Galaxies study with HST & JWST

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What is a Galaxy ?

- Gravitationally bound system of stars, stellar remnants, interstellar gas, and dark matter.
- Supermassive black holes at their centers.
- few hundred million stars to hundred trillion stars.
- categorized by visual morphology (elliptical, spiral, or irregular).

Figure – NGC 3318 galaxy

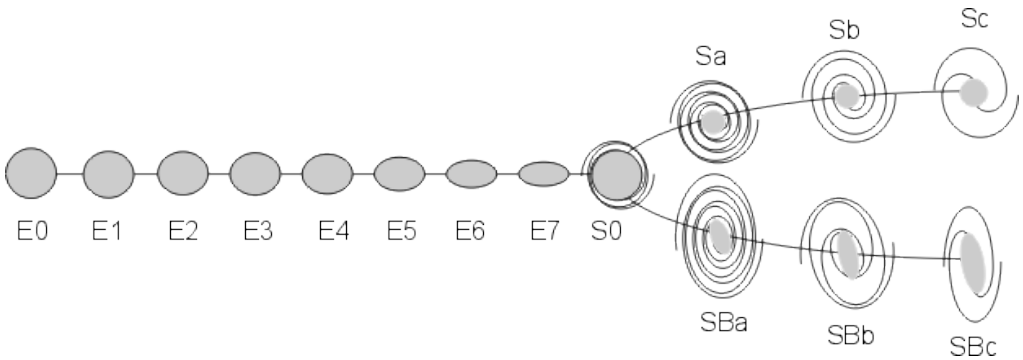


Figure – Hubble Sequence

Importance of Galaxies in Astronomy

- One of the largest structure in the universe.
- Ø from 1,000 to 100,000 parsecs (3,000 to 300,000 ly).
- Understand universe evolution.
- Organisation of matter on large scales and how it has changed through out time.

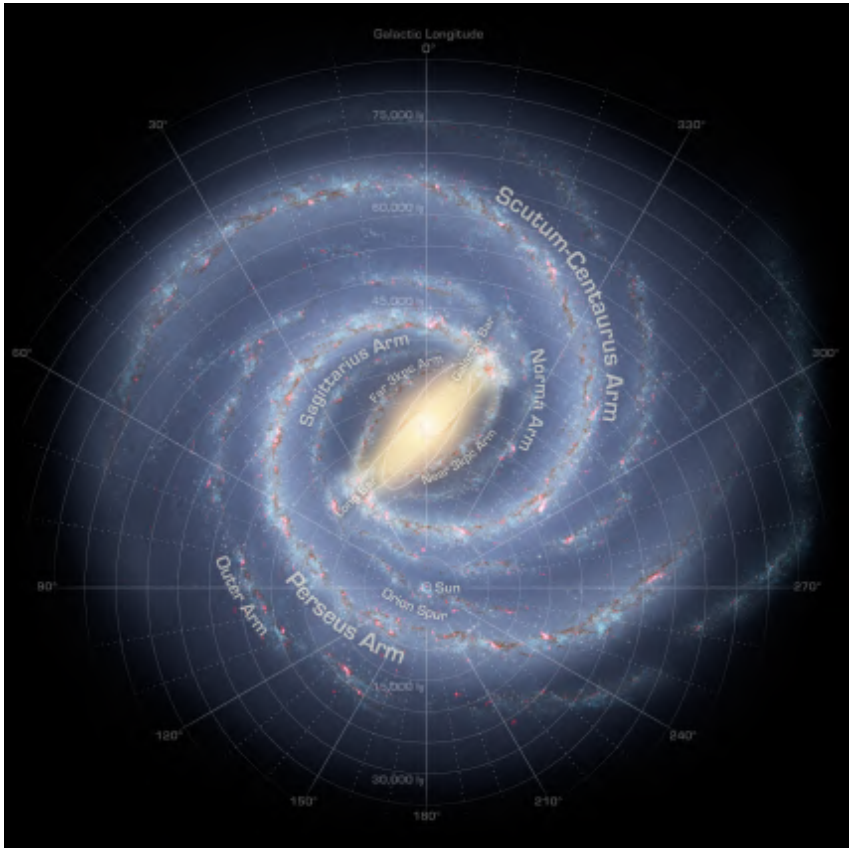
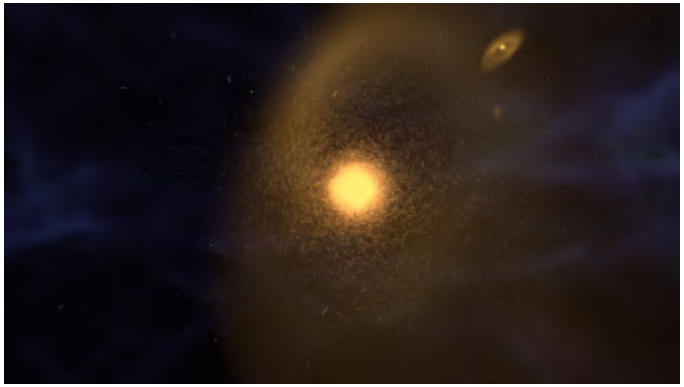
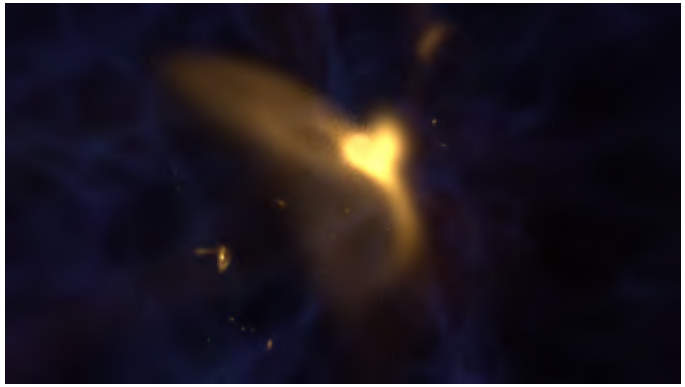


