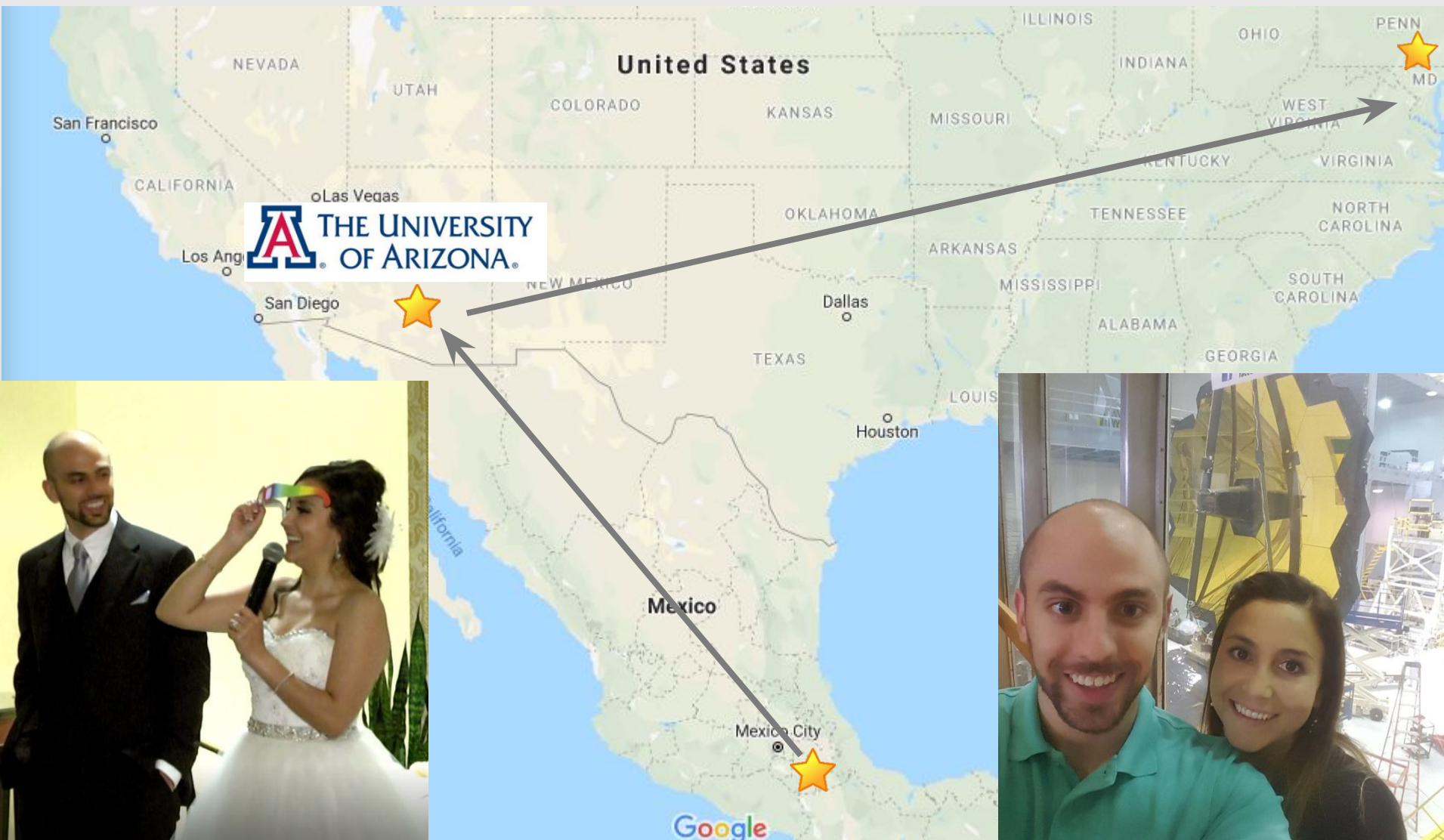


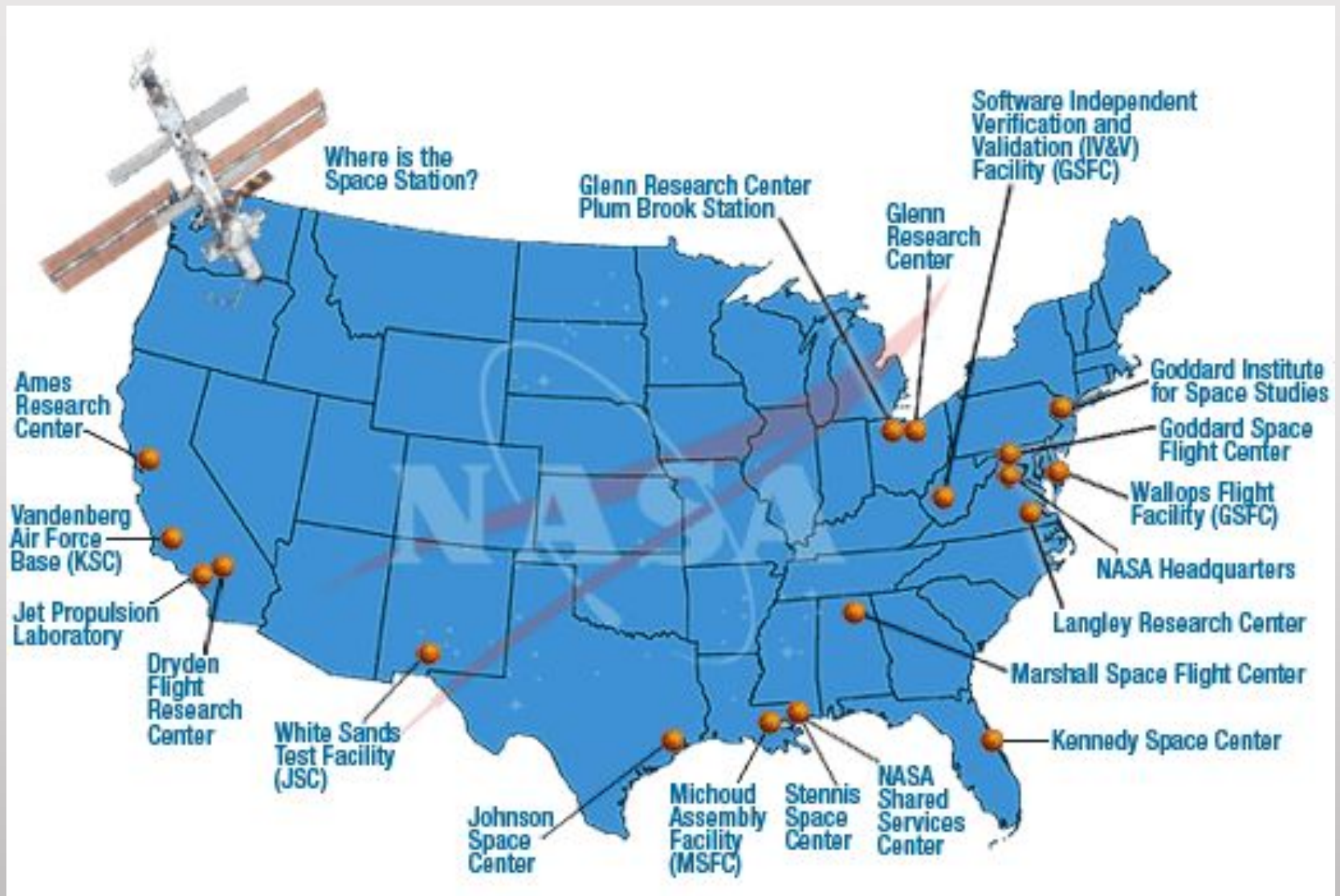
Webb and Roman, the present and future of astronomical space telescopes

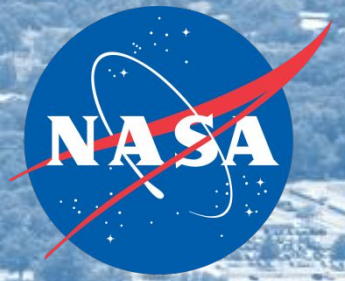
Margaret Z. Dominguez Ph.D.
Optical Engineer at NASA Goddard
OPTICA ambassador

Chesapeake Section of the American Association of Physics Teachers
Semiannual meeting
April 1st, 2023

A little about myself







Goddard

Space Flight Center

Astrophysics

Decadal Survey Missions

1990



1972
Decadal
Survey
Hubble

1999



1982
Decadal
Survey
Chandra

2003



1991
Decadal
Survey
Spitzer

2021

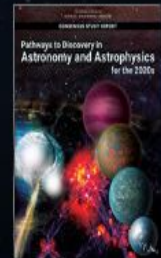


2001
Decadal
Survey
Webb

2027



2010
Decadal
Survey
Roman



2021
Decadal
Survey

????

