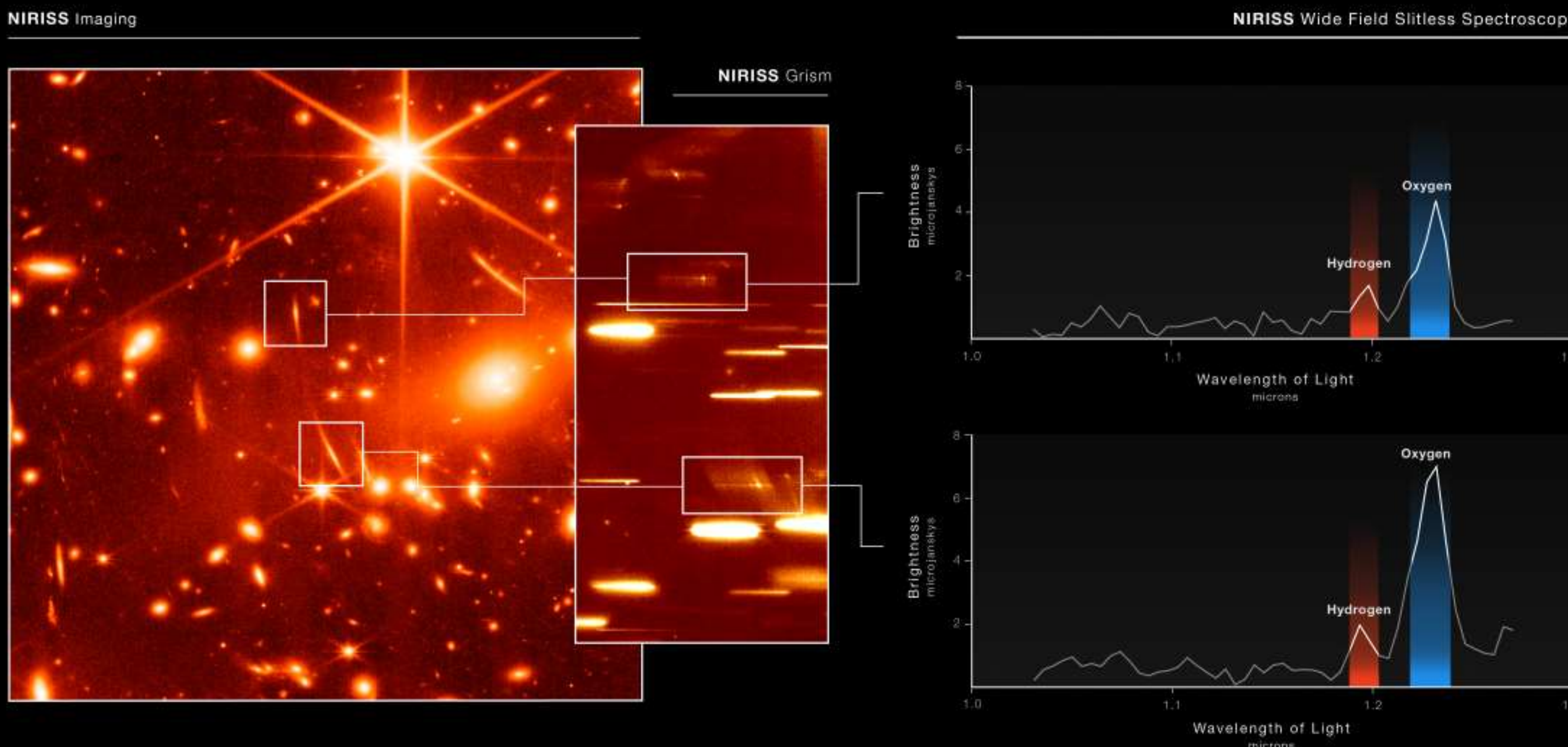


This deep field, taken by Webb's Near-Infrared Camera (NIRCam), is a composite made from images at different wavelengths, totaling 12.5 hours – achieving depths at infrared wavelengths beyond the Hubble Space Telescope's deepest fields, which took weeks.