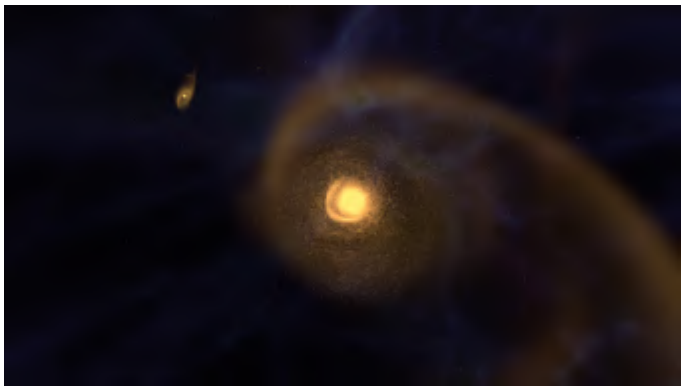
Figure – the milky way galaxy



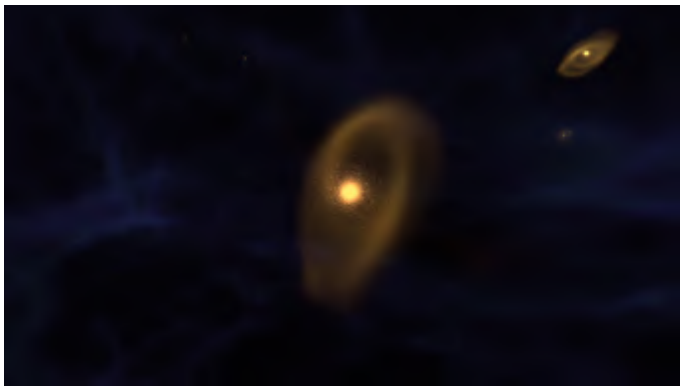
(a) Galaxies begin as small clouds of stars and dust swirling through space.



(b) When galaxies get close, gravity pulls them together, causing a collision.



(c) Stars and other material begin settling into orbits around a new galactic core.



(d) Myr/Gyr may pass before galaxies merge completely into a single larger galaxy.