Decadal Survey Missions Telescope sizes

Telescope sizes compared

Webb will be the largest astronomical telescope ever put into space. Spitzer, the current infrared telescope, is tiny by comparison.

Hubble

Webb

Spitzer

Mirror sizes

The size of the mirror makes the biggest difference in a telescope's light-gathering capability.



Hubble
94.5 inches
(2.4 meters)



Human

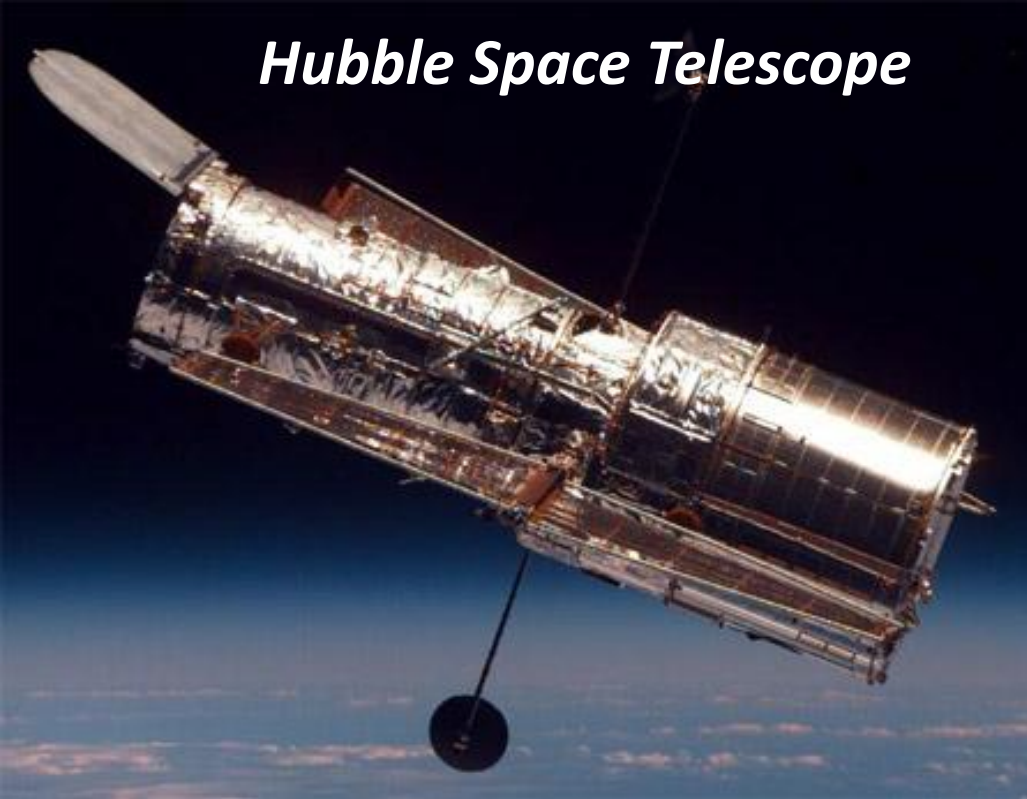


Webb
255.6 inches
(6.5 meters)



Spitzer
33.5 inches
(0.85 meters)

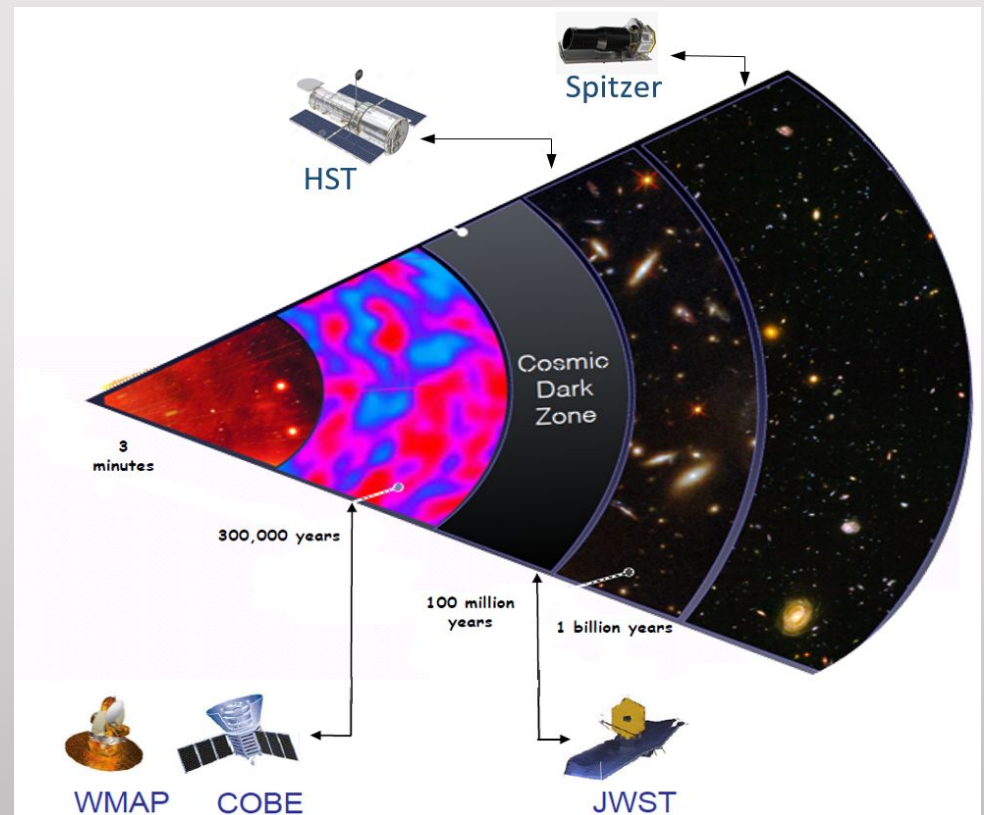
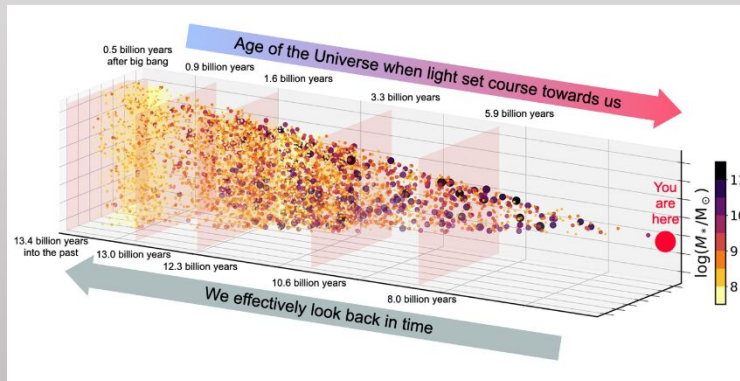
Hubble Space Telescope



Webb Space Telescope mission



- Webb will operate in a manner like Hubble to enable a wide range of science investigations proposed by astronomers world-wide
- General Observer community will drive science investigations
- Four science themes:
 - First light and reionization
 - Galaxy formation and evolution
 - Star formation in our galaxy
 - Planetary systems



