



DIVISION OF
ASTRONOMY AND ASTROPHYSICS

Faculty of Mathematics, Physics and Informatics
Comenius University
Bratislavá



TOP ĎALEKOHLÁDY SÚČASNOSTI

RNDr. Roman Nagy, PhD.





TOP ĎALEKOHĽADY SVETA (A NIE LEN)

○ James Webb Space Telescope:

- *Dlhá cesta časom a priestorom*
- *Ako James Webb pozoruje?*
- *Čo všetko nám už stihol objasniť?*

○ Vera Rubin Observatory

- *Gigantická dominanta Ánd*
- *Prvé dátá sú už tu*



DLHÁ CESTA ČASOM

- Rozpočet 10 mld. \$



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O





DLHÁ CESTA ČASOM



○ 25.12.2021 – štart z Francúzskej Guyany



6

DL

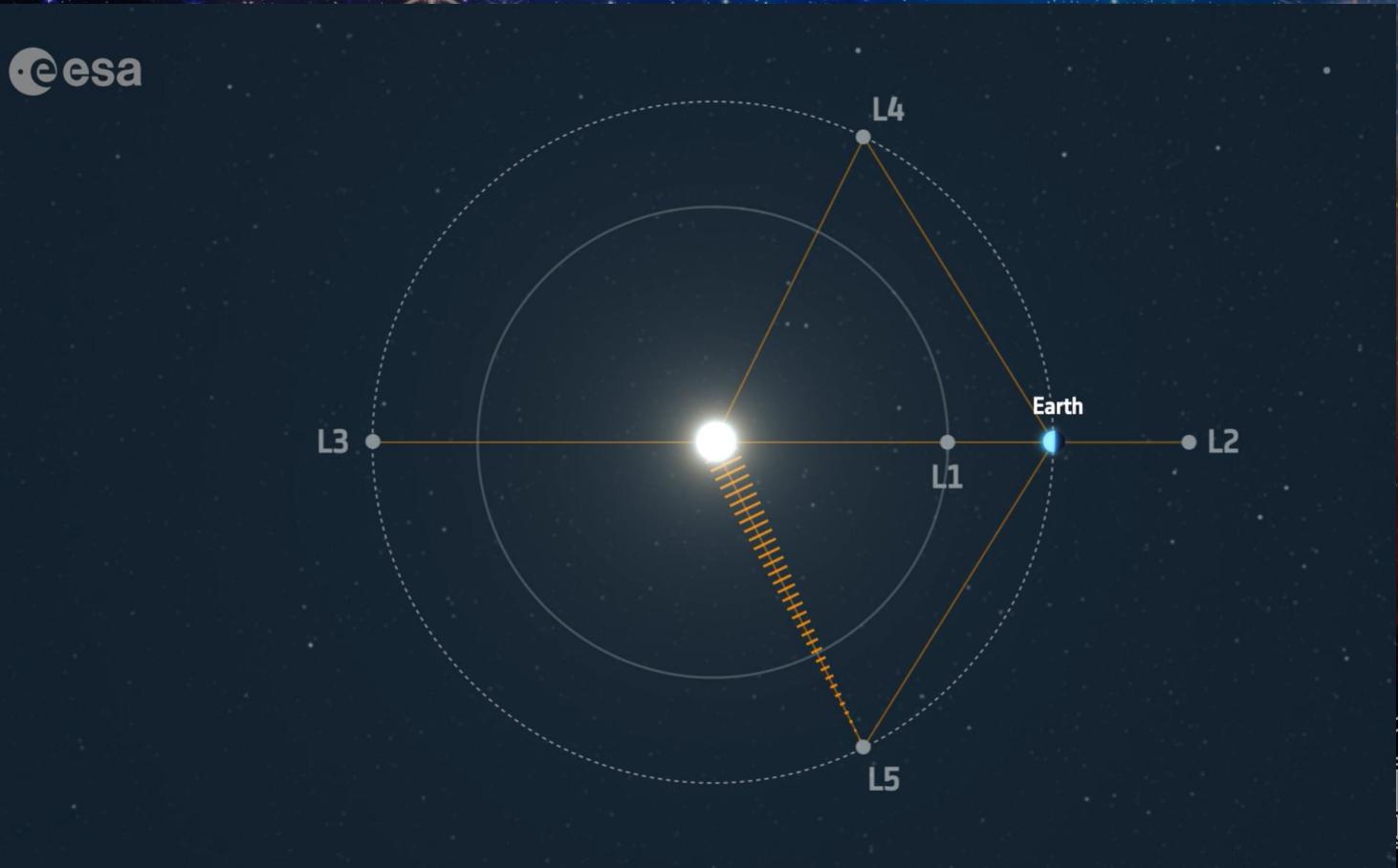
O 2



Crédit : ESA-CNES-ONERA/SPACE Optique/Video © CSG - J.-P. GUILLOU



A KAM TO VLASTNE IDE?

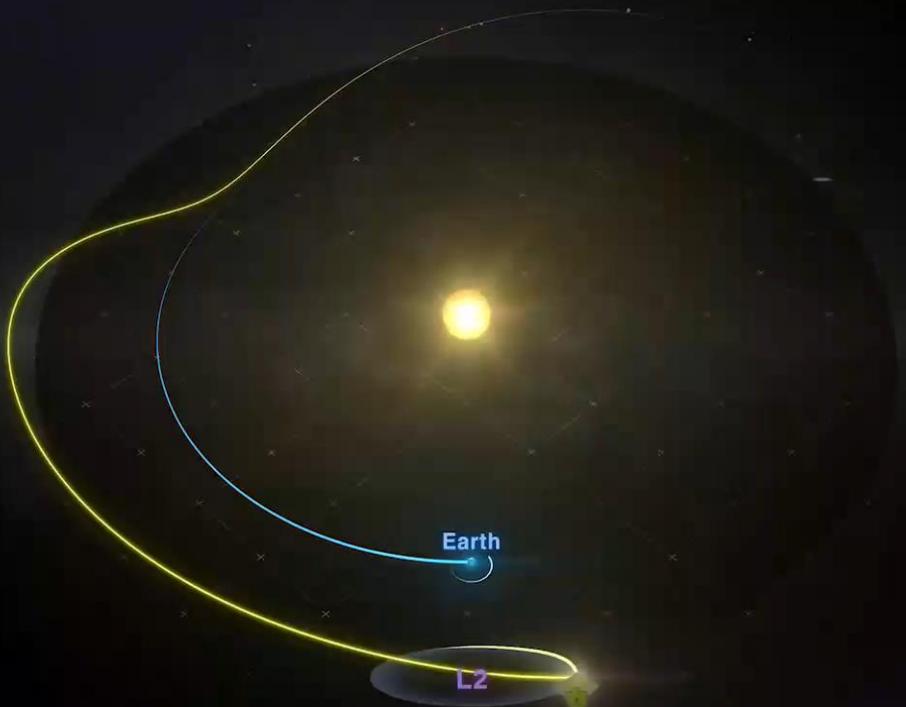


A KAM TO VLASTNE IDE?



esa





10

A ČO NA TO HOVORÍ STARÝ PÁN HUBBLE?

- 2,4m zrkadlo

- 6,5m zrkadlo

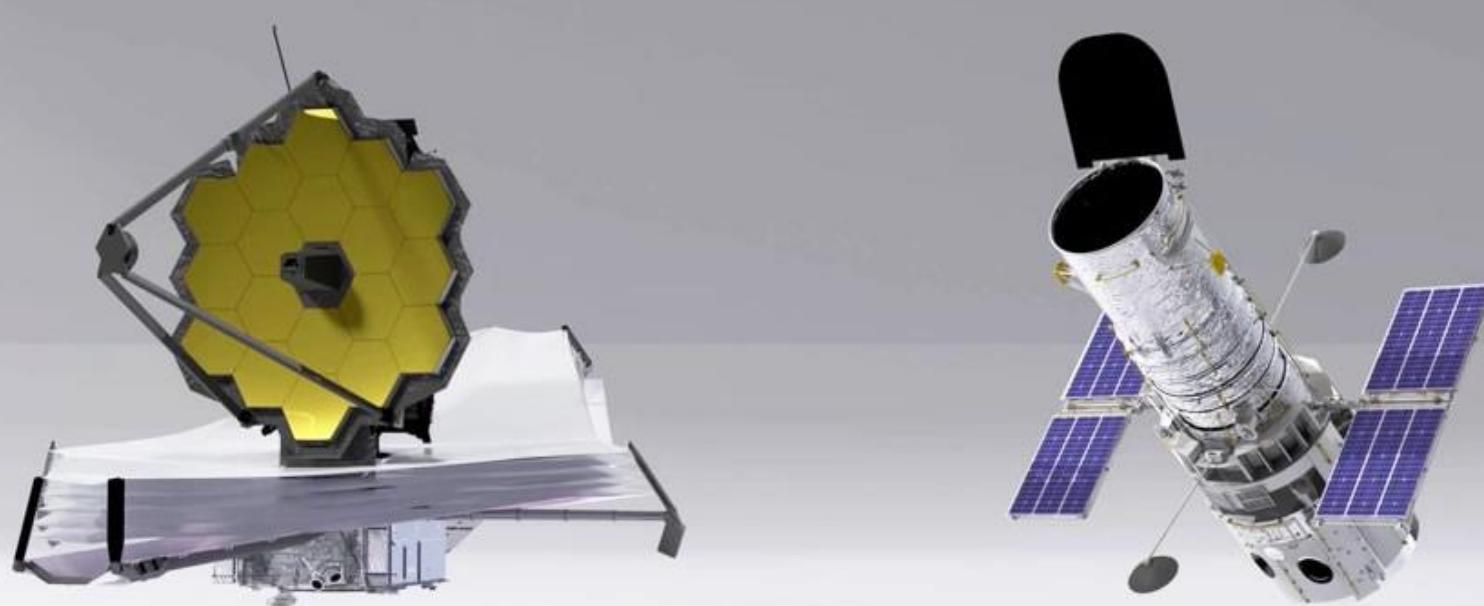


A ČO NA TO HOVORÍ STARÝ PÁN HUBBLE?



O 2,2 m zrkadlo

O 1,5 m zrkadlo

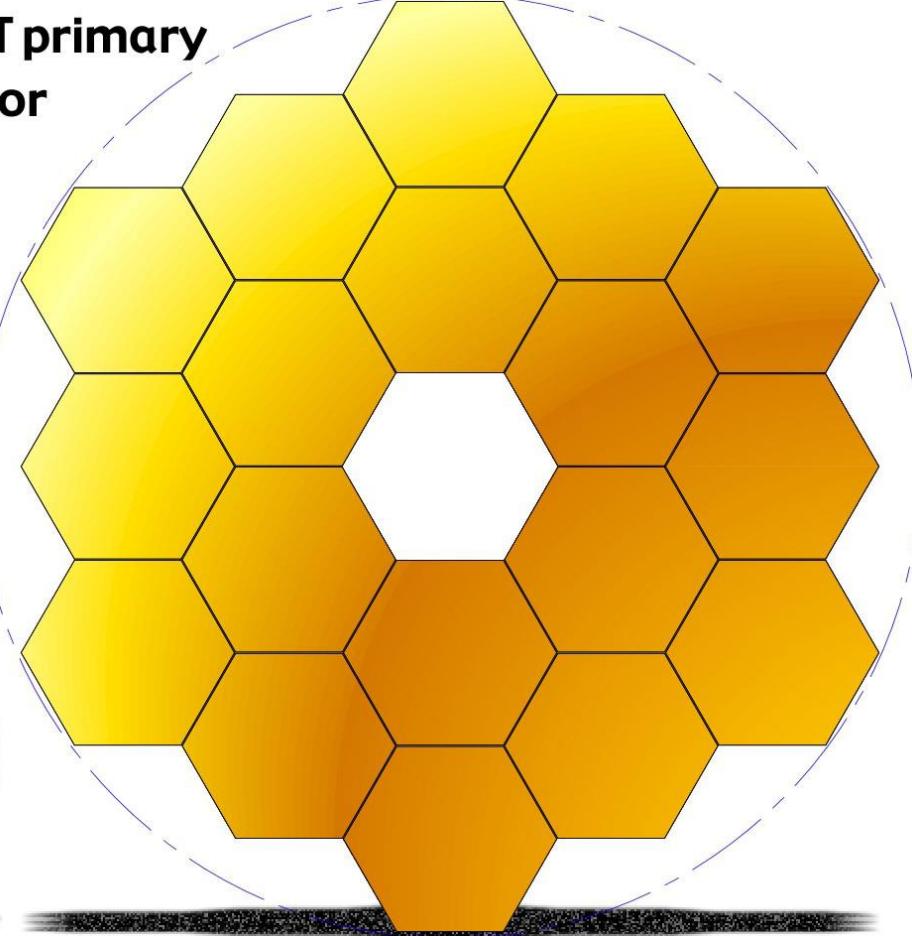
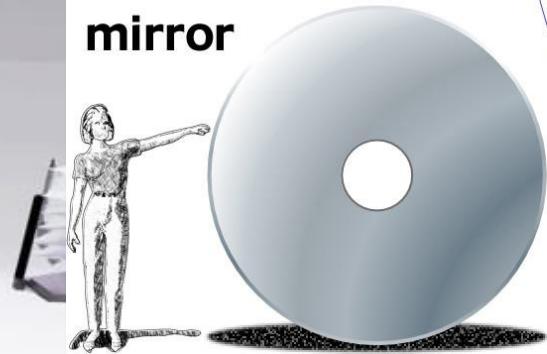


10

A
C
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JWST primary
mirror

Hubble primary
mirror



A ČO NA TO HOVORÍ STARÝ PÁN HUBBLE?



- 2,4m zrkadlo
- 6,5m zrkadlo
- Viditeľná a UV oblasť
- Infračervená oblasť

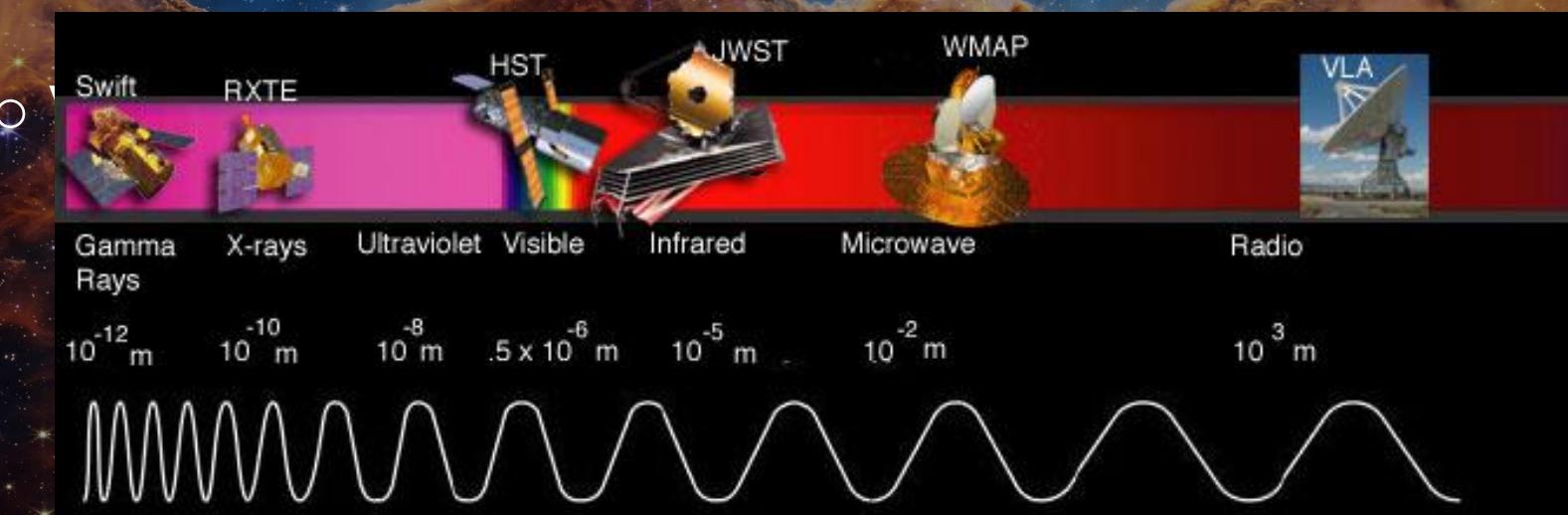




A ČO NA TO HOVORÍ STARÝ PÁN HUBBLE?

- 2,4m zrkadlo

- 6,5m zrkadlo





A ČO NA TO HOVORÍ STARÝ PÁN HURRIE?



Visible ■ WFPC2 ■ 2001

Infrared ■ WFC3/IR ■ 2014



AČ
LIVE



Visible ■ WFPC2 ■ 2001



Infrared ■ WFC3/IR ■ 2014



A PREČO PRÁVE IR?



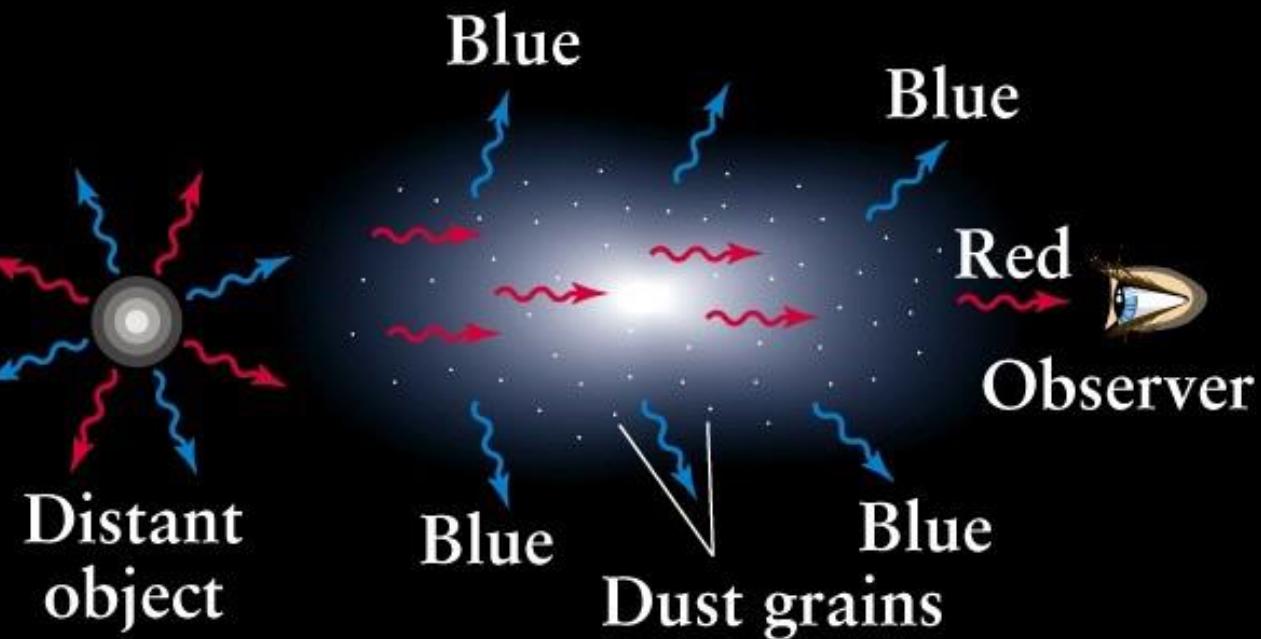
- Medzihviezdna a medzигalaktická absorpcia



A PREČO PRÁVE IR?



o Medzih



A PREČO PRÁVE IR?



