

Galactic and Extra-galactic Astronomy

AA 472/672

Spring Semester

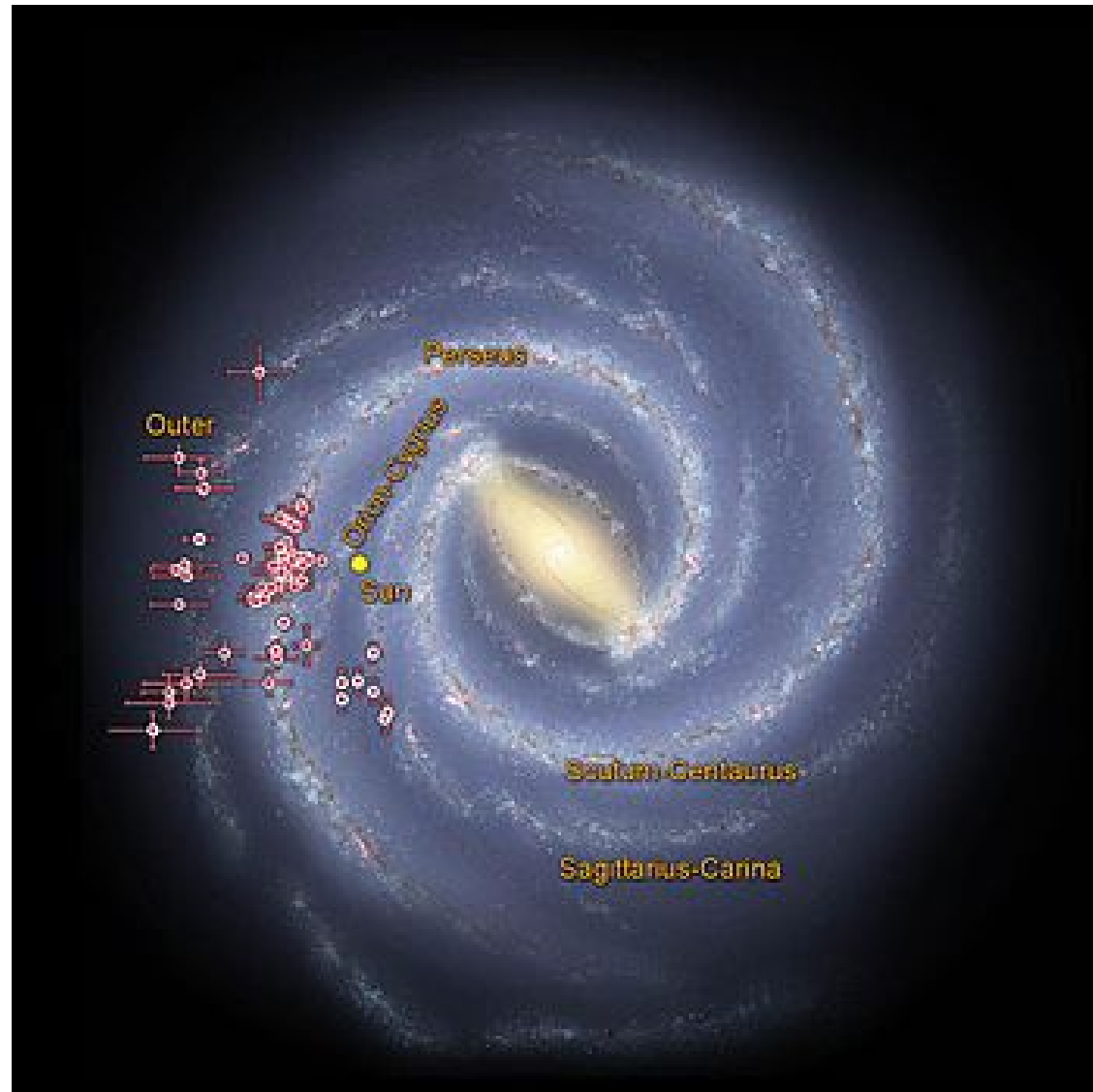
Instructor: Manoneeta Chakraborty

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