Webb Space Telescope IR mission

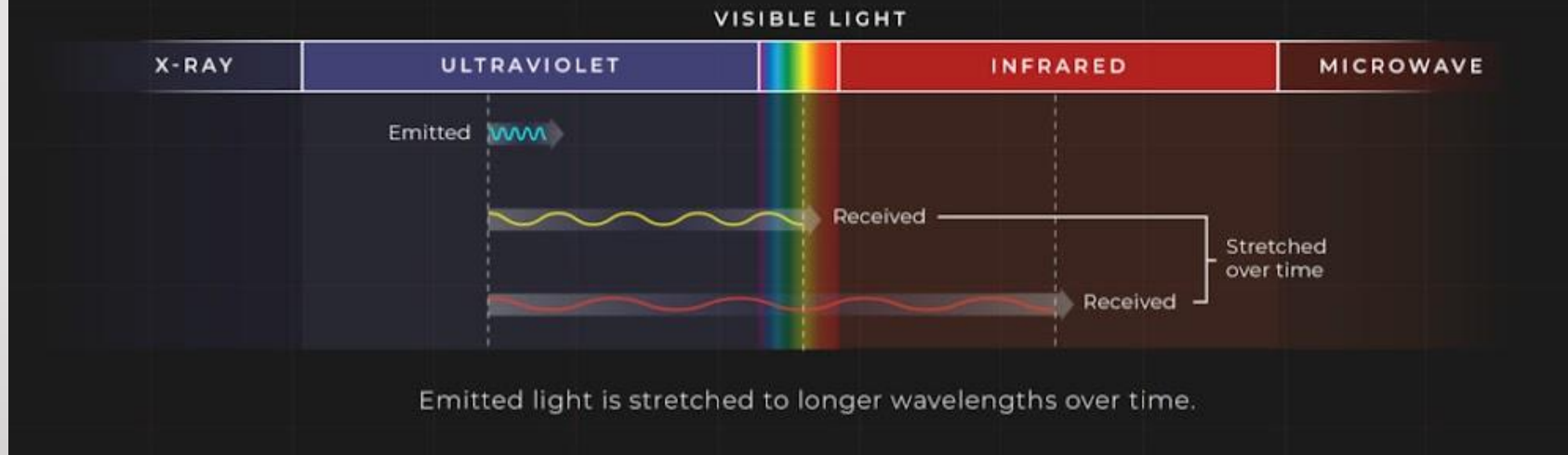


REDDER THAN RED

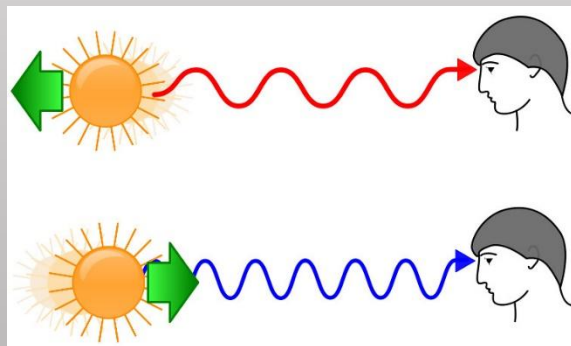
The longest visible wavelength is red.

Beyond red are longer wavelengths that we can't see, starting with infrared.

When light is stretched by the expansion of space, we say that it is **redshifted**—from its originally emitted wavelength to a longer, redder one.



The expanding universe shifts visible and ultraviolet to the infrared (doppler effect).

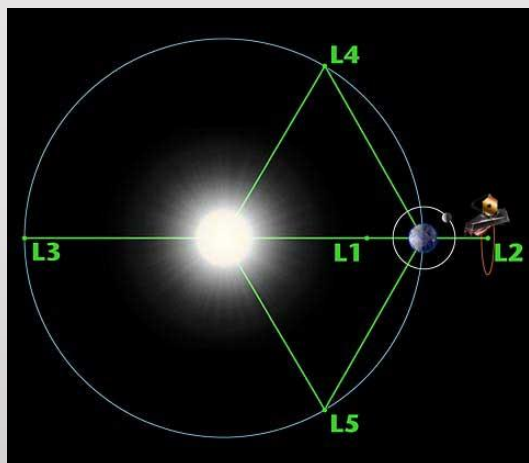


Webb Space Telescope temperature



Webb must be very cold to see infrared: 30K

With sun shields and cryostats, entire observatories can be cooled actively to <10 K, or passively to <35 K

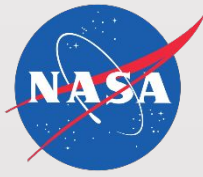


Recipe on how to get *cold*:

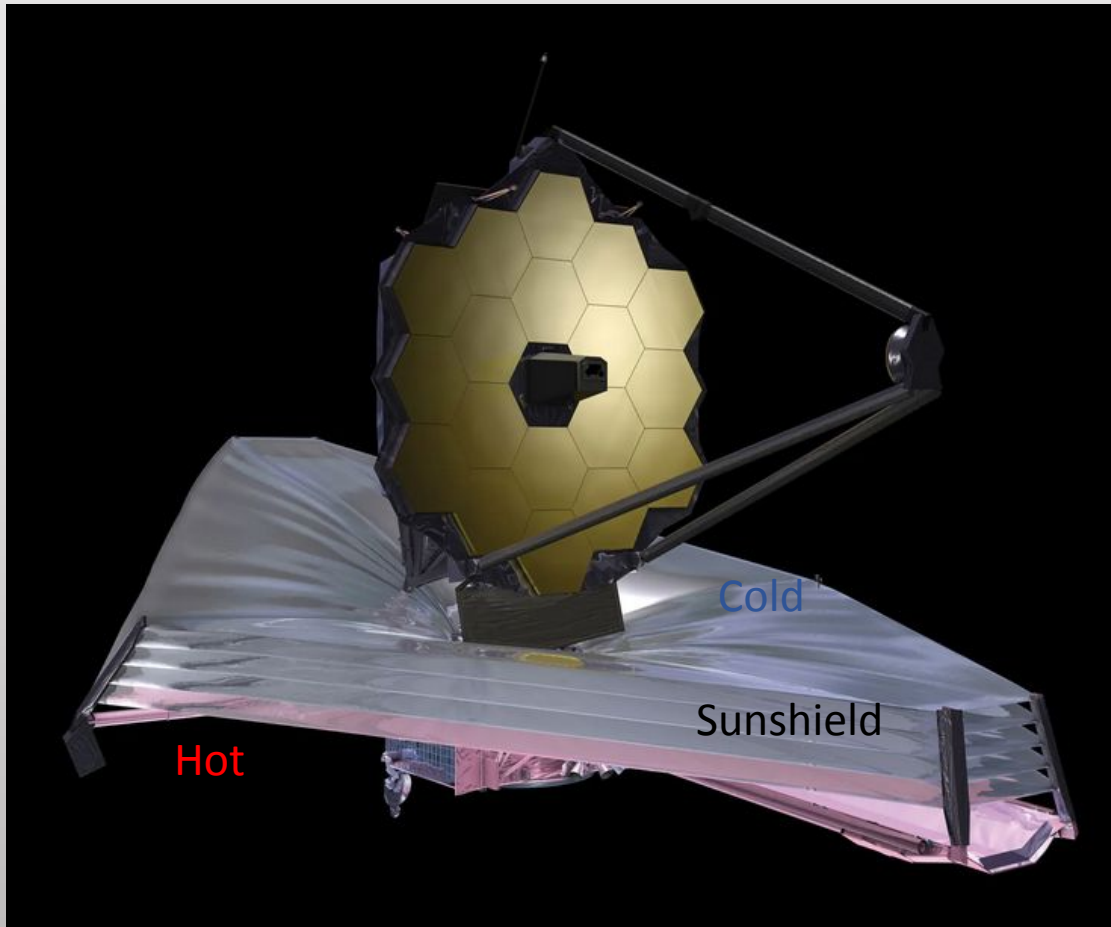
1. Get far away from Earth (Sun-Earth L2 point)
2. Hide in the shade