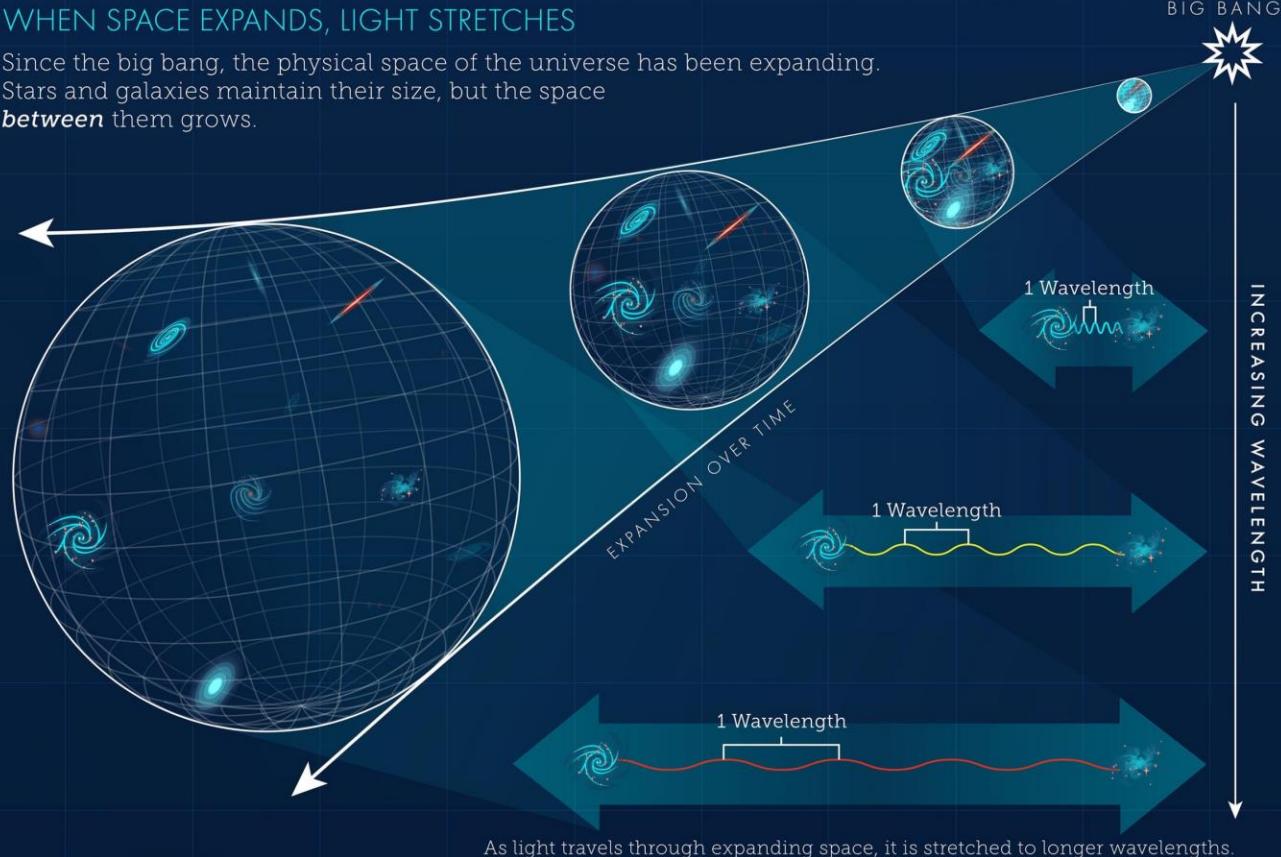
- Medzihviezdna a medzигalaktická absorpcia
- Rozpínanie vesmíru



WHAT IS COSMOLOGICAL REDSHIFT?

WHEN SPACE EXPANDS, LIGHT STRETCHES

Since the big bang, the physical space of the universe has been expanding. Stars and galaxies maintain their size, but the space *between* them grows.



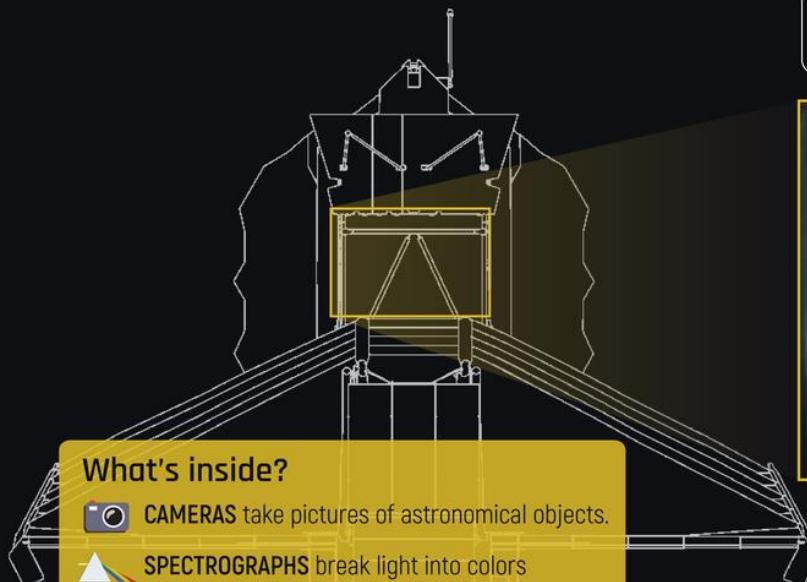
As light travels through expanding space, it is stretched to longer wavelengths.



A AKO WEBB POZORUJE?



Webb's Science Instruments



What's inside?

- CAMERAS** take pictures of astronomical objects.
- SPECTROGRAPHS** break light into colors for analysis.
- CORONAGRAPHES** block starlight, allowing observation of planets orbiting nearby.



NIRSpec



FGS/NIRISS



NIRCam



MIRI



A AKO WÉBB POZORUJE?



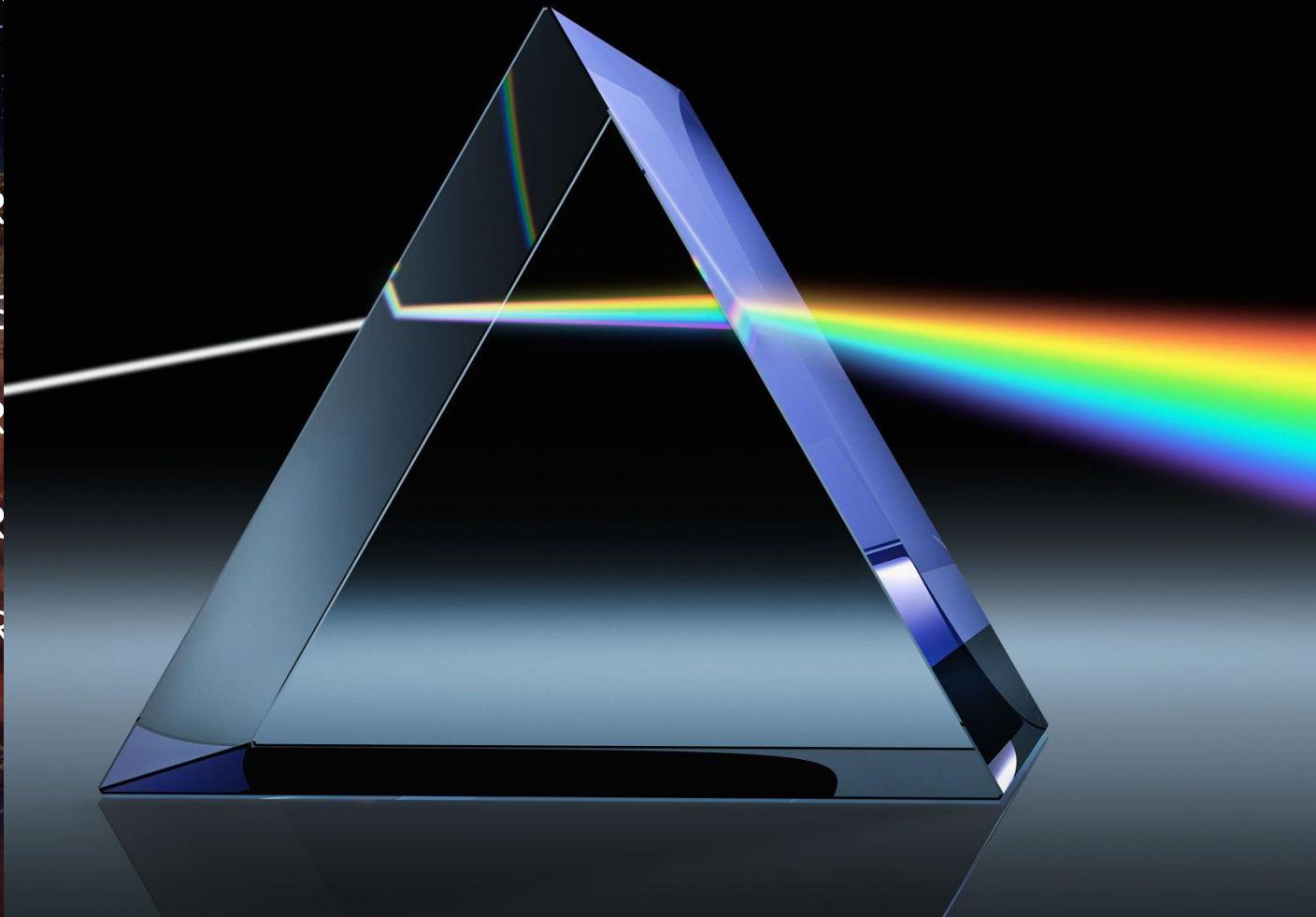
- NIRSpec - Near-Infrared Spectrograph
- FGS – Fine Guiding Sensor
- NIRISS - The Near Infrared Imager and Slitless Spectrograph
- NIRCam - Near-Infrared Camera
- MIRI - Mid-Infrared Instrument



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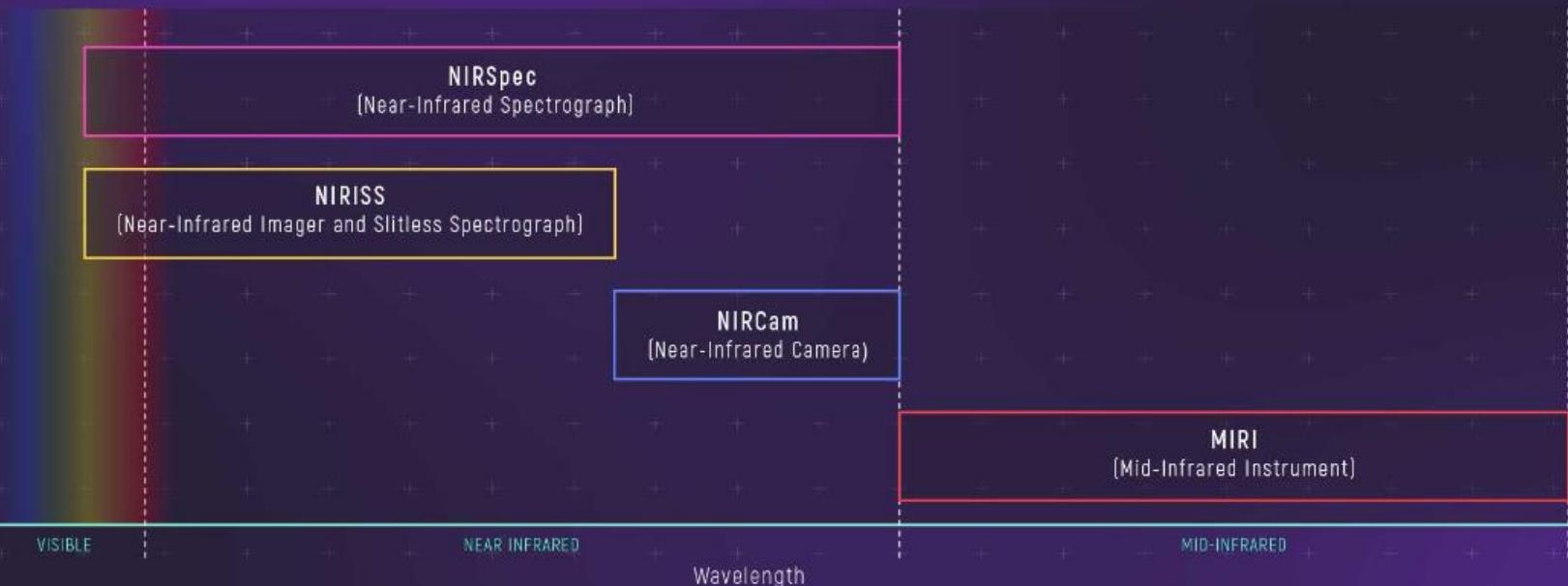
A A k

○ NIR
○ FGS
○ NIR
○ NIR
○ MIR

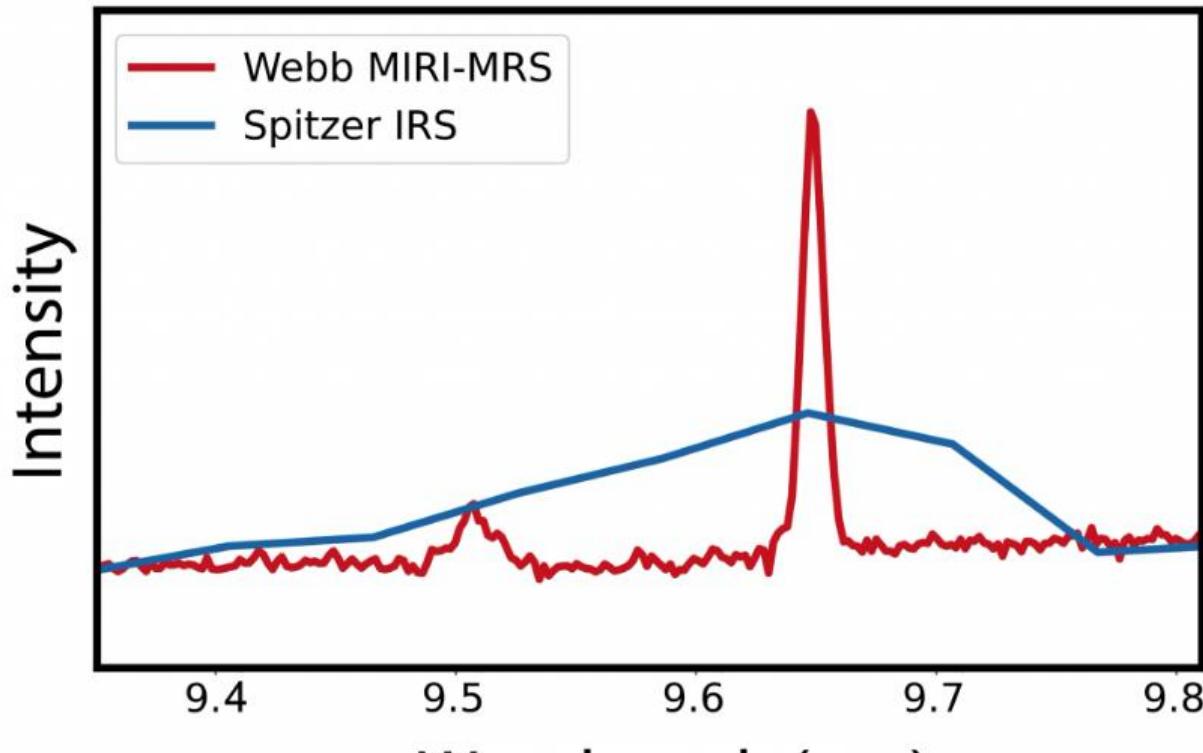




WAVELENGTH RANGE OF WEBB'S SPECTROSCOPIC INSTRUMENTS



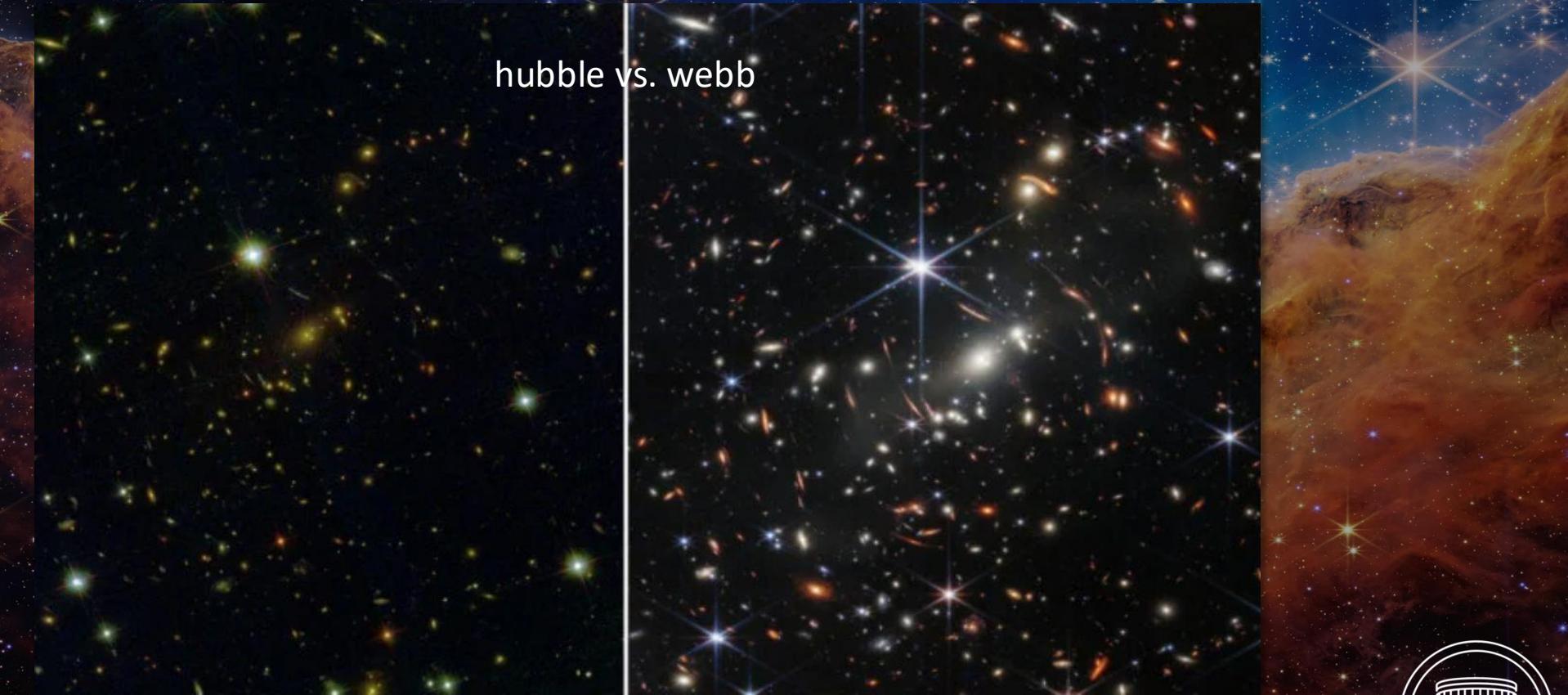
AAk



WEBB DEEP FIELD (NIRCAM)