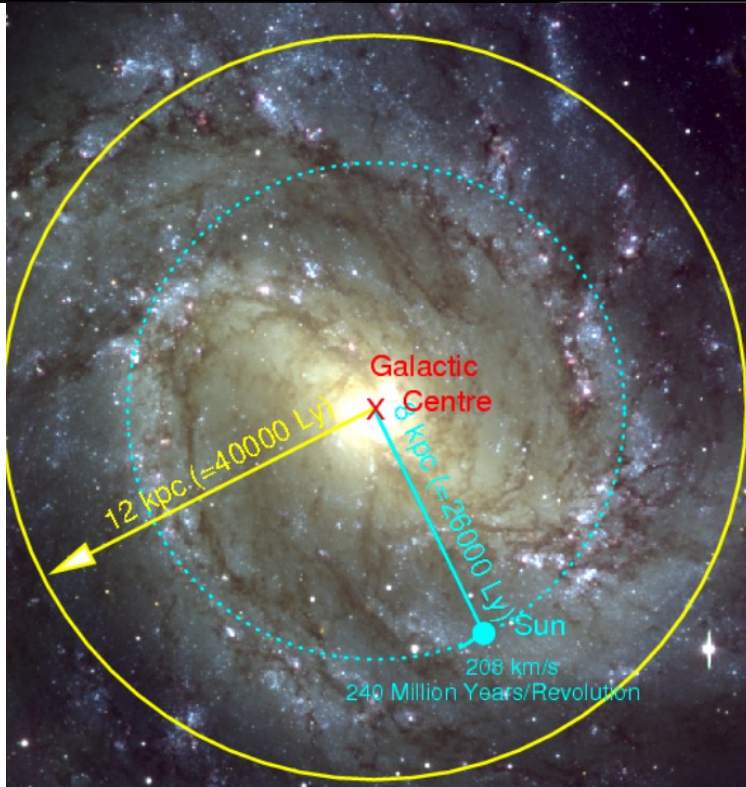
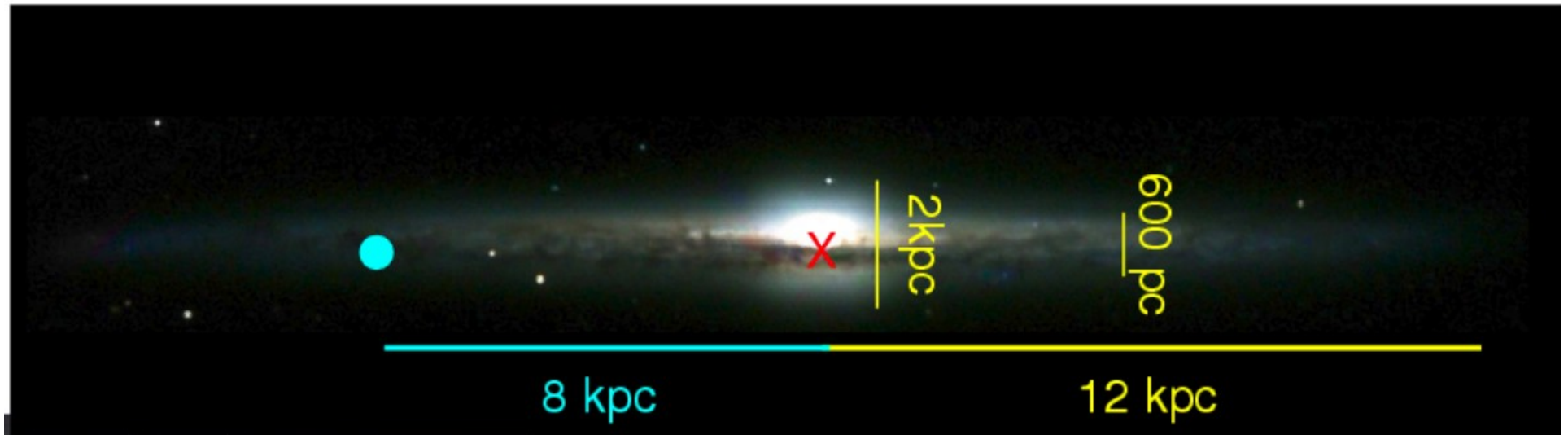
Course webpage: <http://www.iiti.ac.in/people/~manoneeta/courses/AA672/>

