

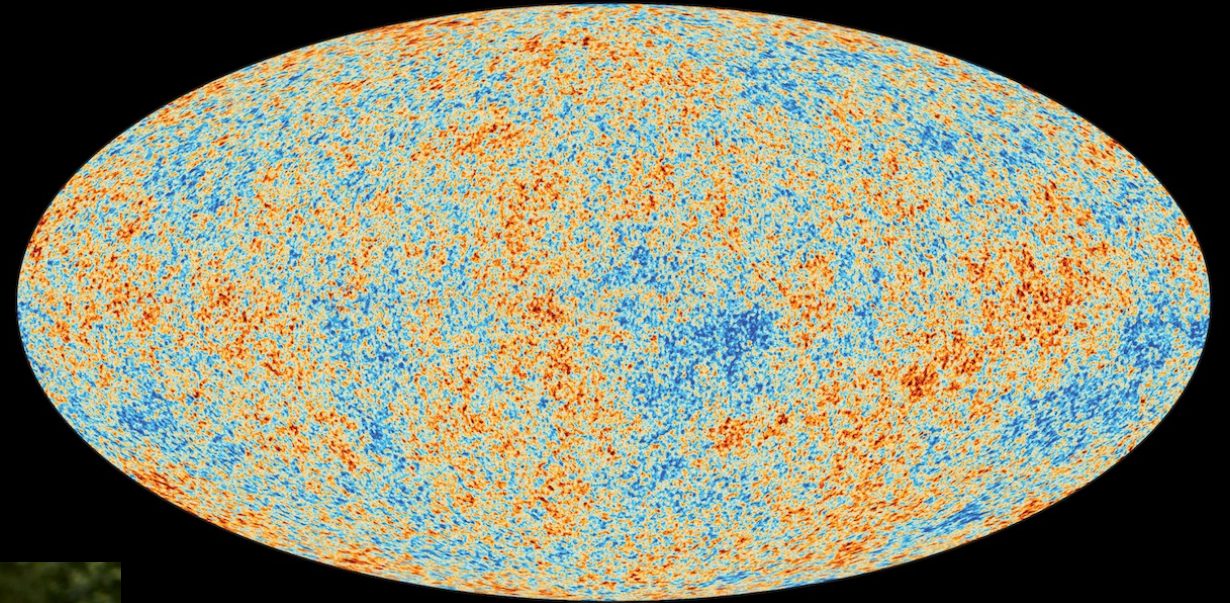


One Year of Science
with the
WEBB
SPACE TELESCOPE

July-November, 2023

The Story of Us

- How do we get from this:



Hydrogen & Helium

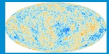





- To this?



Carbon, Oxygen, Nitrogen, Calcium, Iron...
All arranged in complex molecules



The Origin of elements

1 H	big bang fusion 										cosmic ray fission 					2 He	
3 Li	4 Be	merging neutron stars? 					exploding massive stars 					5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	dying low mass stars 					exploding white dwarfs 					13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn	
87 Fr	88 Ra																
		57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	
		89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	Very radioactive isotopes; nothing left from stars									

Graphic created by Jennifer Johnson
<http://www.astronomy.ohio-state.edu/~jaj/nucleo/>

