

Flipping Bits in the James Webb Space Telescope's Cameras

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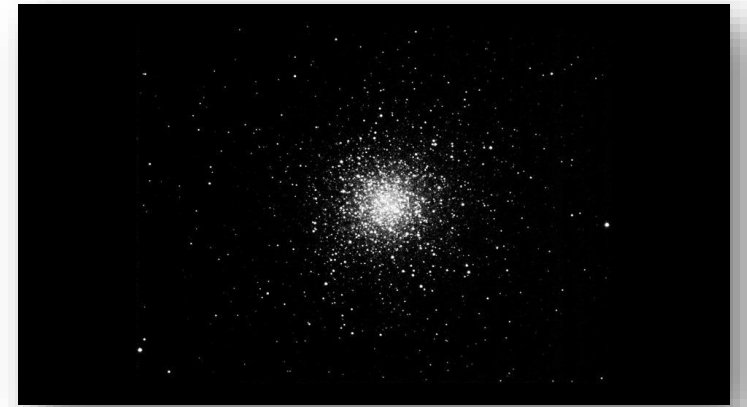
Do you like really cool telescopes?



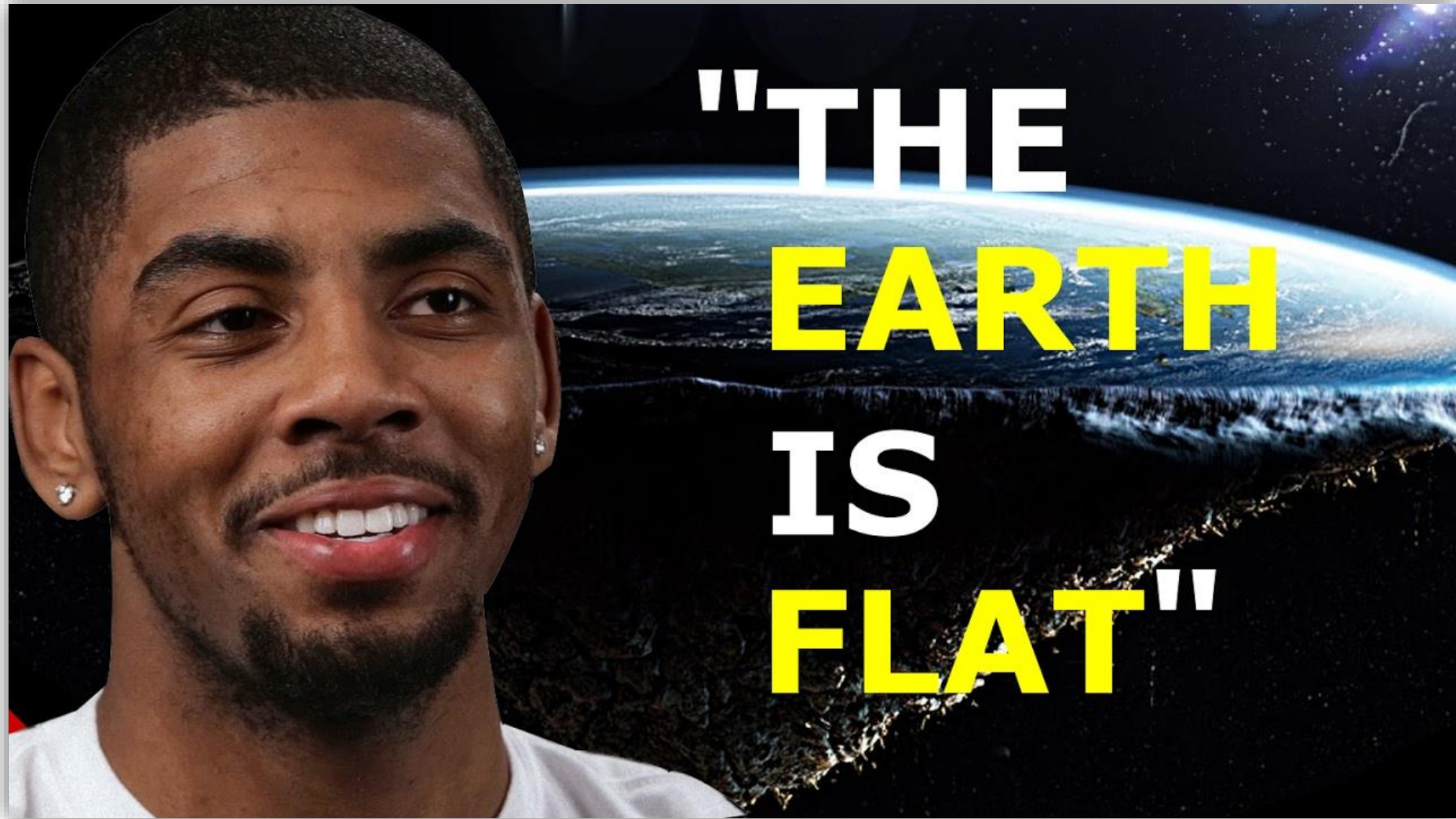
Do you like fun, interesting people?



Come join the Tri-Valley Stargazers!



We can turn you from this...



...Into this



Hubble is on its way out



JWST is on its way in



THE JWST TEAM

Image taken from jwst.nasa.gov



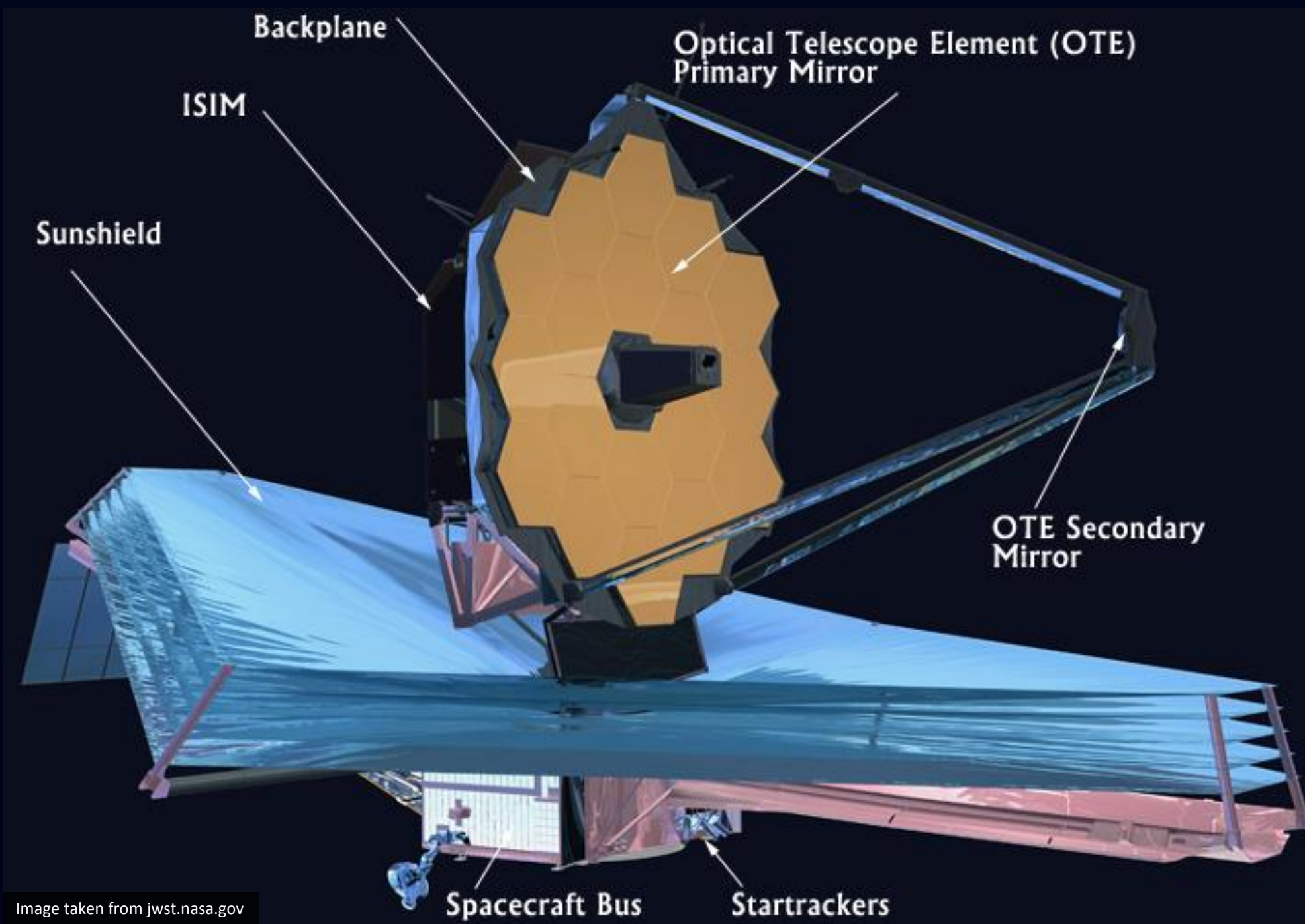
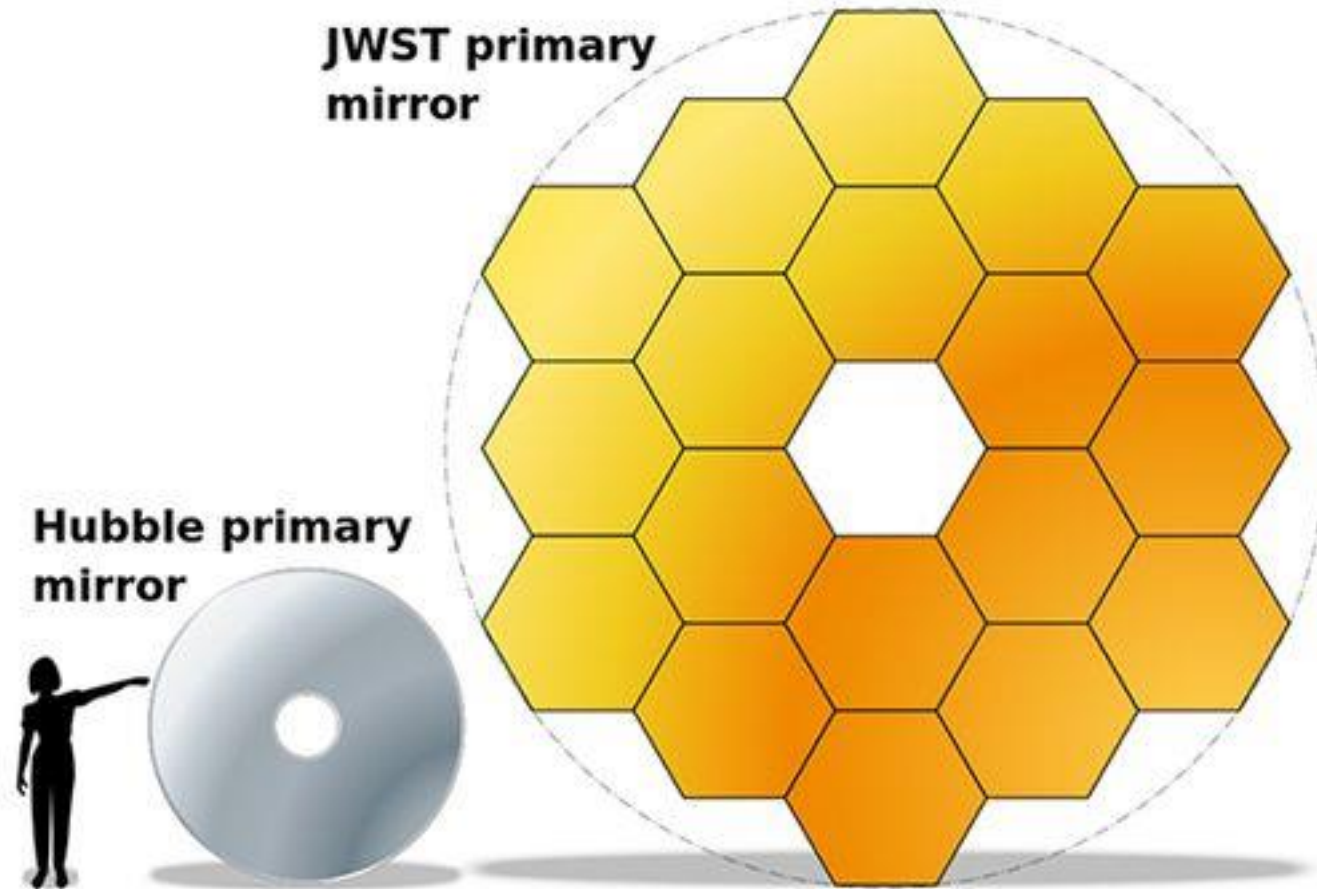