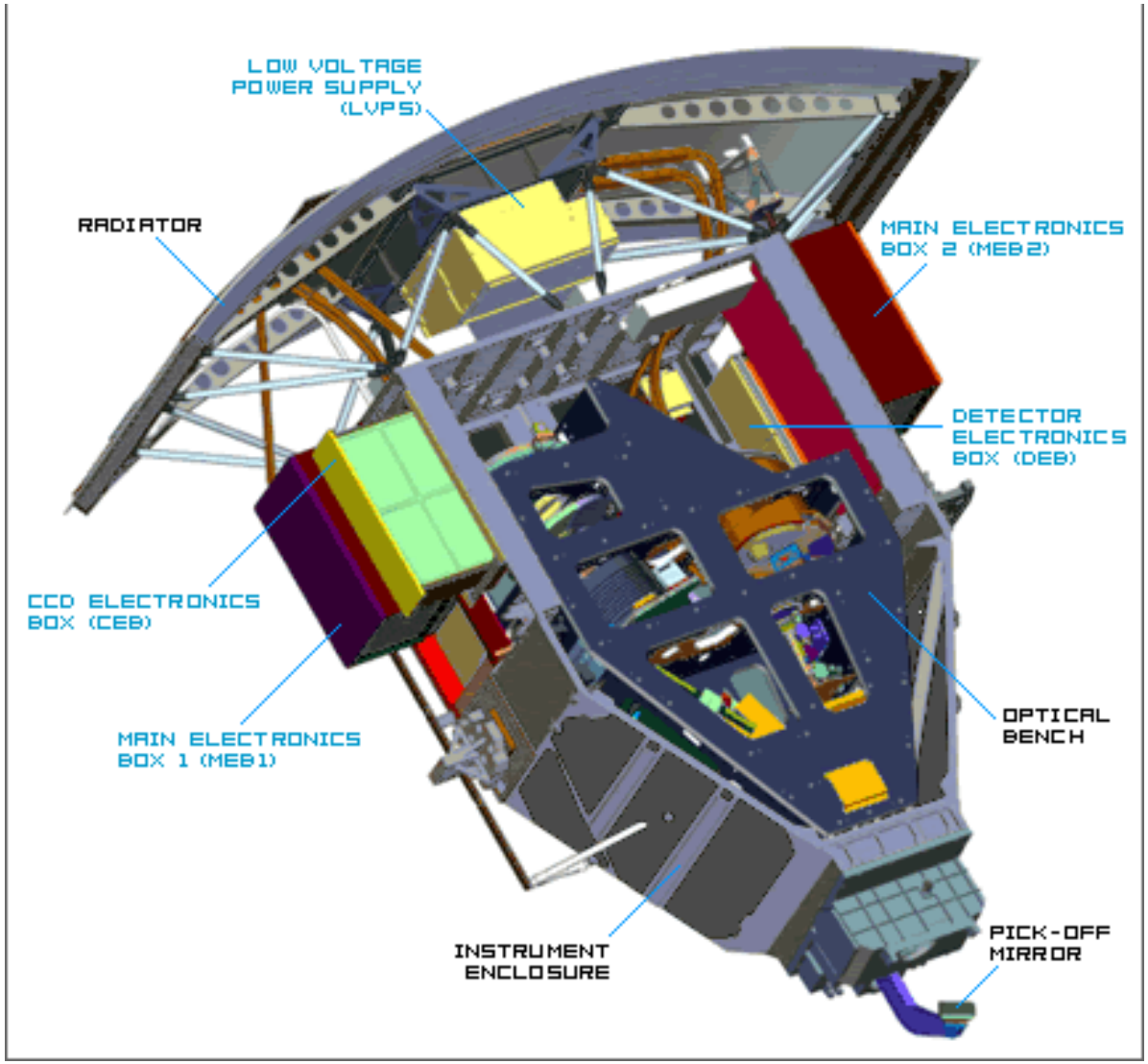
Hubble Space Telescope

Hubble Space Telescope (HST)

- Since 1990
- from UV to IR (115–2500 [nm])
- 6 instruments (WFC3, ACS, ...)
- HST changed our fundamental understanding of the cosmos :
  - Dark energy / matter
  - Galaxies growth
  - Birth of stars
  - etc...

Figure – Hubble Ultra Deep Field

Wide Field Camera 3 (WFC3)