Astronomical Image Credits:
 ESA/NASA/AASNova



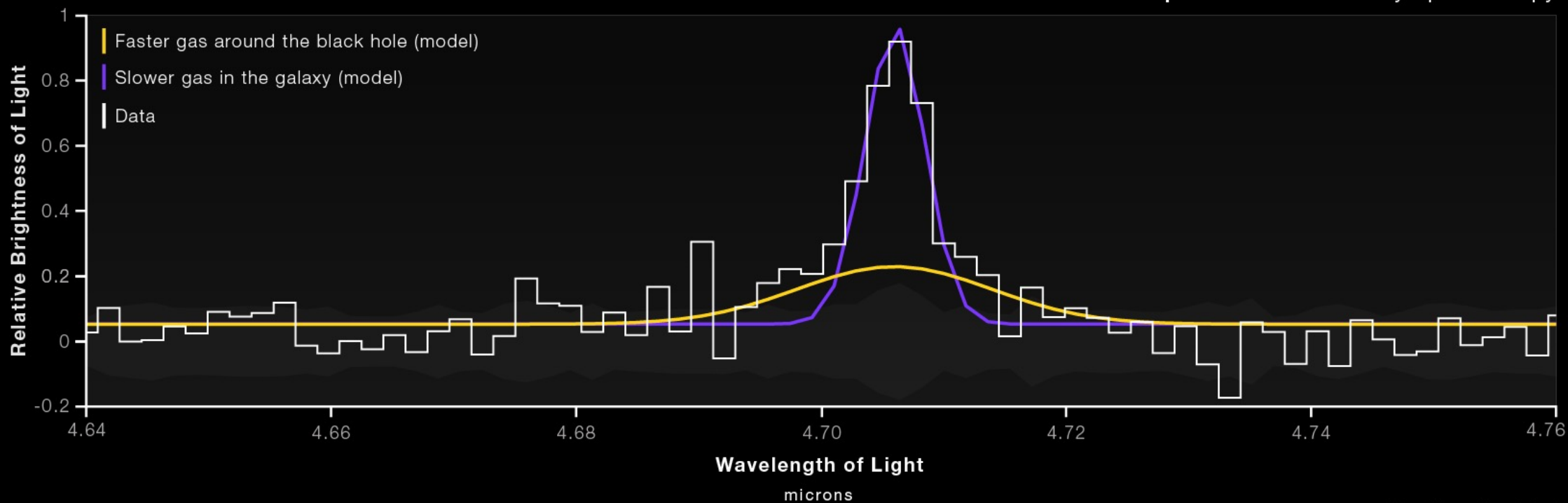
NIRCam Imaging

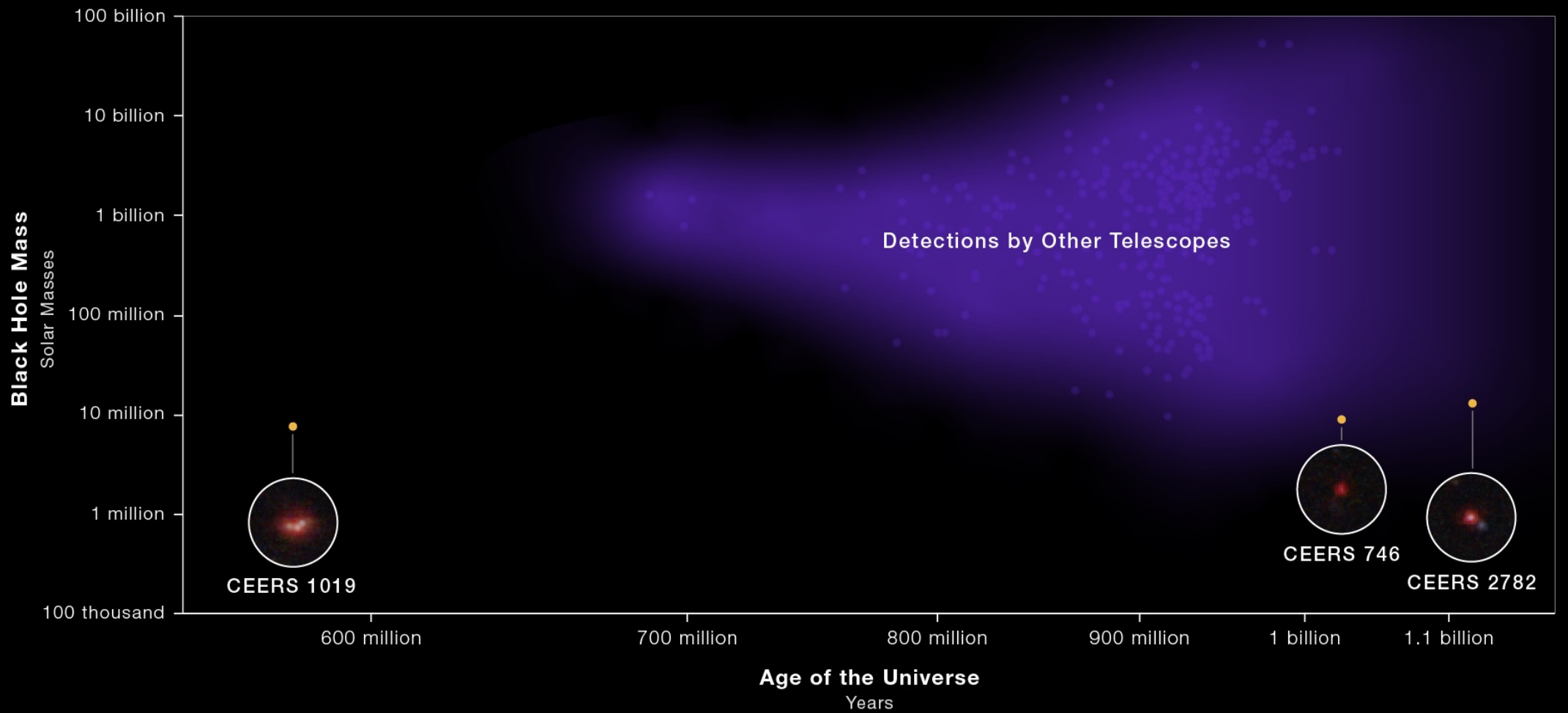


CEERS 1019
13.2 billion years



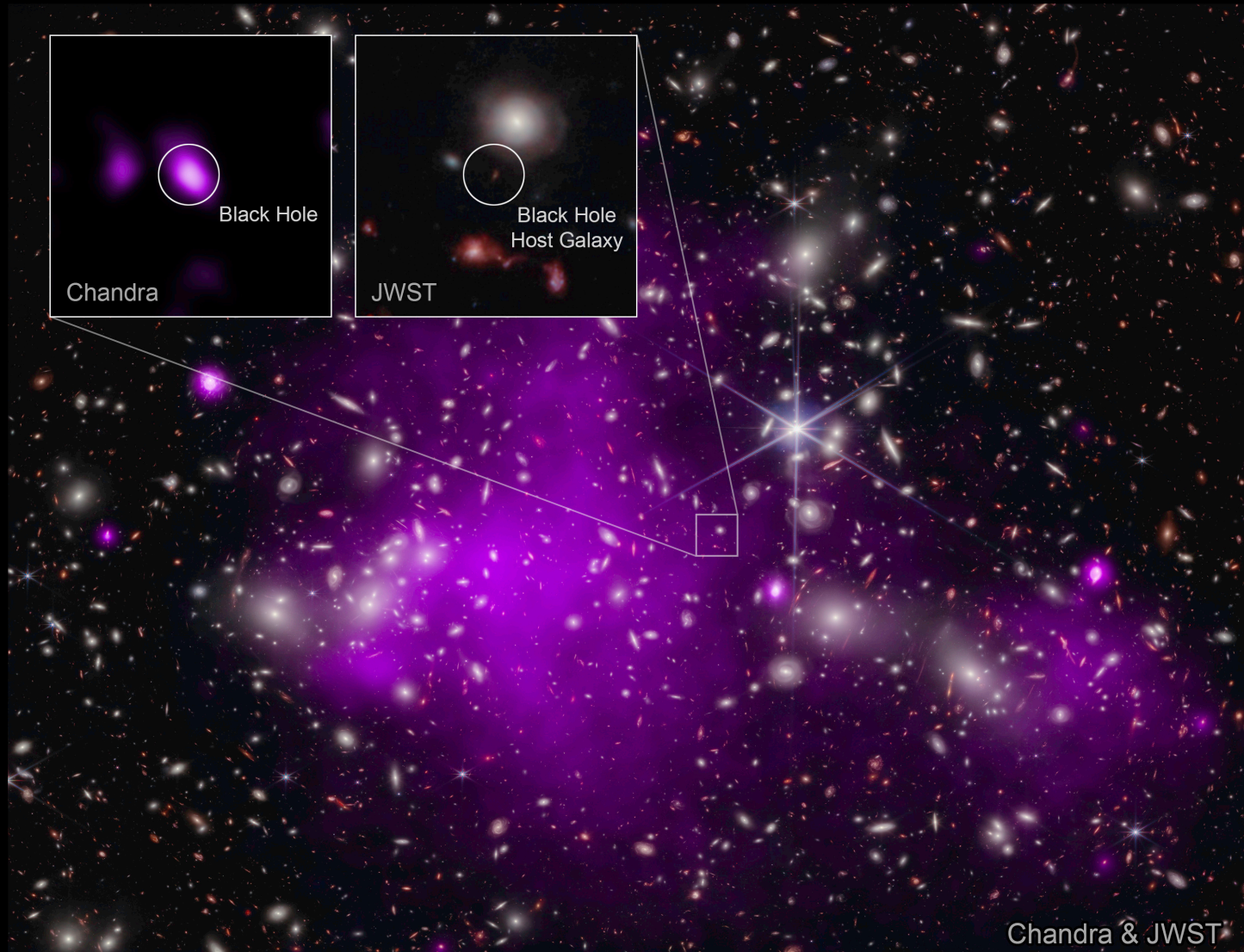