GALAXY CLUSTER SMACS 0723

WEBB SPECTRA CONFIRM TWO ARCS ARE THE SAME GALAXY

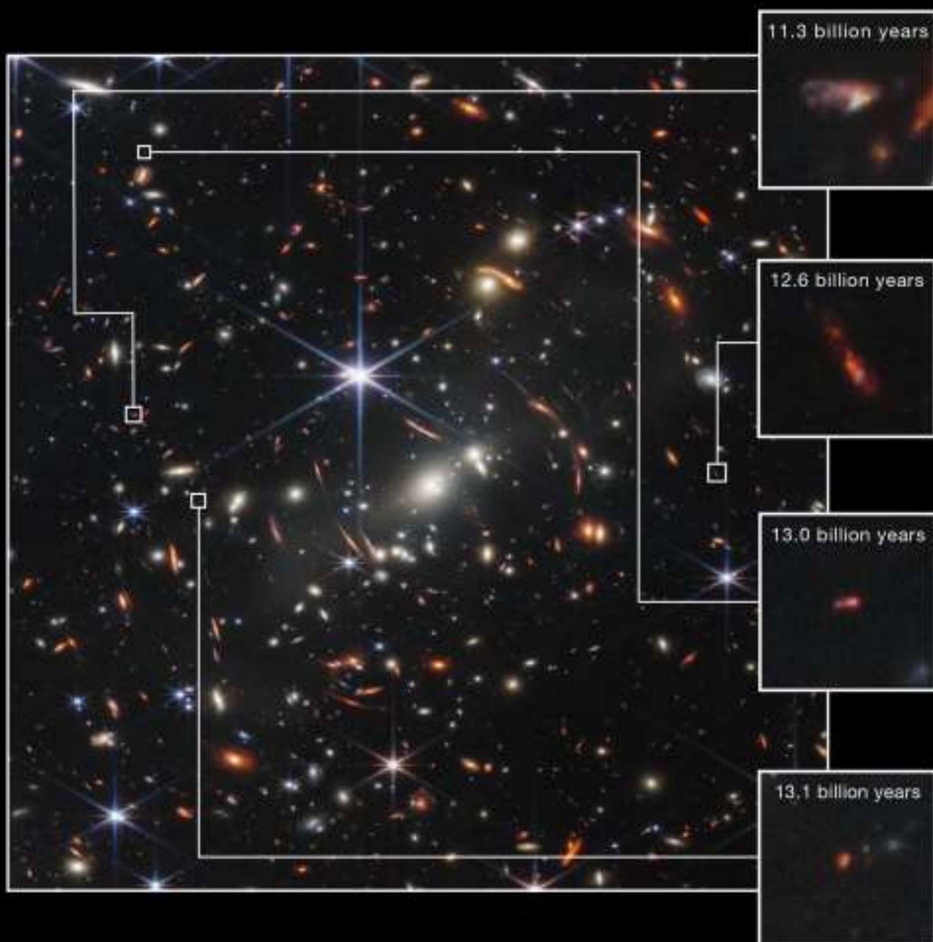


WEBB
SPACE TELESCOPE

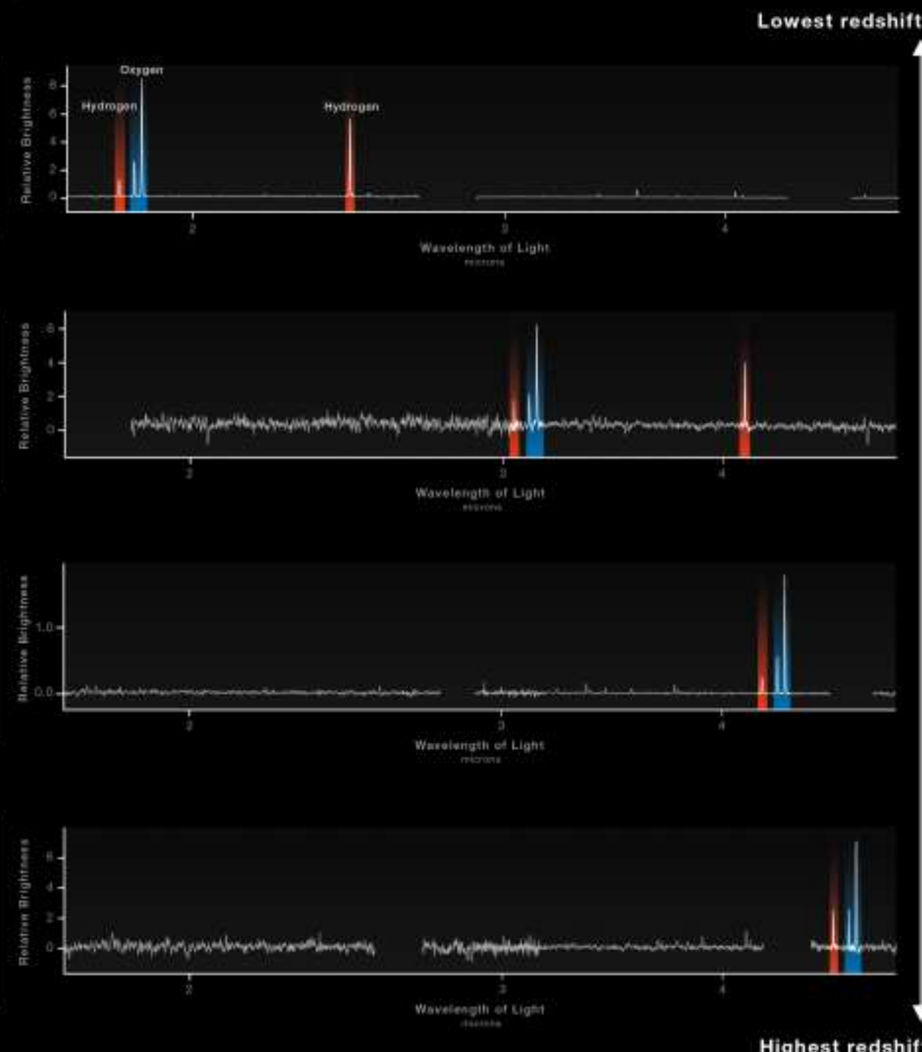
GALAXY CLUSTER SMACS 0723

WEBB SPECTRA IDENTIFY GALAXIES IN THE VERY EARLY UNIVERSE

NIRCam Imaging



NIRSpec Microshutter Array Spectroscopy



WEBB
SPACE TELESCOPE

Kohde Pegasus-tähdistössä.

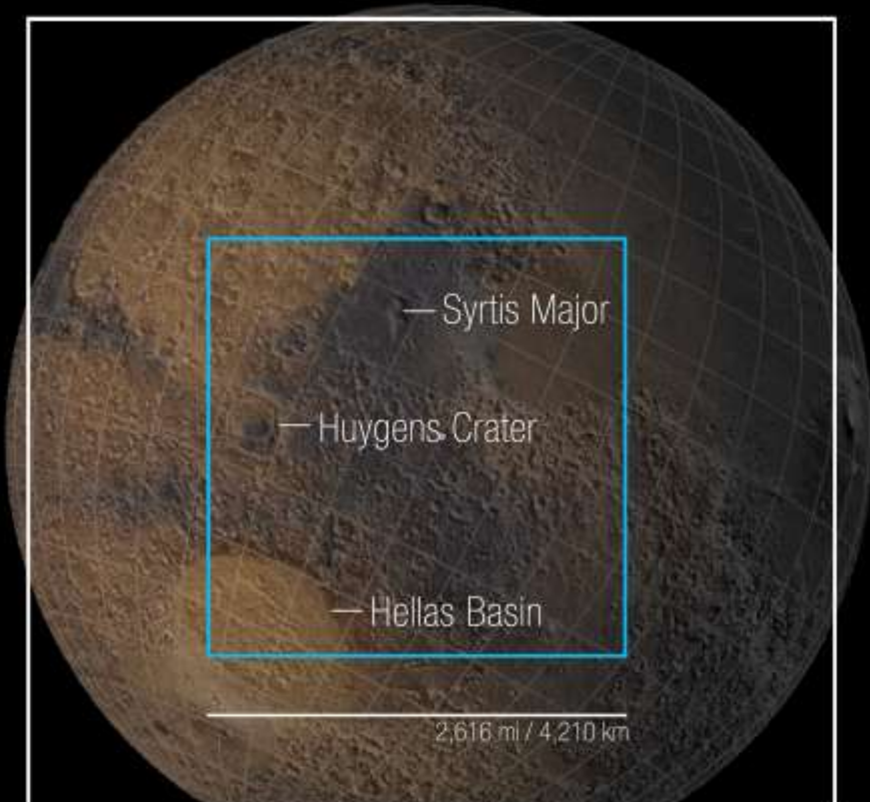
An enormous mosaic of Stephan’s Quintet is the largest image to date from NASA’s James Webb Space Telescope, covering about one-fifth of the Moon’s diameter. It contains over 150 million pixels and is constructed from almost 1,000 separate image files. The visual grouping of five galaxies was captured by Webb’s Near-Infrared Camera (NIRCam) and Mid-Infrared Instrument (MIRI).

With its powerful, infrared vision and extremely high spatial resolution, Webb shows never-before-seen details in this galaxy group. Sparkling clusters of millions of young stars and starburst regions of fresh star birth grace the image. Sweeping tails of gas, dust and stars are being pulled from several of the galaxies due to gravitational interactions. Most dramatically, Webb’s MIRI instrument captures huge shock waves as one of the galaxies, NGC 7318B, smashes through the cluster. These regions surrounding the central pair of galaxies are shown in the colors red and gold.