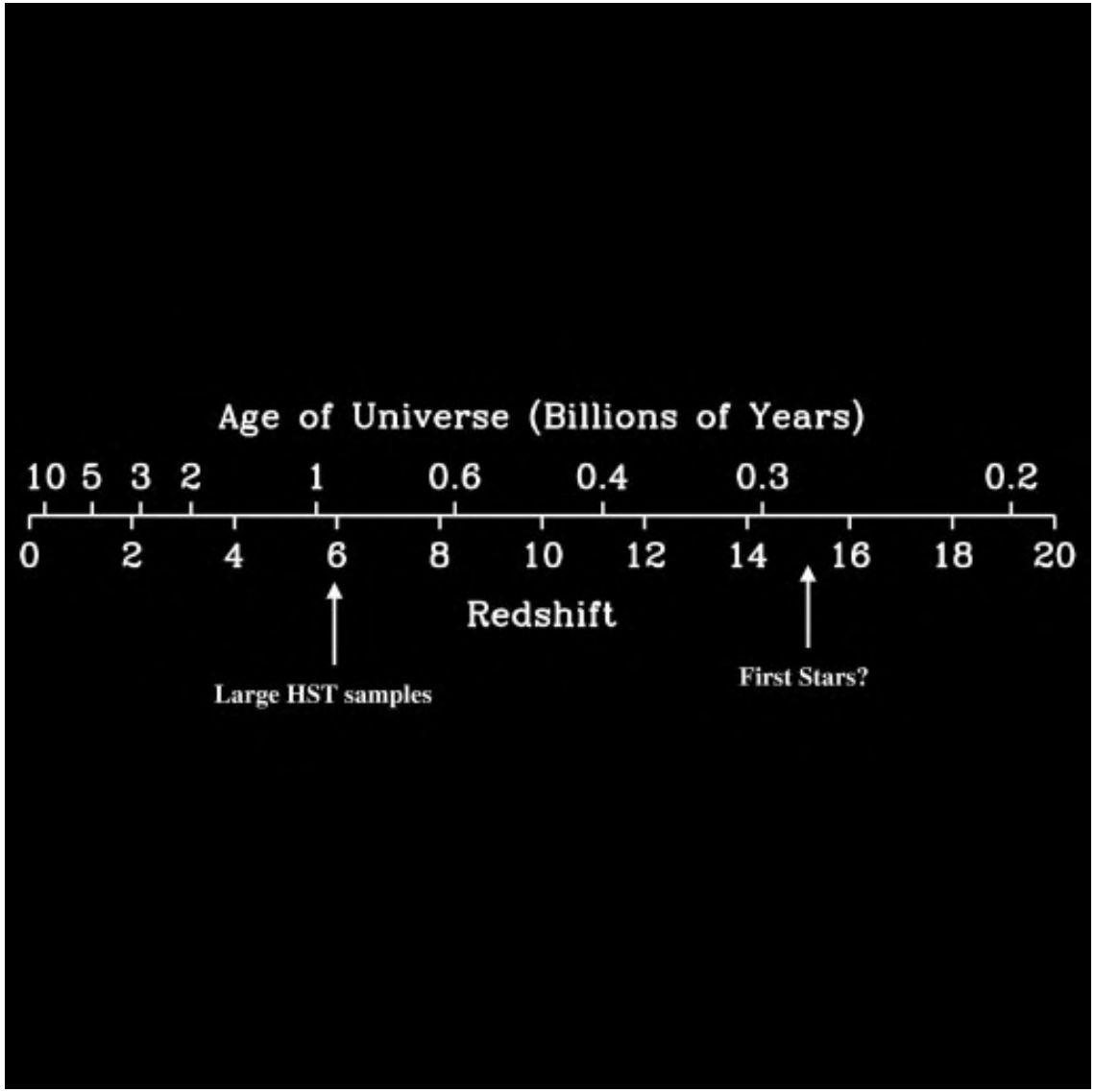


Figure – Age/Redshift of the Universe : $z = \frac{\lambda_{obsv}}{\lambda_{emit}} - 1$