NIRSpec Microshutter Array Spectroscopy



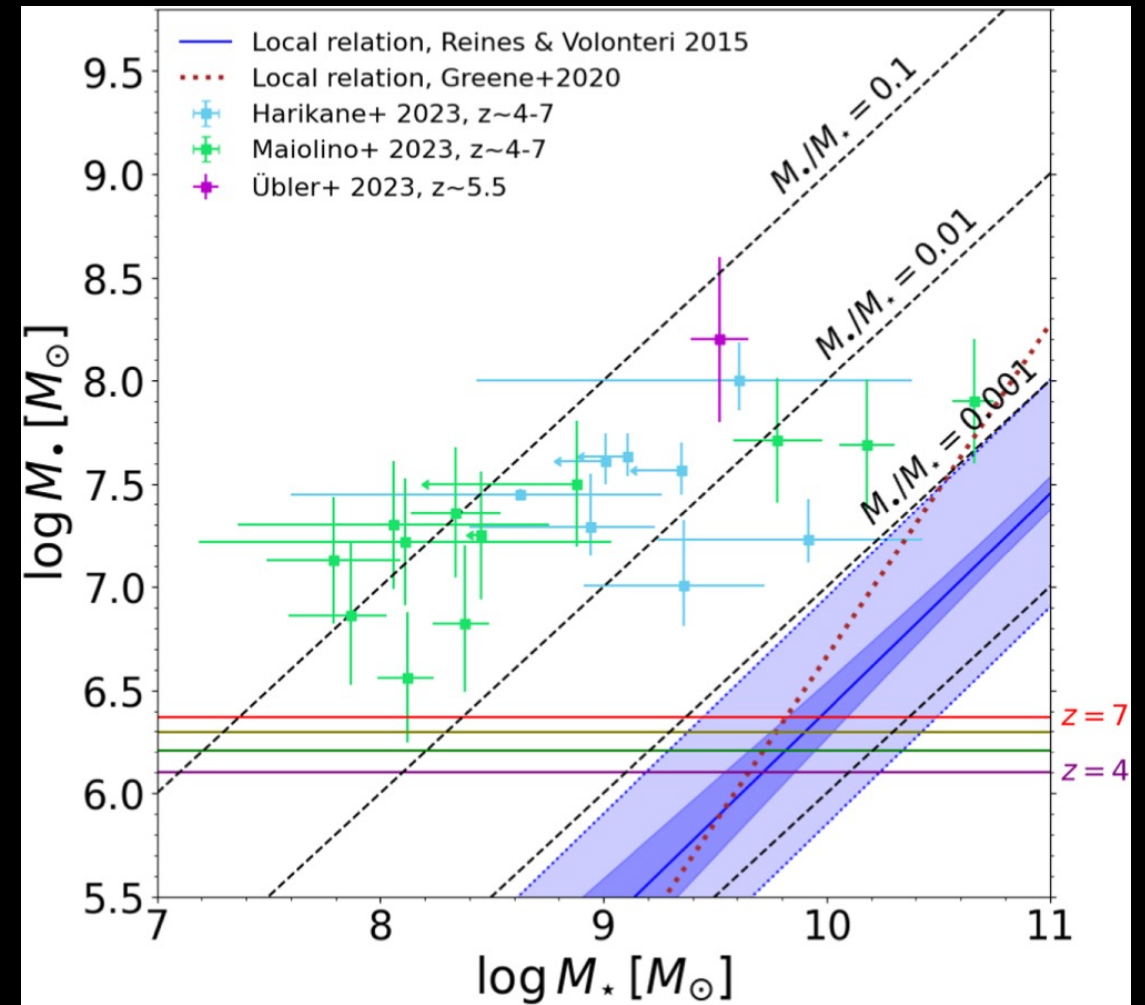




Leveraging multiple telescopes



- JWST early black holes are more massive compared to their galaxies than local black holes
- Evidence of “direct collapse” formation?