hubble vs. webb



WEBB



JADES deep field





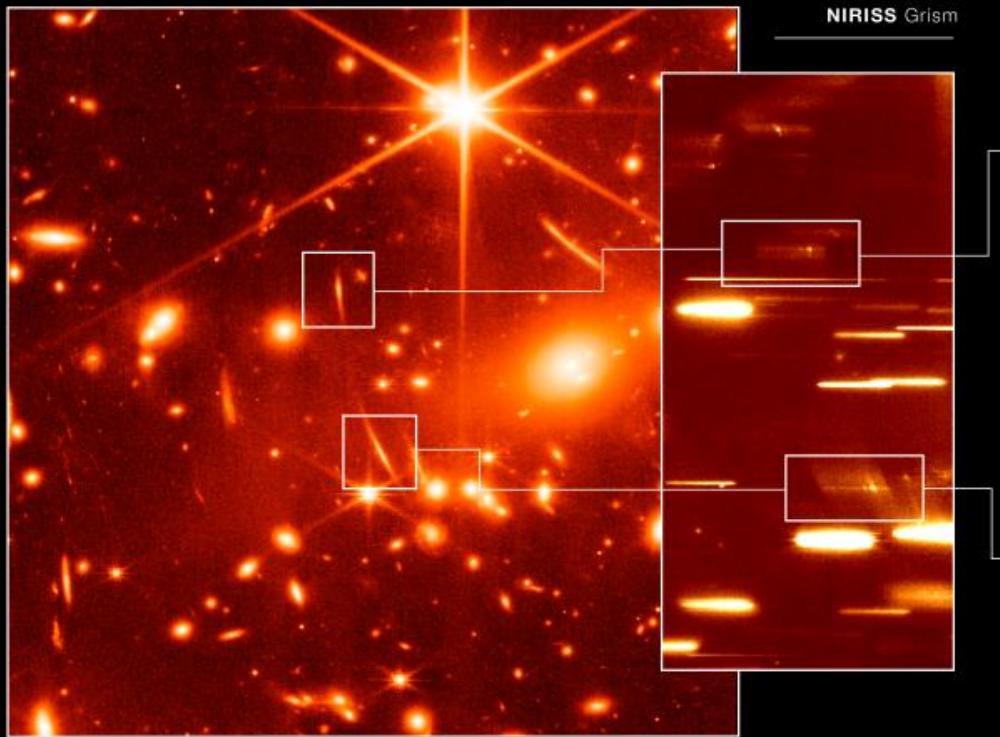
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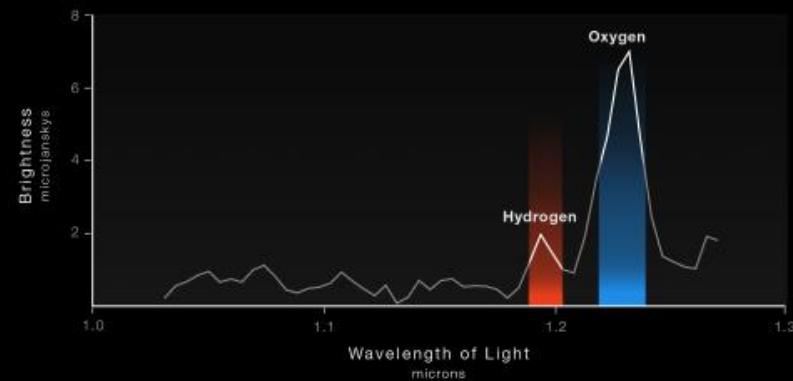
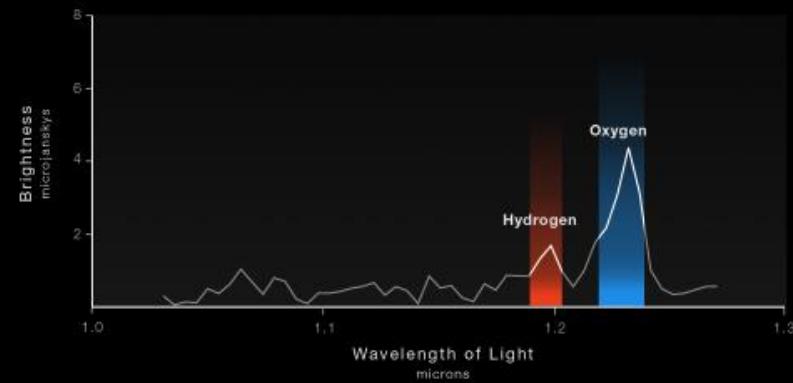
GALAXY CLUSTER SMACS 0723

WEBB SPECTRA CONFIRM TWO ARCS ARE THE SAME GALAXY

NIRISS Imaging



NIRISS Wide Field Slitless Spectroscopy



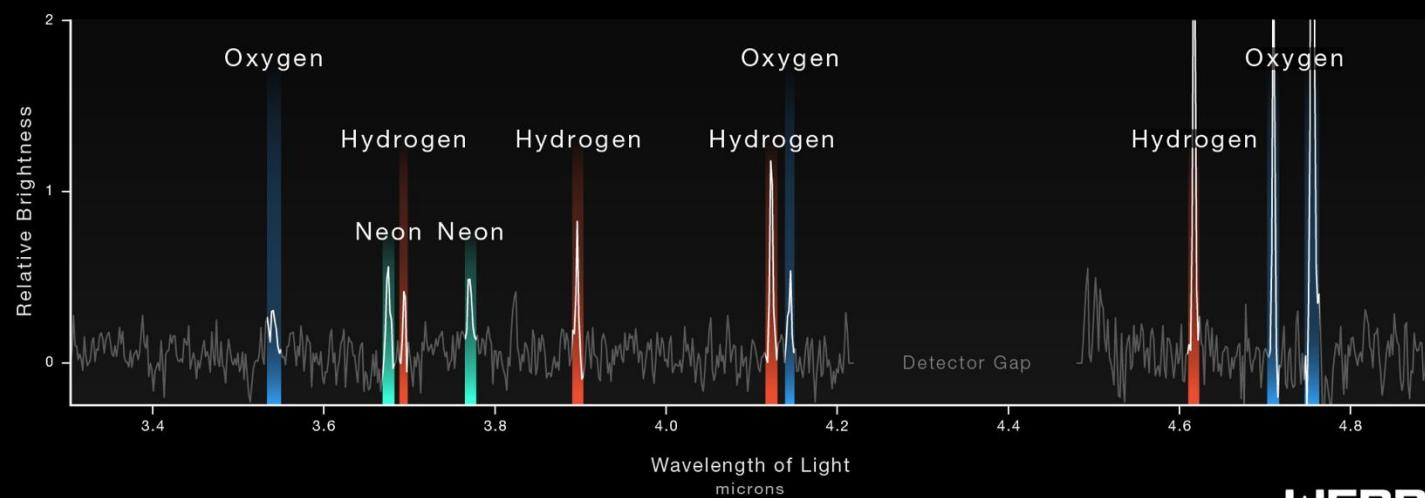
DISTANT GALAXY BEHIND SMACS 0723

WEBB SPECTRUM SHOWCASES GALAXY'S COMPOSITION

NIRCam Imaging



NIRSpec Microshutter Array Spectroscopy



WEBB
SPACE TELESCOPE



DISTANT
WEBB

GALAXY CLUSTER SMACS 0723

WEBB SPECTRA IDENTIFY GALAXIES IN THE VERY EARLY UNIVERSE



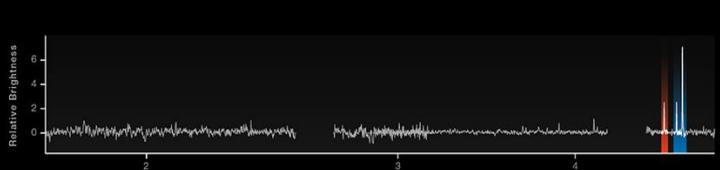
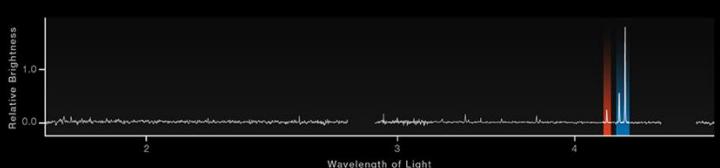
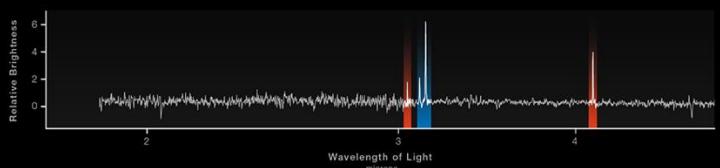
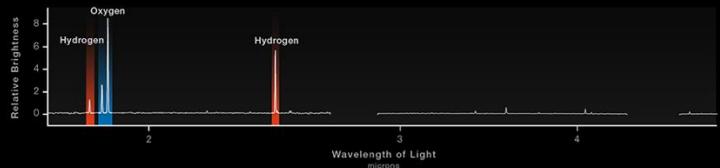
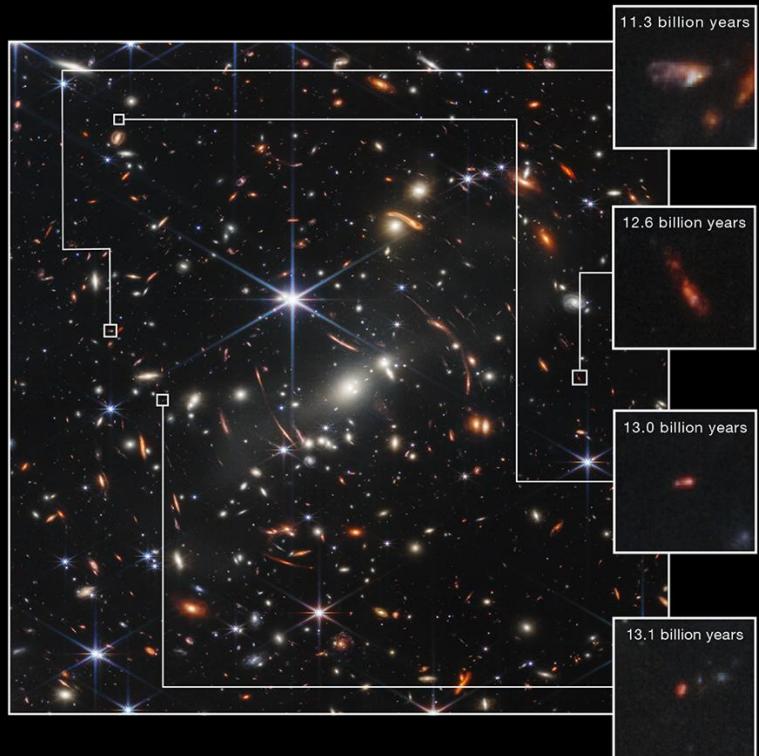
NIRCam I