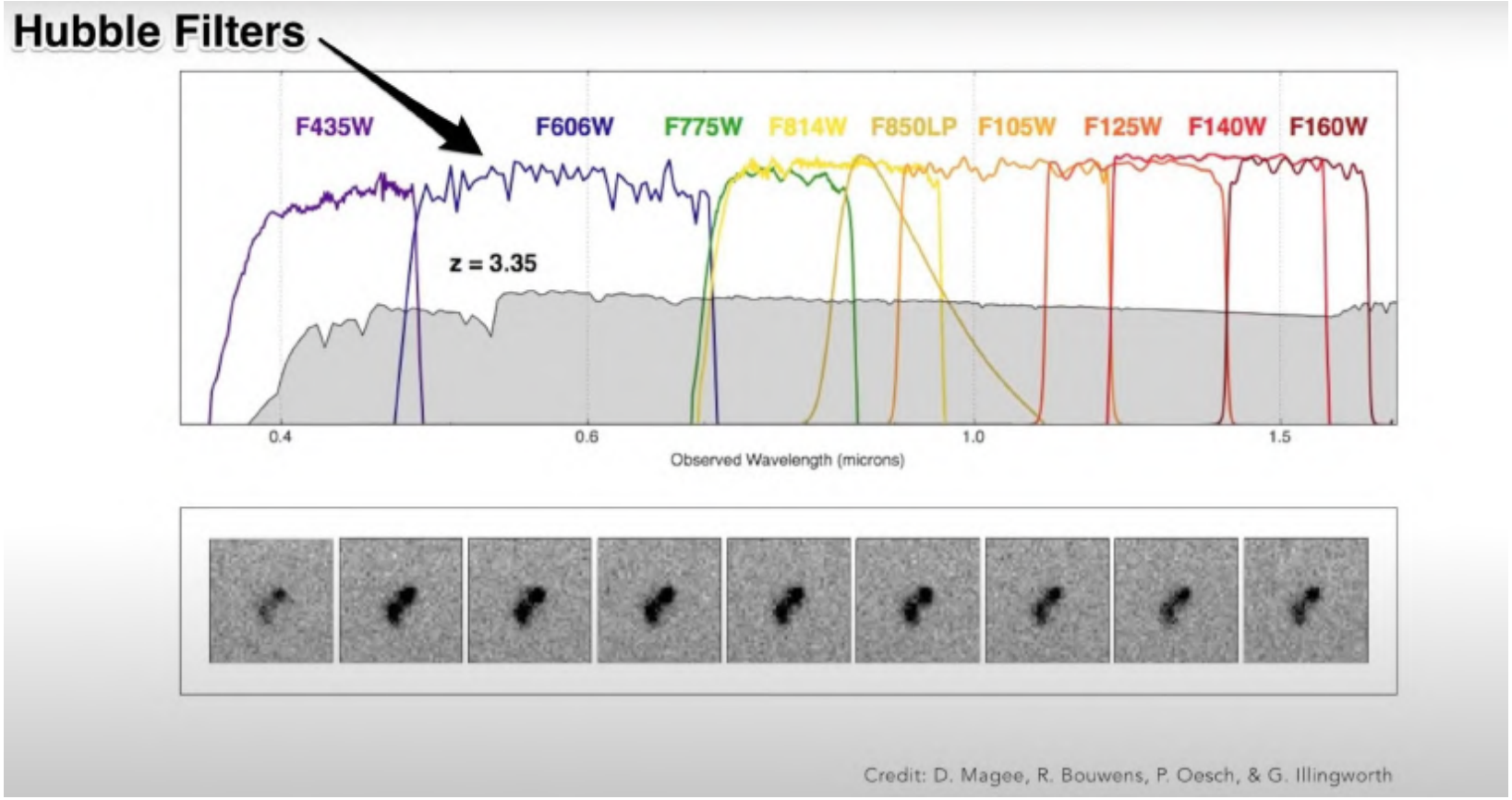