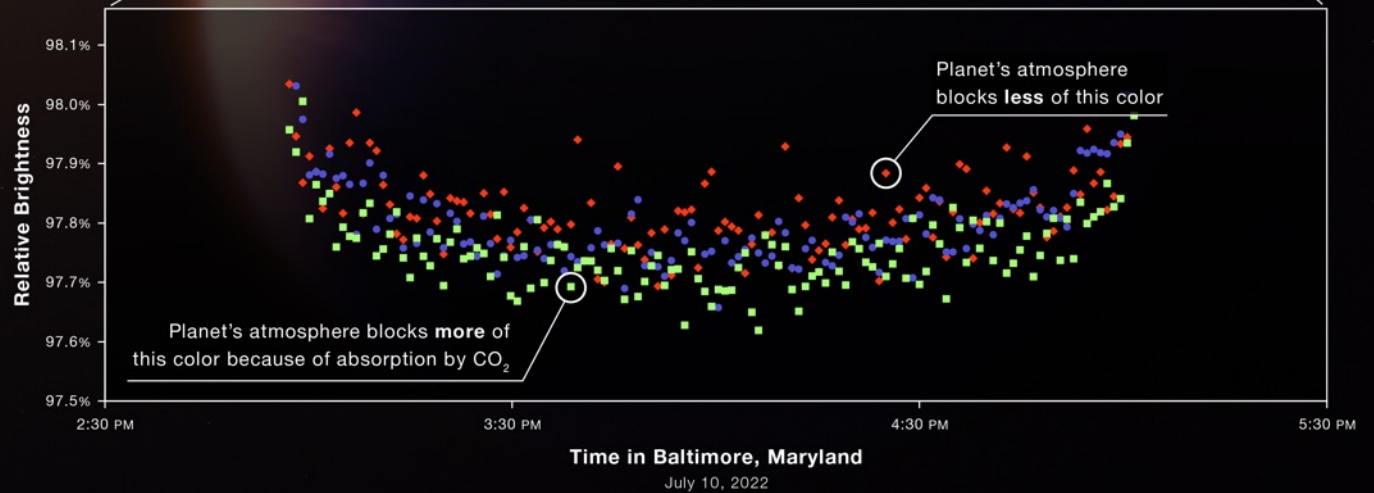
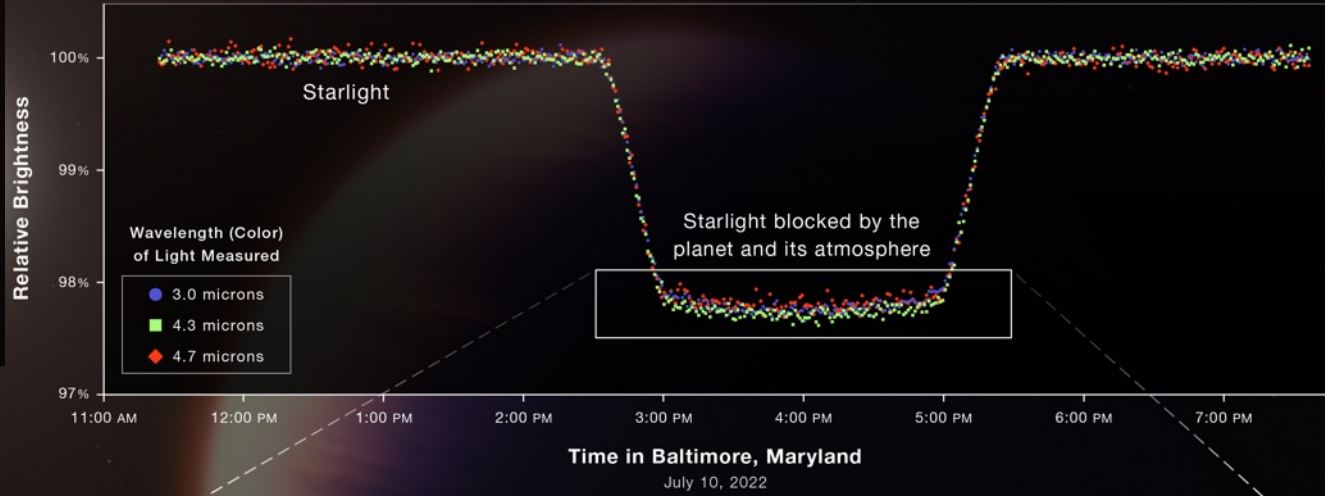
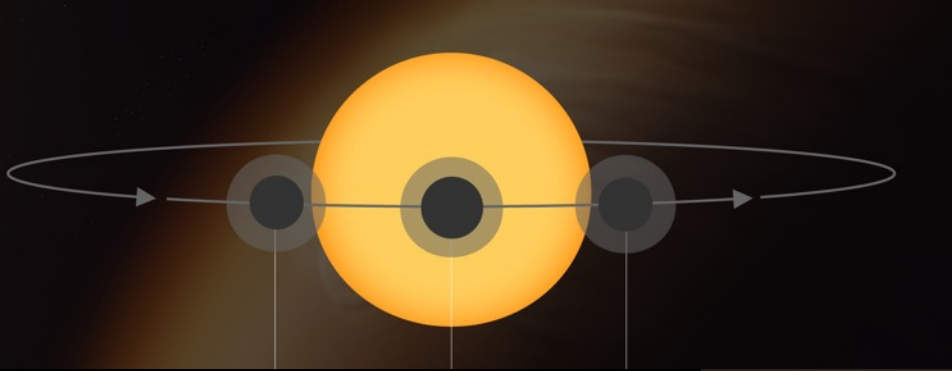


Over to you, Kelly!