NIRCam Imaging

NIRSpec Microshutter Array Spectroscopy

Lowest redshift

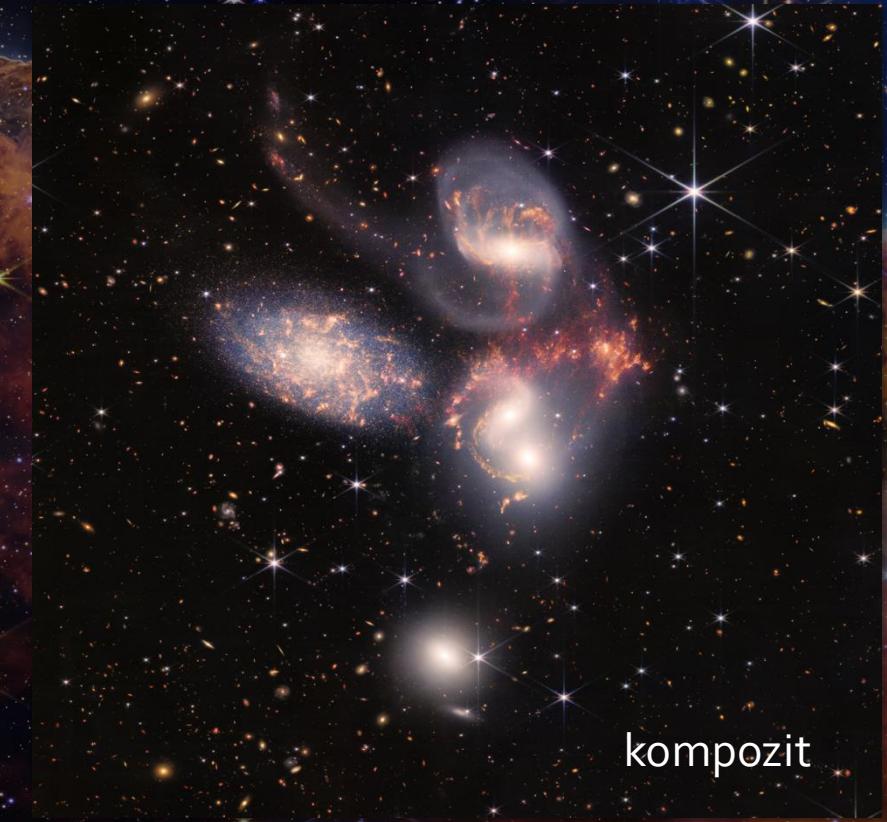
Highest redshift



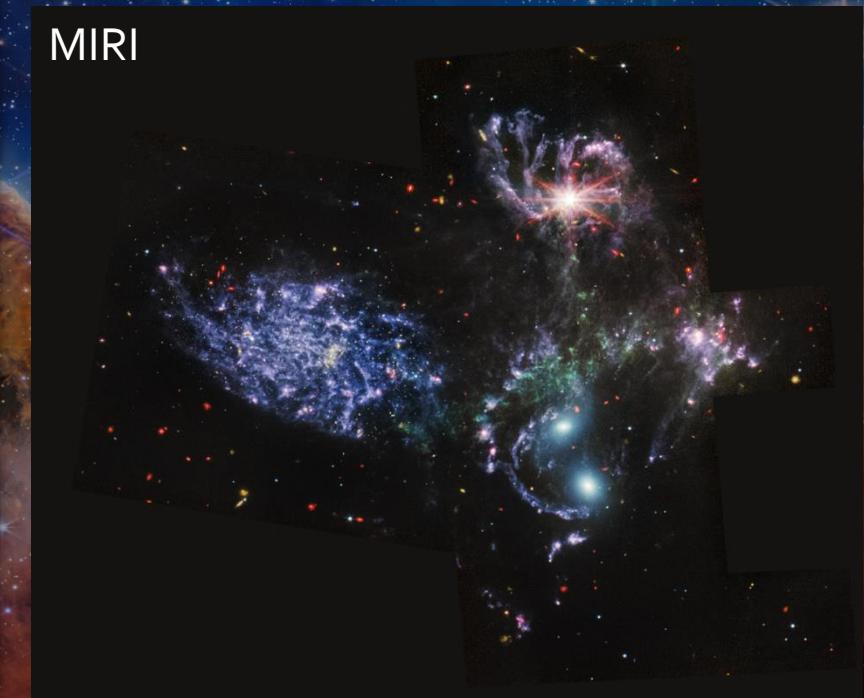
WEBB
SPACE TELESCOPE

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STEPHAN'S QUINTET



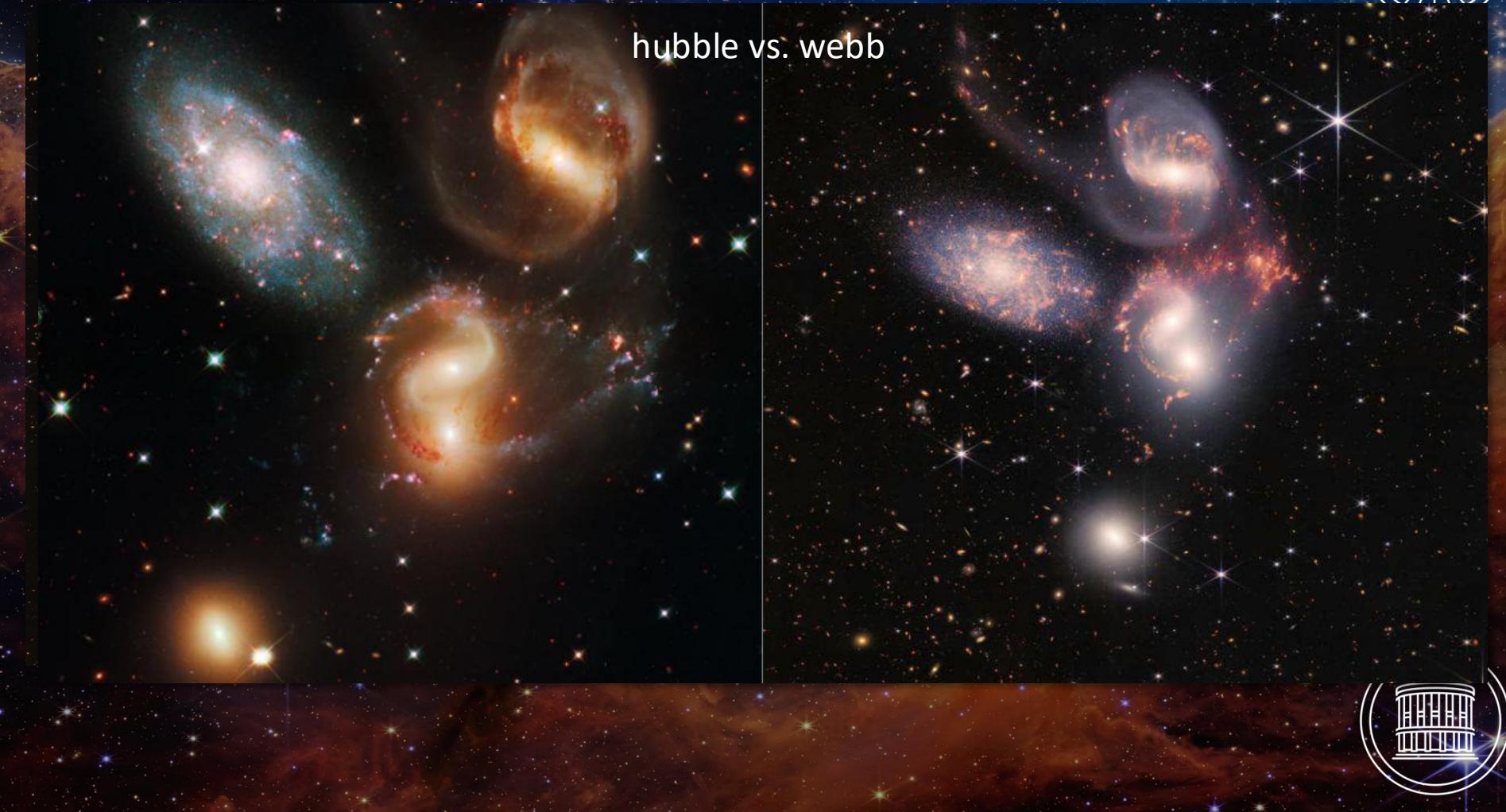
MIRI



STEPHAN'S QUINTET



hubble vs. webb

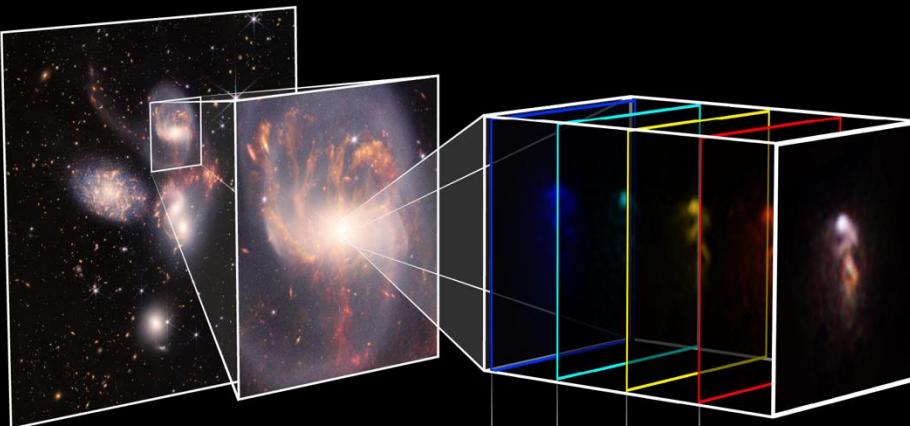


INTERACTING GALAXIES | STEPHAN'S QUINTET

COMPOSITION OF GAS AROUND ACTIVE BLACK HOLE

NIRCam and MIRI Imaging

NIRSpec IFU Spectroscopy



Atomic Hydrogen

0.656 microns
Wavelength of Light

Iron Ions

1.64 microns
Wavelength of Light

Atomic Hydrogen

1.87 microns
Wavelength of Light

Molecular Hydrogen

4.7 microns
Wavelength of Light

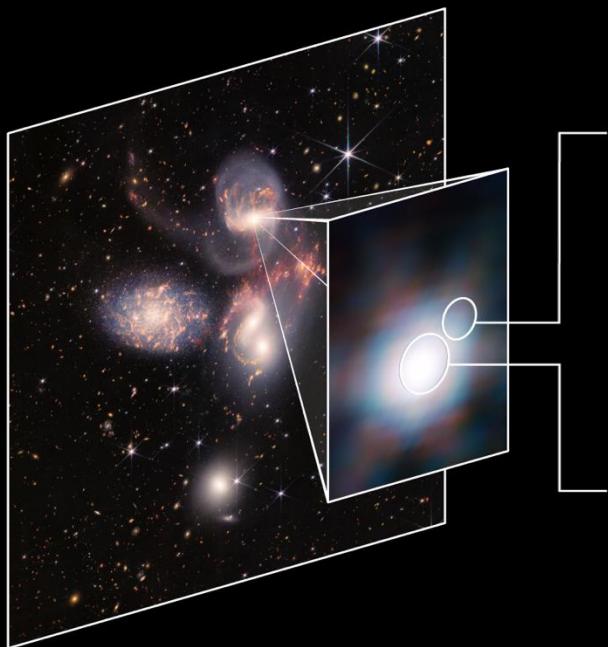
WEBB
SPACE TELESCOPE



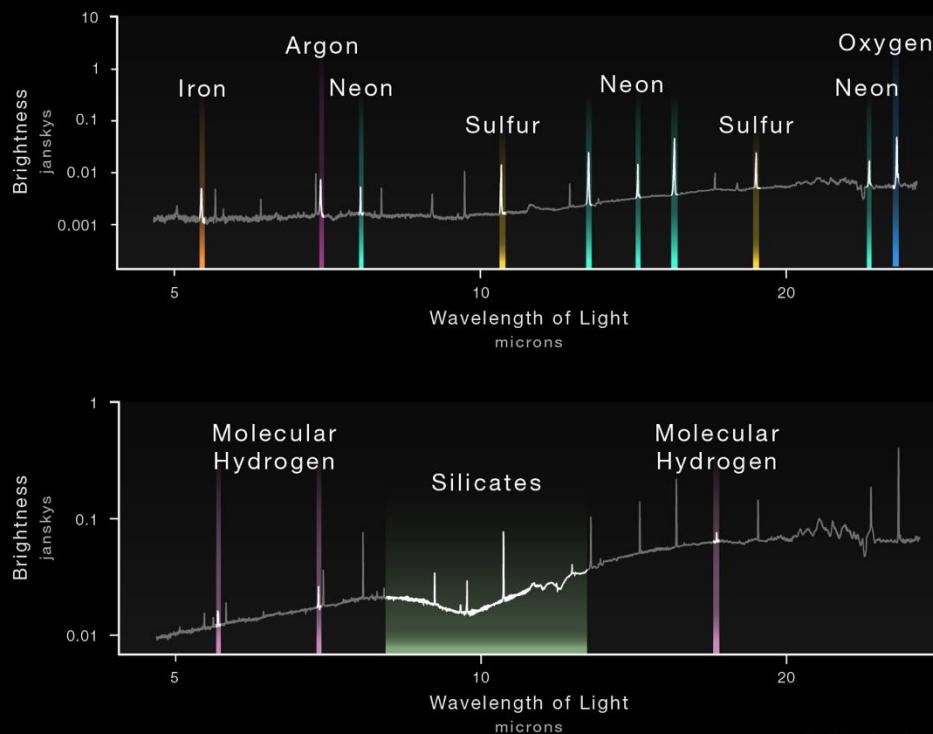
INTERACTING GALAXIES | STEPHAN'S QUINTET