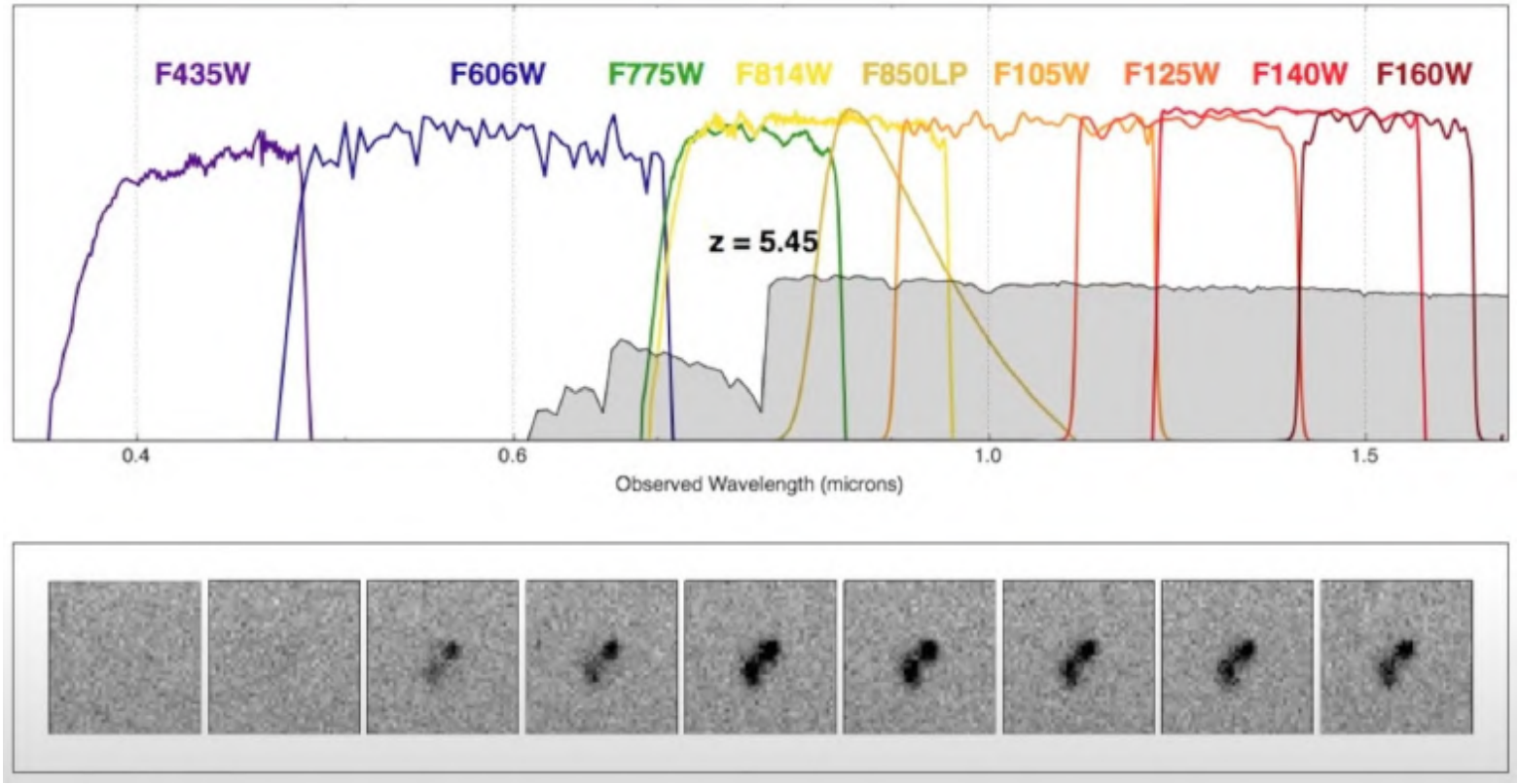
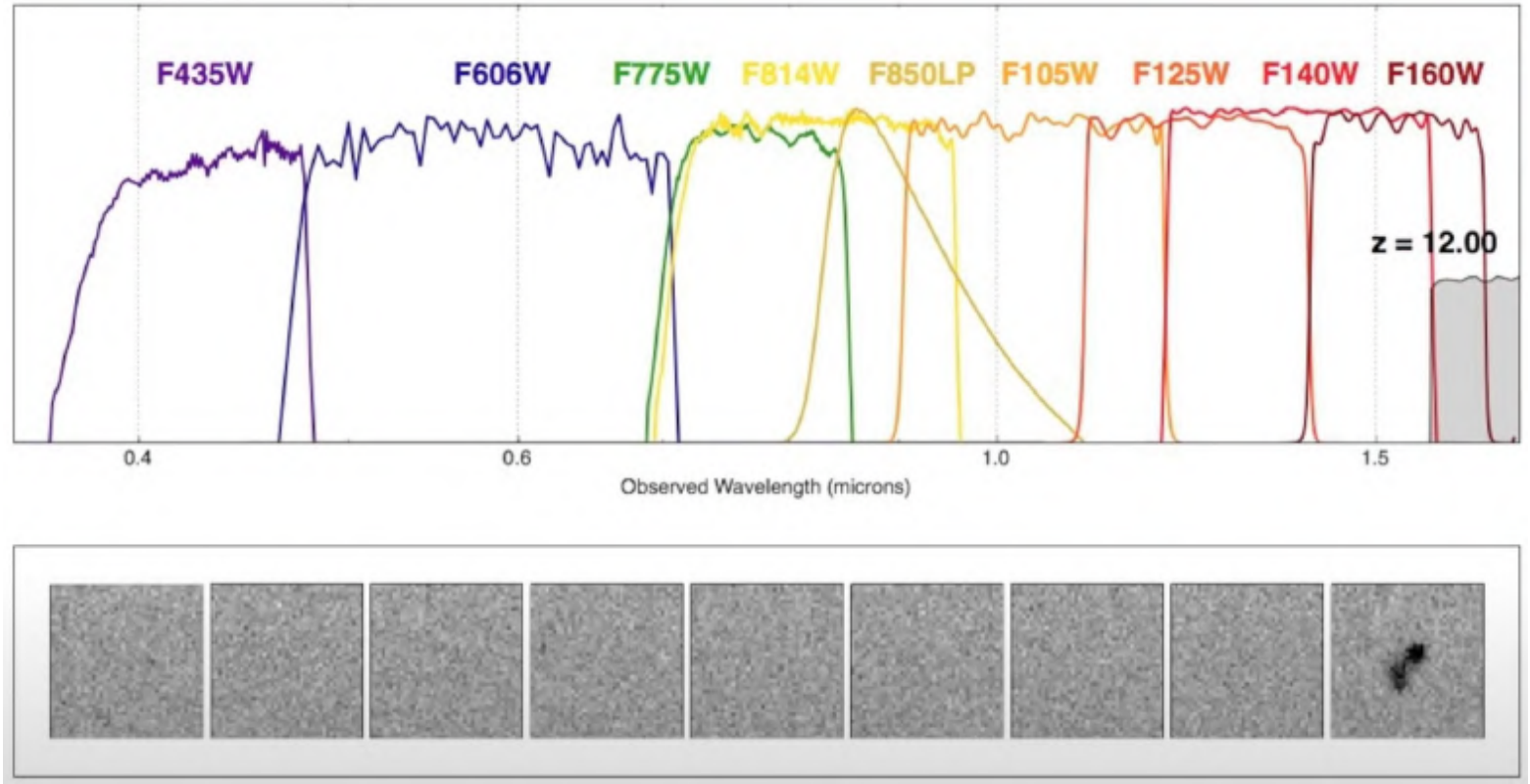