Image taken from jwst.nasa.gov

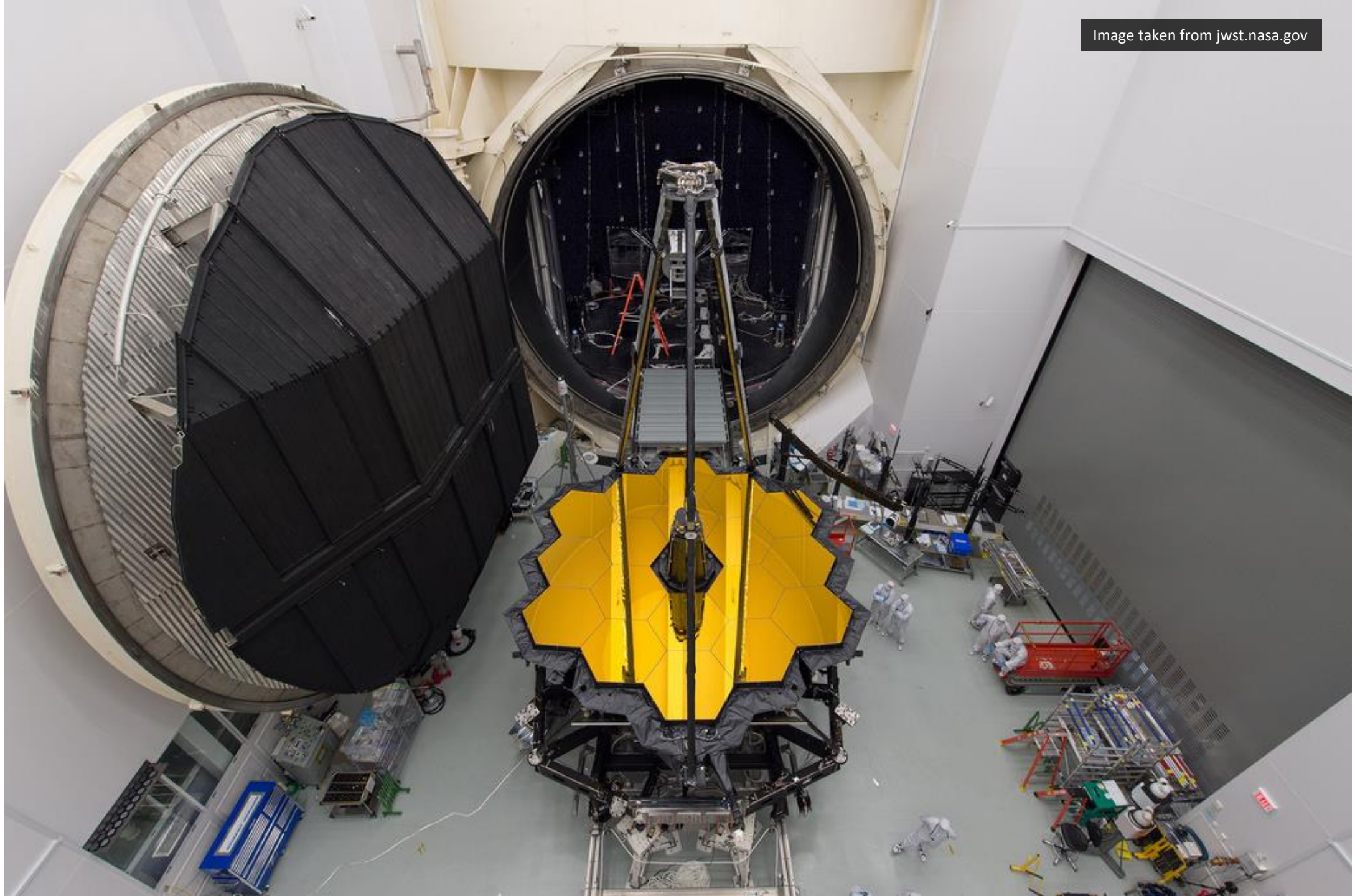
Primary Mirror: 6.5 meter diameter aperture



7X improvement in light-gathering

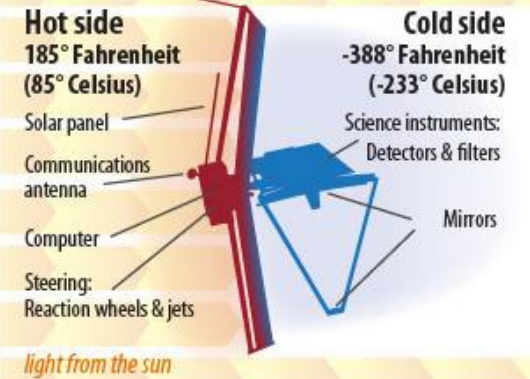


Image taken from [jwst.nasa.gov](https://www.jwst.nasa.gov)