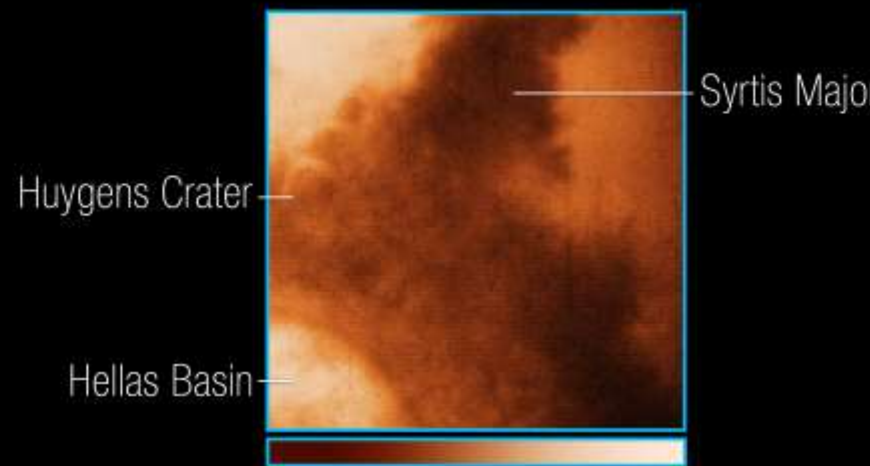
Mars

James Webb Space Telescope

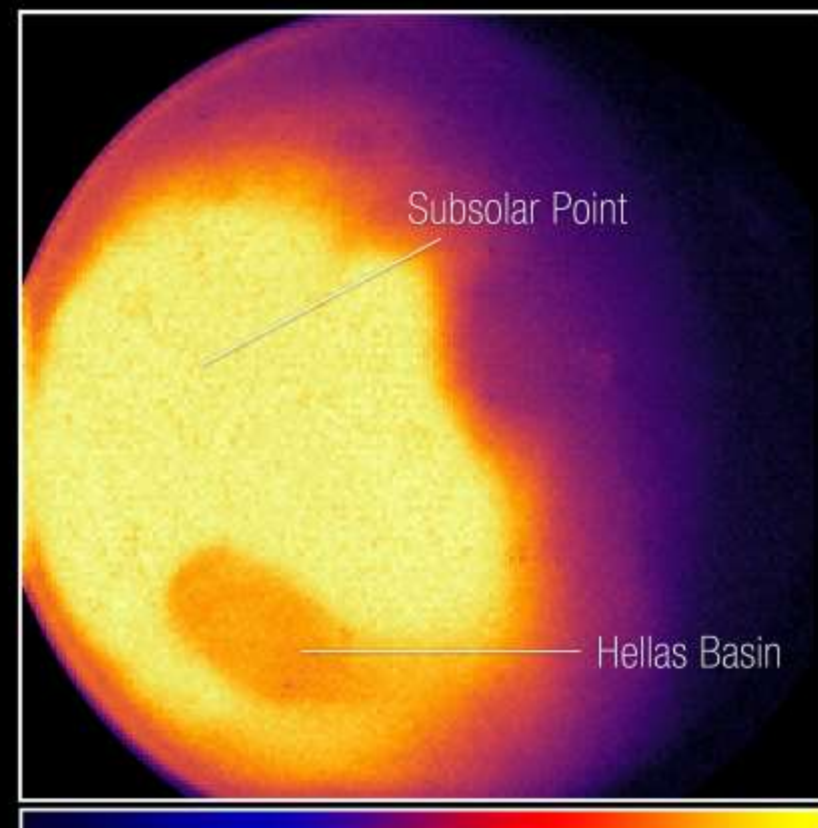
NIRCam - September 5, 2022



Simulated Mars image with base maps from NASA and MOLA data

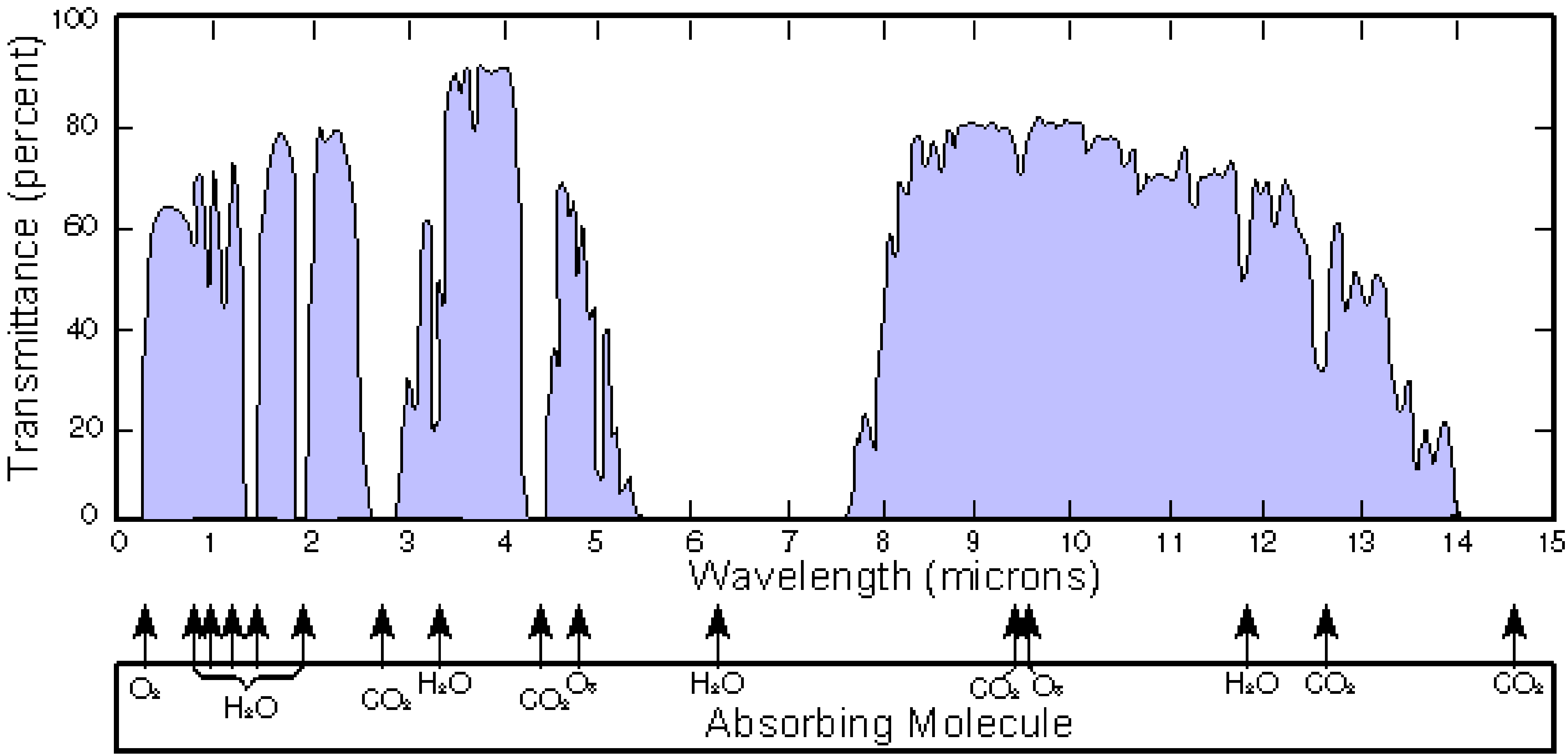


NIRCam brightness at 2.1 microns



NIRCam brightness at 4.3 microns

NASA, ESA, CSA, STScI, MARS JWST/GTO team



Transmittance (percent)
100
80
60
40
20
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Wavelength (microns)
O2
H2O
CO2
H2O
CO2
O3
H2O
CO2
O3
H2O
CO2
CO2
Absorbing Molecule

Jupiter and its moon Europa, left, are seen through the James Webb Space Telescope’s NIRCam instrument 2.12 micron filter. (Image credit: NASA, ESA, CSA, and B. Holler and J. Stansberry (STScI))

Webb NIRCam composite image of Jupiter from three filters – F360M (red), F212N (yellow-green), and F150W2 (cyan) – and alignment due to the planet's rotation. Credit: NASA, ESA, CSA, Jupiter ERS Team; image processing by Judy Schmidt.