Webb Space Telescope temperature



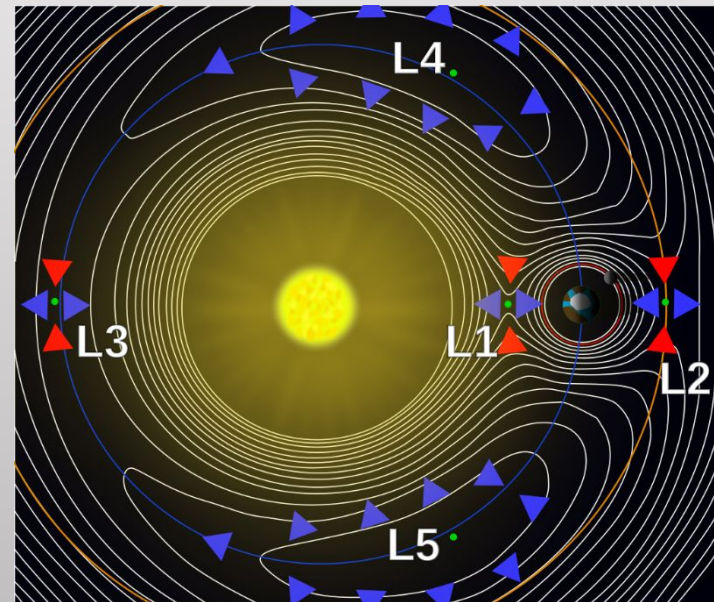
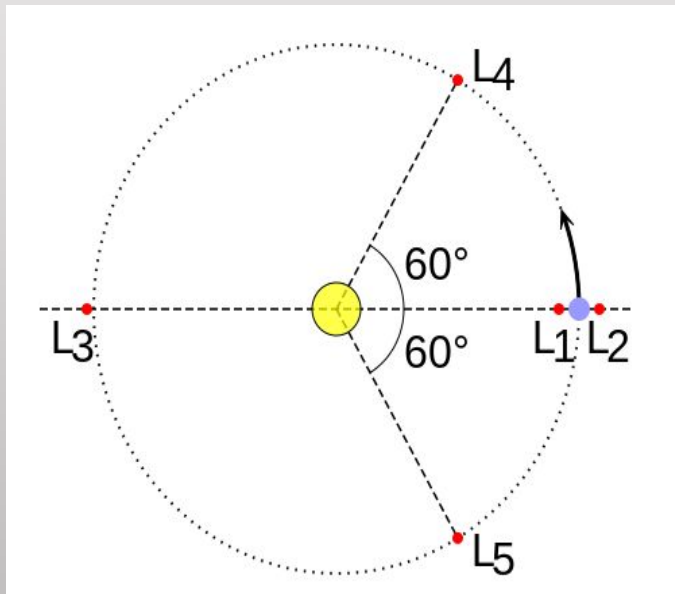
- Sunshield protection: SPF of ~ 1.2 million
- 500 degrees difference between the top and bottom of the sunshield