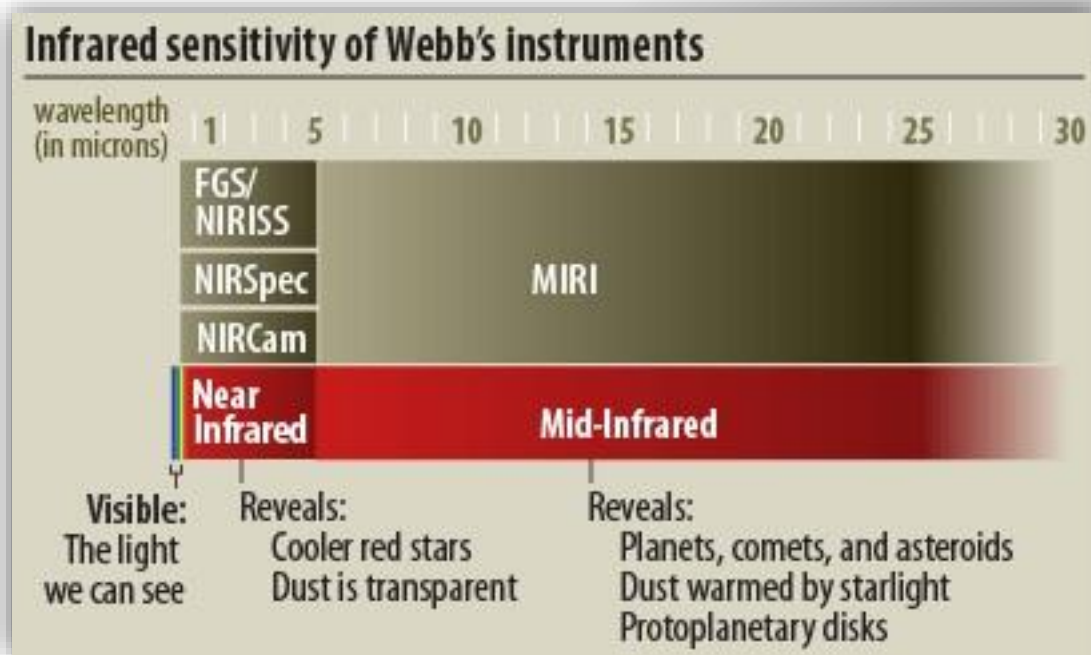


The Sunshade

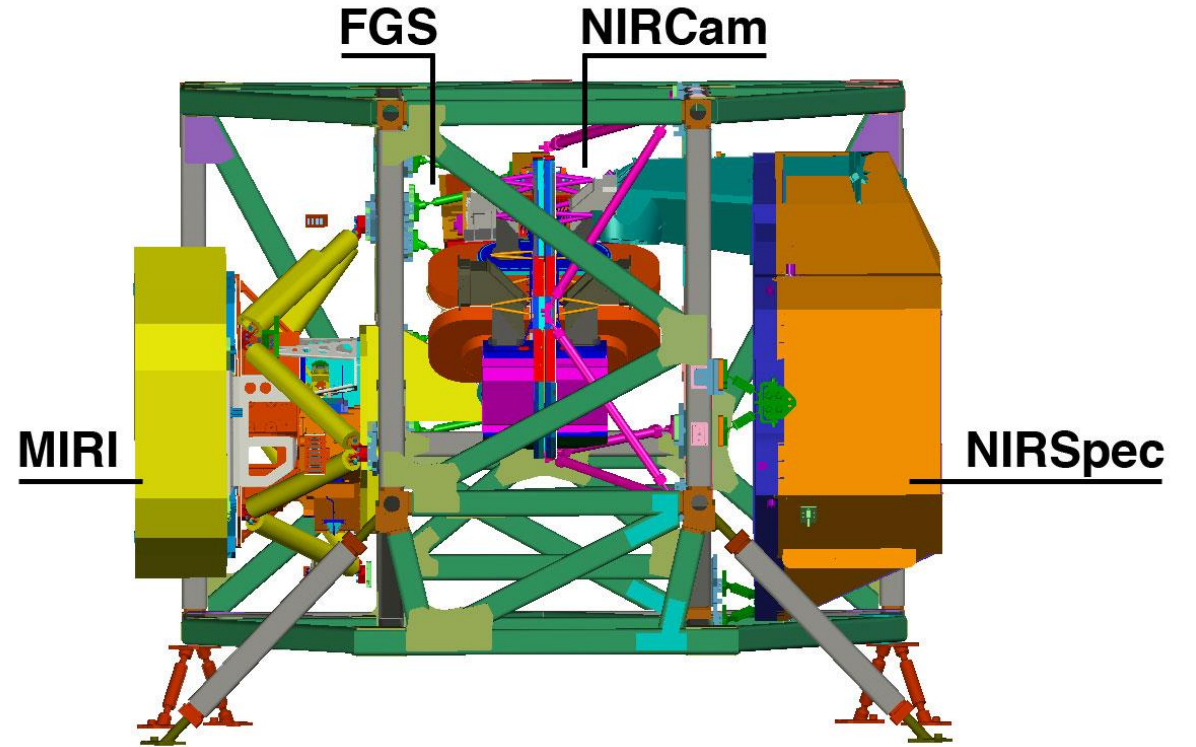
The Two Sides of the Webb Telescope



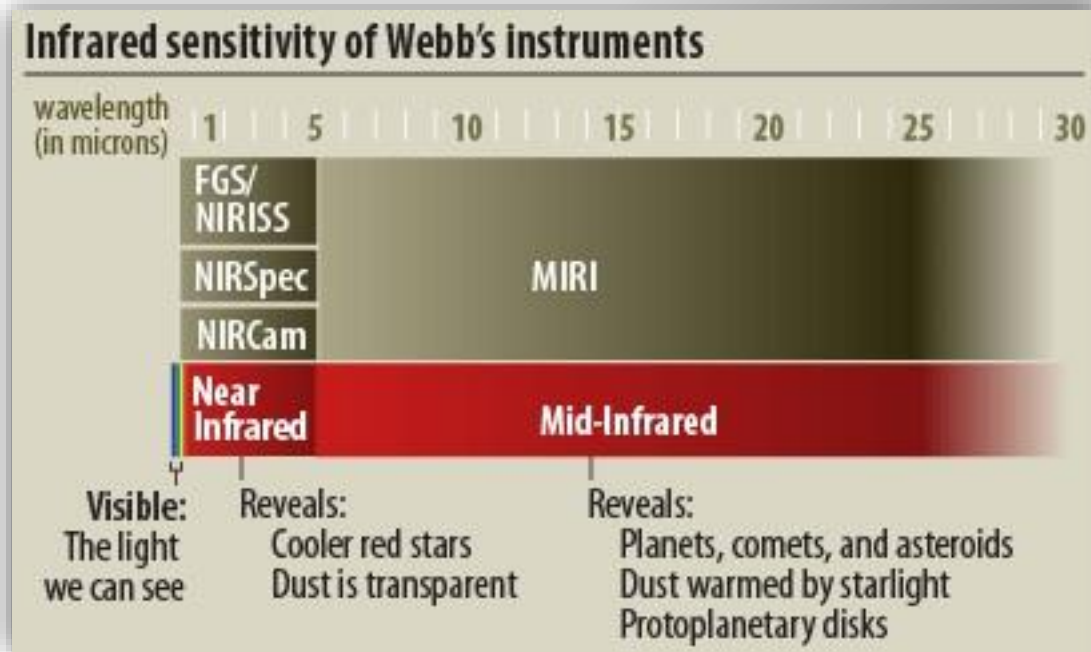
Integrated Science Instrument Module (ISIM)



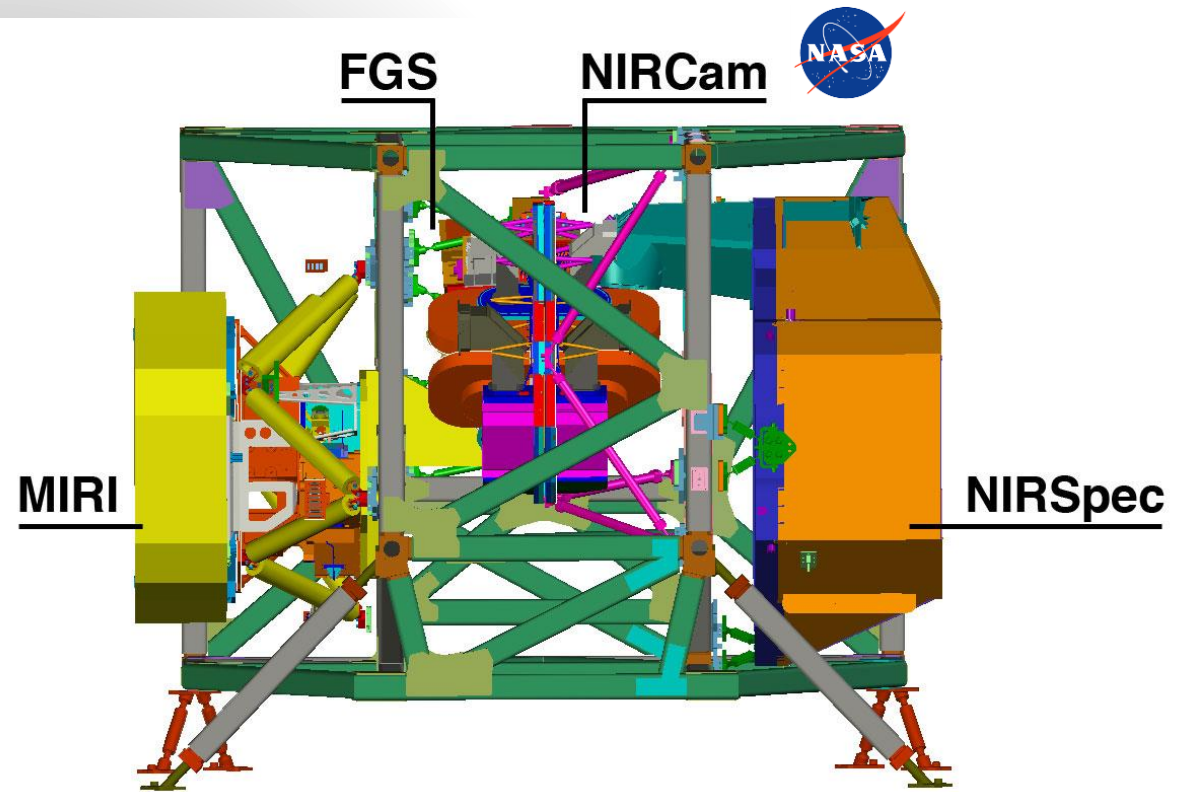
*Graphic and info taken from jwst.nasa.gov