Transit Spectroscopy



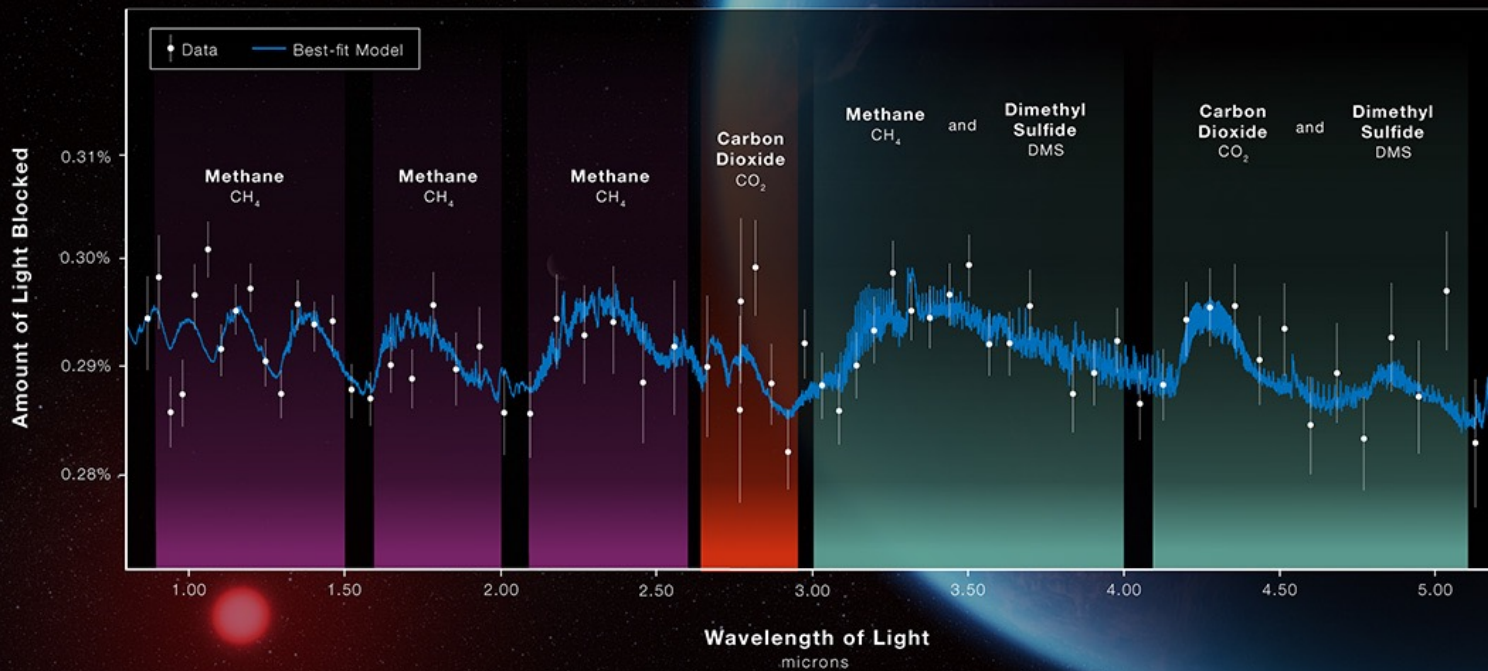


K2-18b: Finding the Missing Methane

Methane is the major carrier of Carbon, and ratio of Carbon to Oxygen is a key indicator of formation channels

EXOPLANET K2-18 b ATMOSPHERE COMPOSITION

NIRISS and NIRSpec (G395H)