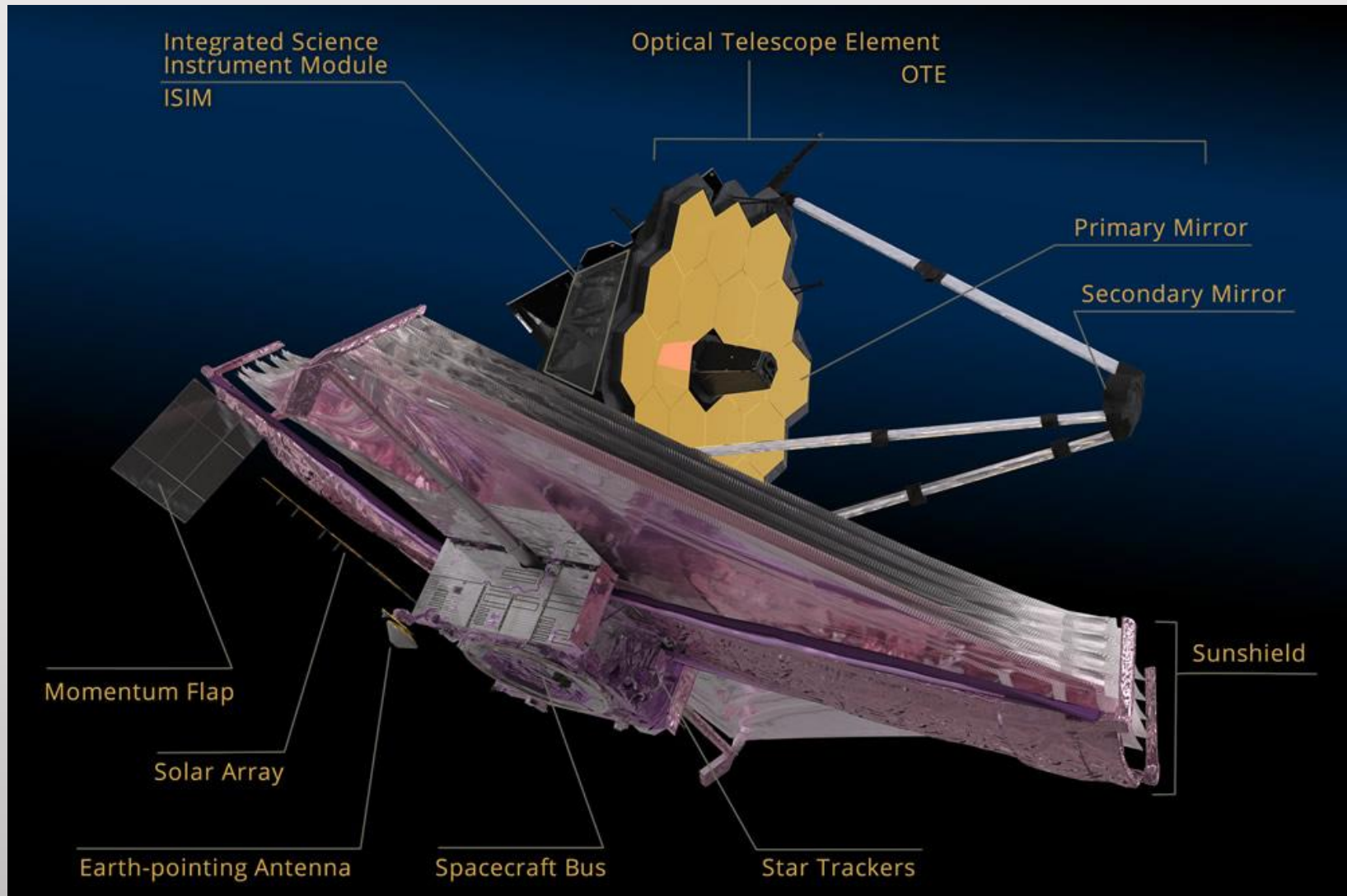
Webb Space Telescope location



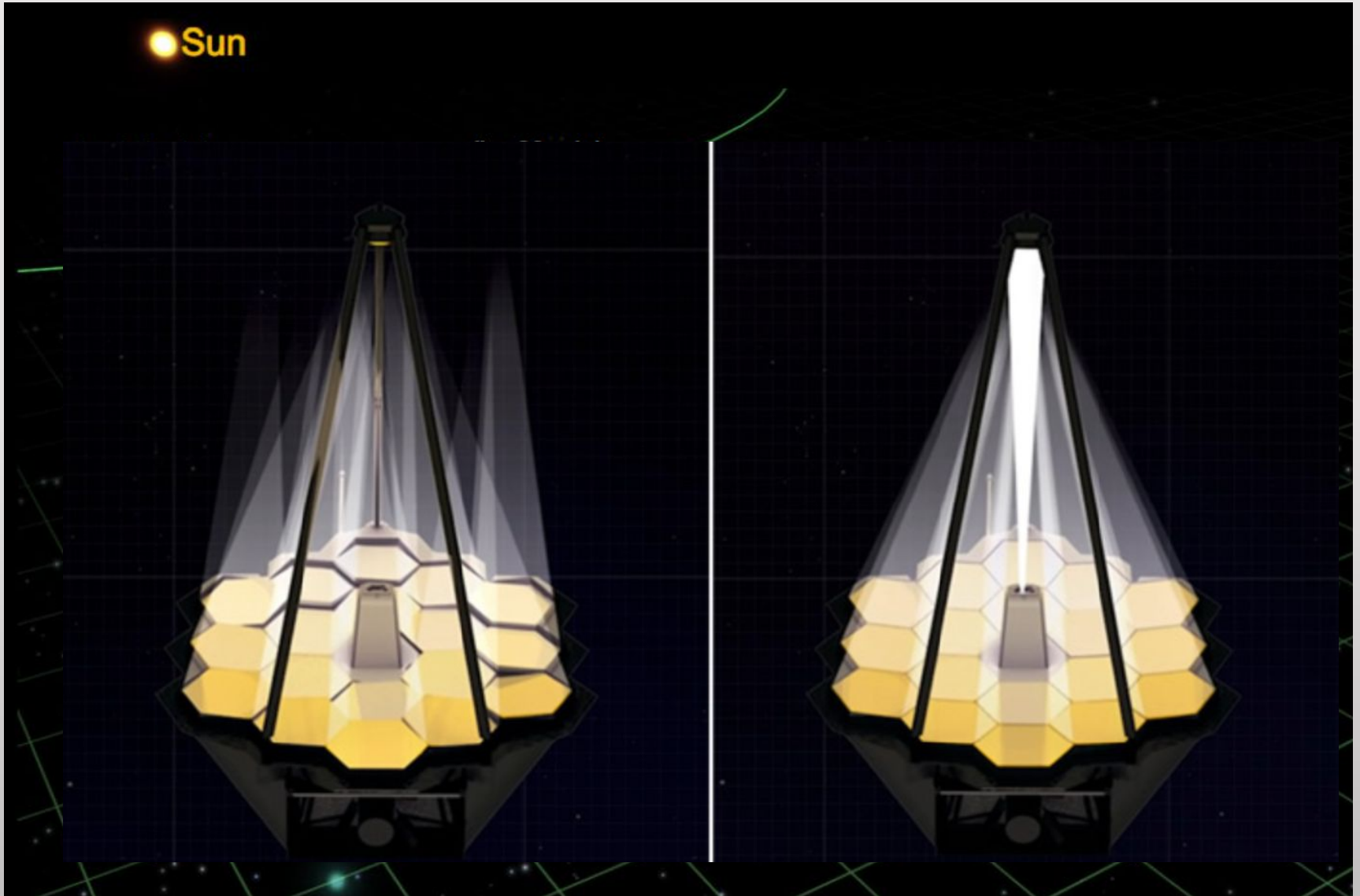
- Why in **Space**? L2 is a very Stable Environment
- The **Red** points labeled L1 to L5 represent “stable” gravity points in the Sun-Earth system (“Lagrange” points)
- L1 is favored for Sun-observing Space Observatories
- L2 is favored for some Astronomical Space Observatories



Webb Space Telescope elements



Webb Space Telescope timeline



Webb's first images



Hubble vs Webb



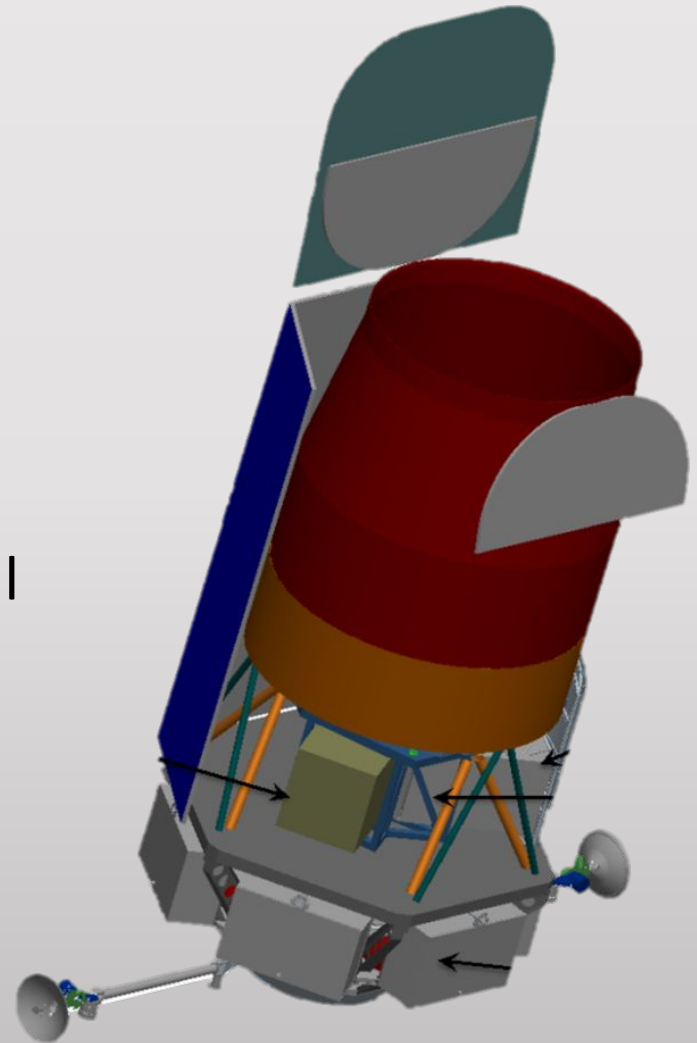
Nancy Grace Roman Space Telescope



Roman Space Telescope overview

The Roman Space Telescope is a NASA observatory:

- 2.4m telescope.
- Launch in 2027.
- Will have a primary mission lifetime of 5 years, with a potential 5 year extended mission.
- Two instruments:
 - Wide Field Instrument
 - Coronagraph Instrument