Meet a Citizen Scientist: Judy Schmidt

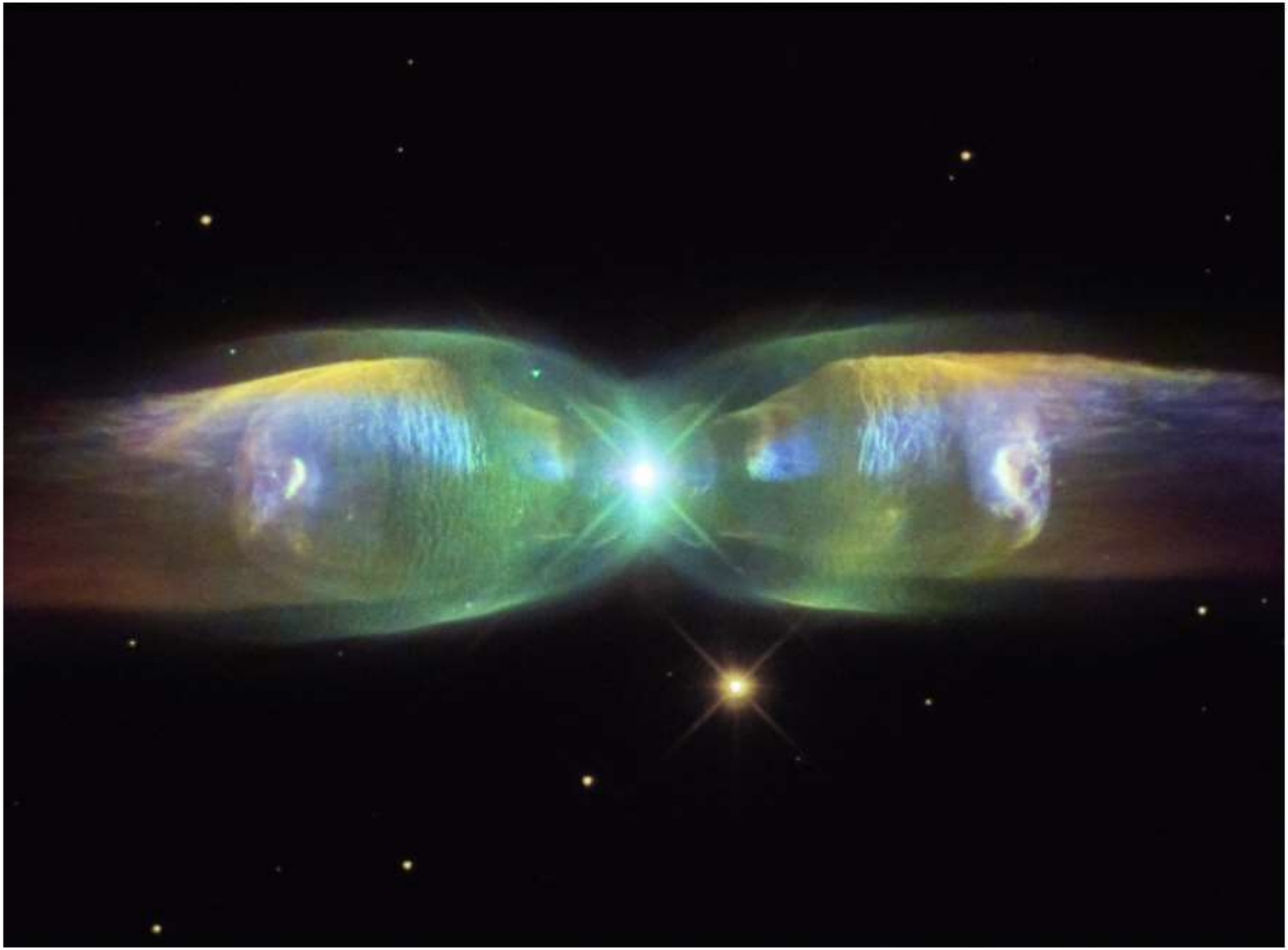
(Image Courtesy of Judy Schmidt)

Location

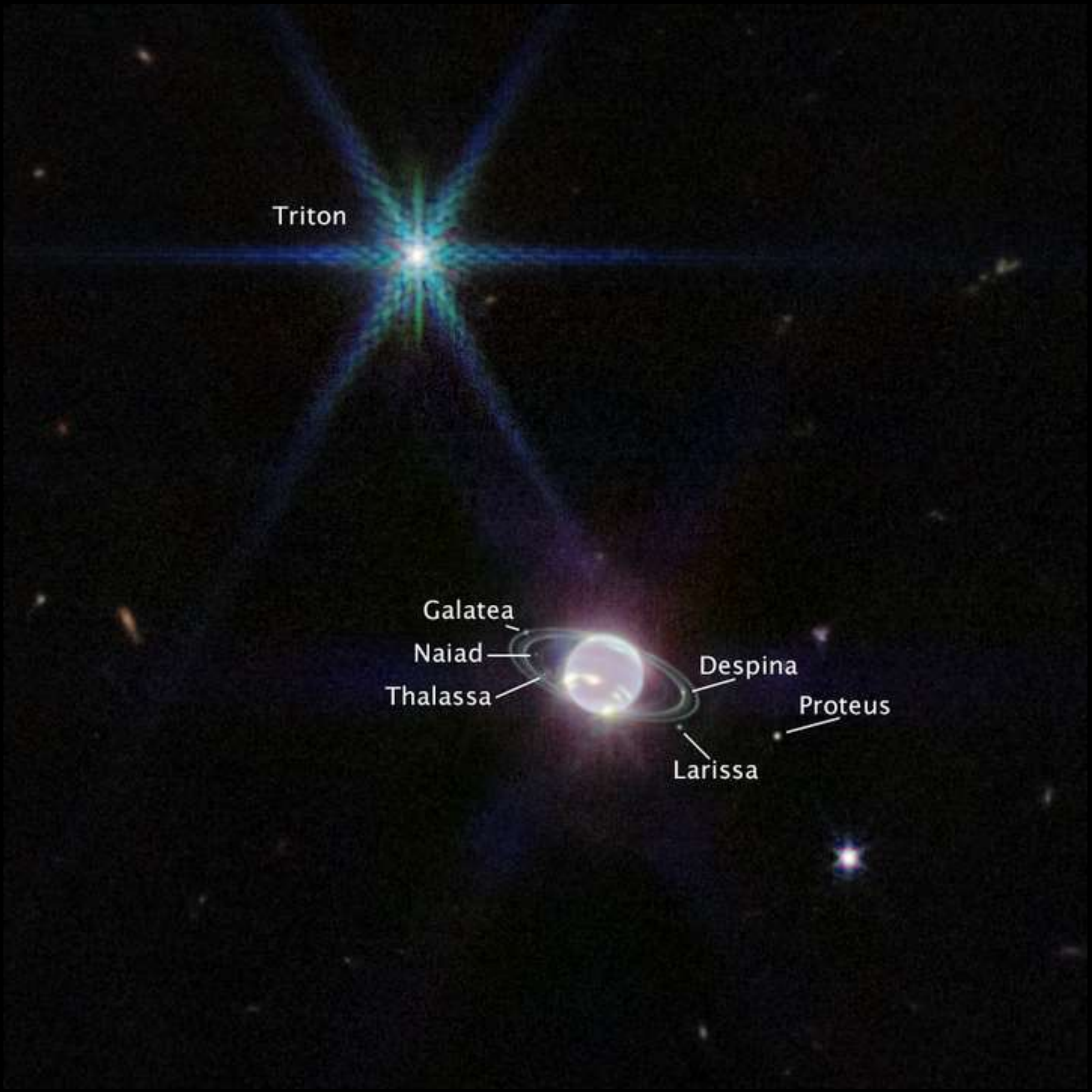
Modesto, California

What do you study?

I study image processing, specifically astronomical image processing. More broadly, I study all sorts of topics in astronomy because there are so many different images of many different types of objects and phenomena. When I first got into it, I was focusing more on planetary nebulas. On top of being very interesting and artistic, they're mysterious.