DAASE
IIT Indore
Indore
Madhya Pradesh
India
Asia
Earth
Solar System
Milkyway
Local Group
Virgo Supercluster
Laniakea galaxy supercluster
Observable Universe
Universe

Galaxies: Milkyway



Galaxies: Milkyway



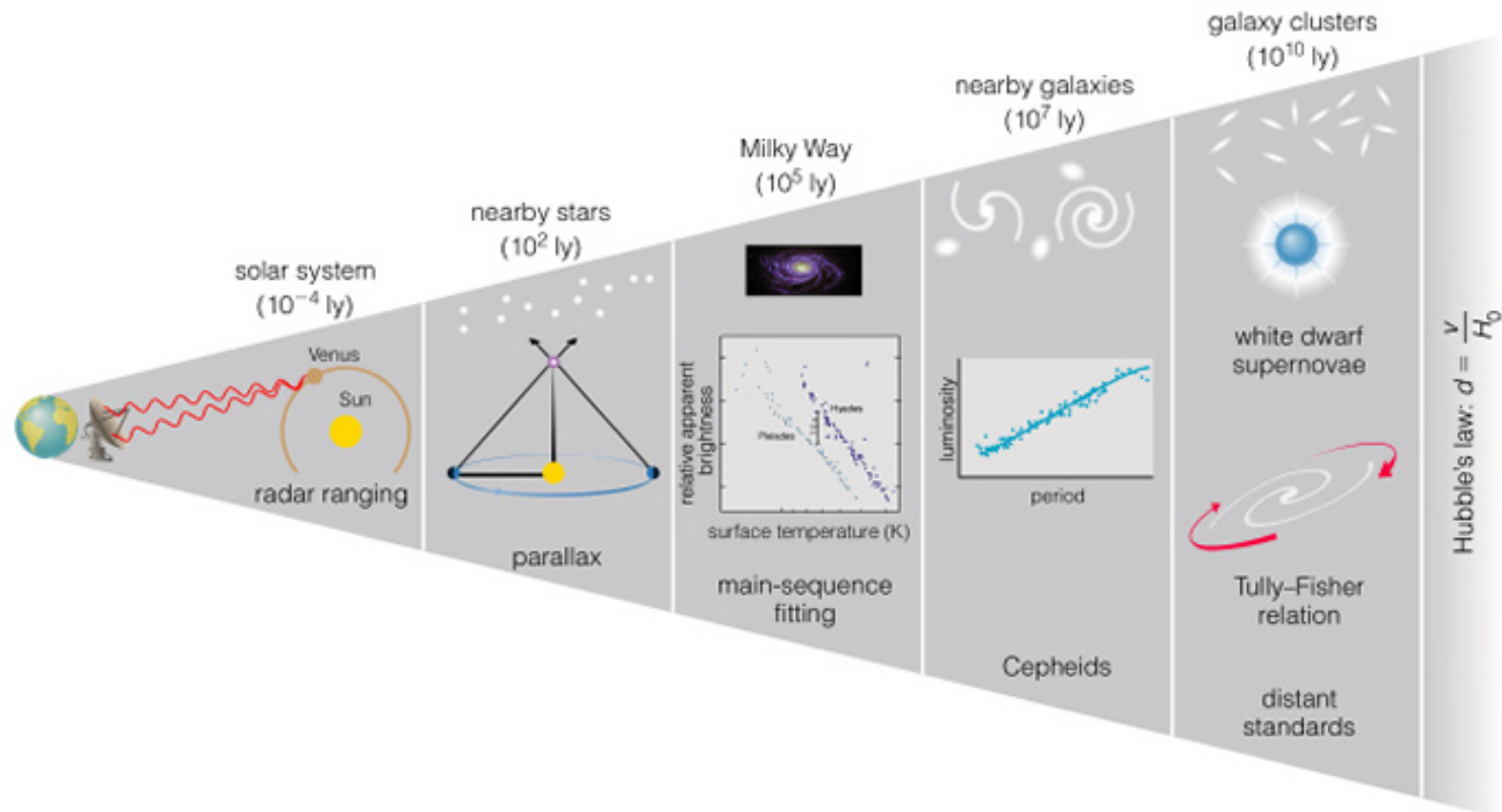
Luminosity: $\sim 2 \times 10^{10} L_{\odot}$