Integrated Science Instrument Module (ISIM)

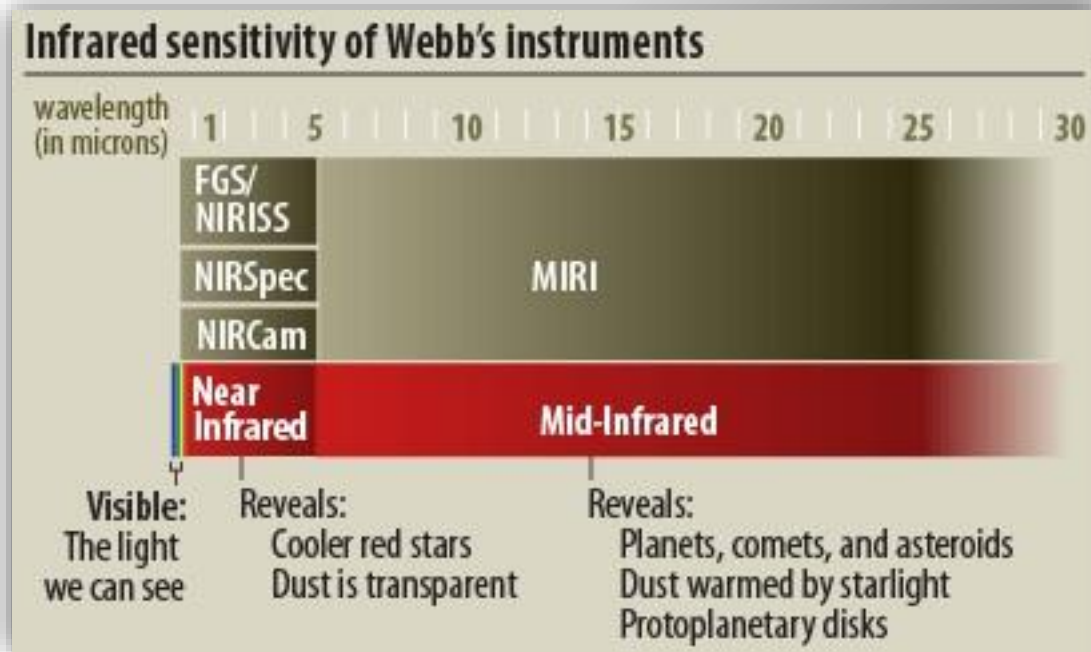


*Graphic and info taken from jwst.nasa.gov

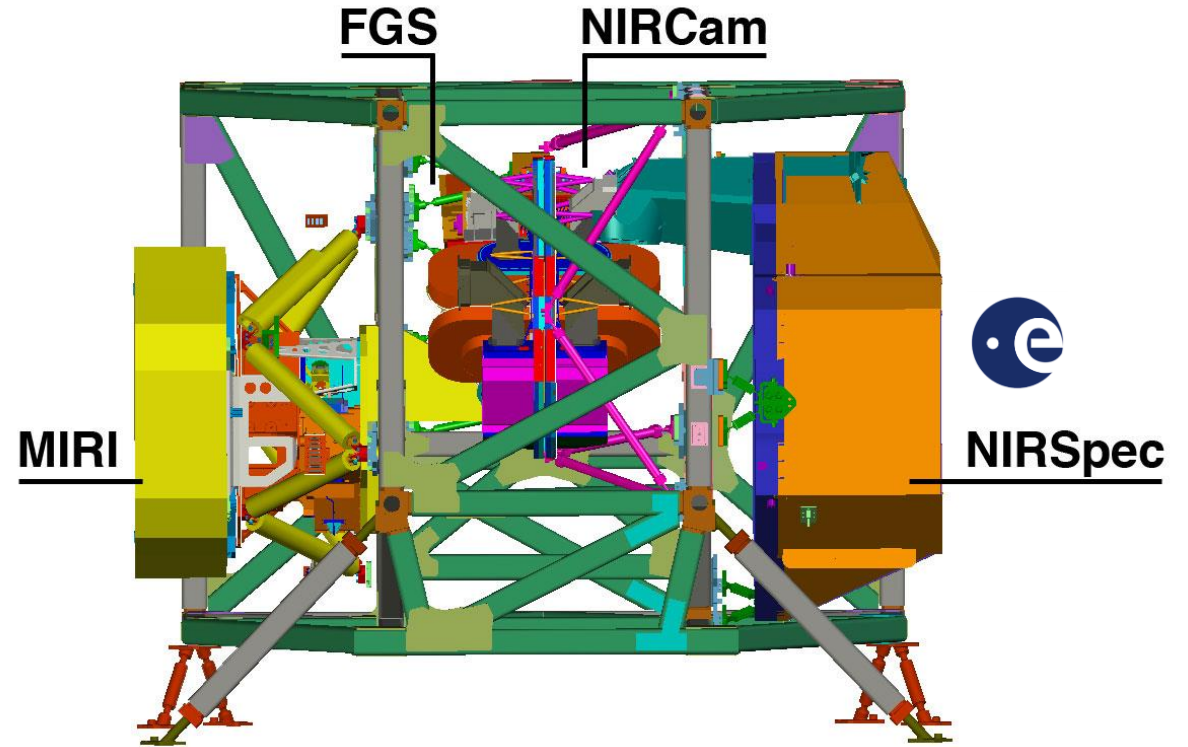


The Near Infrared Camera (NIRCam) – will detect light from: the earliest stars and galaxies in the process of formation; the population of stars in nearby galaxies; as well as young stars in the Milky Way and Kuiper Belt objects.

Integrated Science Instrument Module (ISIM)