This image from NASA's Hubble Space Telescope shows the butterfly-like planetary nebula M2-9, processed by citizen scientist Judy Schmidt.(Credit: NASA/ESA/Hubble Legacy Archive/Judy Schmidt)



On Sept. 21, 2022

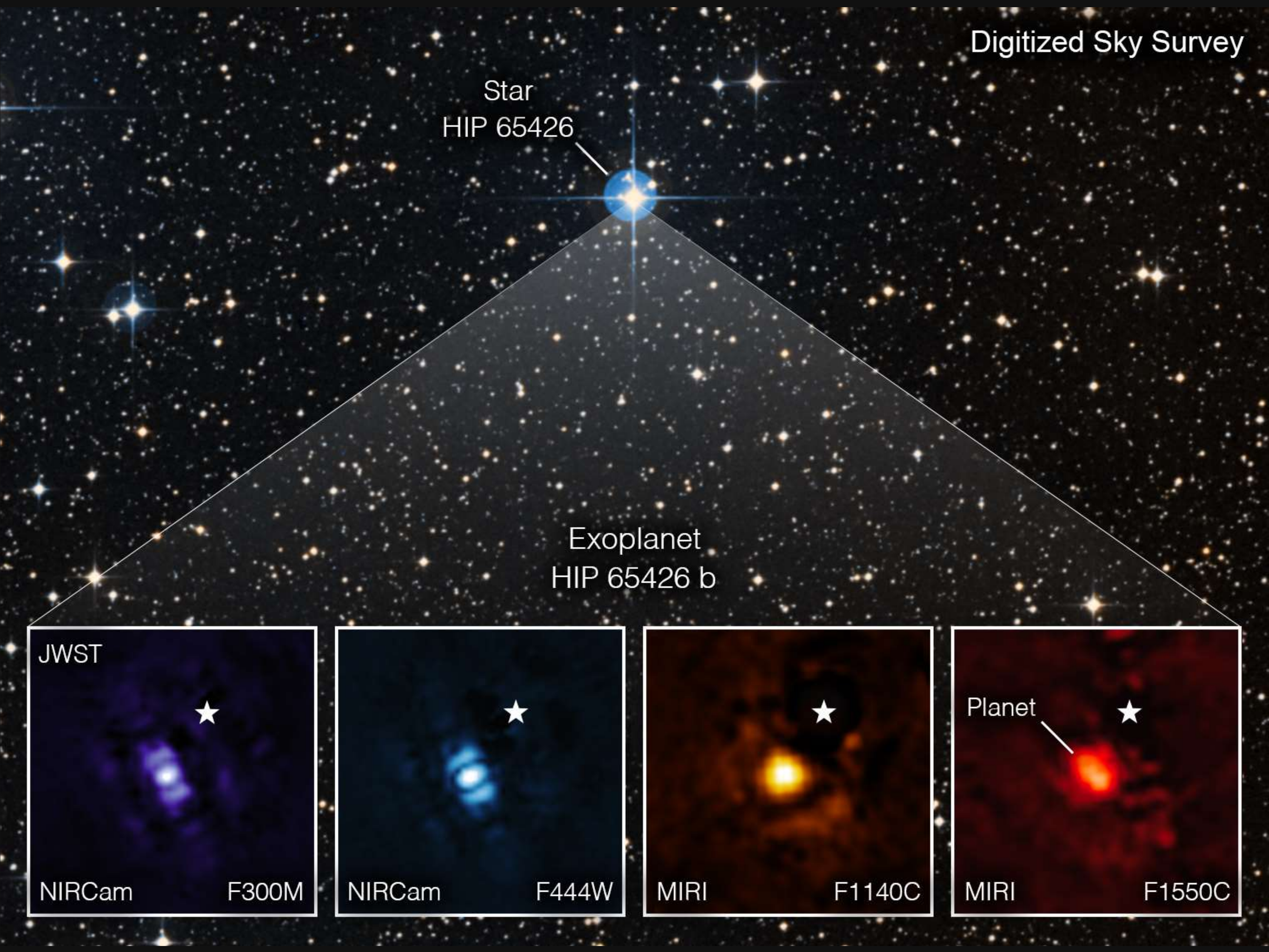
Since NIRCam images objects in the near-infrared range from 0.6 to 5 microns, Neptune does not appear blue to Webb. In fact, the methane gas so strongly absorbs red and infrared light that the planet is quite dark at these near-infrared wavelengths, except where high-altitude clouds are present. Those methane-ice clouds are prominent as bright streaks and spots, which reflect sunlight before it is absorbed by methane gas.

On Sept. 21, 2022

In this image, green, yellow, and red were assigned to Webb's near-infrared data taken in 0.9, 1.5, and 3.56 microns (F090W, F150W, and F356W respectively). Blue was assigned to two Hubble filters, ultraviolet data taken in 0.34 microns (F336W) and visible light in 0.61 microns (F606W). Read the full description and download the image files by clicking or tapping the image above. Credit: NASA, ESA, CSA, Rogier Windhorst (ASU), William Keel (University of Alabama), Stuart Wyithe (University of Melbourne), JWST PEARLS Team

Hubble

Webb


Digitized Sky Survey
Star
HIP 65426
Exoplanet
HIP 65426 b
JWST
NIRCam
F300M
NIRCam
F444W
MIRI
F1140C
Planet
MIRI
F1550C

HIP 65426 b etäisyys tähdestä 92 AU

HIP 65426 etäisyys meistä 356 valovuotta

1 valovuosi = 63240 AU

Näistä voidaan laskea exoplaneetan kulmaetäisyys tähdestä https://archive.stsci.edu/

Featured Data Products

JWST data will be available in various stages:

- **Raw FITS Files (Stage 0):** Raw spacecraft output converted to FITS file format
- **Detector Corrected Exposures (Stage 1):** Output count-rate images after applied detector-level corrections to raw data
- **Flux Calibrated Exposures (Stage 2):** Fully-calibrated individual exposures, and associated files, to all imaging/spectroscopy data and modes
- **Calibrated Combined Products + Associations (Stage 3):** Combined final data products specific to each observing mode

https://unistellaroptics.com/ephemeris/

Webb vihreän nuolen kohdalla. Kuva: Gaia


Jorma Ryske: 26.2.2022 Klo 23.27 - 00.15 - Orimattila, Artjärvi, Viestikallio (I)