WEBB
SPACE TELESCOPE

STScI | SPACE TELESCOPE
SCIENCE INSTITUTE

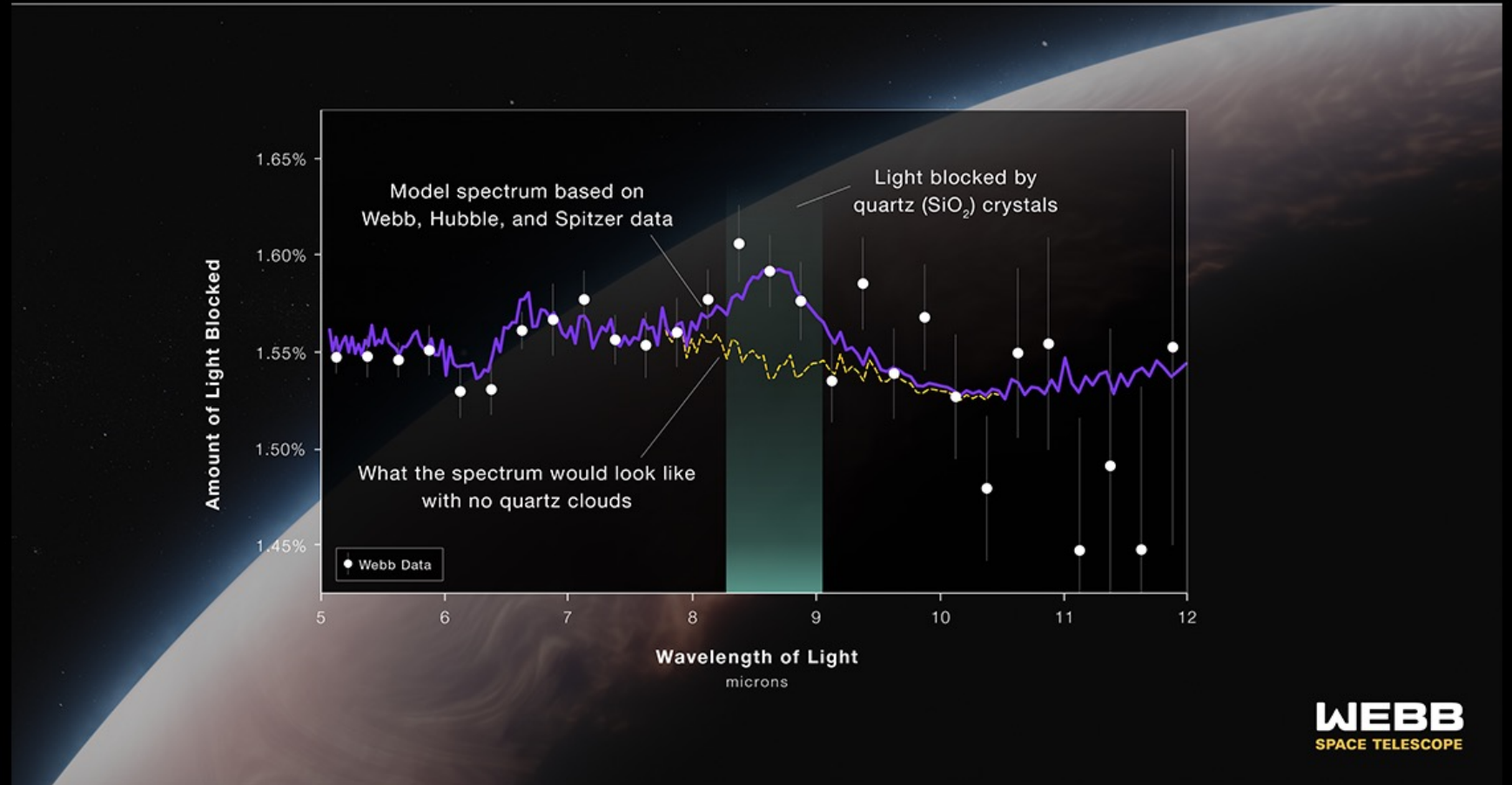


Tiny Quartz crystals

Oxygen
locked up in
 SiO_2 crystals
created in
atmosphere

HOT GAS GIANT EXOPLANET WASP-17 b COMPOSITION OF CLOUD PARTICLES

MIRI | Low-Resolution Time-Series Spectroscopy