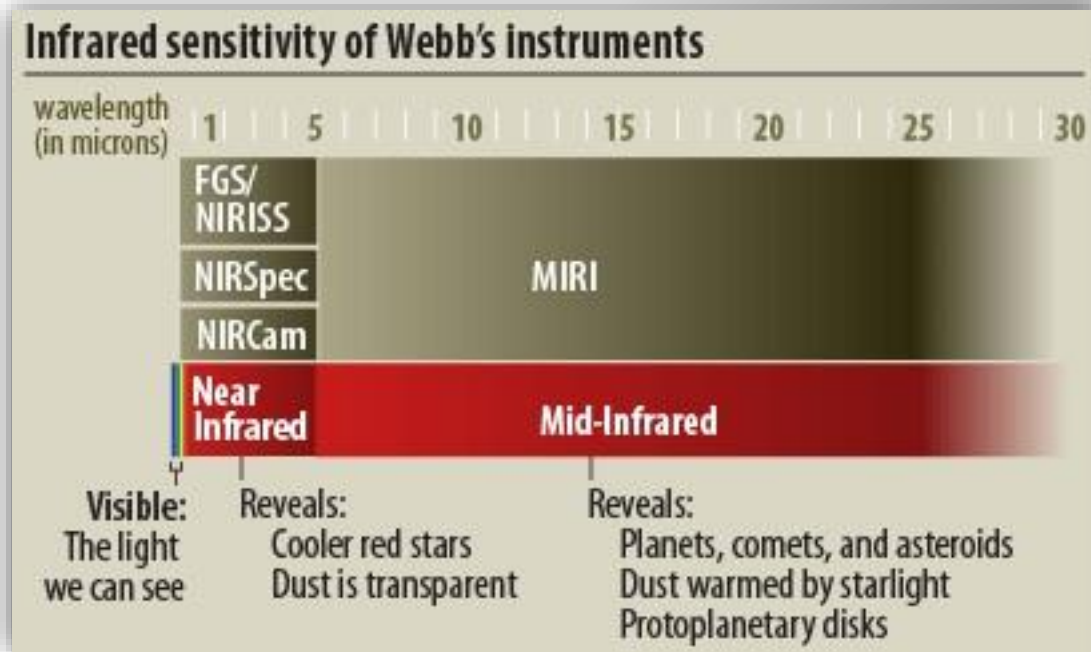


*Graphic and info taken from jwst.nasa.gov

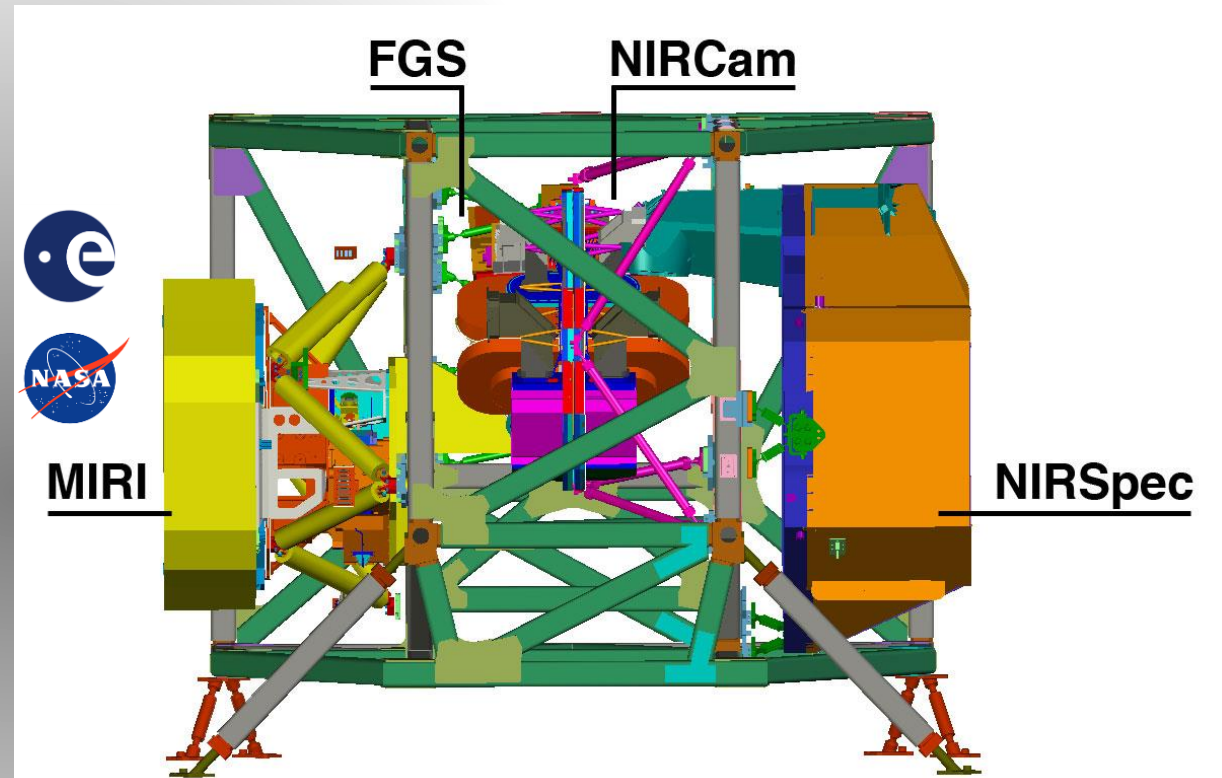


The Near Infrared Spectrograph (NIRSpec) – can tell us about an object's physical properties, including temperature, mass, chemical composition, and rotation (for the case of extended objects like galaxies)

Integrated Science Instrument Module (ISIM)

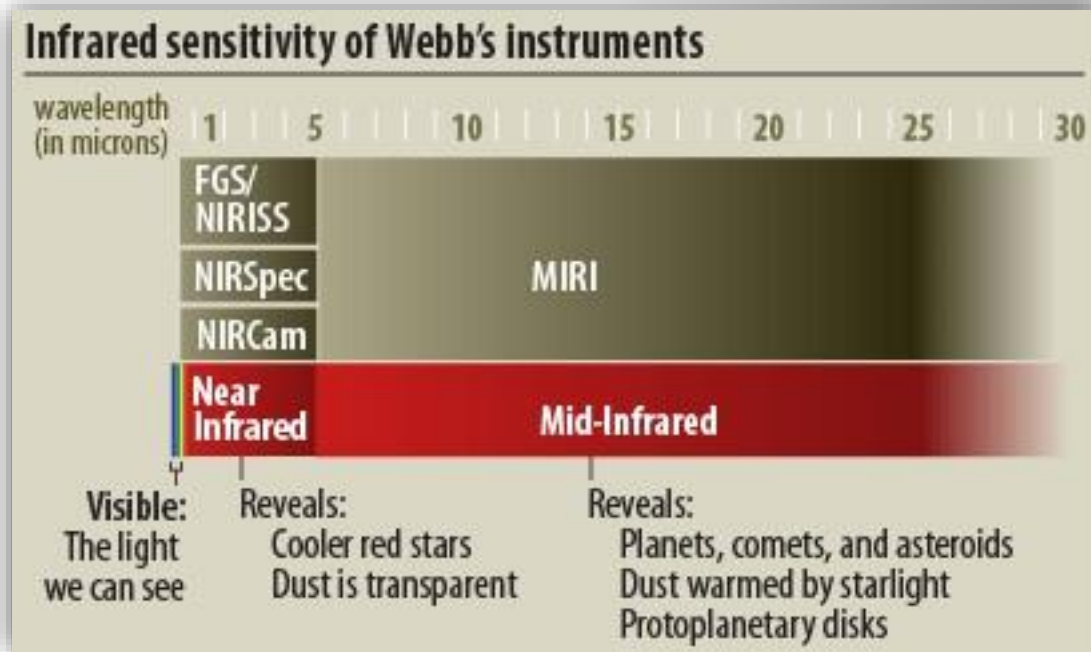


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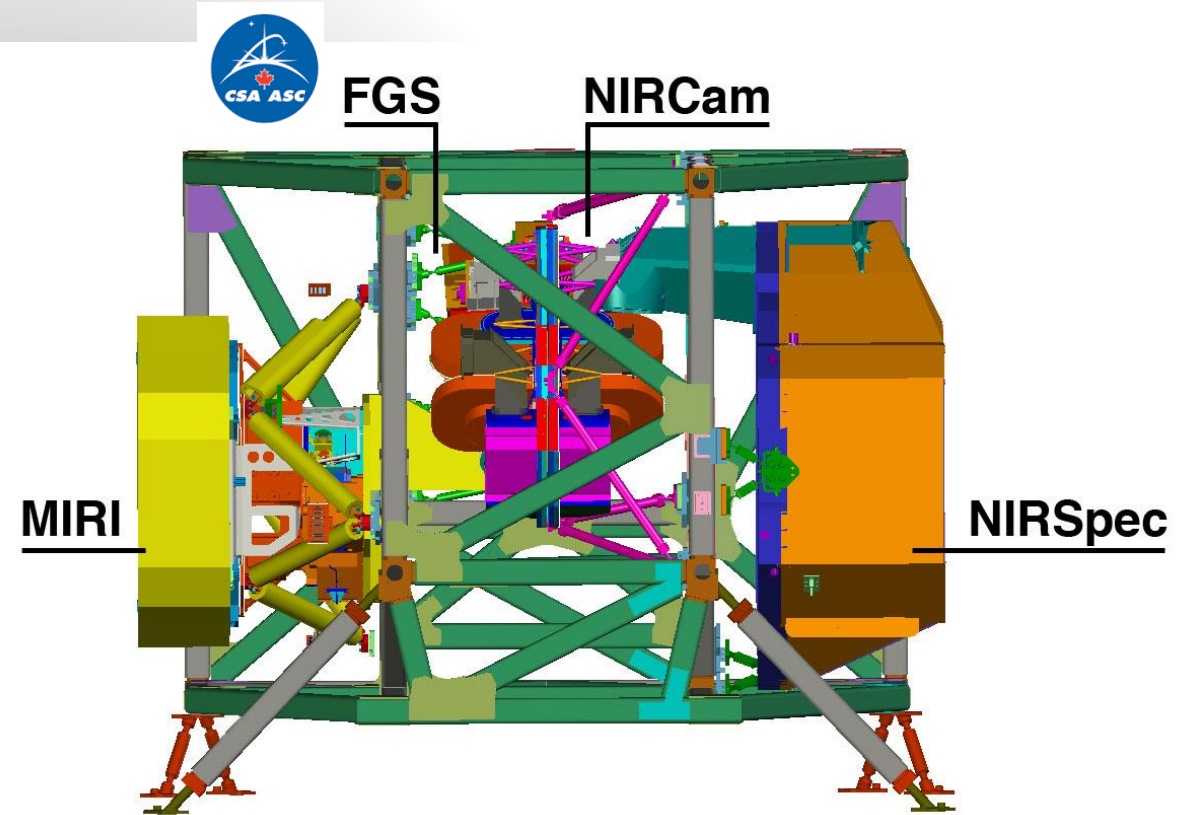


Mid-Infrared Instrument (MIRI) – will see the redshifted light of distant galaxies, newly forming stars, and faintly visible comets as well as objects in the Kuiper Belt. MIRI's camera will provide wide-field, broadband imaging that will continue the breathtaking astrophotography that has made Hubble so universally admired.