Jäsenilta

Katse kauemmaksi
eli
James Webb -teleskooppi

Hannu Määttänen

31.10.2018

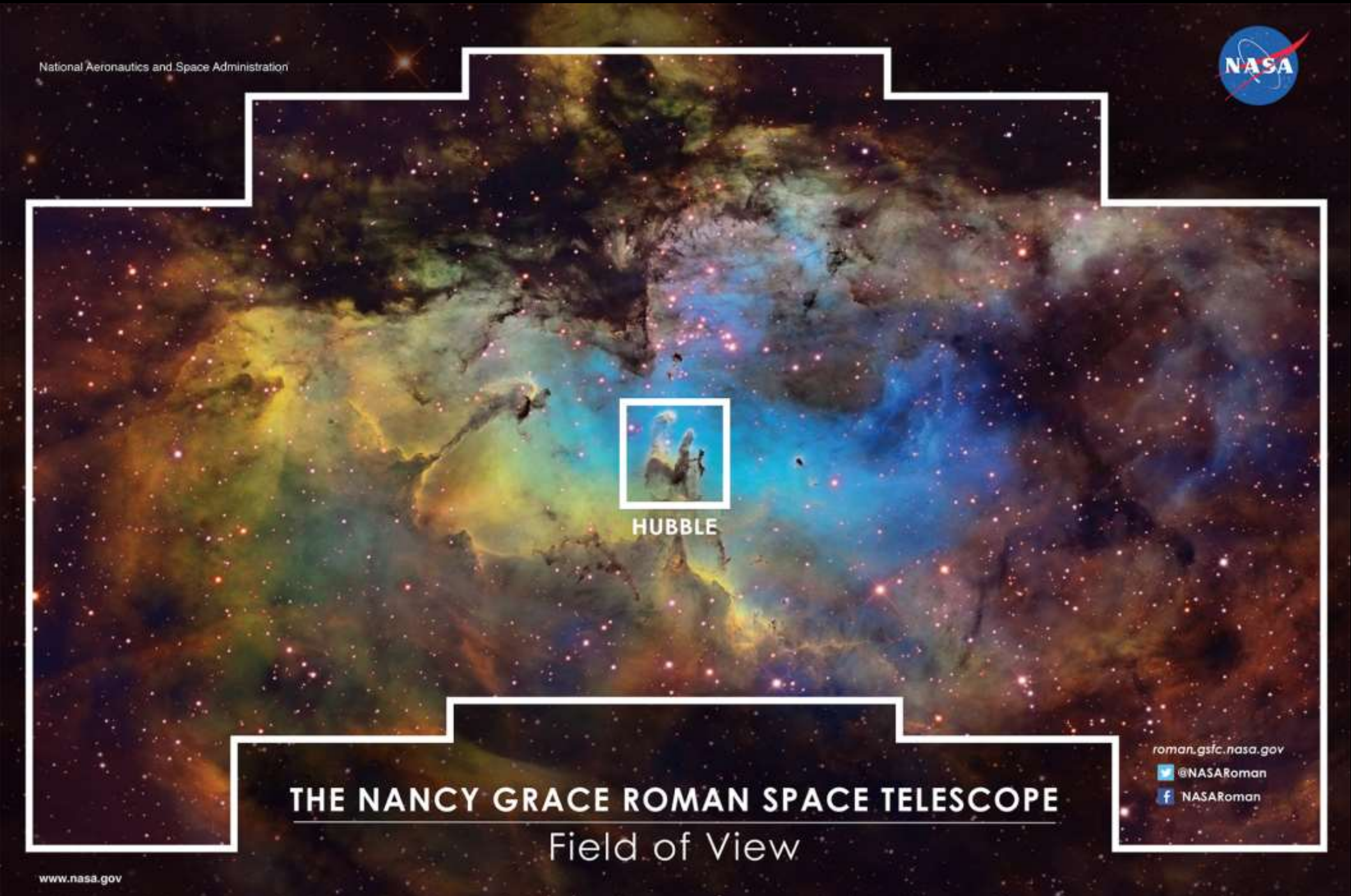
Eikä tässä kaikki

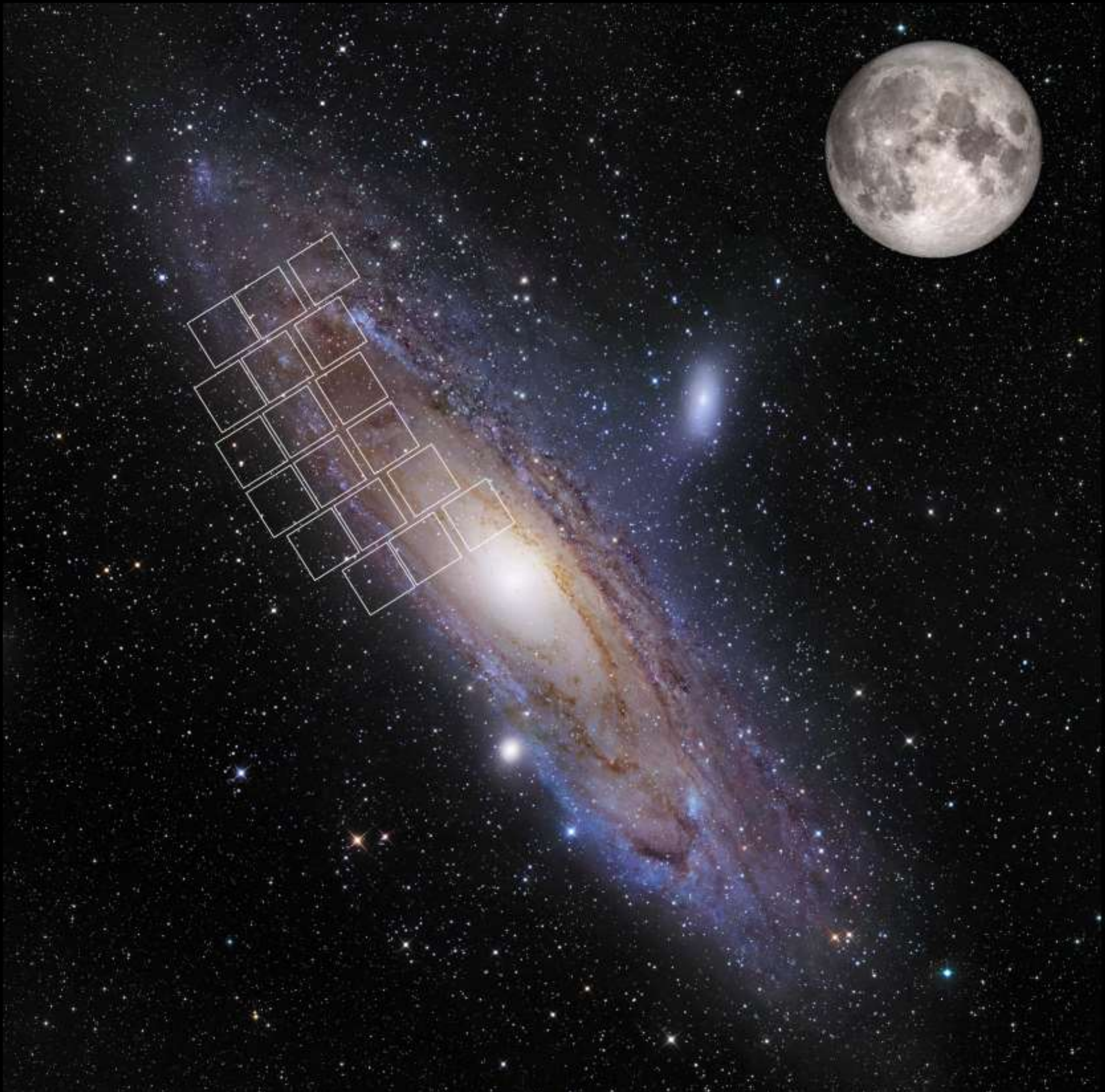
NANCY GRACE ROMAN

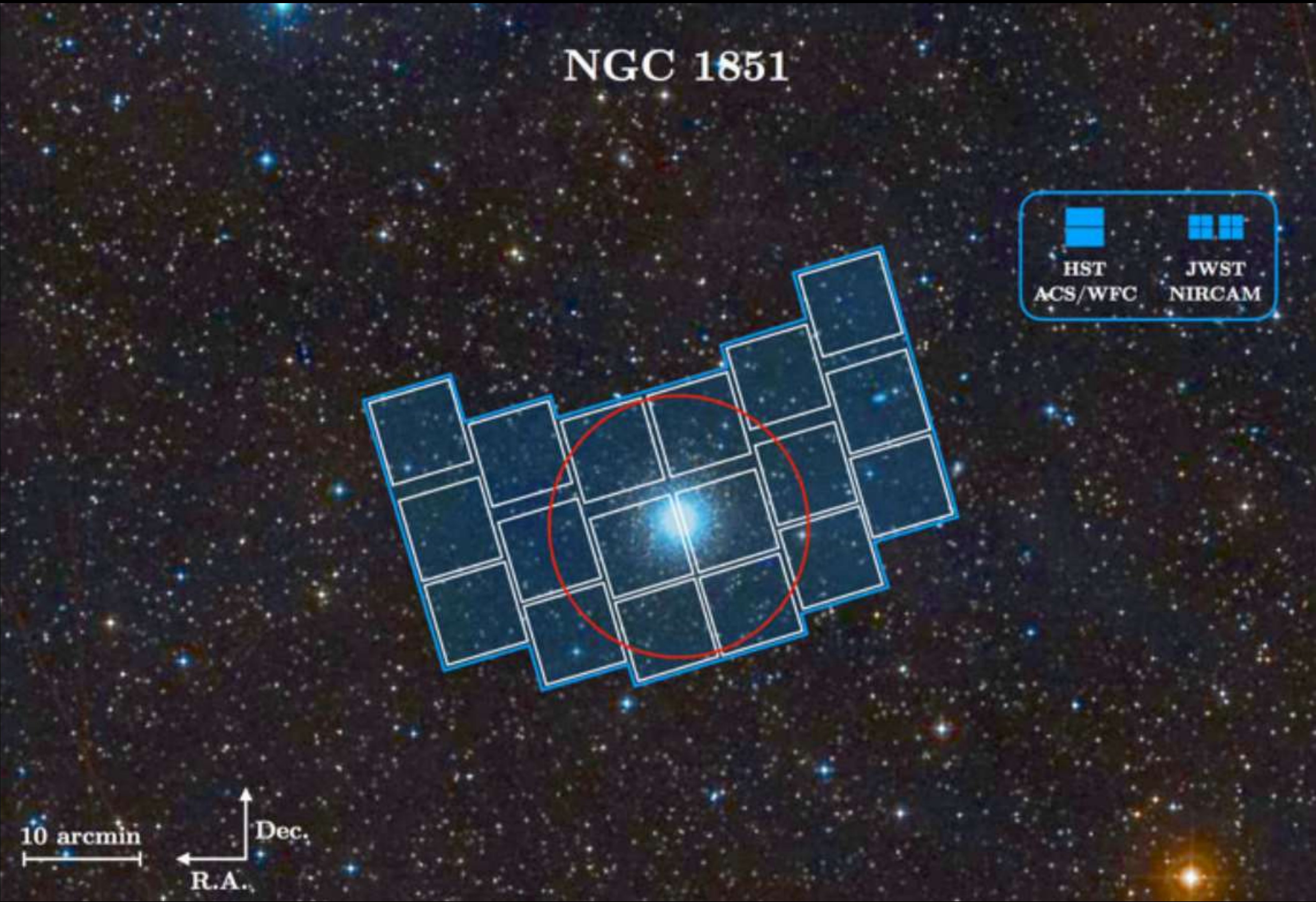
SPACE TELESCOPE

Nancy Grace Roman (1925 - 2018)