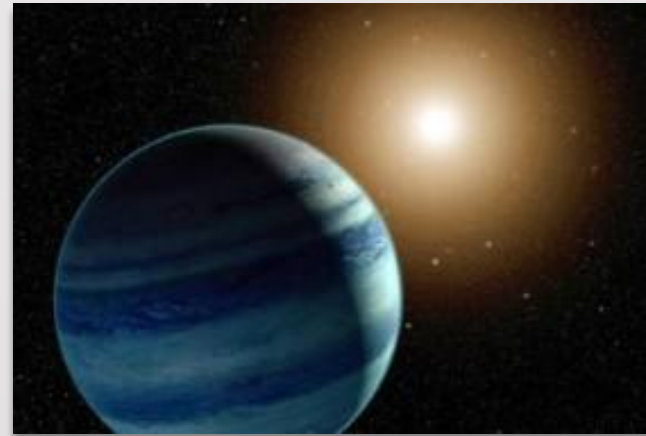


Roman Space Telescope Mission

Dark Energy



Exoplanets



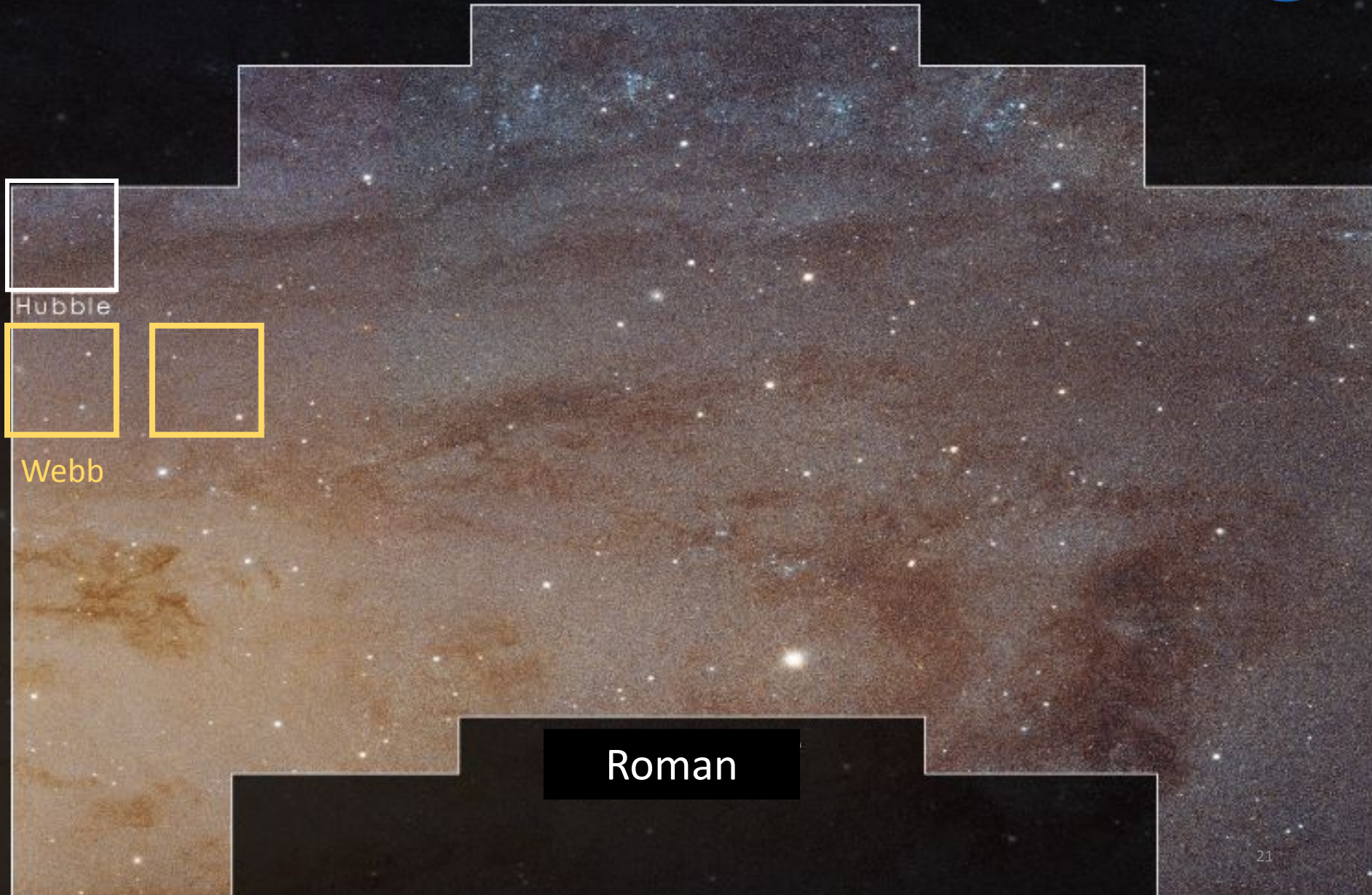
Science Objectives

- Use 3 different methods to determine cosmic expansion history:
- Enables tests of theories of accelerated expansion including Dark Energy
- Expand census of exoplanets ($>$ Mars Mass)
- Conduct Near Infrared (NIR) imaging and spectroscopic surveys
- General Astrophysics
 - Provide General Observer and Guest Investigator Programs for the community

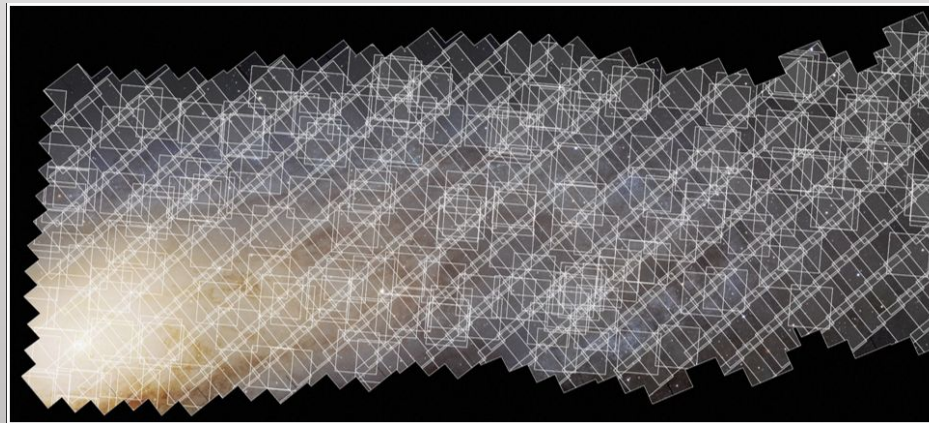
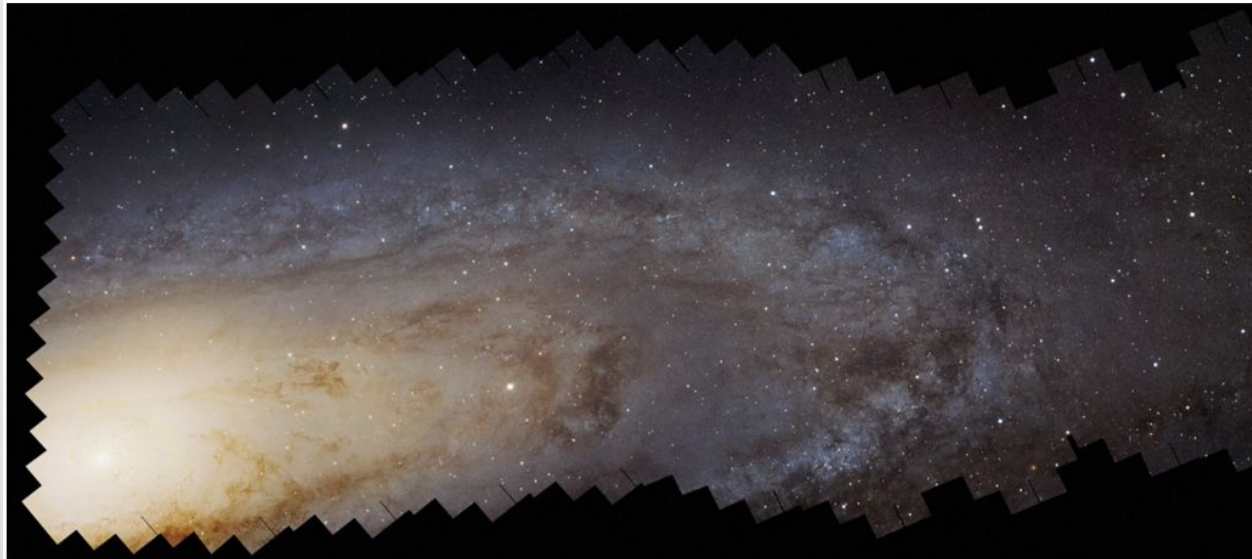
Technology Demonstration Objective