COMPOSITION OF GAS AROUND ACTIVE BLACK HOLE

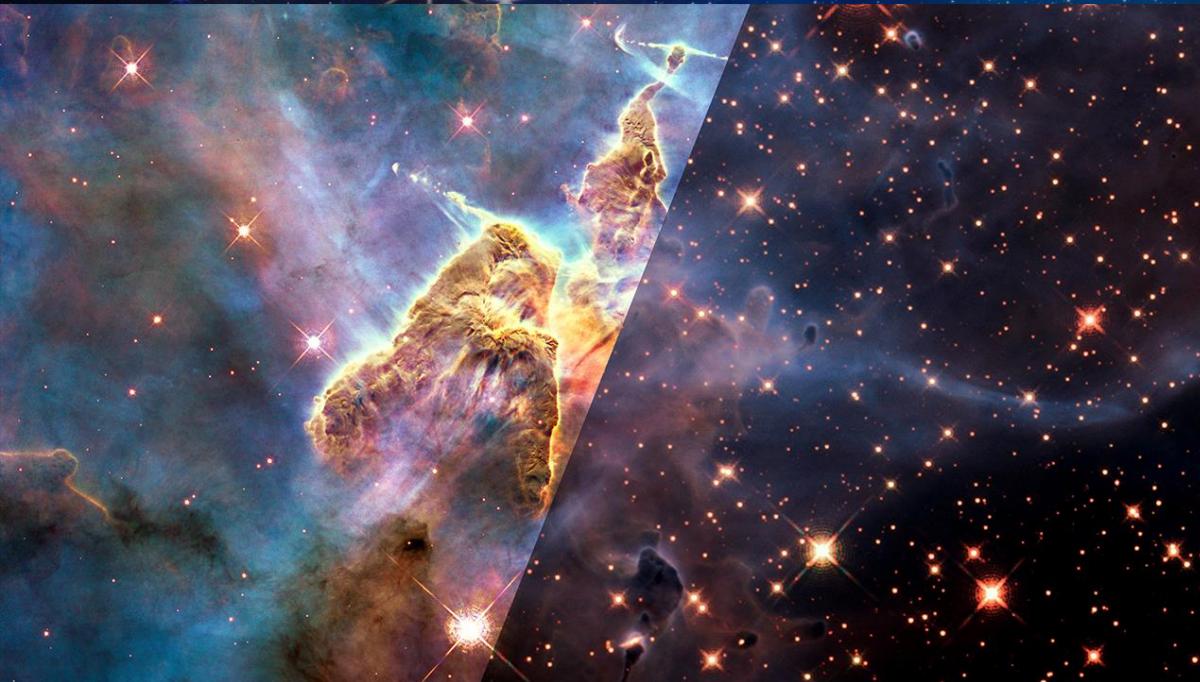
NIRCam and MIRI Imaging



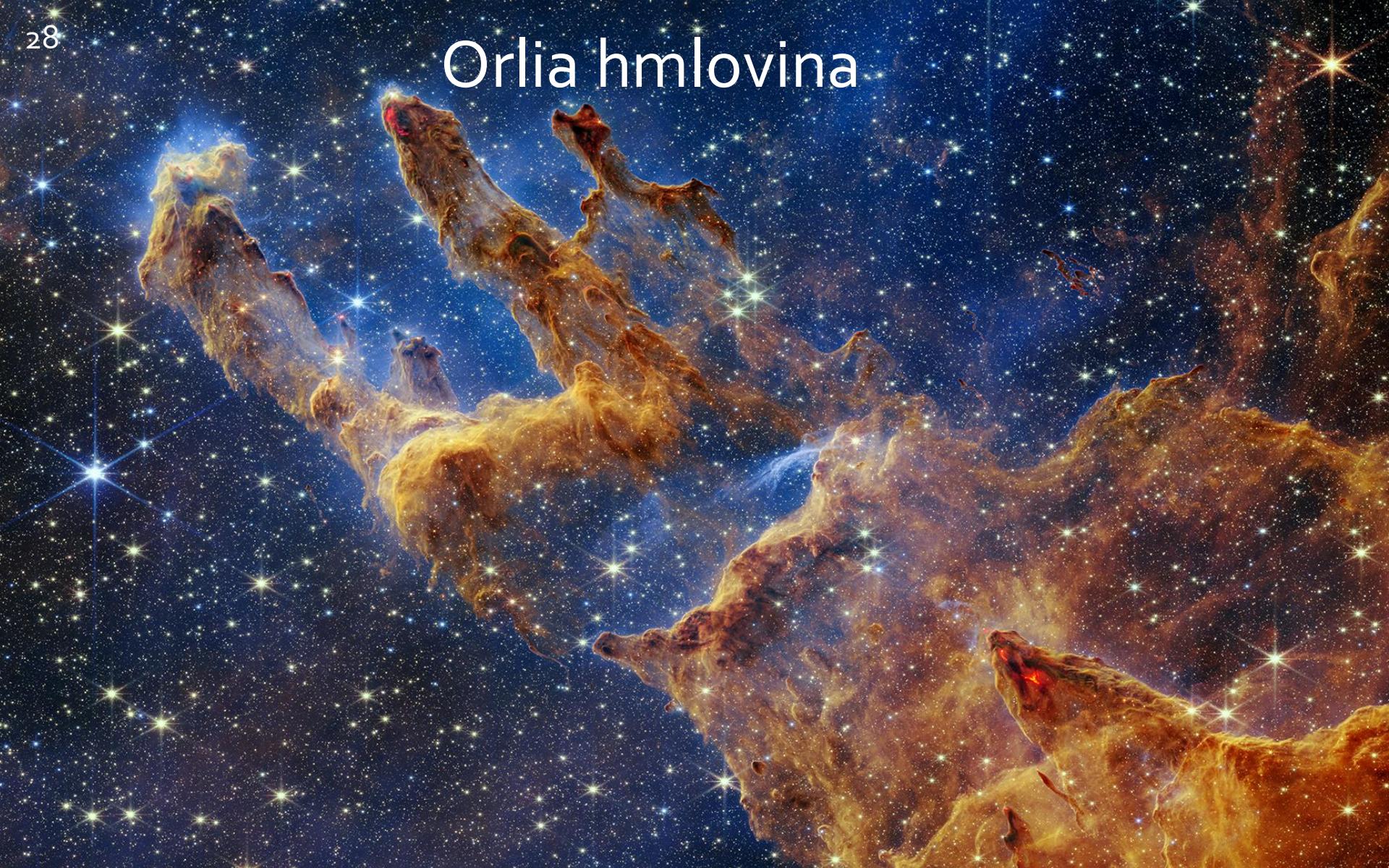
MIRI IFU Medium Resolution Spectroscopy

**WEBB**
SPACE TELESCOPE

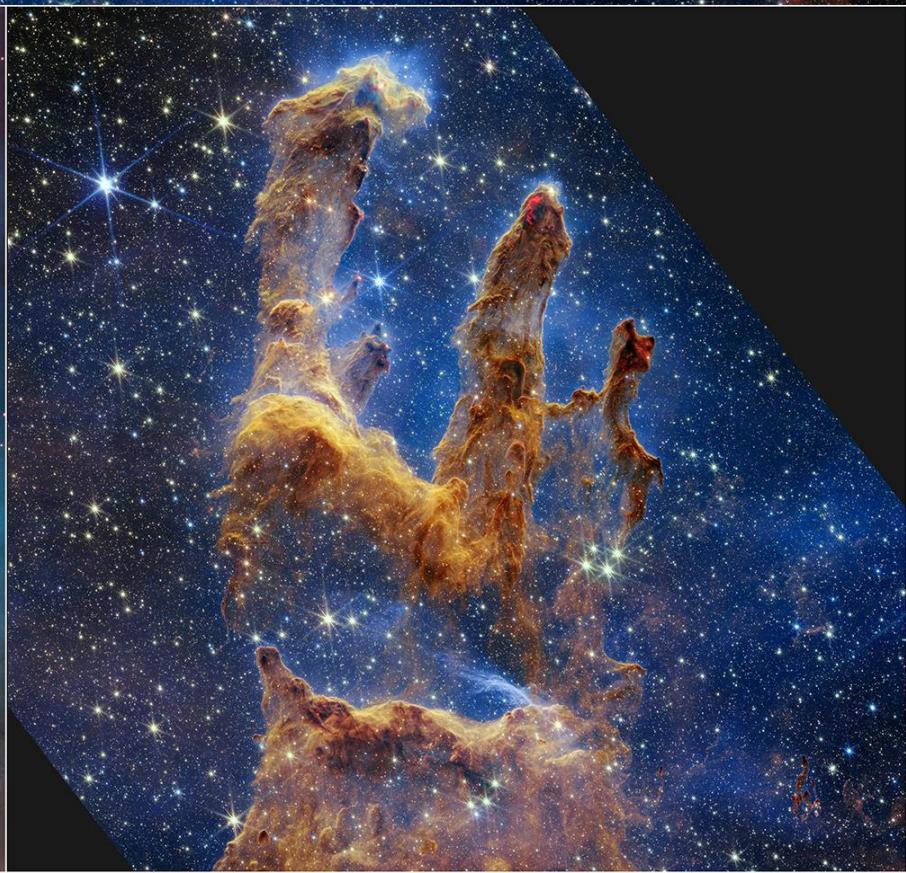
Hmlovina Carina



Orlia hmlovina



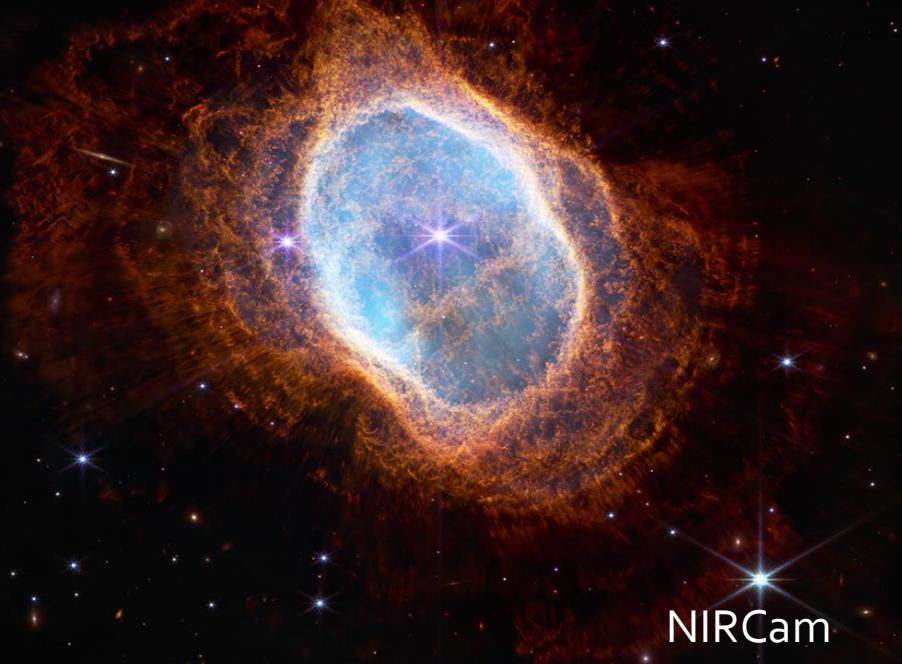
Orlia hmlovina





južná prstencová hmlovina

NIRCam



NIRCam

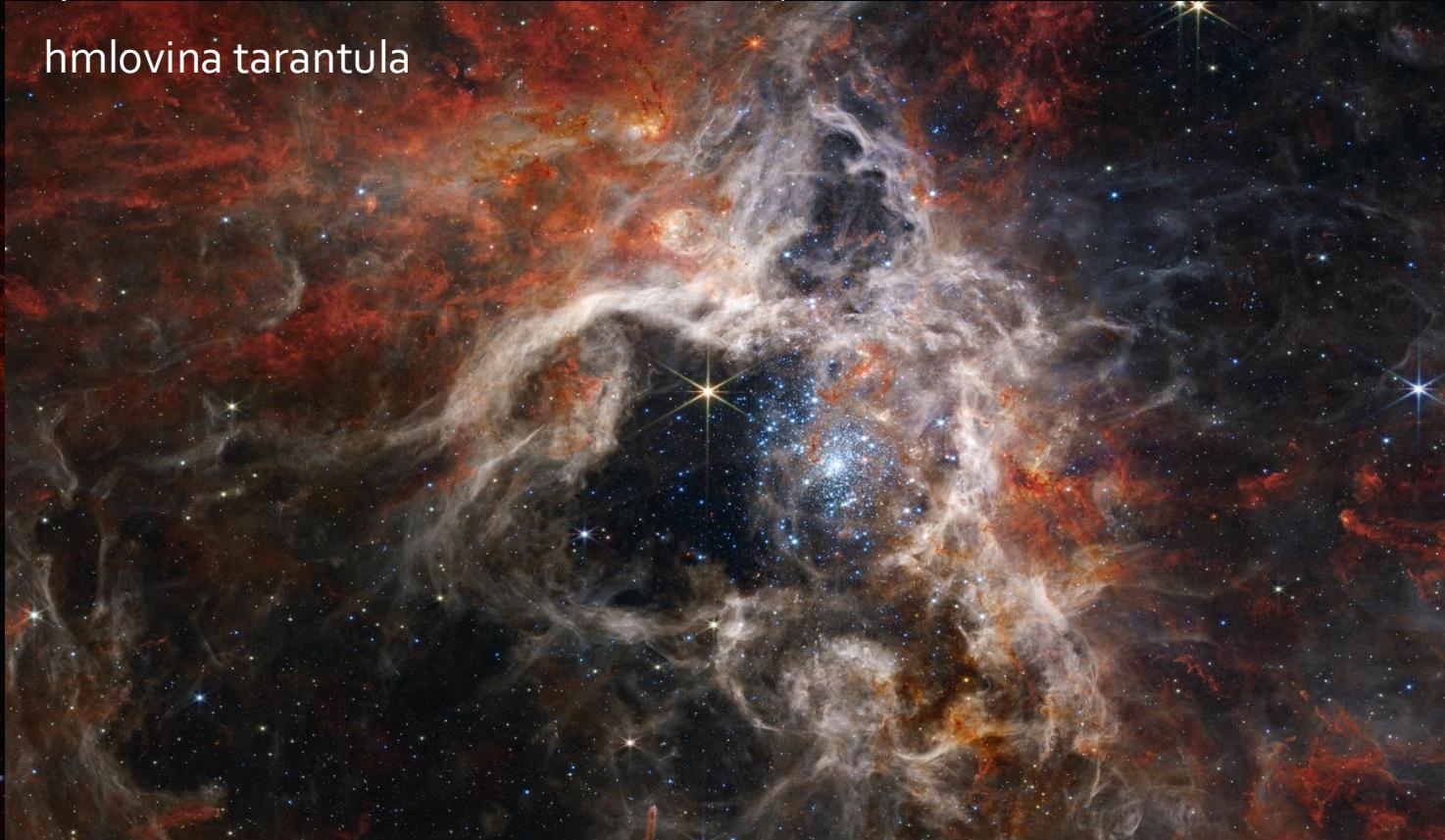
MIRI





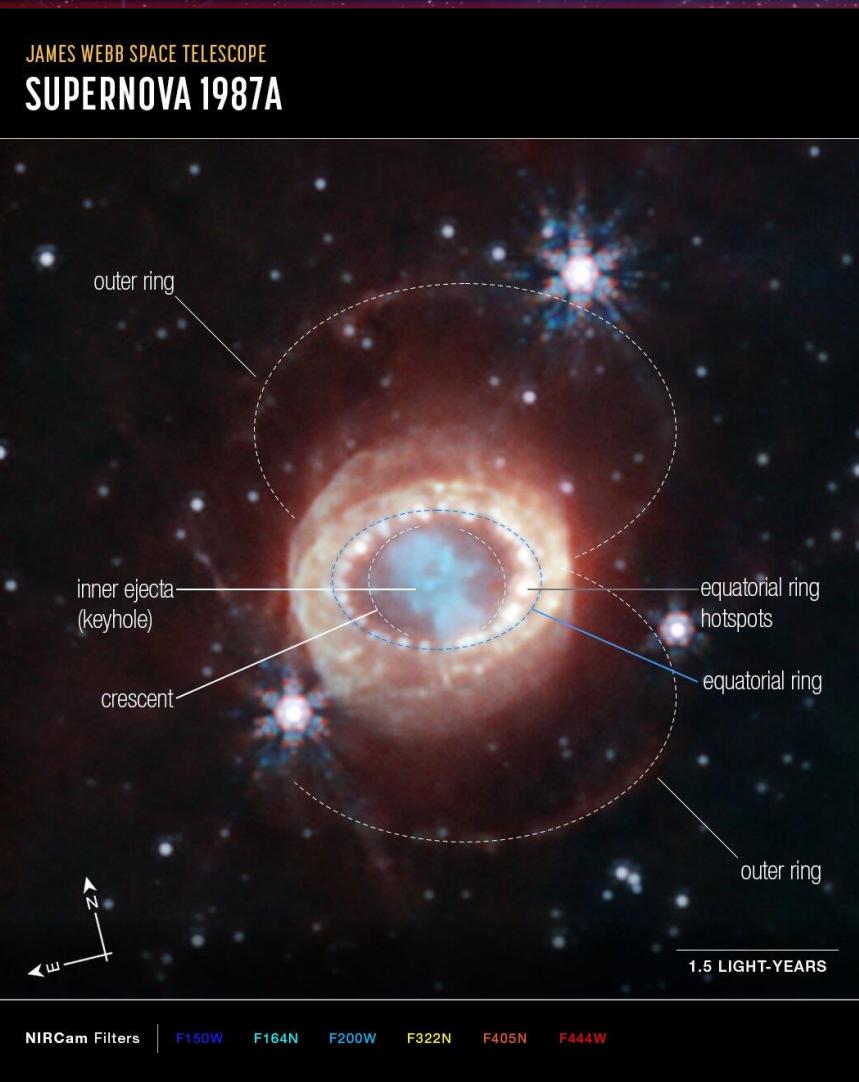
južná prstencová hmlovina

hmlovina tarantula





južná prstencová hmloviná Tarantu

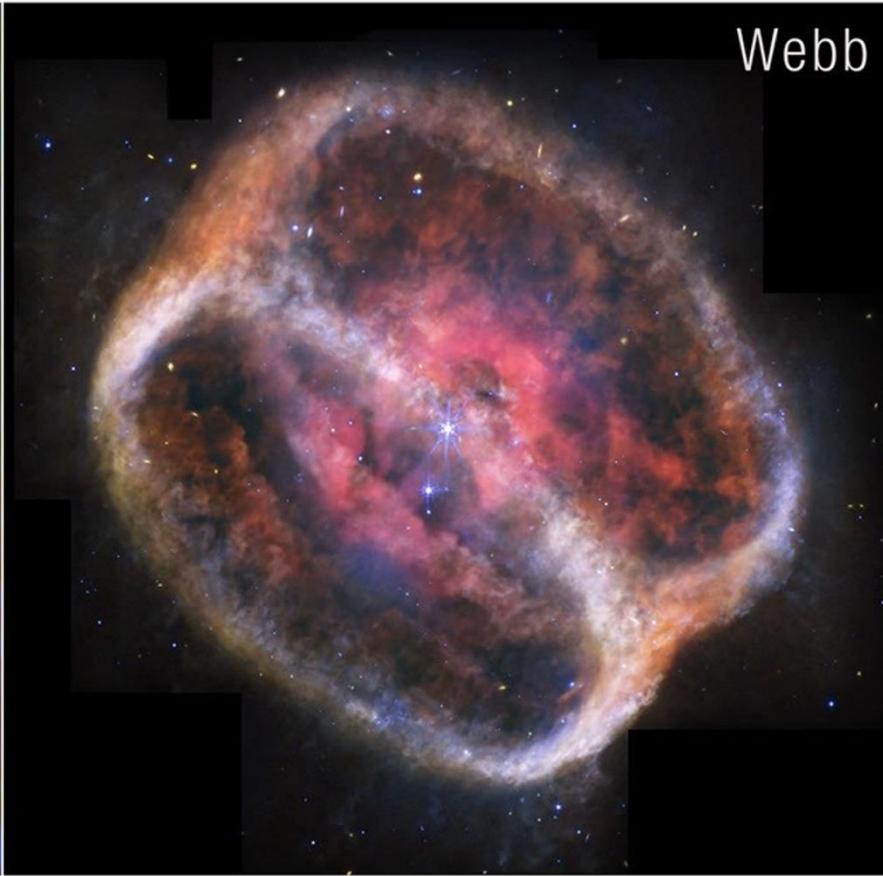
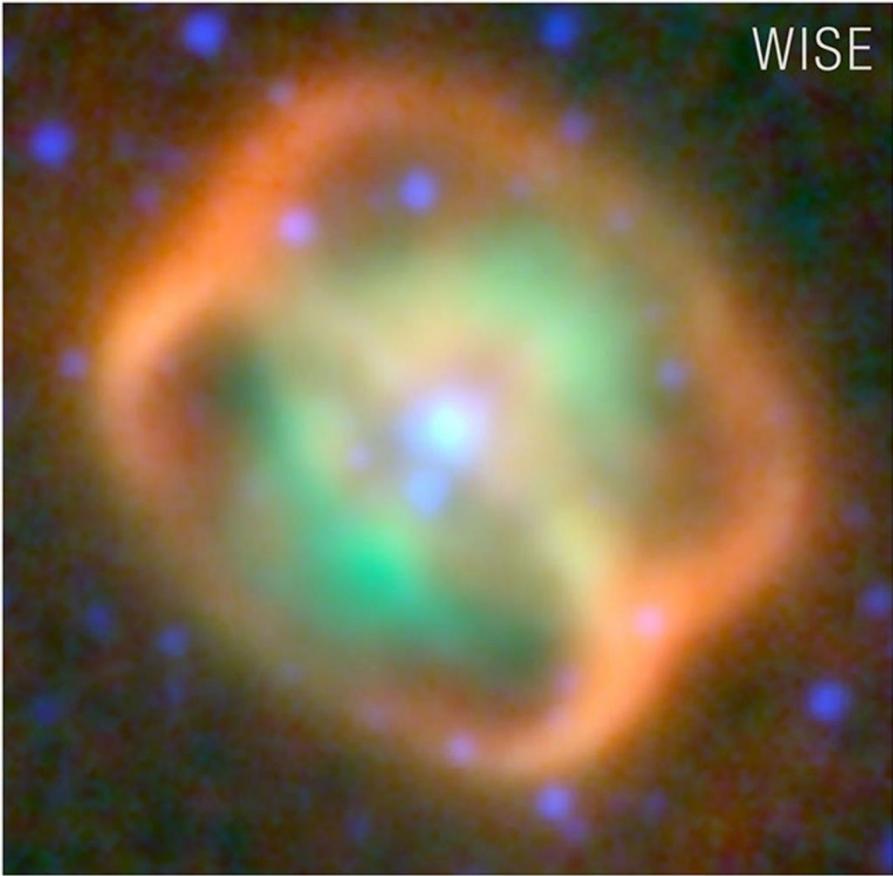




JAMES WEBB SPACE TELESCOPE

WISE

Webb



1.5 LIGHT-YEARS



NIRCam Filters

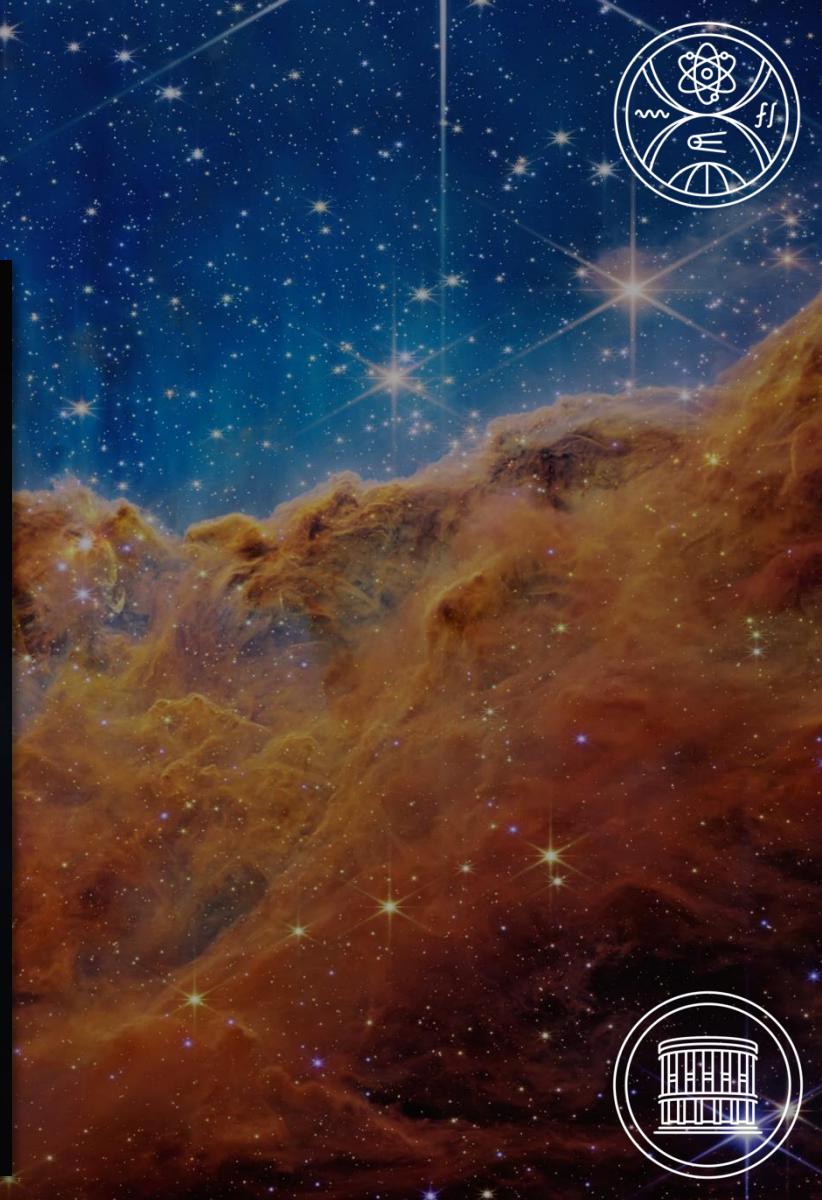
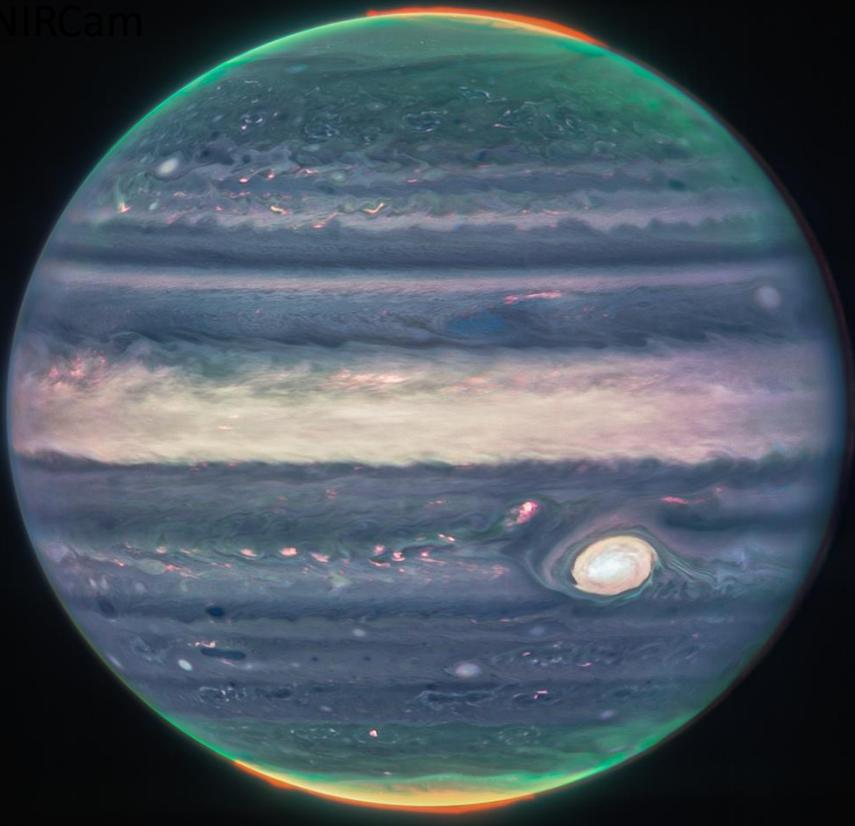
F150W F164N F200W F322N F405N F444W



JUPITER A JEHO OKOLIE



NIRCam

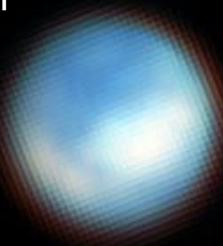


JUPITER A JEHO OKOLIE

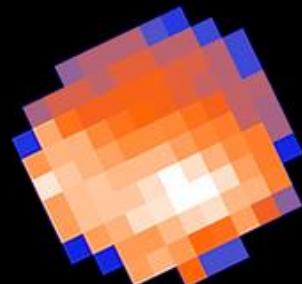
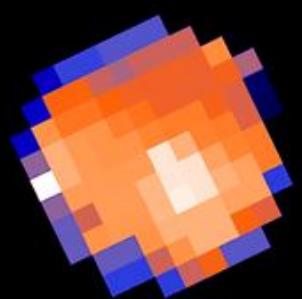
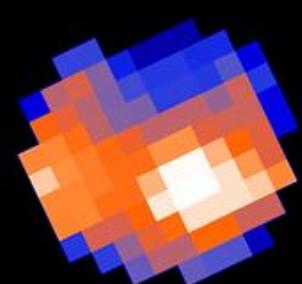


NIRCam

Europa



Europa (NIRCam)

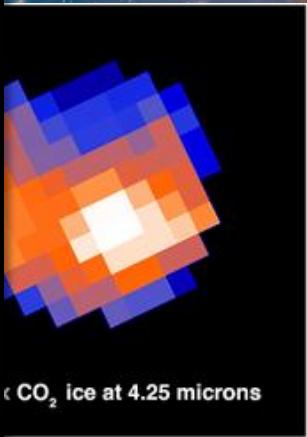
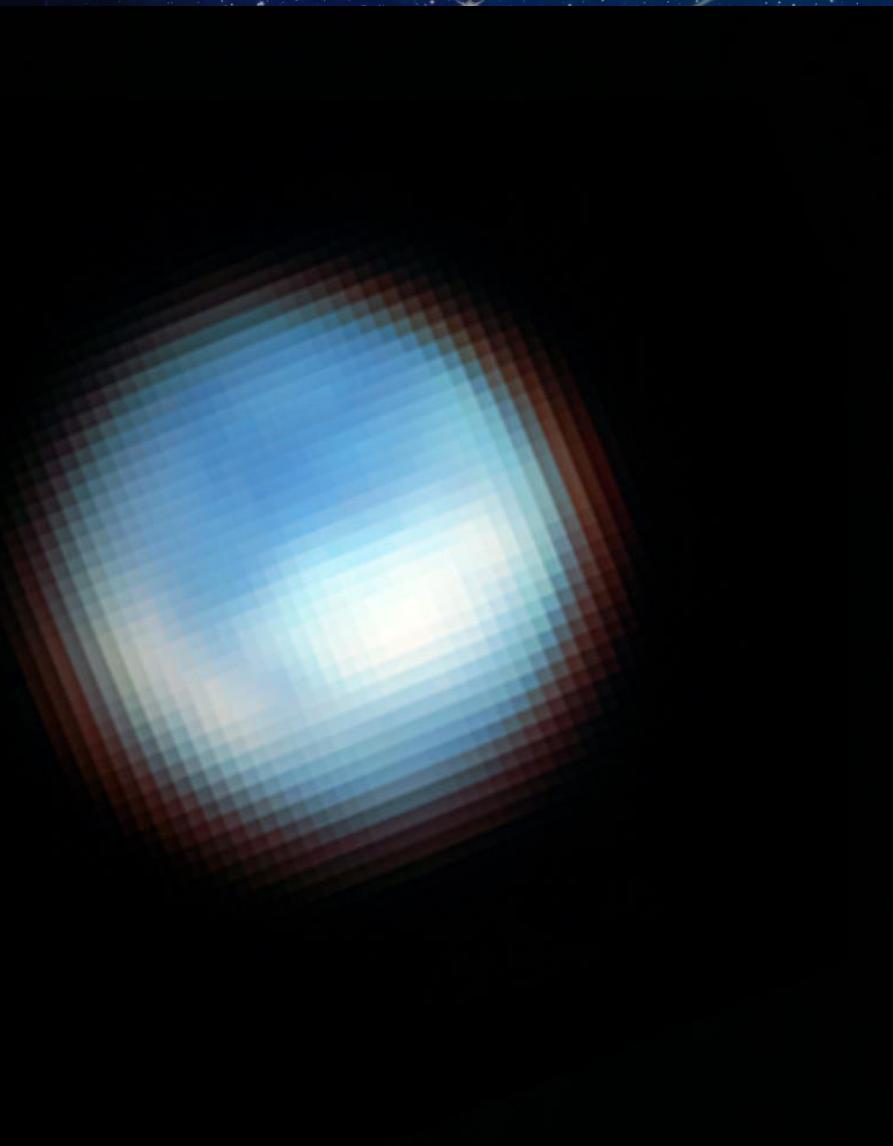
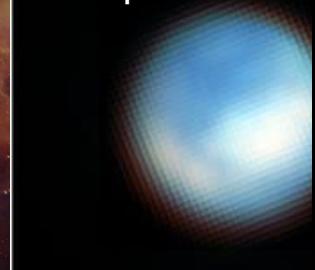
Crystalline CO₂ ice at 2.7 micronsCrystalline CO₂ ice at 4.27 micronsComplex CO₂ ice at 4.25 microns