Integrated Science Instrument Module (ISIM)



*Graphic and info taken from jwst.nasa.gov



Fine-Guide Sensor (FGS) – allows Webb to point precisely, so that it can obtain high-quality images. The Near Infrared Imager and Slitless Spectrograph part of the FGS/NIRISS will be used to investigate the following science objectives: first light detection, exoplanet detection and characterization, and exoplanet transit spectroscopy.

Integrated Science Instrument Module

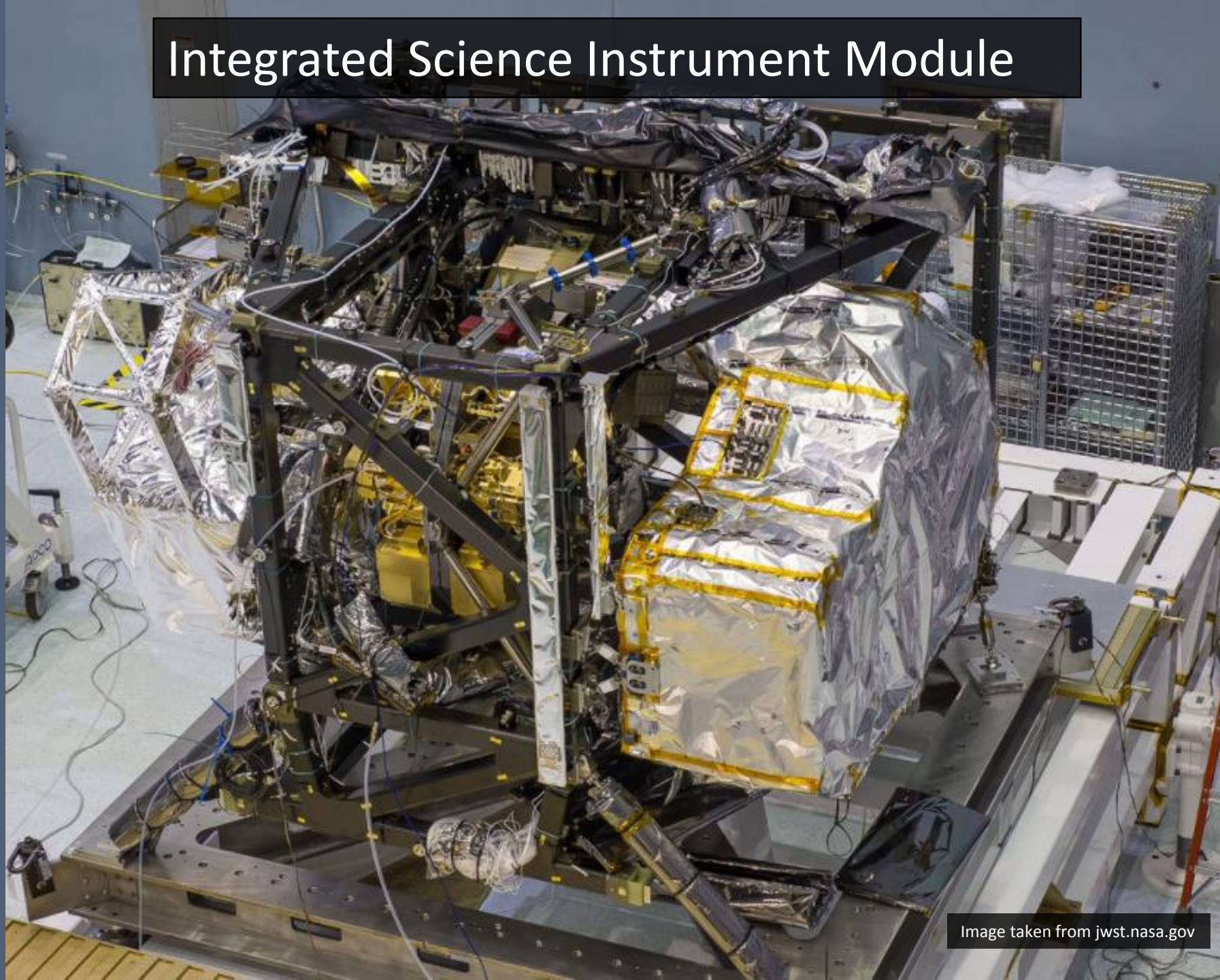
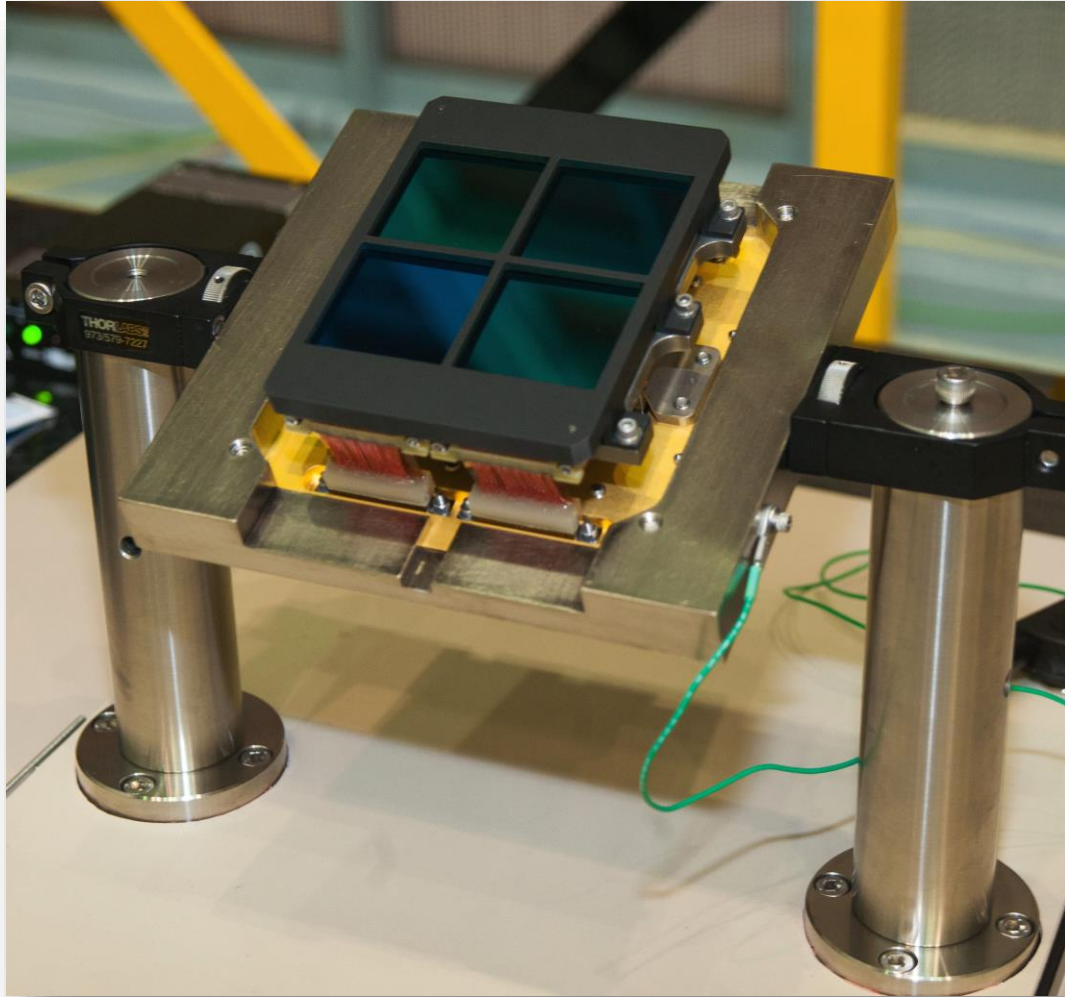
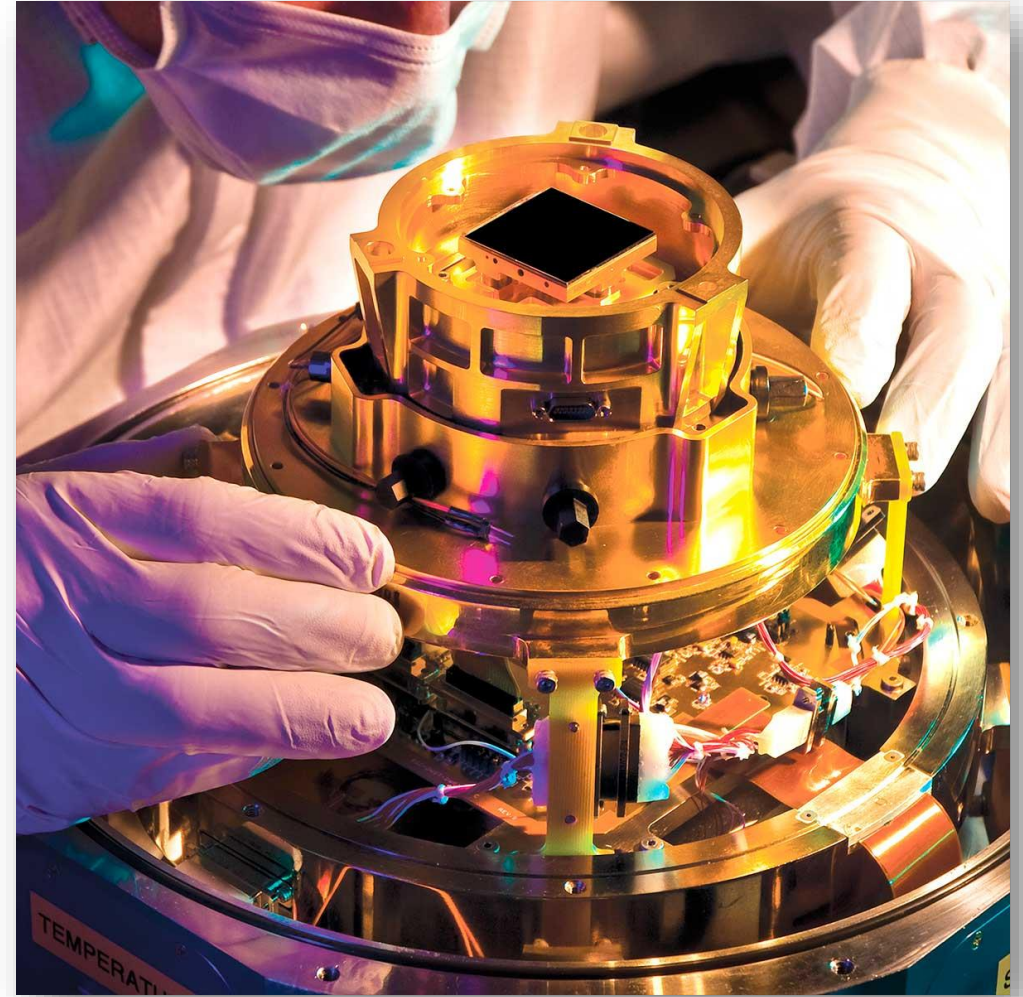