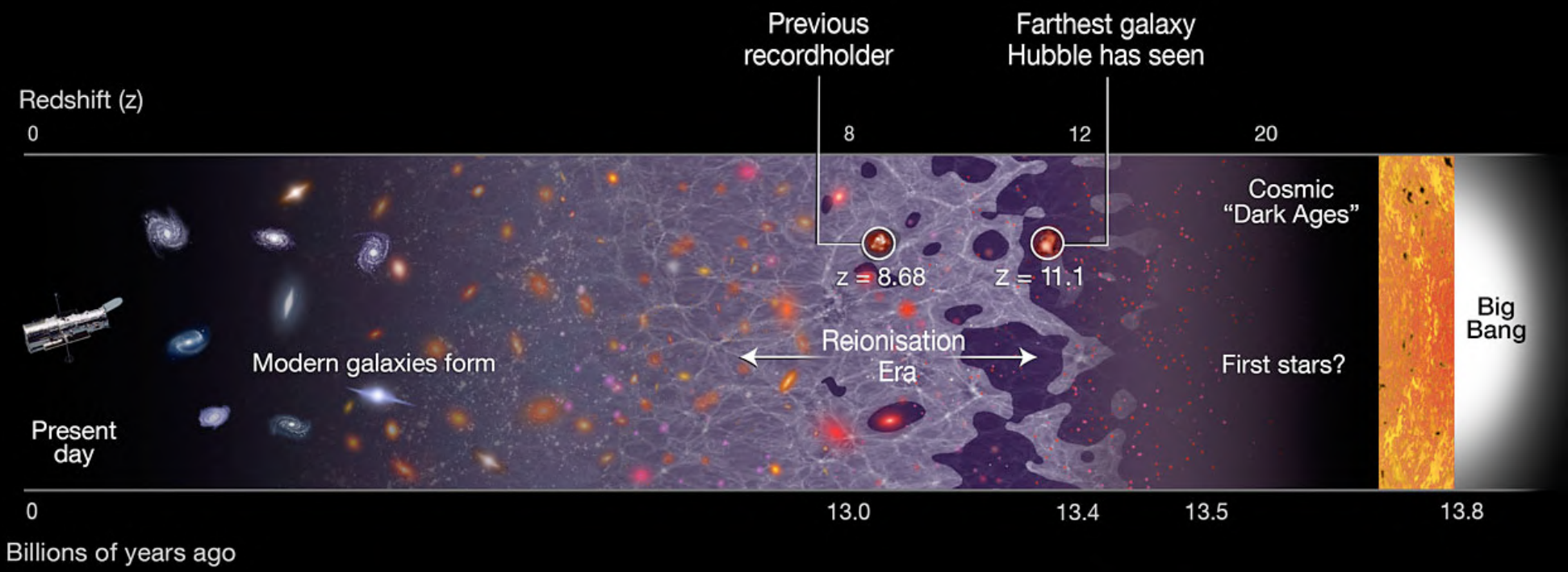