30

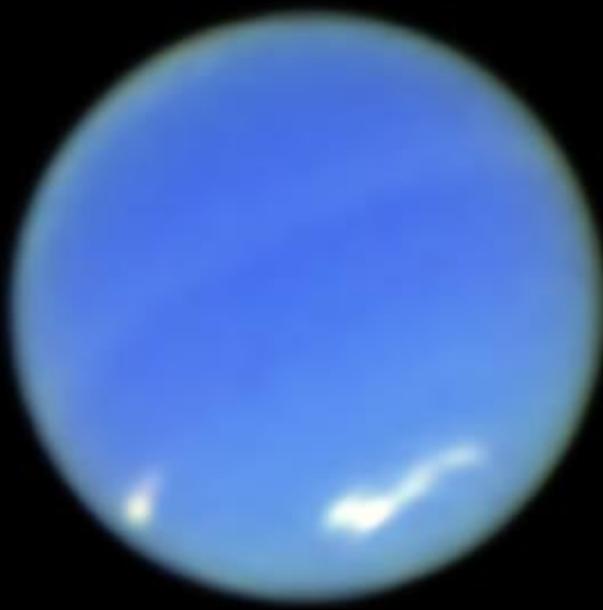
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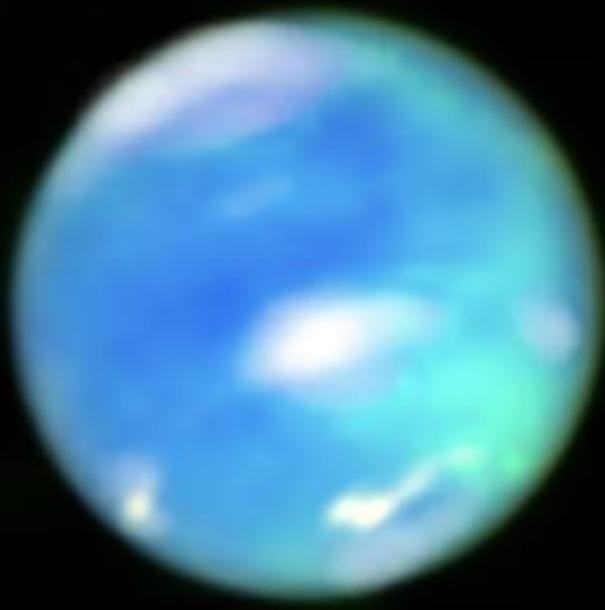
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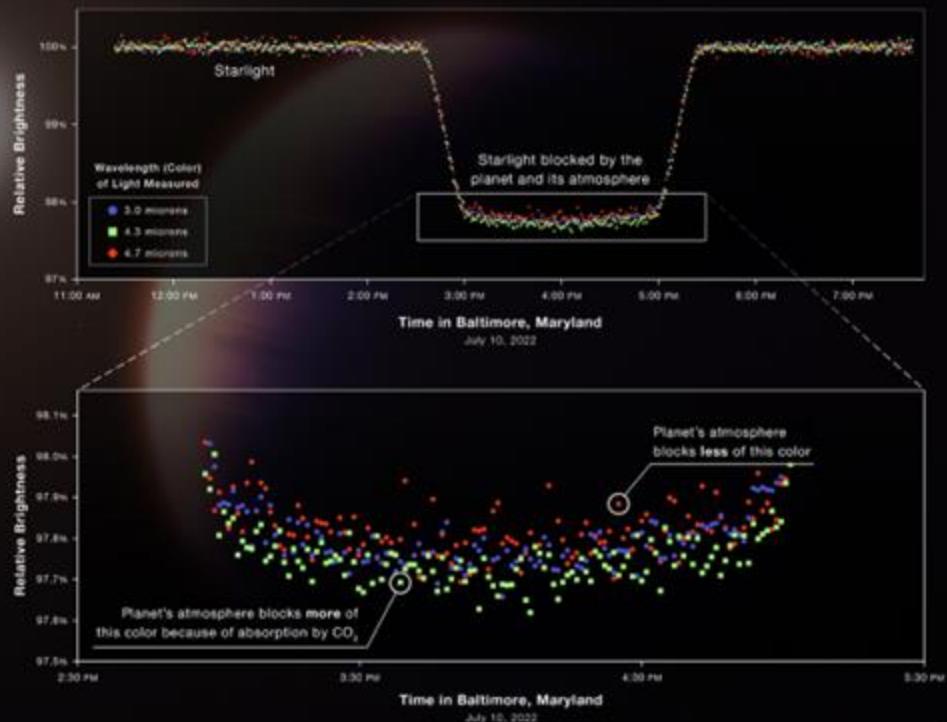
Hubble



Hubble + Webb

HOT GAS GIANT EXOPLANET WASP-39 b TRANSIT LIGHT CURVE

NIRSpec | Bright Object Time-Series Spectroscopy



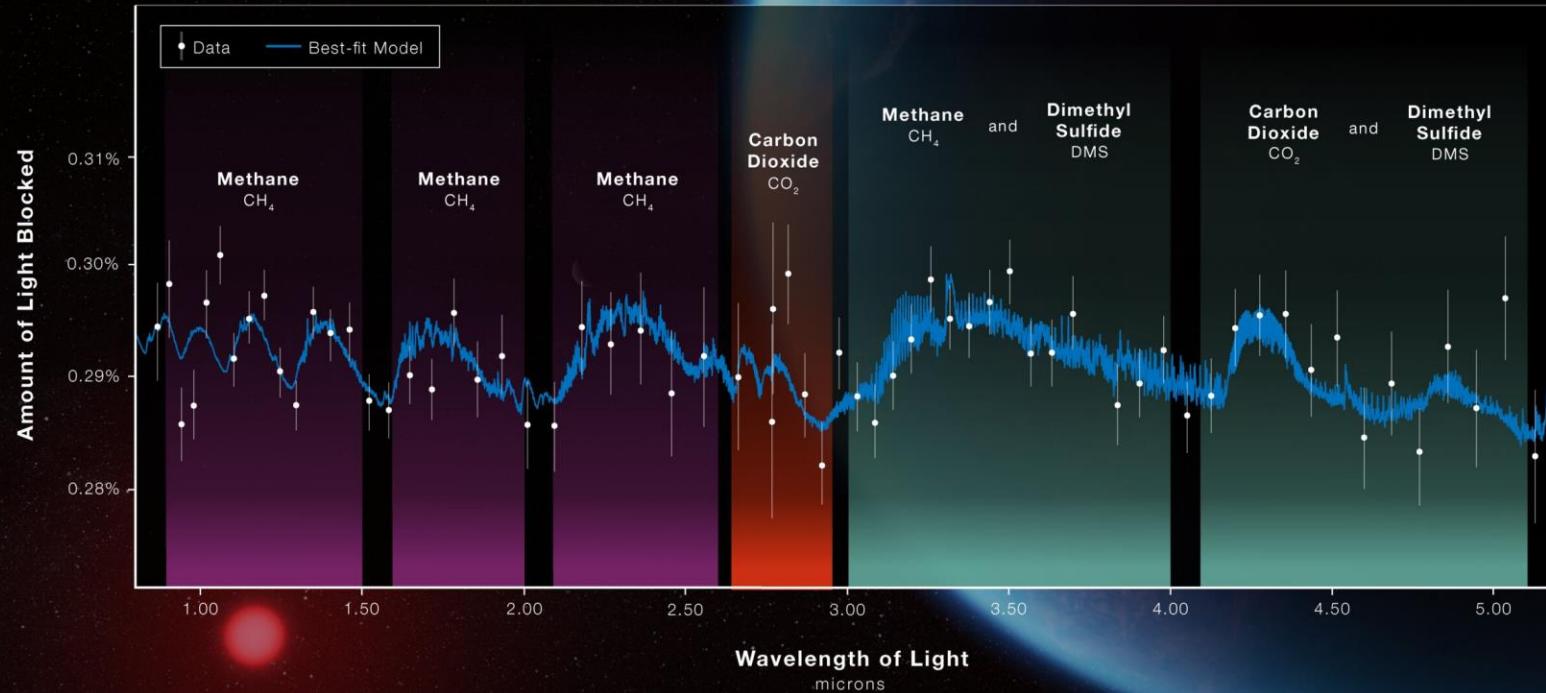
WEBB
SPACE TELESCOPE



EXOPLANET K2-18 b

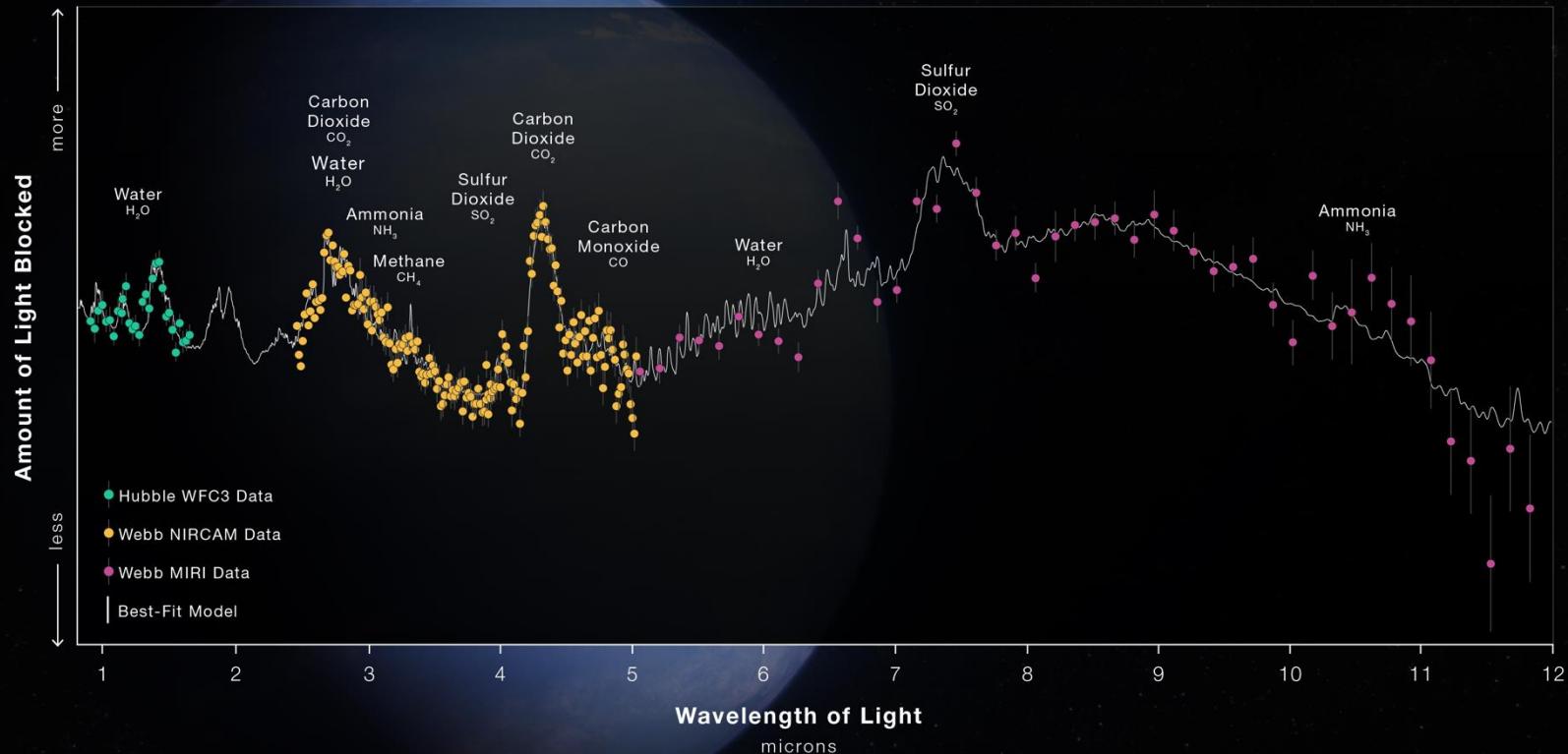
ATMOSPHERE COMPOSITION

NIRISS and NIRSpec (G395H)

**WEBB**
SPACE TELESCOPE

GAS-GIANT EXOPLANET WASP-107 b TRANSMISSION SPECTRUM

Hubble WFC3 | Grism Spectroscopy
Webb NIRCam | Grism Spectroscopy
Webb MIRI | Low-Resolution Spectroscopy

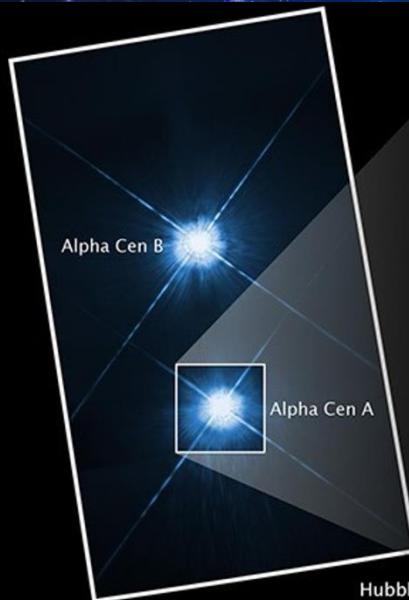




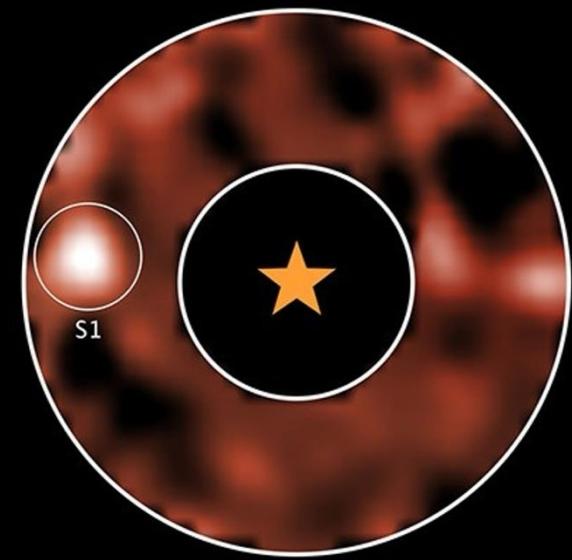
Binary Star System
Alpha Centauri A and B



Digitized Sky Survey – Optical



Hubble – Optical



Webb – Infrared (starlight subtracted)

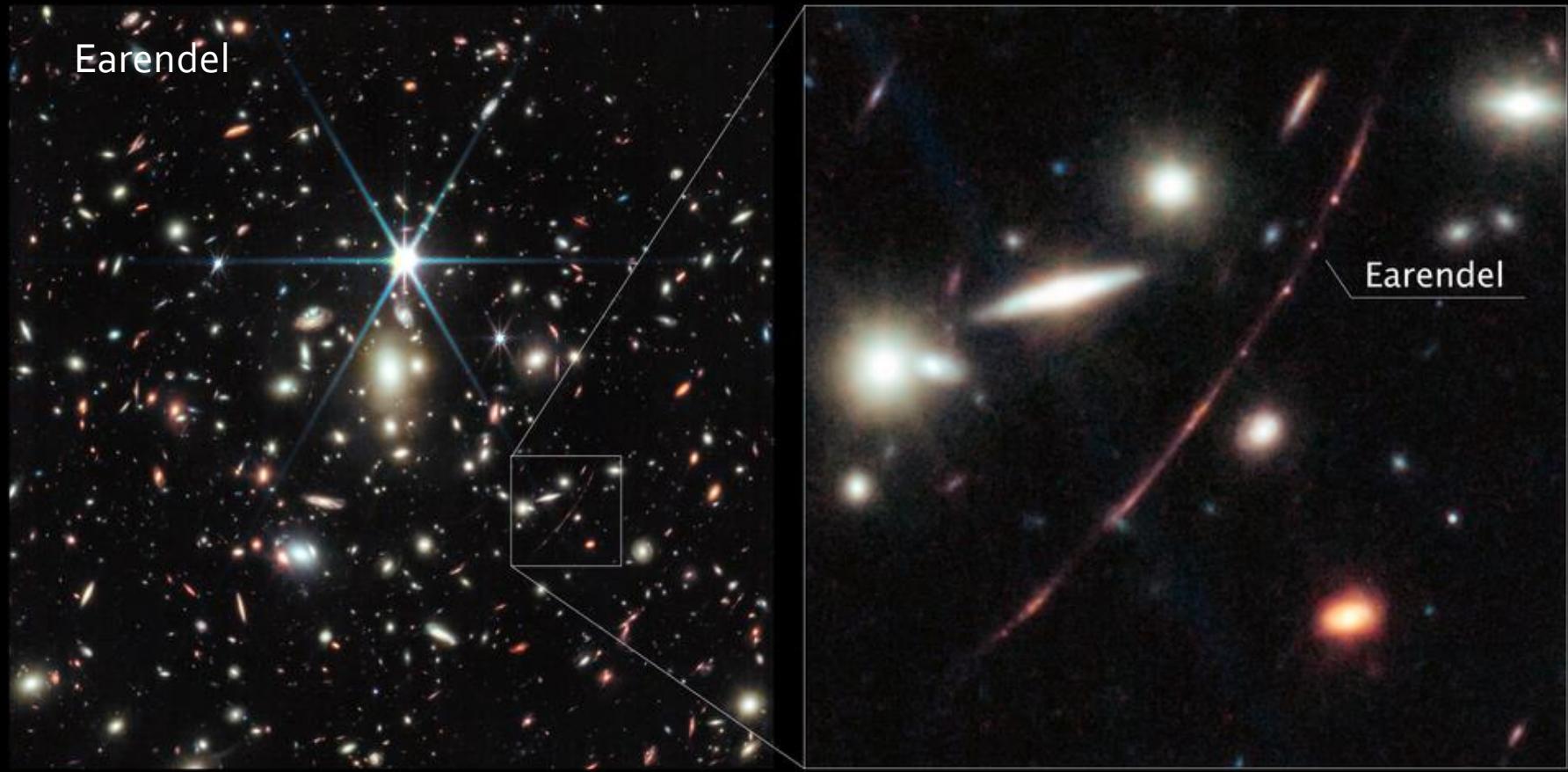


BULLET CLUSTER



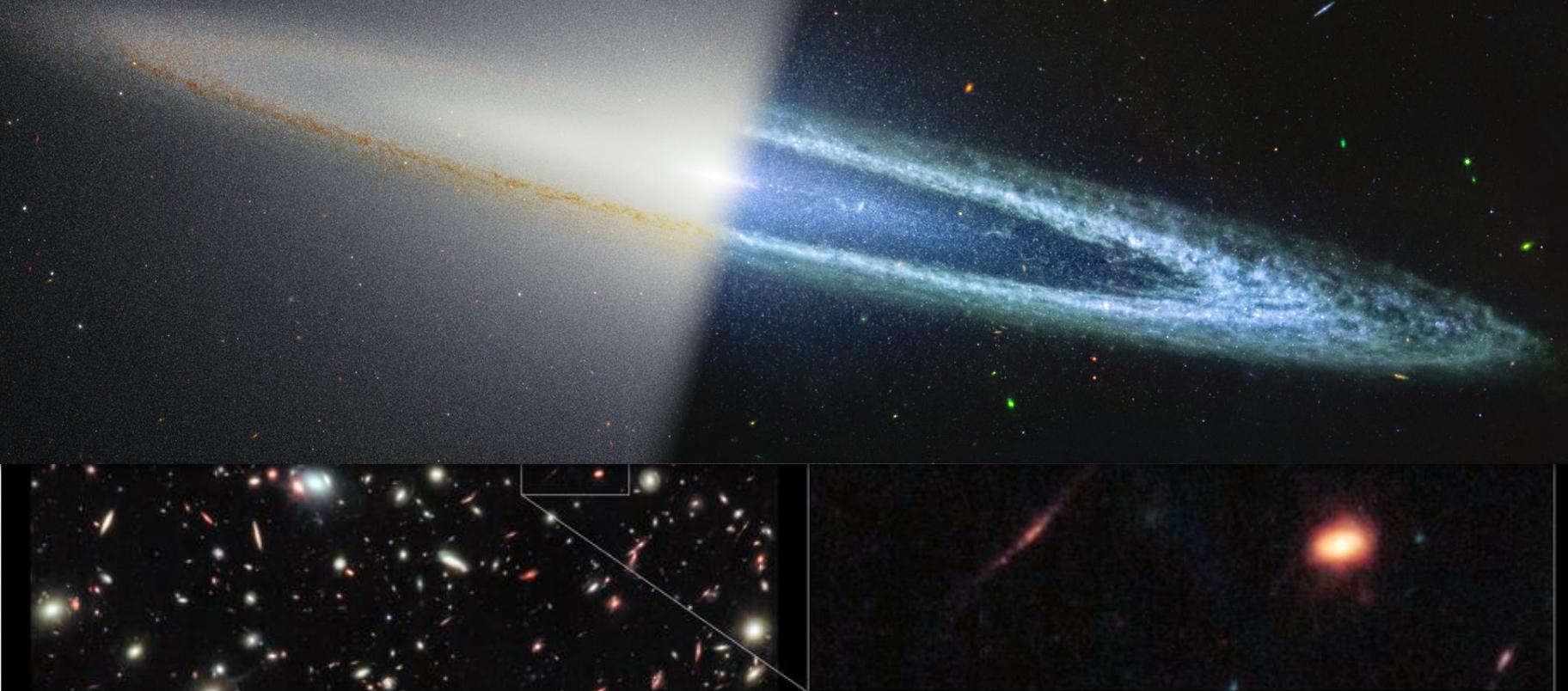
BULLET CLUSTER







Sombrero Galaxy (NIRCam/MIRI)