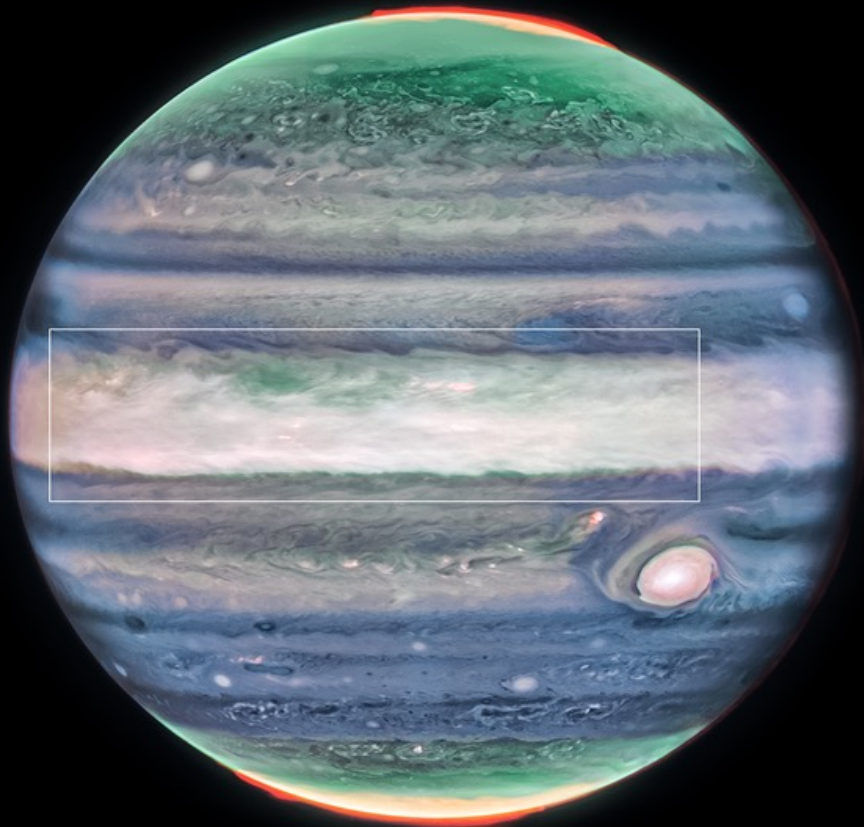
WEBB
SPACE TELESCOPE

STScI | SPACE TELESCOPE
SCIENCE INSTITUTE

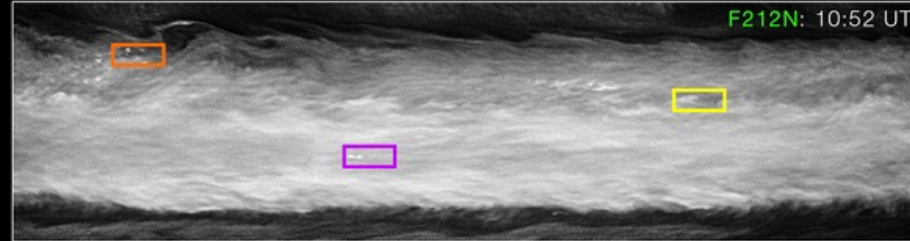


Jet stream on Jupiter

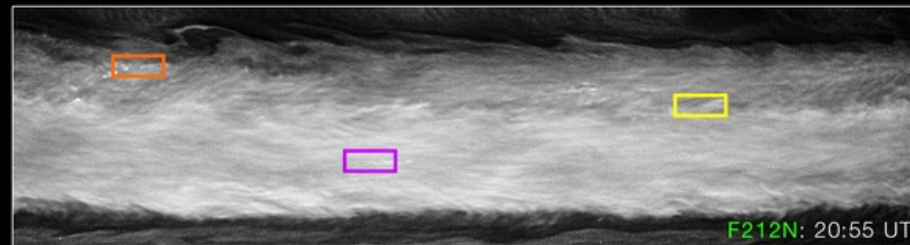
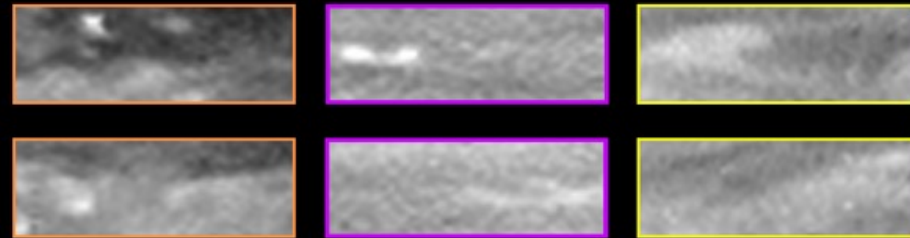
JAMES WEBB SPACE TELESCOPE
JUPITER | JULY 27, 2022