Figure – The Drop-Out Method :
`https://www.youtube.com/watch?v=6dR96S0HfJo`

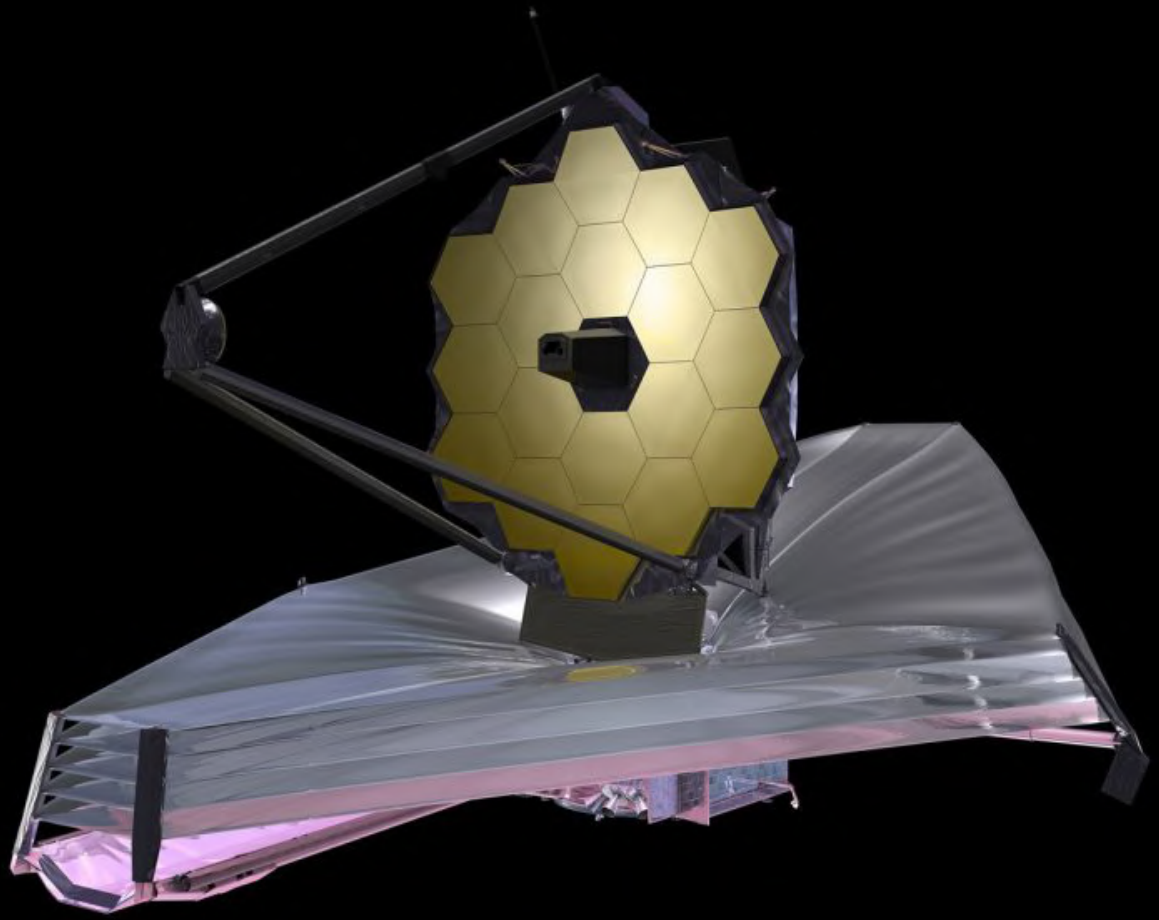

F435W
F606W
F775W
F814W
F850LP
F105W
F125W
F140W
F160W
z = 5.45
0.4
0.6
1.0
1.5
Observed Wavelength (microns)


F435W
F606W
F775W
F814W
F850LP
F105W
F125W
F140W
F160W
z = 12.00
0.4
0.6
1.0
1.5
Observed Wavelength (microns)



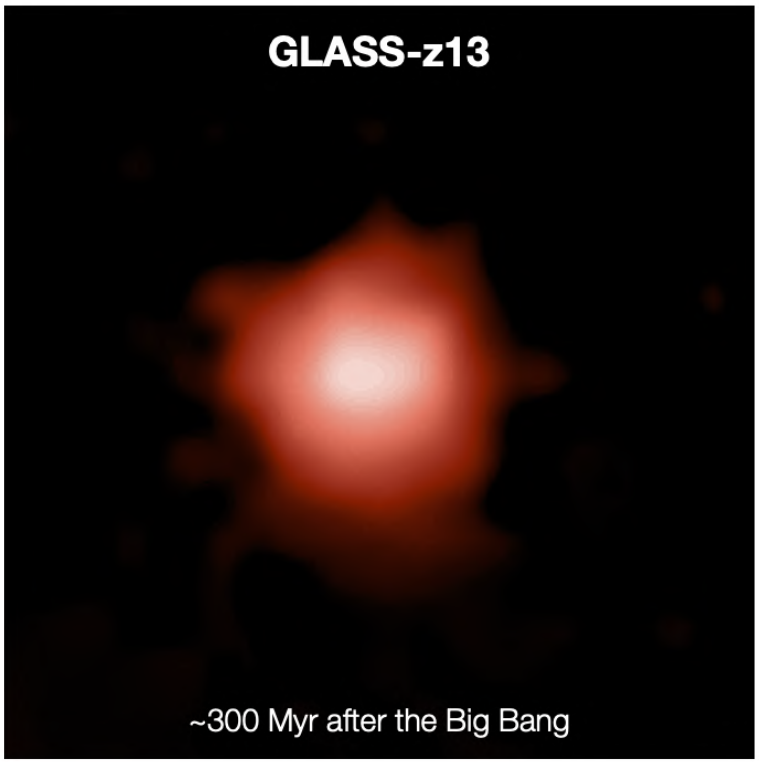
- Hubble : 13.5 Billion years
- To see further : ?

James Webb Space Telescope



New Farthest Galaxy (Maybe...)

- NIRCam instrument, found two very luminous galaxies : GLASS-z11 and GLASS-z13 (z=11 and z=13)
- New record-breaking galaxy in first week of operation : GLASS-z13
- Already built up an estimated 1 Billion solar mass in stars in a very short amount of time $\Rightarrow$ Even older galaxies ?



Acknowledgements and Sources

- Special thanks to Pascal Oesch for the help & sources
- Sources :

  - www.nasa.gov, (HST & JWST sites)
  - www.esa.int, (HST & JWST sites)
  - www.firstgalaxies.org
  - UniGE-ExtragalScience & HighRedshiftGalaxyObservations
  - A remarkably luminous galaxy at z=11.1 measured with HST grism spectroscopy
  - https ://www.unige.ch/sciences/astro/cosmicdawn/