Roman’s mirror weighs only 410 pounds (186 kilograms) thanks to major improvements in technology


National Aeronautics and Space Administration
NASA
HUBBLE
THE NANCY GRACE ROMAN SPACE TELESCOPE
Field of View
roman.gsfc.nasa.gov
@NASARoman
NASARoman
www.nasa.gov

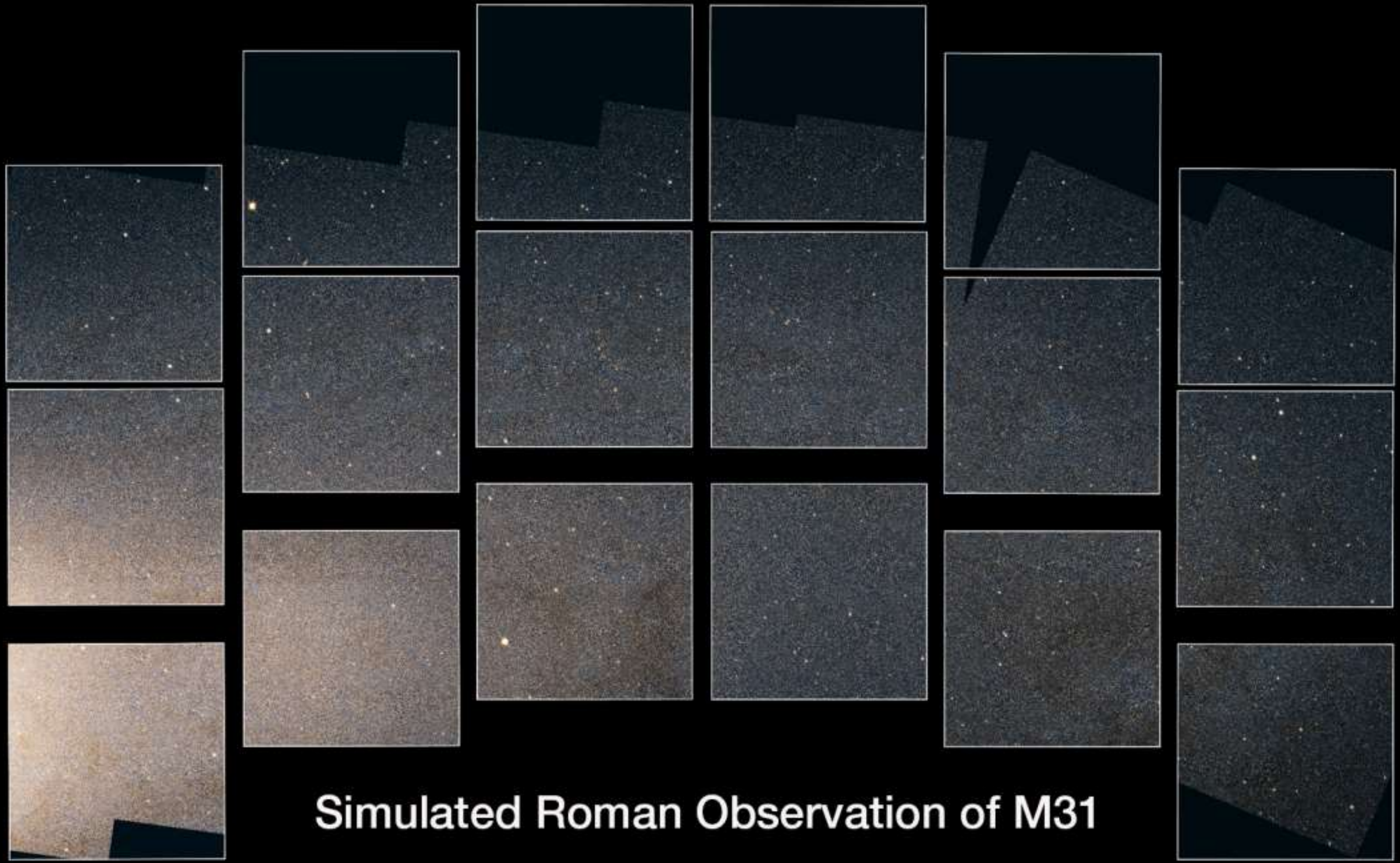



NGC 1851
HST
ACS/WFC
JWST
NIRCAM
10 arcmin
Dec.
R.A.