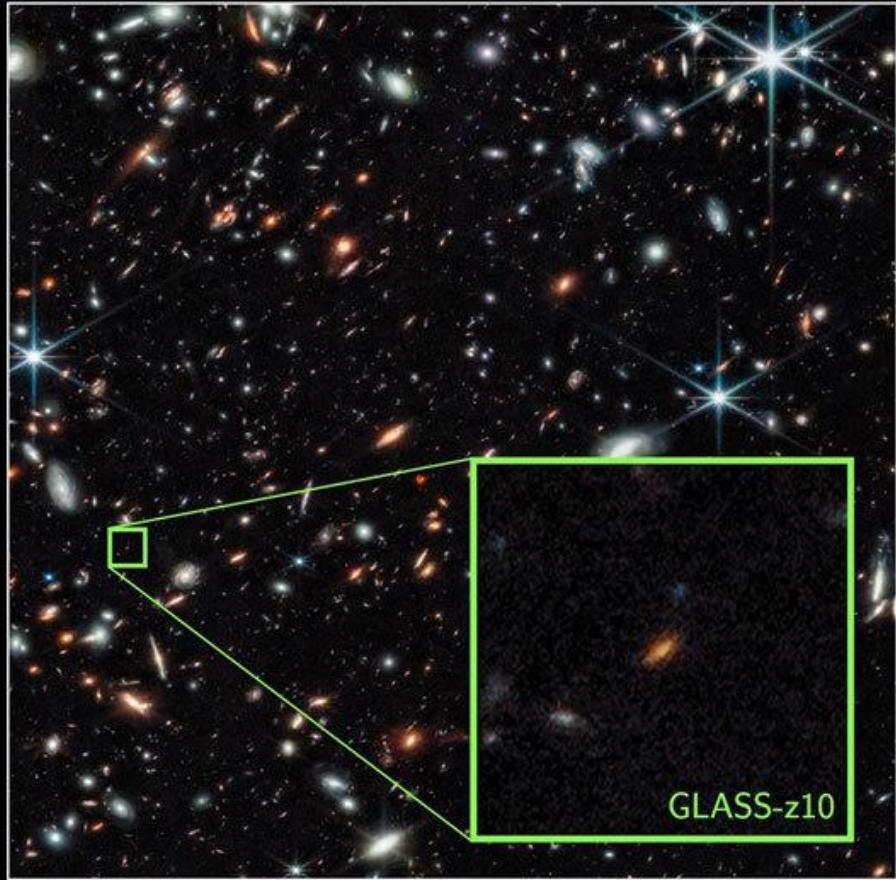
Sombrero Galaxy (NIRCam/MIRI)

Arp 107



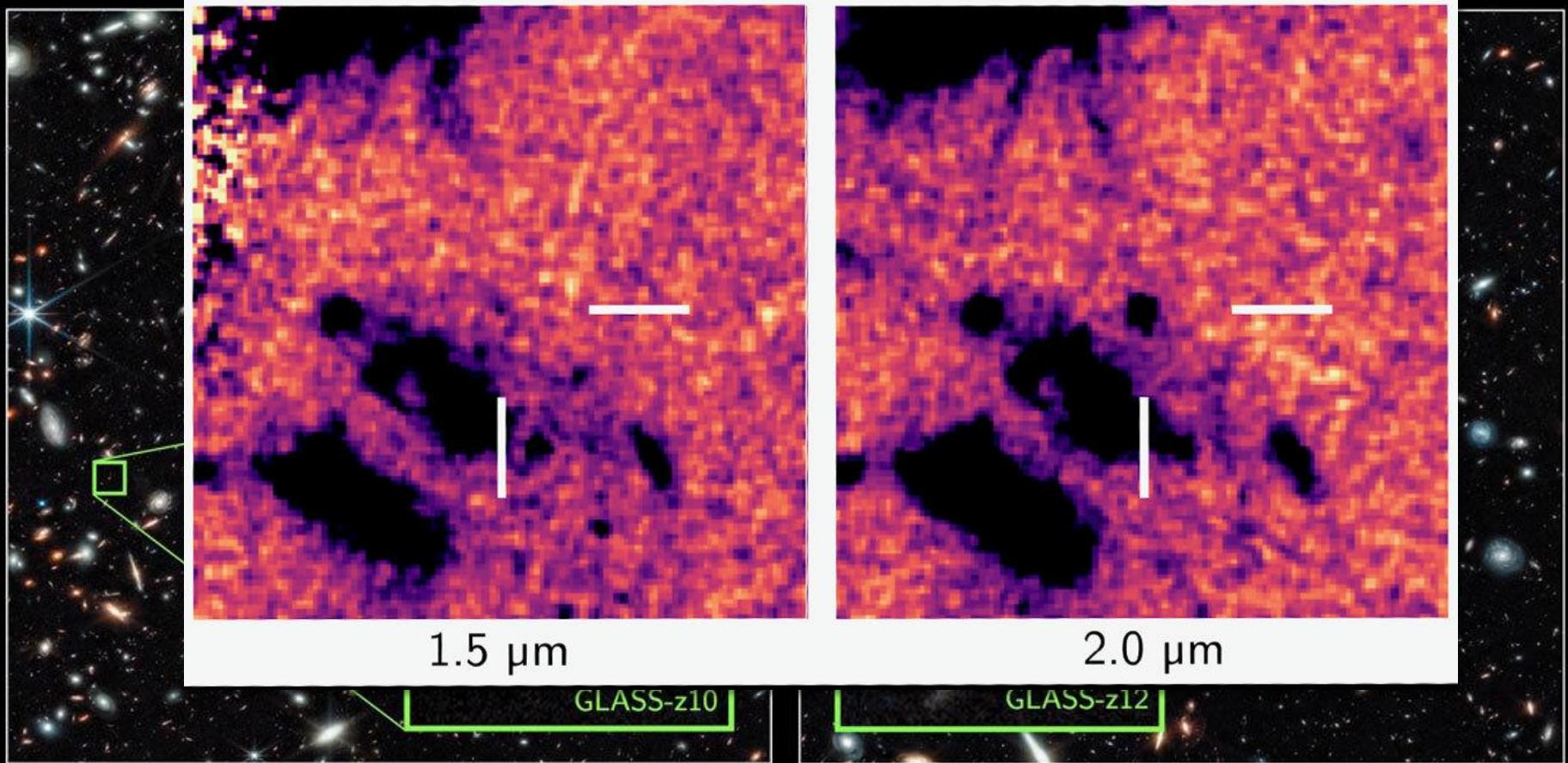


NAJVZDIALENEJŠIA JWST GALAXIA

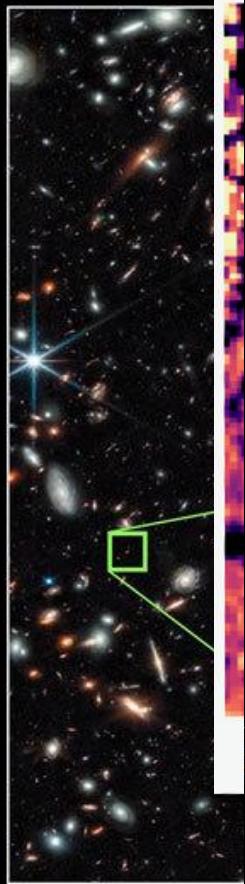




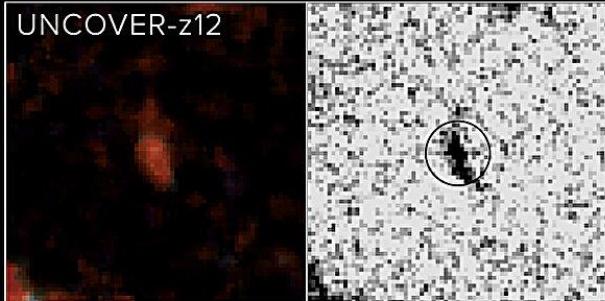
NAJVZDIALENEJŠIA JWST GALAXIA



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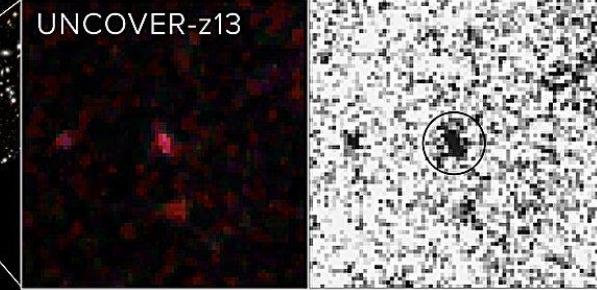
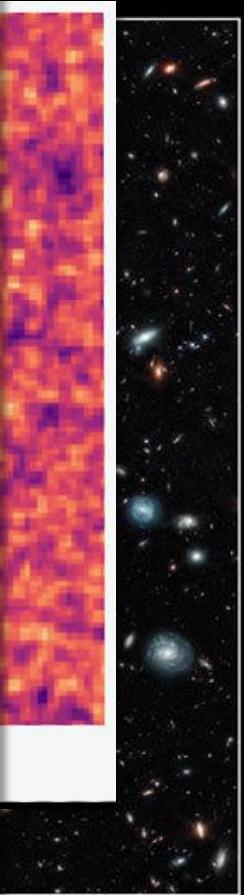


UNCOVER-z12

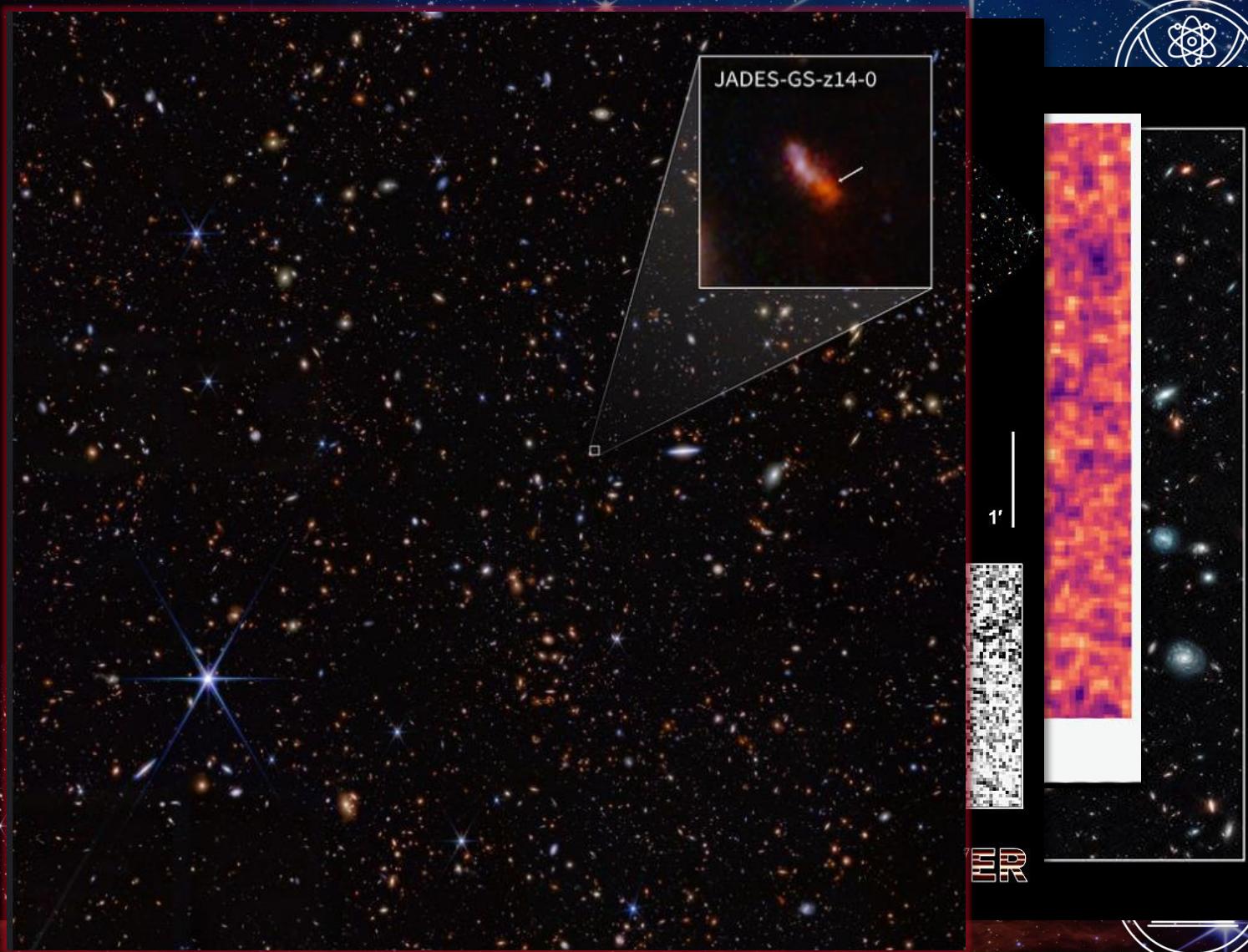
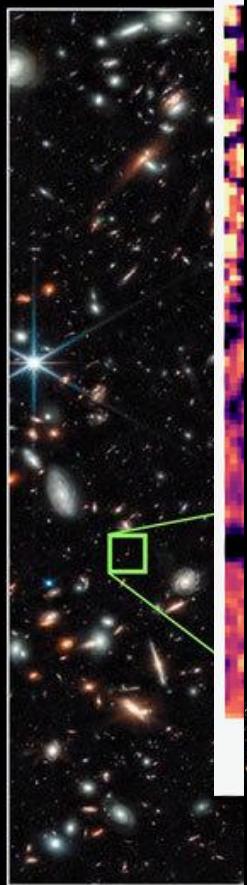


Abell 2744

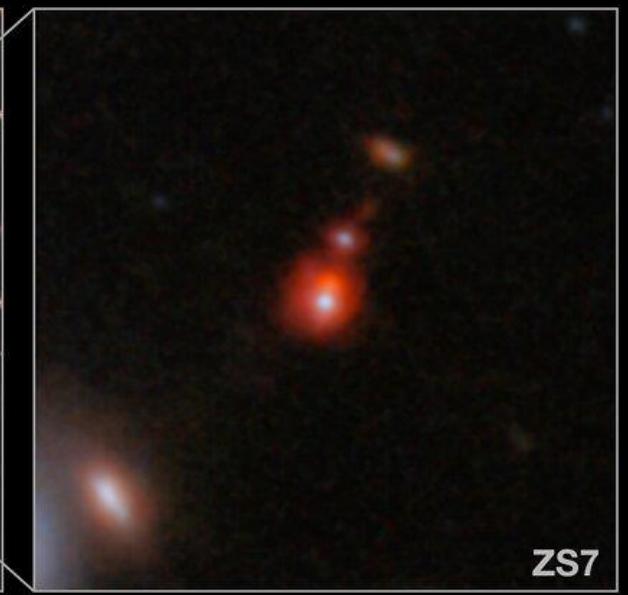
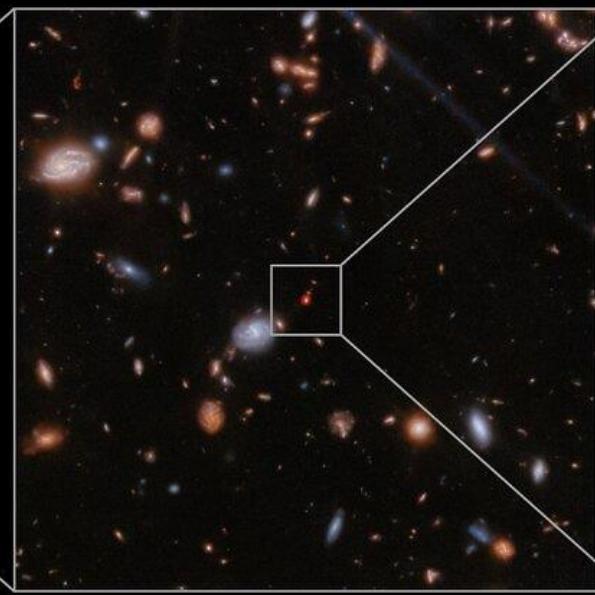
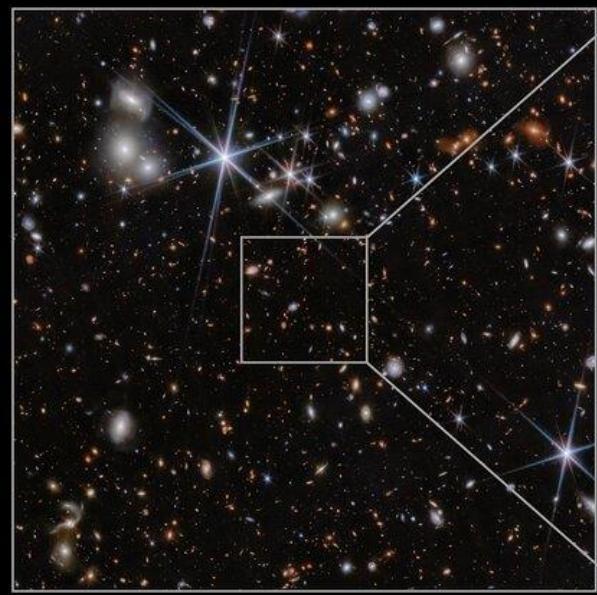
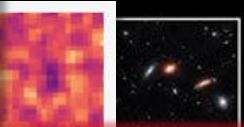
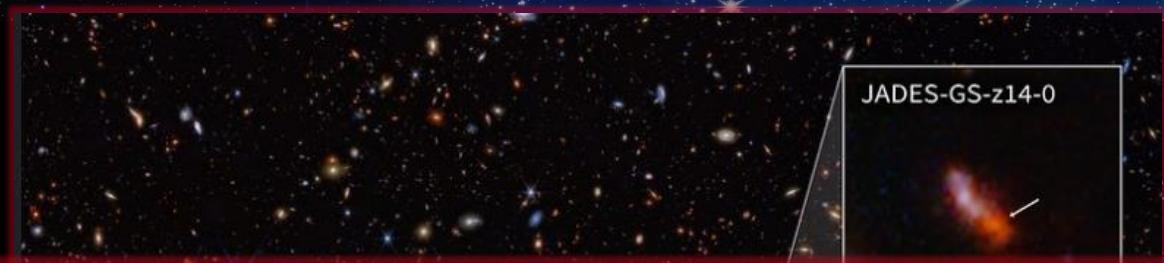
UNCOVER-z13