Image taken from [jwst.nasa.gov](https://www.jwst.nasa.gov)

The Detectors



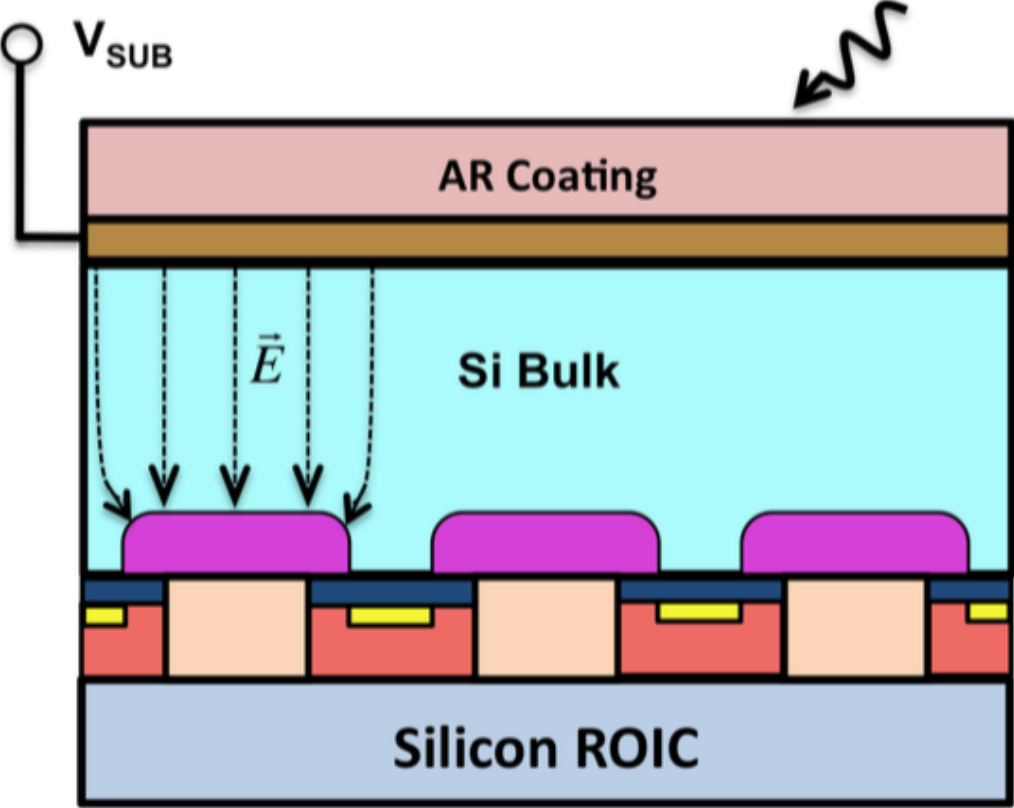
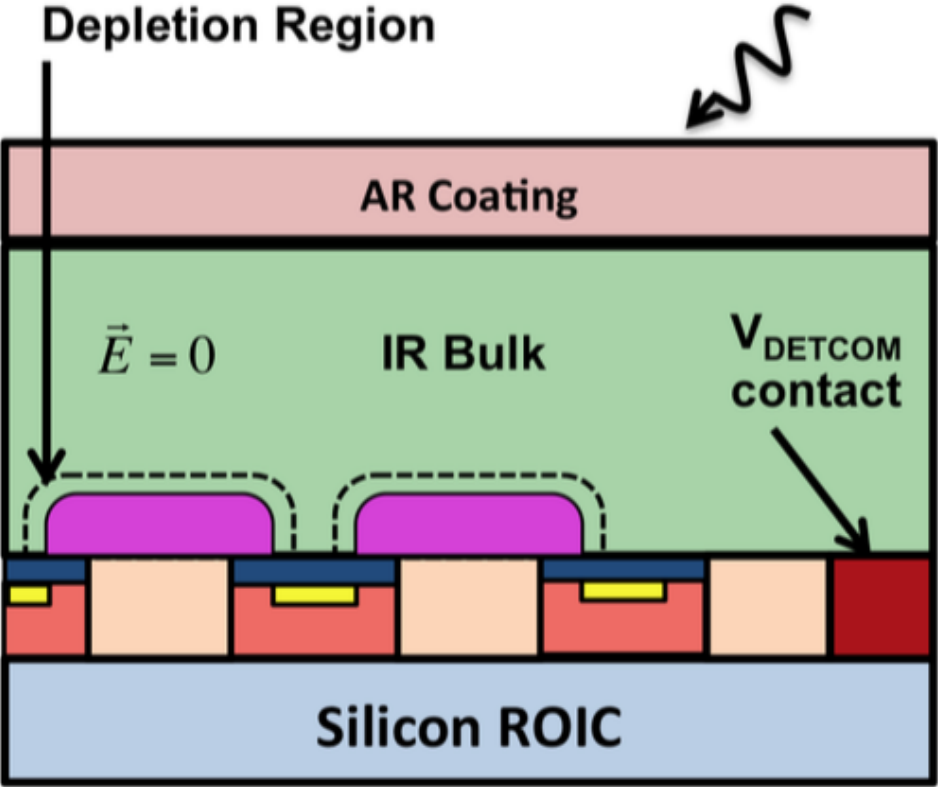
4 H2RG NIRCAM detector detectors taken from jwst-docs.stsci.edu



FGS sensor being tested at Teledyne Scientific Imaging for cryogenic performance testing (image taken from <http://www.osa-opn.org/>).