Teledyne Imaging Sensors (TIS) is a leading manufacturer of high performance infrared detectors for Astronomy. Recently, TIS has completed assembling and delivering Eighteen (18) H4RG-10 focal plane arrays that will comprise the focal plane mosaic for Roman Space Telescope. Each individual array is 4,096 by 4,096 pixels, with a pixel size of 10 x 10 microns.

Roman’s Wide Field Instrument (WFI) will operate in the 0.48–2.3 micron range, and will include eight imaging filters and a grism and prism for spectroscopy

The CGI instrument contrast is expected to be better than 1e-9, which implies that it will be capable of seeing exoplanets with an apparent magnitude > 30. With such a low brightness, its optical detectors will perceive only a few photons per hour.



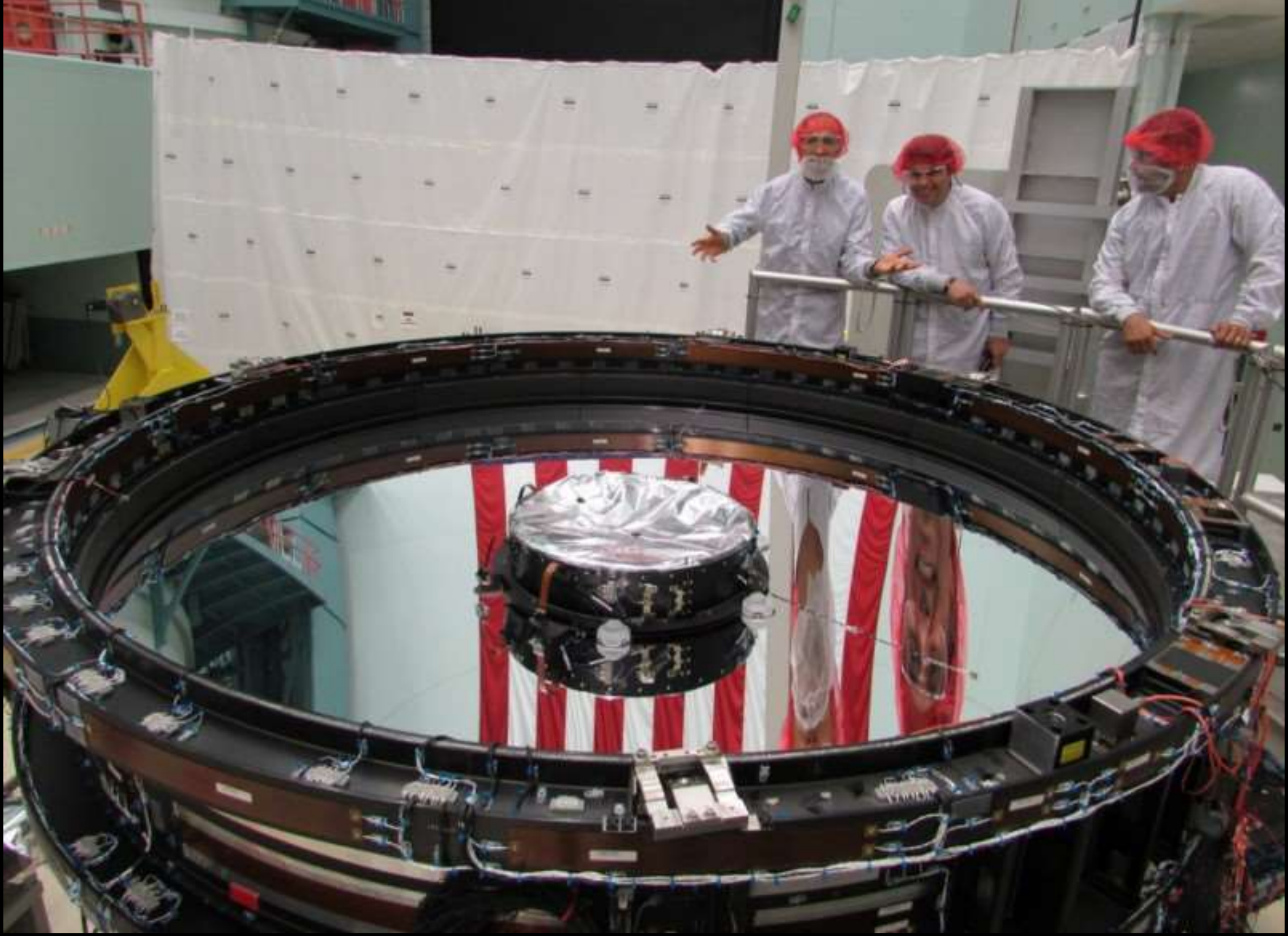
Simulated Roman image of a portion of the Andromeda galaxy showing the 0.28-square-degree field of view and unique footprint of Roman's Wide Field Instrument. Image made using data from the Panchromatic Hubble Andromeda Treasury Program. Credit: NASA, STScI, and B.F. Williams, University of Washington

Roman will observe the universe to answer crucial questions needed for the complete understanding of our universe, especially in the areas of dark energy, exoplanets, and infrared astrophysics.

According to a new study published by a team of researchers from the University of Arizona, Roman will be able to use one of its onboard instruments to measure a specific kind of space dust littered around the habitable zones of the planetary system, thereby helping astronomers know more about habitable planets beyond the solar system.

Utilizing one of two telescopes donated to NASA by the National Reconnaissance Office (NRO) in 2012 has drastically affected the program, giving NASA access to a larger mirror than had originally been planned for a fraction of a cost, despite the work needed to convert it for use in astronomical observations instead of the equipment’s original Earth-imaging mission.

The Nancy Grace Roman Space Telescope, previously known as Wide-Field Infrared Survey Telescope or WFIRST, has had a rocky history, with delays and cost growth affecting the project. It was first introduced in the report of the 2010 Astronomy and Astrophysics Decadal Survey, a 10-year plan created by the US National Academies to outline scientific missions and goals related to astronomy.



The observatory will host the 288-megapixel Wide-Field Instrument (WFI). With a faster focal length than Hubble's (f/7.8 vs. Hubble’s f/24), the mission will have a field of view 100 times larger. Astronomers hope to use the Roman Space Telescope to probe the nature of dark energy by hunting for Type 1a supernovae and gravitationally lensed galaxies.

The Roman Space Telescope’s mirror is coated with an extraordinarily thin layer of silver, used because of its ability to reflect light in the infrared to the visible light spectrum.

20.7.2022

NASA announced today that it has contracted SpaceX to launch its new Roman Space Telescope.

Now in development, it will go skywards between October 2026 and May 2027 from Launch Complex 39A at NASA’s Kennedy Space Center in Florida atop a SpaceX Falcon Heavy rocket. SpaceX will make $255 million from the contract.

LEARN MORE ABOUT THE ROMAN SPACE TELESCOPE

Roman-science-and-technical-overview.pdf

STSCI

https://www.stsci.edu/roman

GODDARD

https://roman.gsfc.nasa.gov/

IPAC

https://roman.ipac.caltech.edu/

JPL

https://science.jpl.nasa.gov/projects/WFIRST/

SCIENCE PUBLICATIONS AND TECHNICAL DOCUMENTATION

https://www.stsci.edu/roman/documentation

Teknofokus

Kiitos!

Tarina jatkuu

Kiitos!

Tarina jatkuu myöhemmin