- Demonstrate exoplanet coronagraphy with active wavefront control

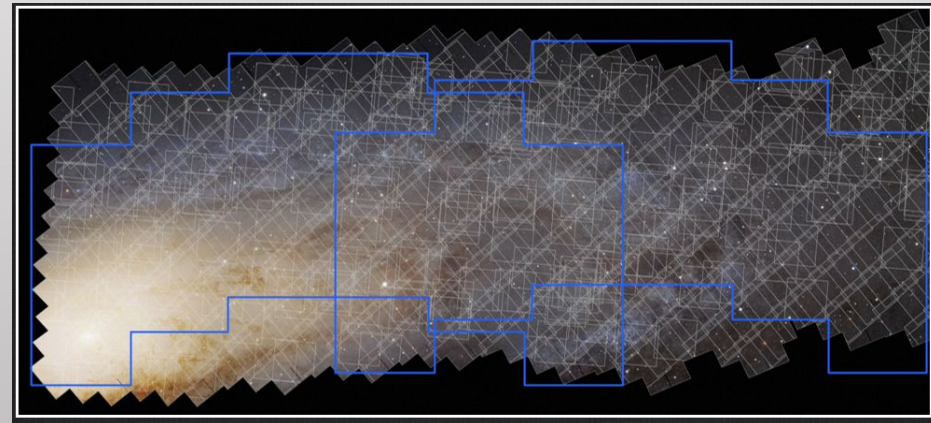
Roman Space Telescope Field of View



Roman Space Telescope overview: Andromeda galaxy

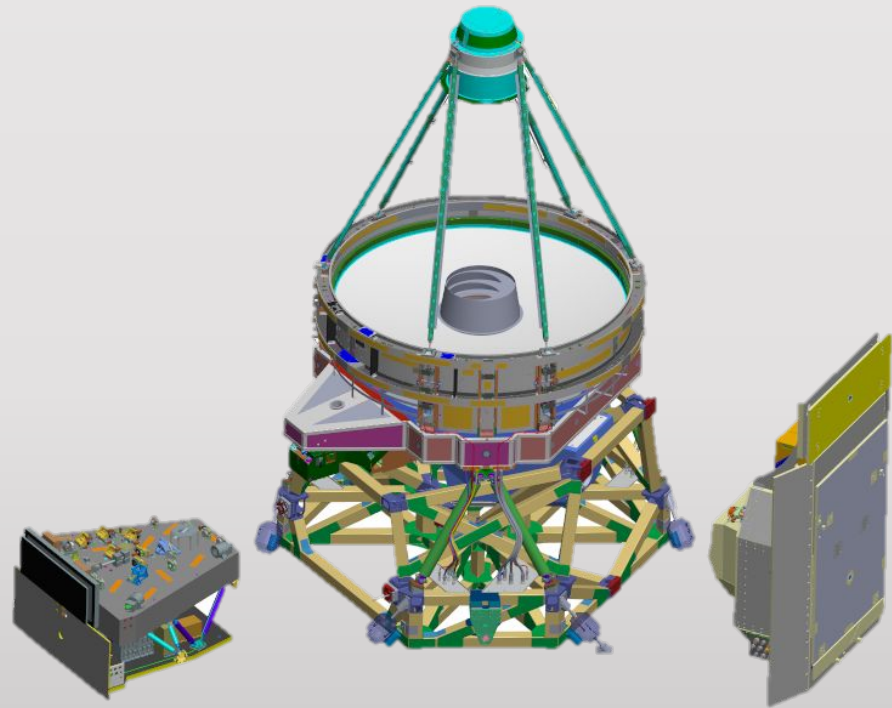
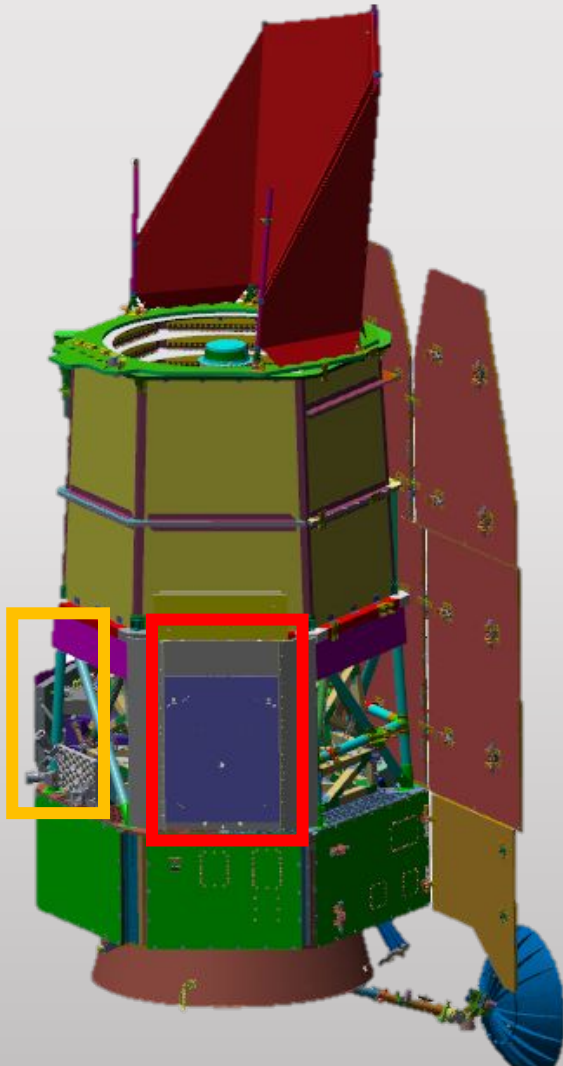


Hubble: 400+ individual pointings



Roman: 2 individual pointings

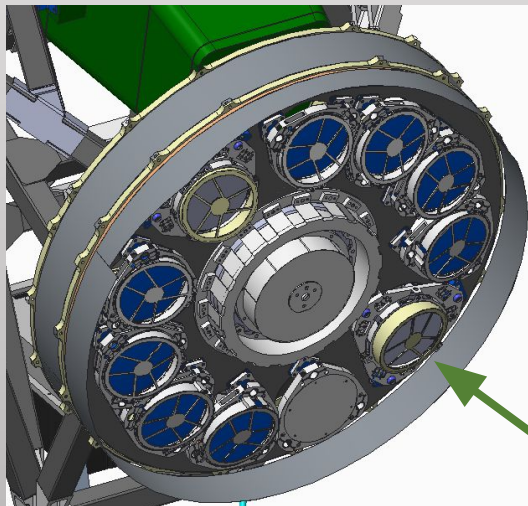
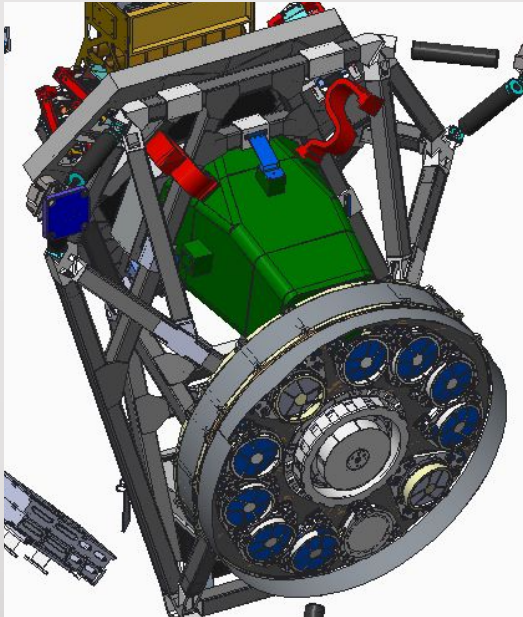
Roman Space Telescope instruments