**UNCOVER**

NA



NA



ZS7



36

CEERS 14448
 $z=4.75$

NGDEEP 4321
 $z=8.92$

PRIMER-COS 10539
 $z=7.48$

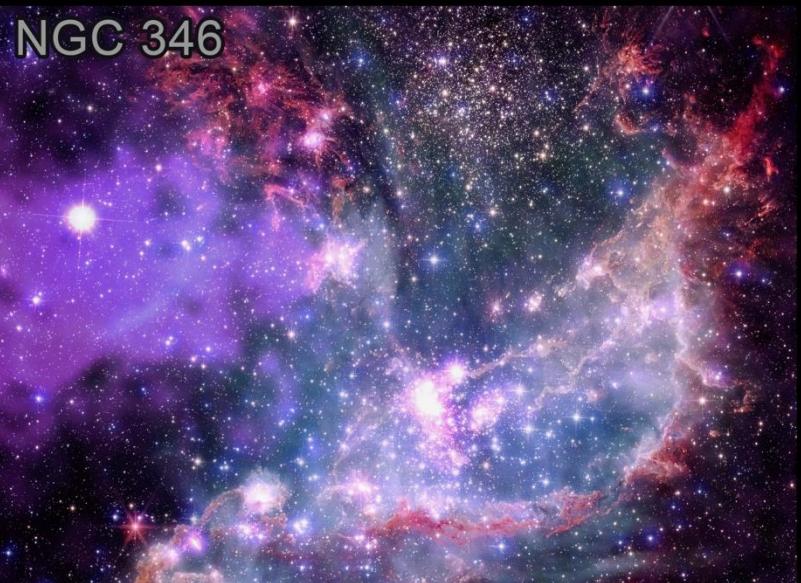
CEERS 20320
 $z=5.27$

JADES 9186
 $z=4.99$

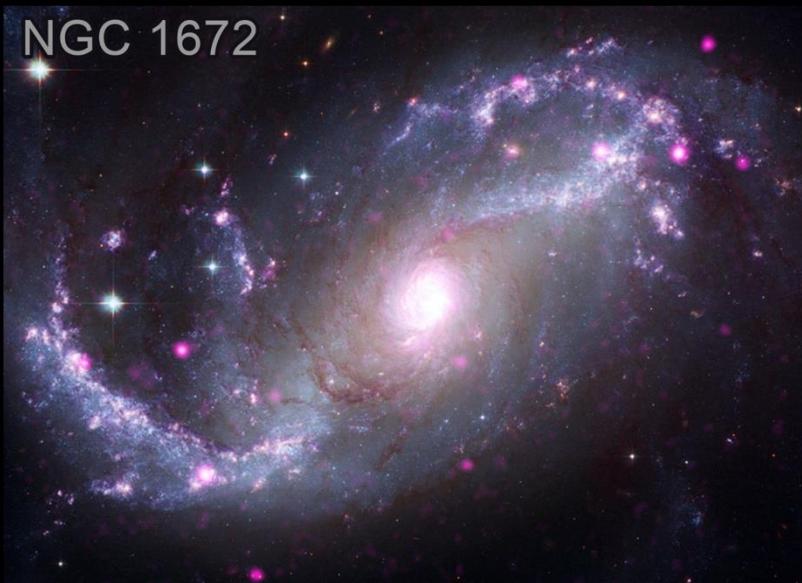
PRIMER-UDS 17818
 $z=6.40$

7

NGC 346



NGC 1672



M74



M16



Webb, Chandra, Hubble a Spitzer

37

NGC 346

1st anniversary

Hubble's 1st

M74



37

2nd anniversary



37

3rd anniversary





A (KONEČNE) NIEČO Z POVRCHU ZEMSKÉHO





VERA RUBIN OBSERVATORY





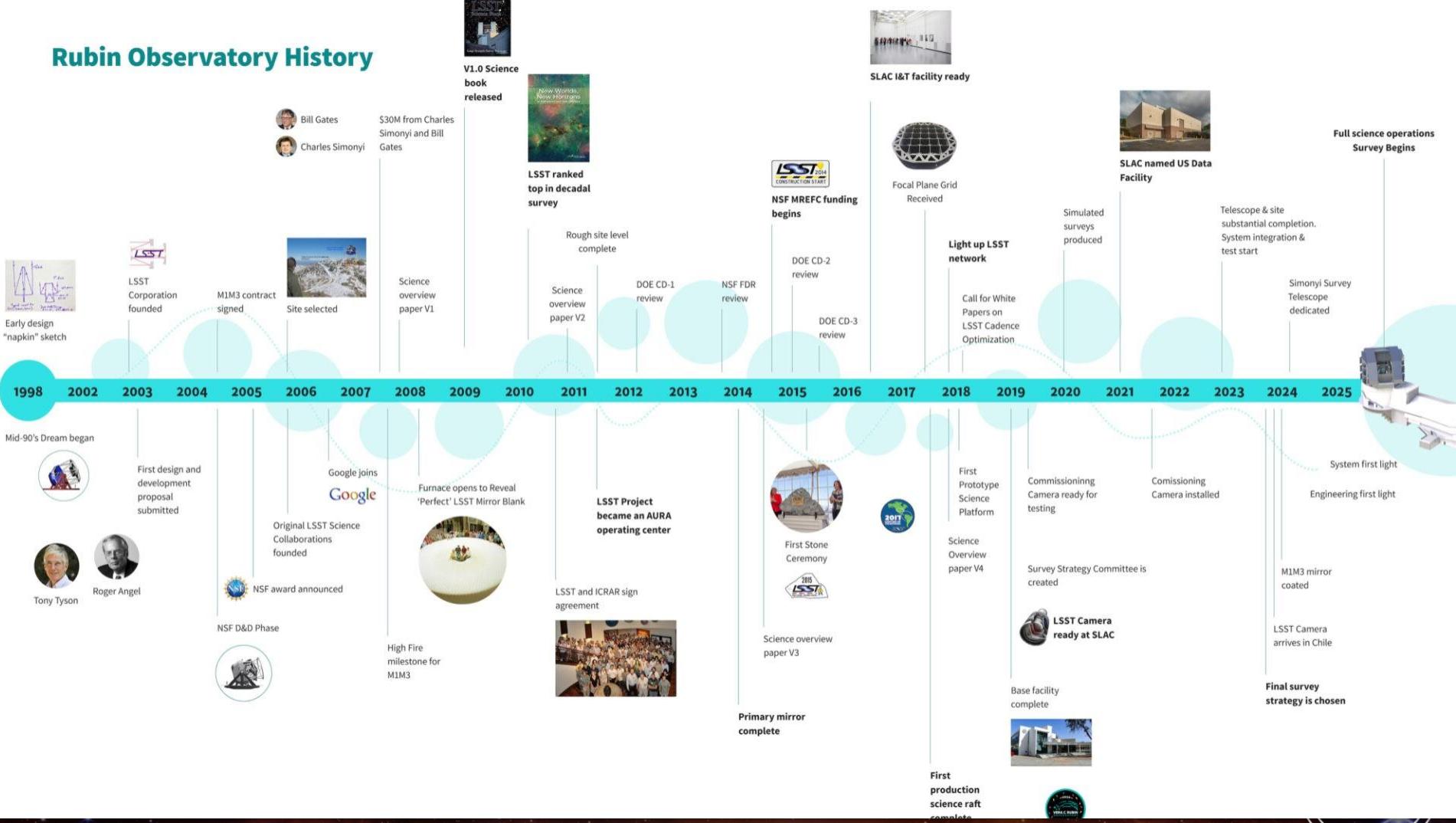
VERA RUBIN OBSERVATORY

- LSST Collaboration (NFS, DOE)
- Cerro Pachón, Chile
- Large Synoptic Survey Telescope
- 2019 -> Vera C. Rubin Observatory



Chile
Argentina
Pacific Ocean

Rubin Observatory History



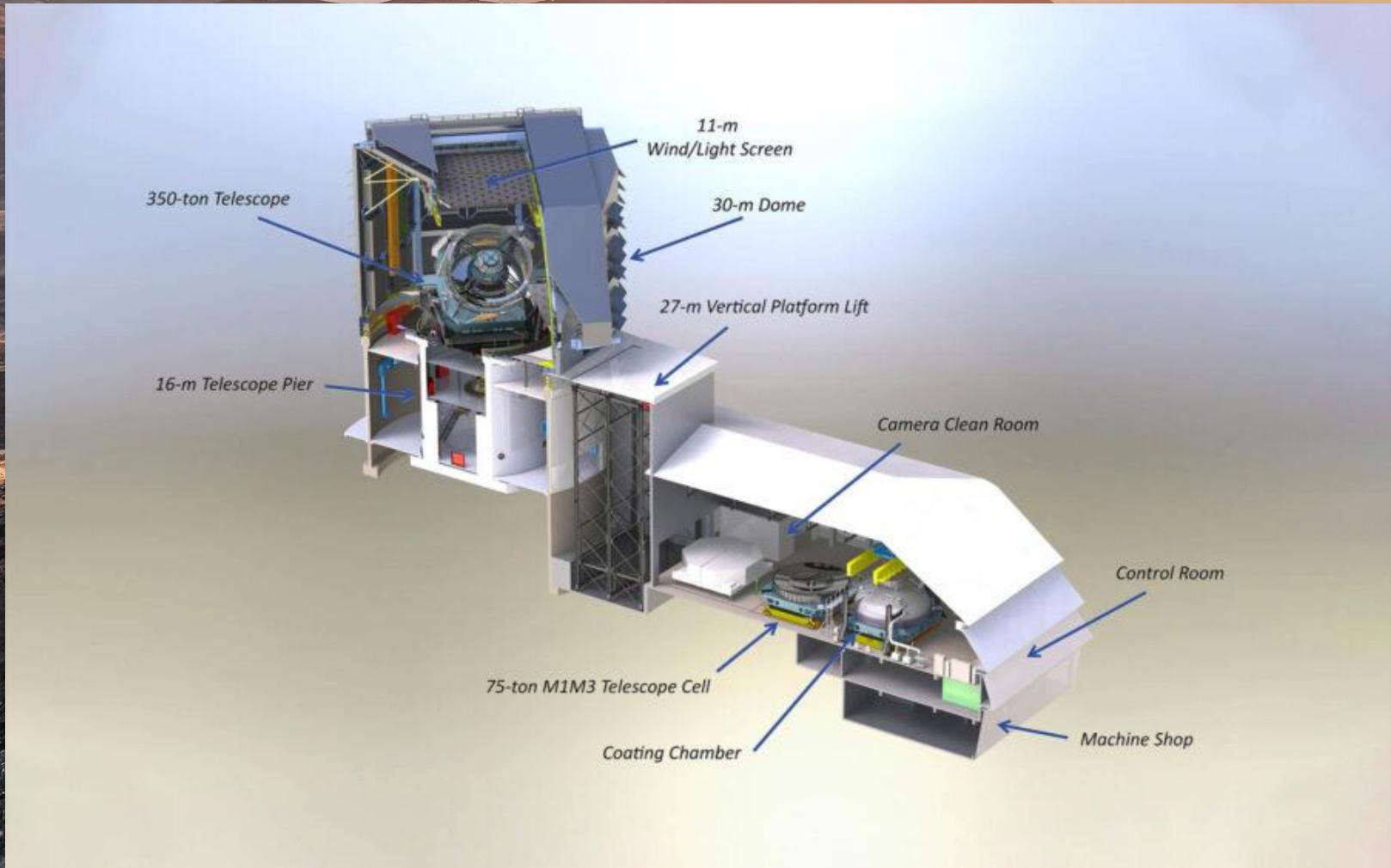
VEDECKÉ CIELE

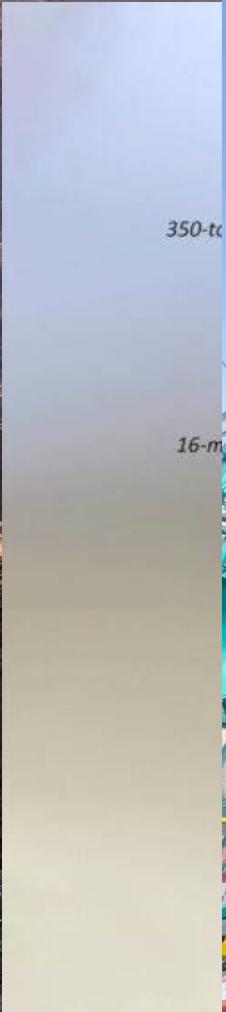


- Pochopenie podstaty tmavej hmoty a temnej energie
- Mapovanie Slnečnej sústavy
- Mapovanie Mliečnej cesty
- Skúmanie tranzientných objektov - ktoré sa pohybujú alebo menia jasnosť





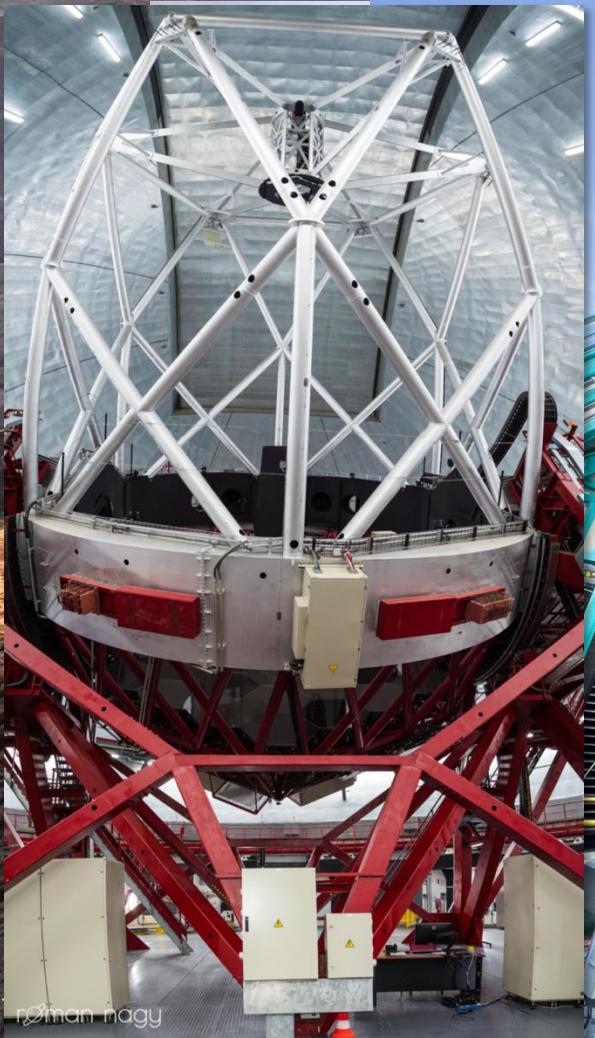






man nagy





roman nagy



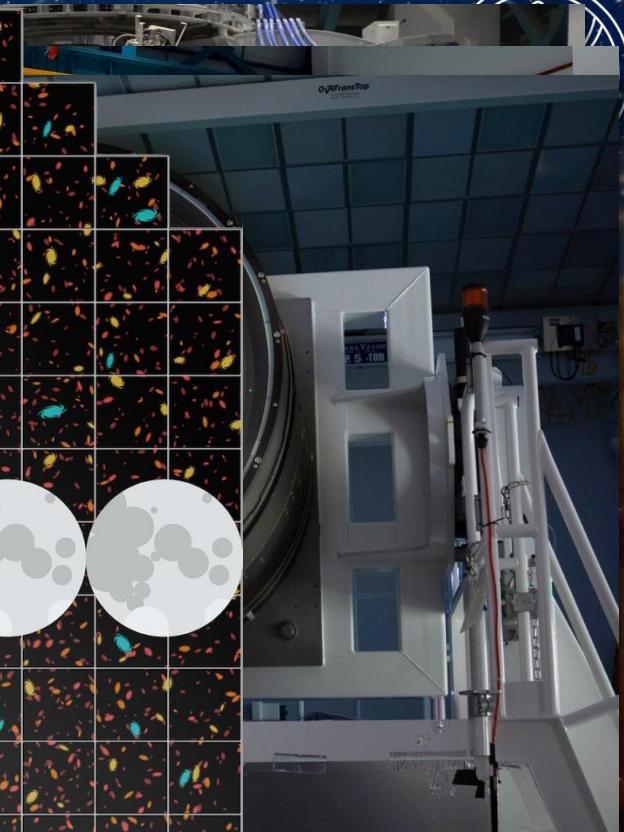
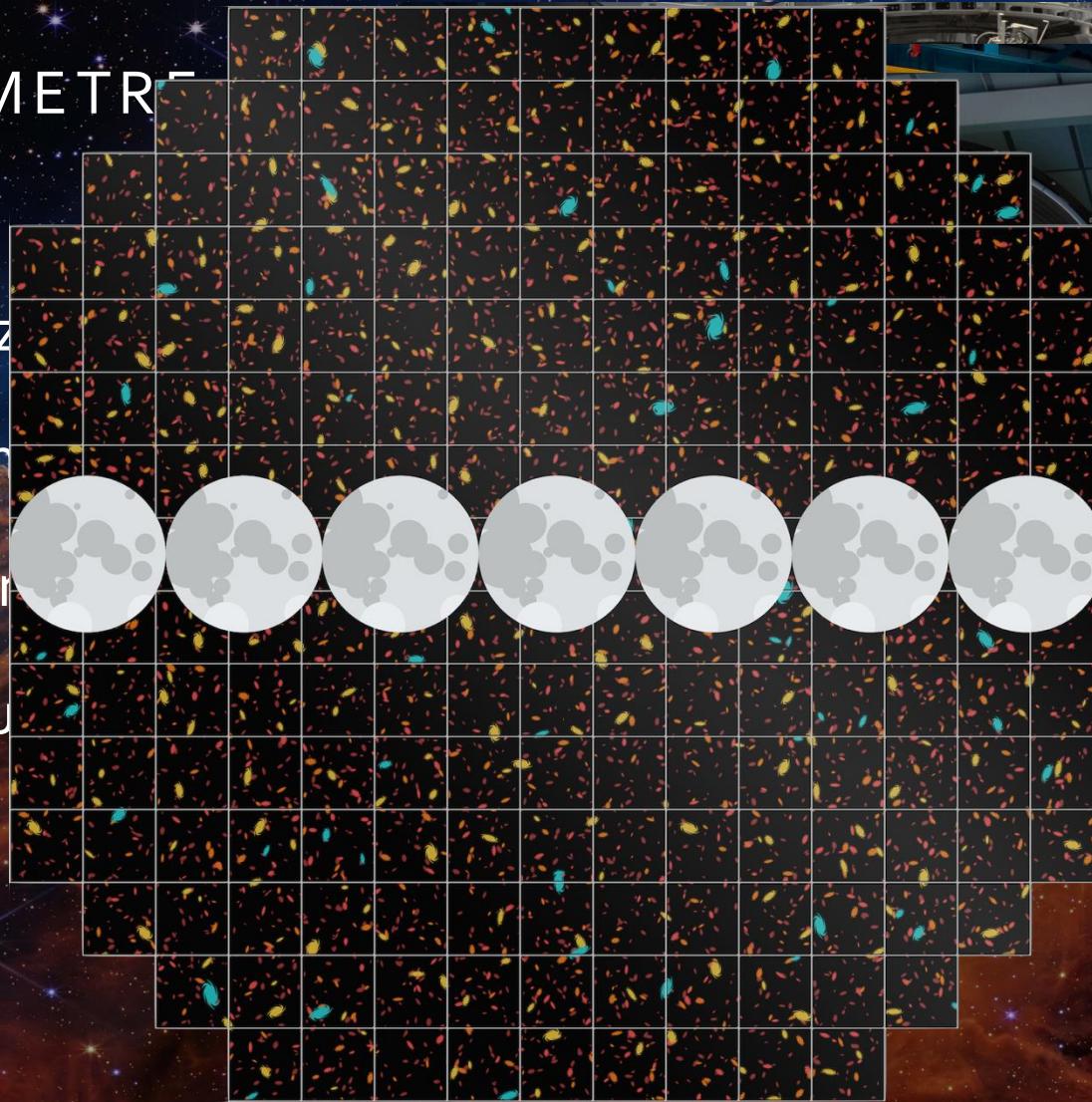
PARAMETRE

- 8,4 m zrkadlo
- 3200 mpx kamera
- 2,8 tony
- 3,5 stupňa veľké pole



PARAMÈTRE

- 8,4 m z
- 3200 n
- 2,8 ton
- 3,5 stu



PARAMETRE



- 20 TB dát za noc
- 37 mld pozorovaných objektov (odhad)
- Pôvodný rozpočet – 470 mil \$
- Aktualizovaný - 570 mil \$



PRVÉ SVĚTLO - OCHUTNÁVKA

- 23. júna 2025 (verejnosť)
- mozaika 678 pozorovaní za 7h pozorovaní
- Vesmírna truhlica pokladov
- Detektia asteroidov

SKYVIEWER.APP

- o skyviewer.app





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VEGA 1/0481/25