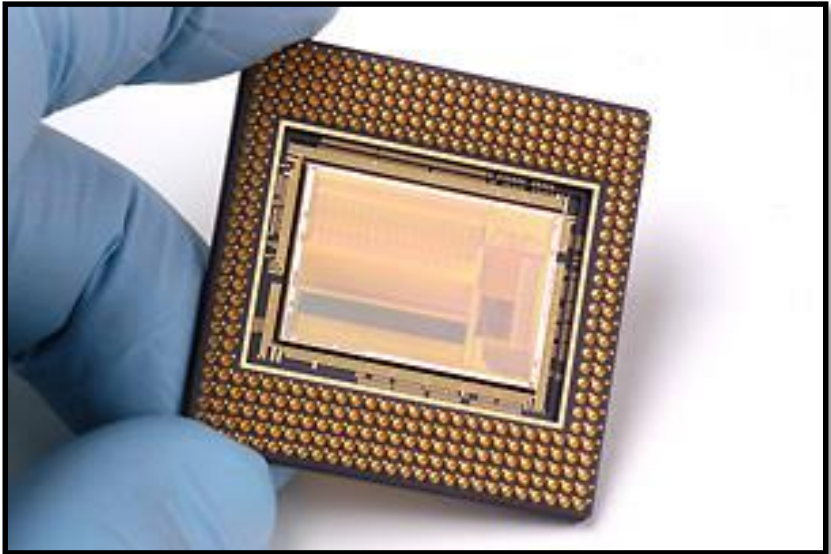
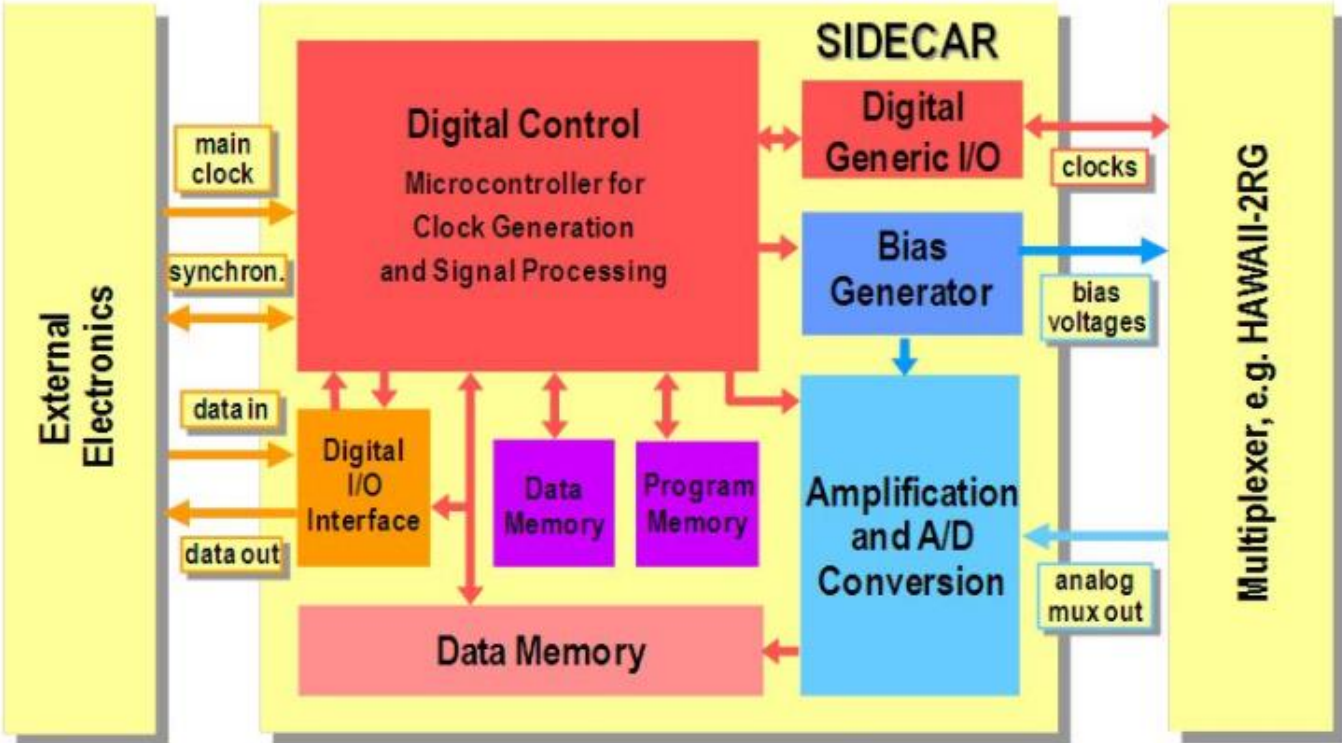
The Detector Cross-Section

- Frontside Passivation
- n⁺ contact
- Metal grid (to control surface potential)
- Indium Bump Bonds
- p⁺ implant
- Epoxy Backfill (or vacuum)



Taken from *Hybrid CMOS SiPIN Detectors as Astronomical Imagers*, L. Simms, 2009

The SIDECAR Controller



System for Image Digitization, Enhancement, Control And Retrieval

Images taken from Teledyne Scientific and Imaging websites

The Assembly Code (Image taken from Chen et al., Proc. of SPIE Vol. 9154 915426-1)

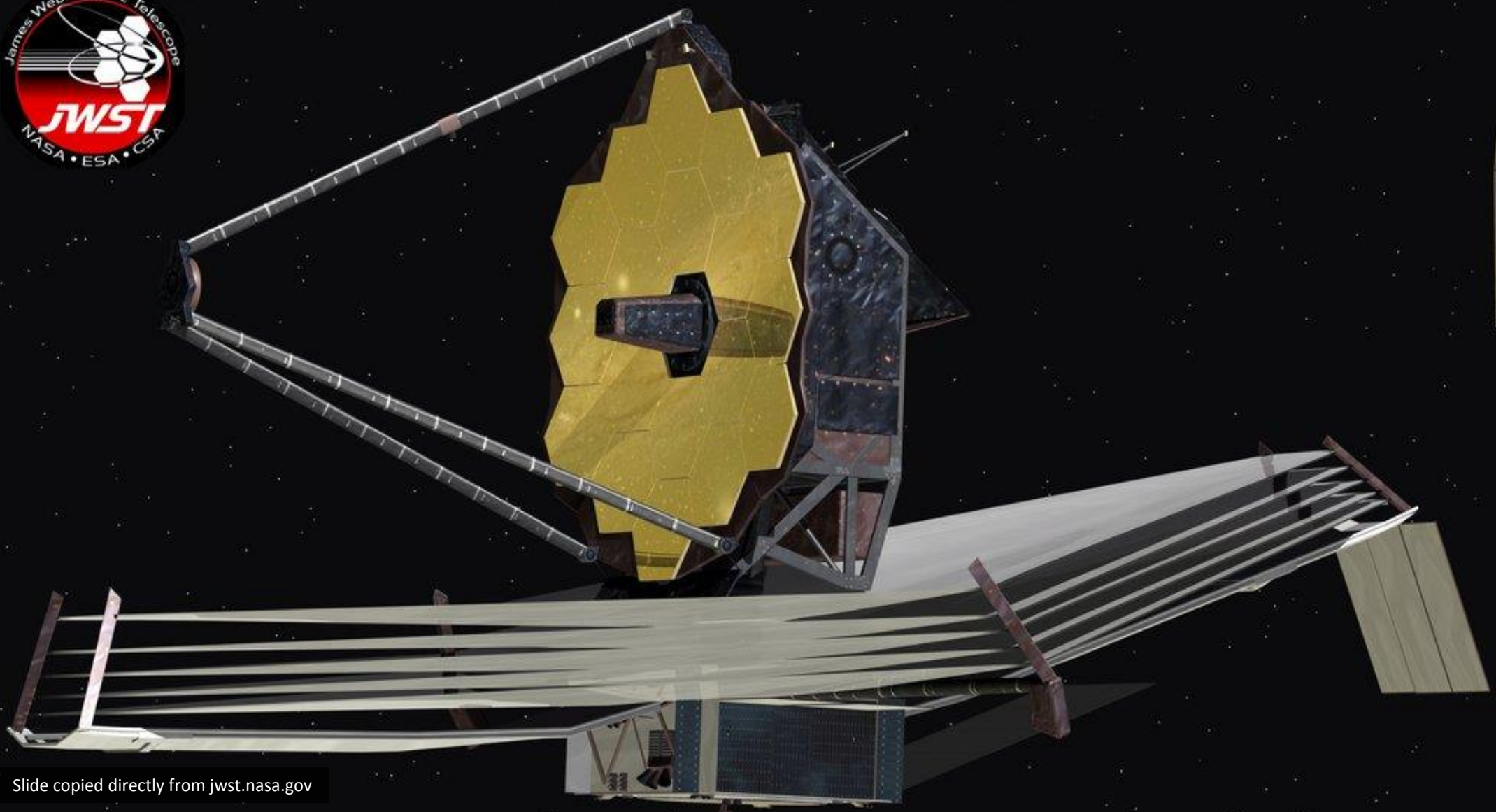
The image shows a screenshot of an IDE window titled "Sidecar ASIC Integrated Development Environment - Euclid_Jade@localhost". The main window is "Assembler - TestPattern2.asm" with a "Code Editor" showing assembly code. The code includes comments for defining port addresses, setting defaults for a 512x512 pixel image, and a main routine that defines Sync and Width, and starts a frame. The code is as follows:

```
11 // define the port addresses
12 .LDREG h6700 h6900 // port0 = SyncReg
13 .LDREG h6701 h4000 // port1 = width/height
14 .LDREG h6702 h4001
15
16 // set defaults
17 .LDREG h4000 h0200 // 512 x 512 pixels
18 .LDREG h4001 20
19
20 // main assembler routine
21 .DEFINE Sync 0
22 .DEFINE Width 1
23
24 MAIN PROC
25
26 startframe:
27 IN R0, Sync
28 BTST R0, 0
29 JPNC startframe
30 BCLR R0, 0
31 OUT Sync, R0
32
33 IN R0, 2 // division factor
34 DEC R0
```

Below the code editor are tabs for "Output", "Errors", and "Machine Code". The "System Log" at the bottom shows: "5/18/2014 7:43:06 AM : Remote HalClient is Initializing HalServer Number Supported devices=1".

To the right, a Notepad window titled "TestPattern2.mcd" displays the hex output of the assembly code:

```
6a00 0000
6a02 0013
6a03 0080
6a18 0001
6a28 0005
6700 6900
6701 4000
6702 4001
4000 0200
4001 0014
blockstart
address 0000
length 75
1000
6d80
86fd
0680
1800
1002
6b81
a701
5019
1802
6b83
```

Slide copied directly from jwst.nasa.gov