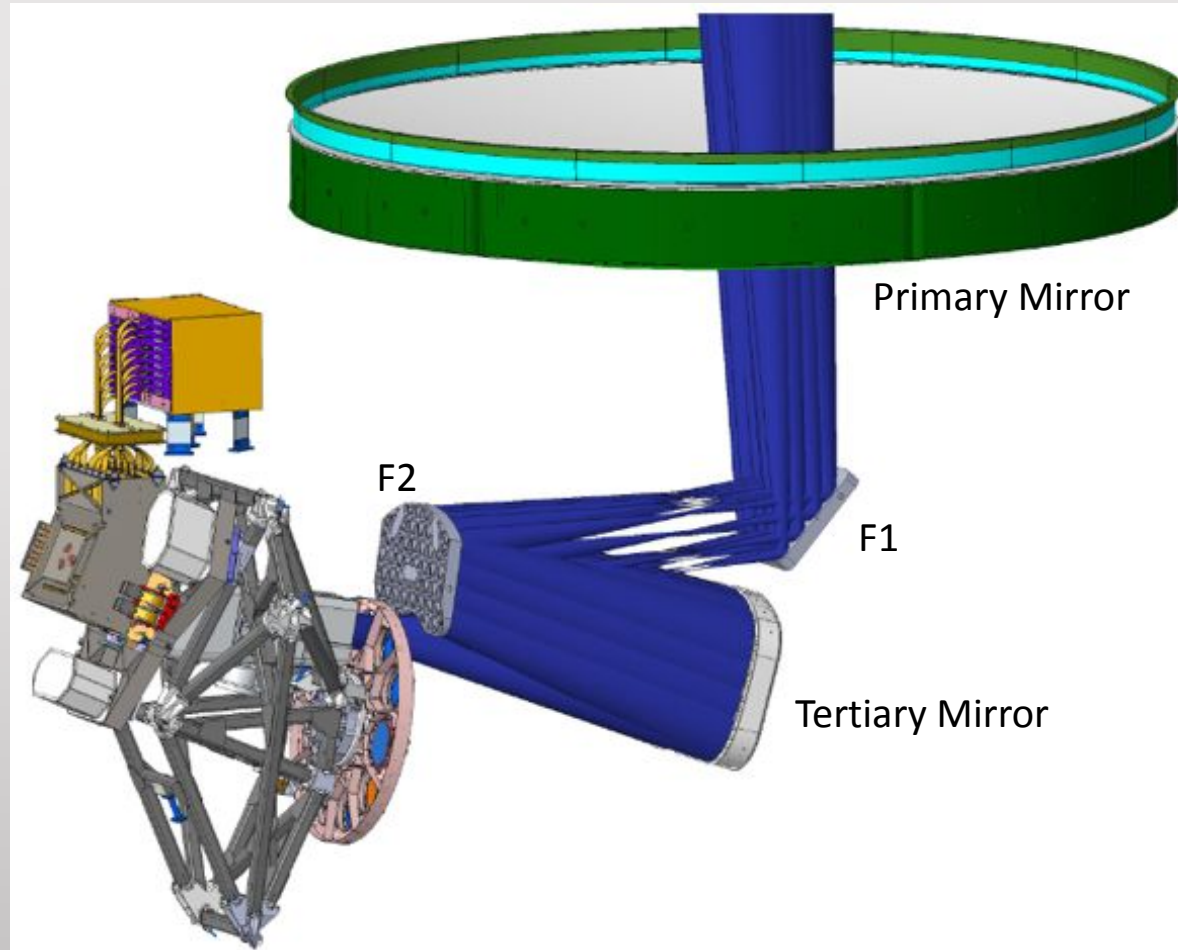
Coronagraph Instrument
(CGI)

Wide Field Instrument
(WFI)

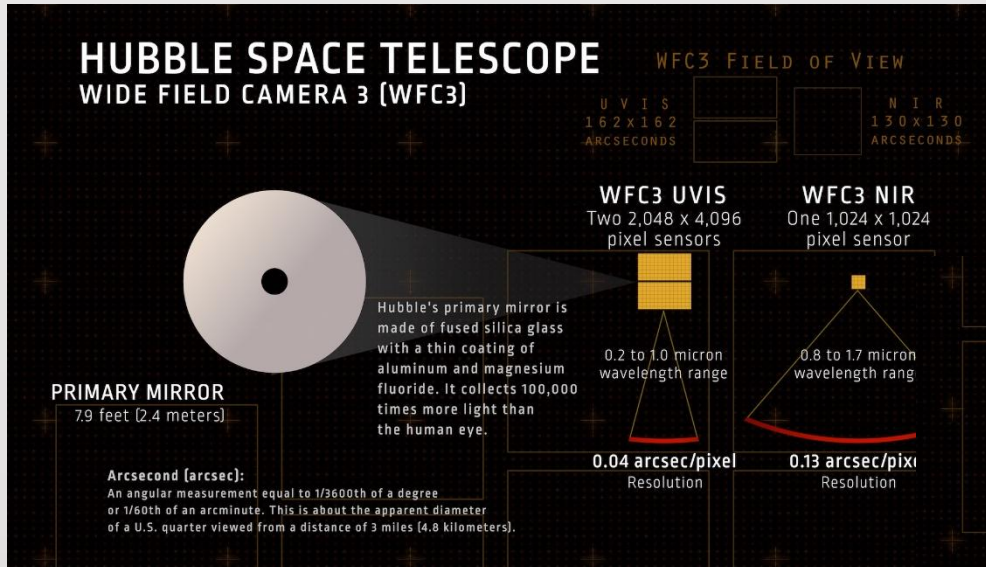
Roman optical configuration: WFI and grism



Grism



Telescope comparative summary



ROMAN SPACE TELESCOPE

WIDE FIELD INSTRUMENT (WFI)

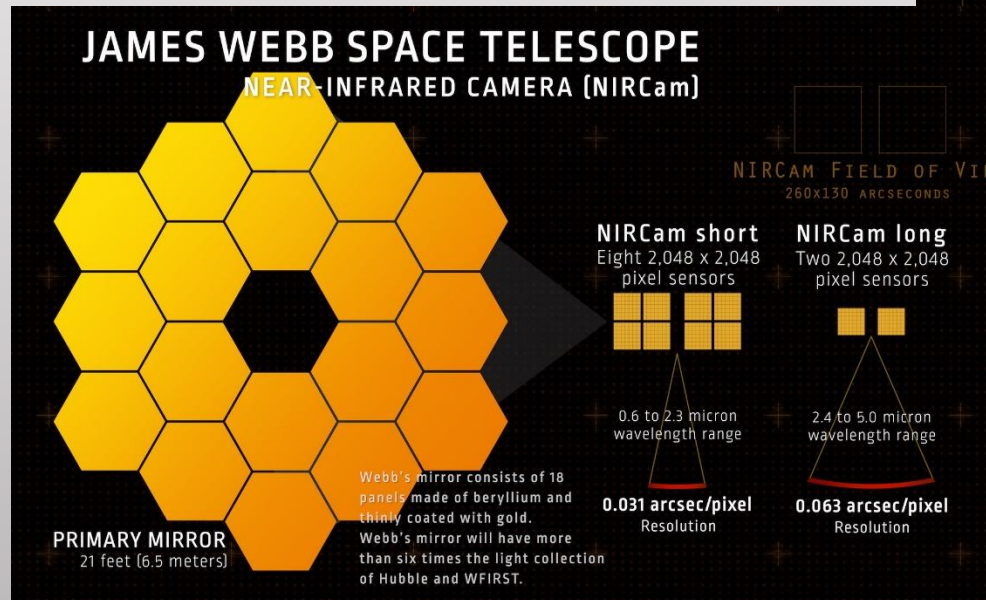
WFI
Eighteen 4,096 x 4,096 pixel sensors

PRIMARY MIRROR
7.9 feet (2.4 meters)

The Nancy Grace Roman Space Telescope's primary mirror is the same size as Hubble's but only one-fourth the weight, due to advancements in technology. It will provide the same sharp resolution in infrared while surveying the cosmos hundreds of times faster.

FIELD OF VIEW
x1380 ARCSECONDS

0.5 to 2.0 micron wavelength range
0.11 arcsec/pixel Resolution





NASA STEM GATEWAY

Your Gateway for Participating in NASA STEM Opportunities



INTERNSHIPS

intern.nasa.gov

Session	Duration	Typical Start and End	Application Deadline
Spring	16 Weeks	Mid-January - Early May	Early November
Summer	10 Weeks	Late May/Early June - August	Early March
Fall	16 Weeks	Late August/Early September - Mid-December	Early July

INTERN

NASA Office of STEM Engagement (OSTEM) paid [internships](#) allow high school and college-level students to contribute to agency projects under the guidance of a NASA mentor.

[LEARN MORE](#)



Free for HSs to apply and paid for 6 weeks!



Life is not easy for any of us.

But what does it matter?

*We must be perseverant and, above all,
have confidence in ourselves.*

Marie Curie