Jupiter's Equatorial Jet Stream



F212N: 10:52 UT



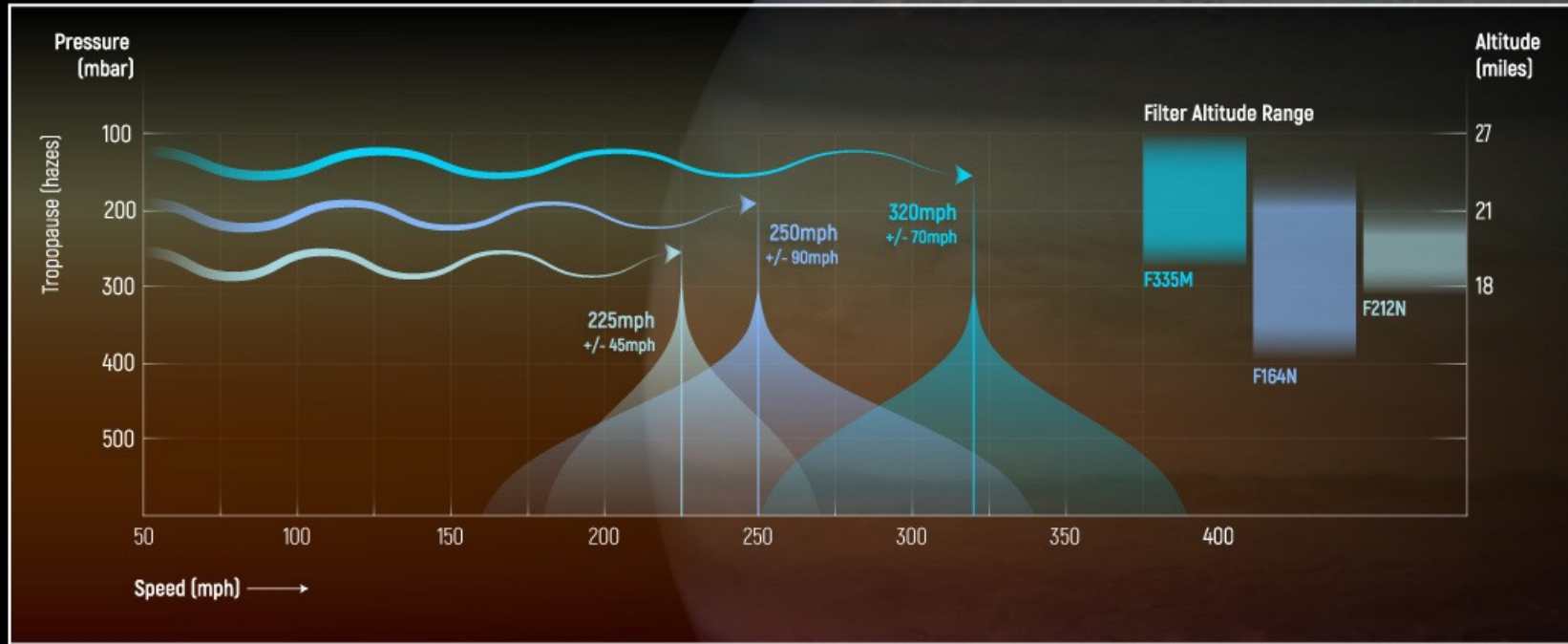
F212N: 20:55 UT

NIRCam Filters | F164N F212N F360M



Strongest at the Tropopause

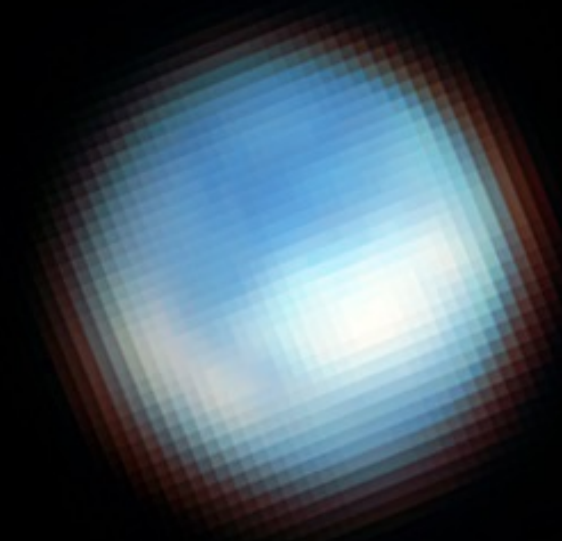
JAMES WEBB SPACE TELESCOPE WINDS ON JUPITER





Ices on Jupiter's Moon Europa

- Do the oceans beneath the ice contain other materials necessary for life?
 - First and foremost: Carbon
- IFU observations: a spectrum for every pixel

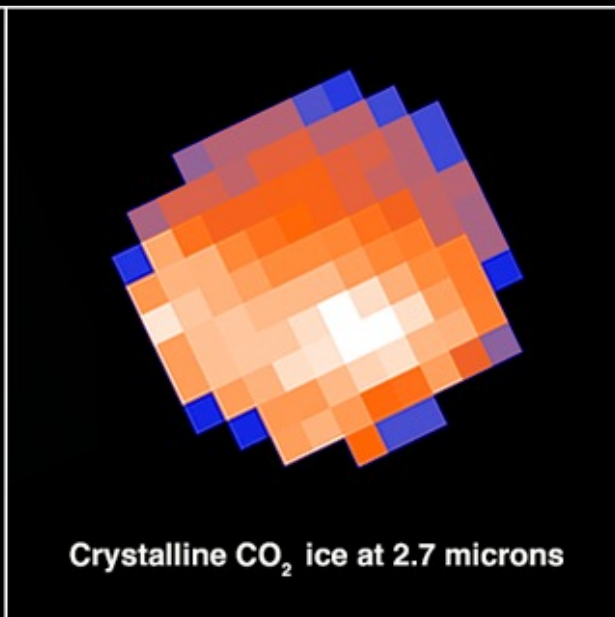




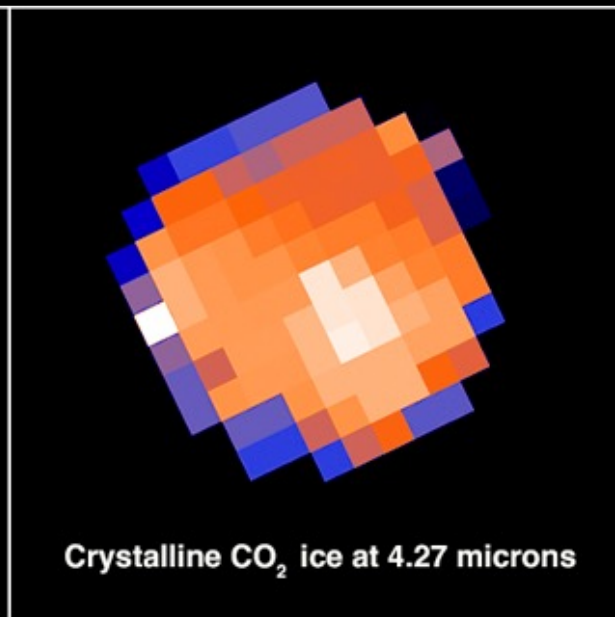
Carbon Ices on Freshest Surface



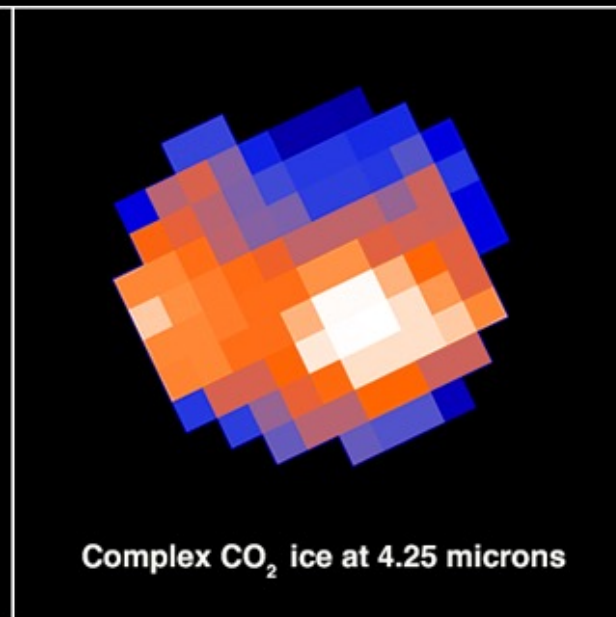
Europa (NIRCam)



Crystalline CO₂ ice at 2.7 microns



Crystalline CO₂ ice at 4.27 microns



Complex CO₂ ice at 4.25 microns



Questions?