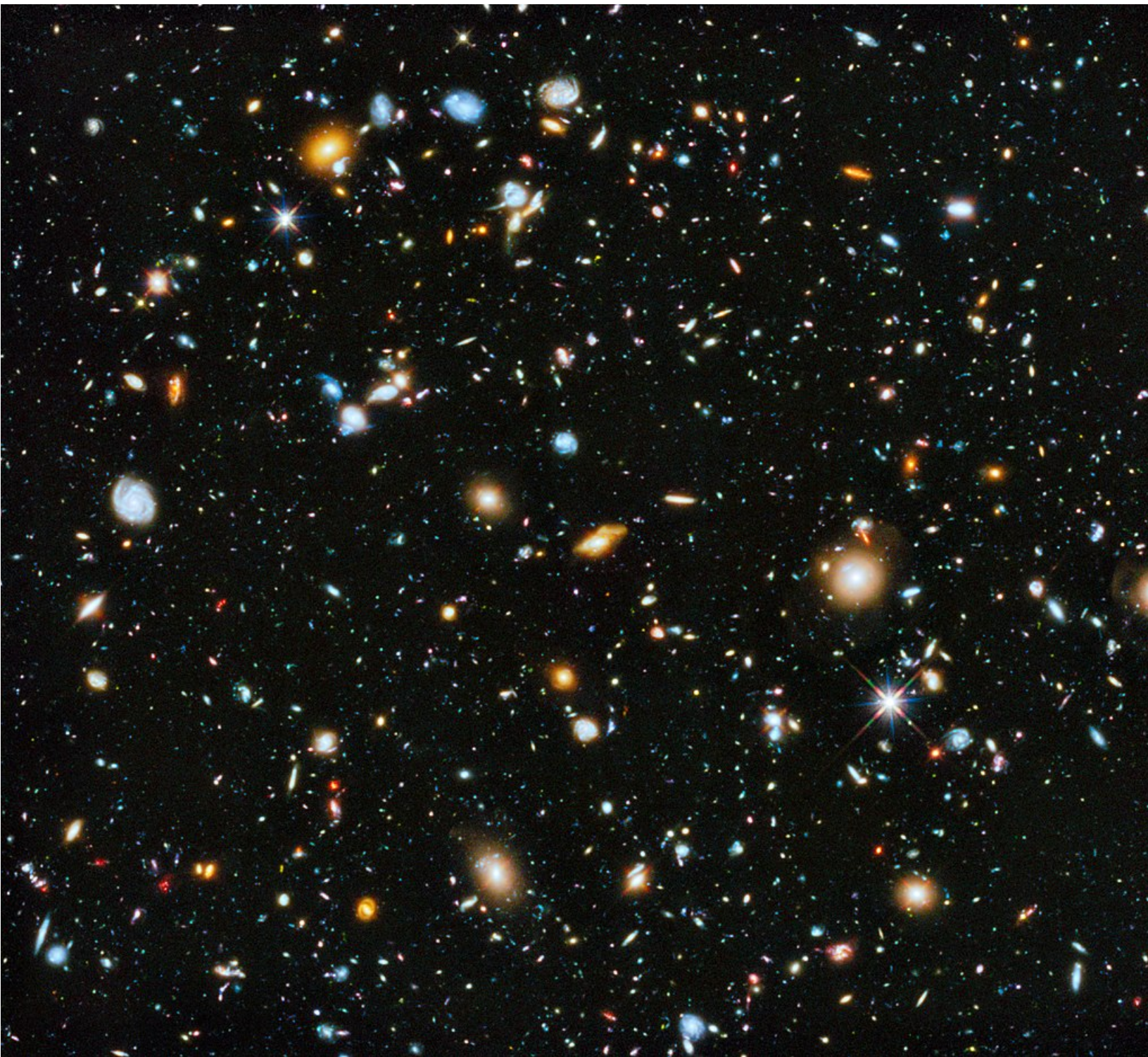
Mass: $\sim 10^{11} M_{\odot}$ (radiating)
 $\sim 10^{12} M_{\odot}$ (total)

Stellar density:
 $\sim 0.3 M_{\odot} \text{ pc}^{-3}$

Credits: J. Wilms

Distance ladder





Hubble Ultra-deep field

Credits:
ESA/Hubble



NGC 1232
face-on

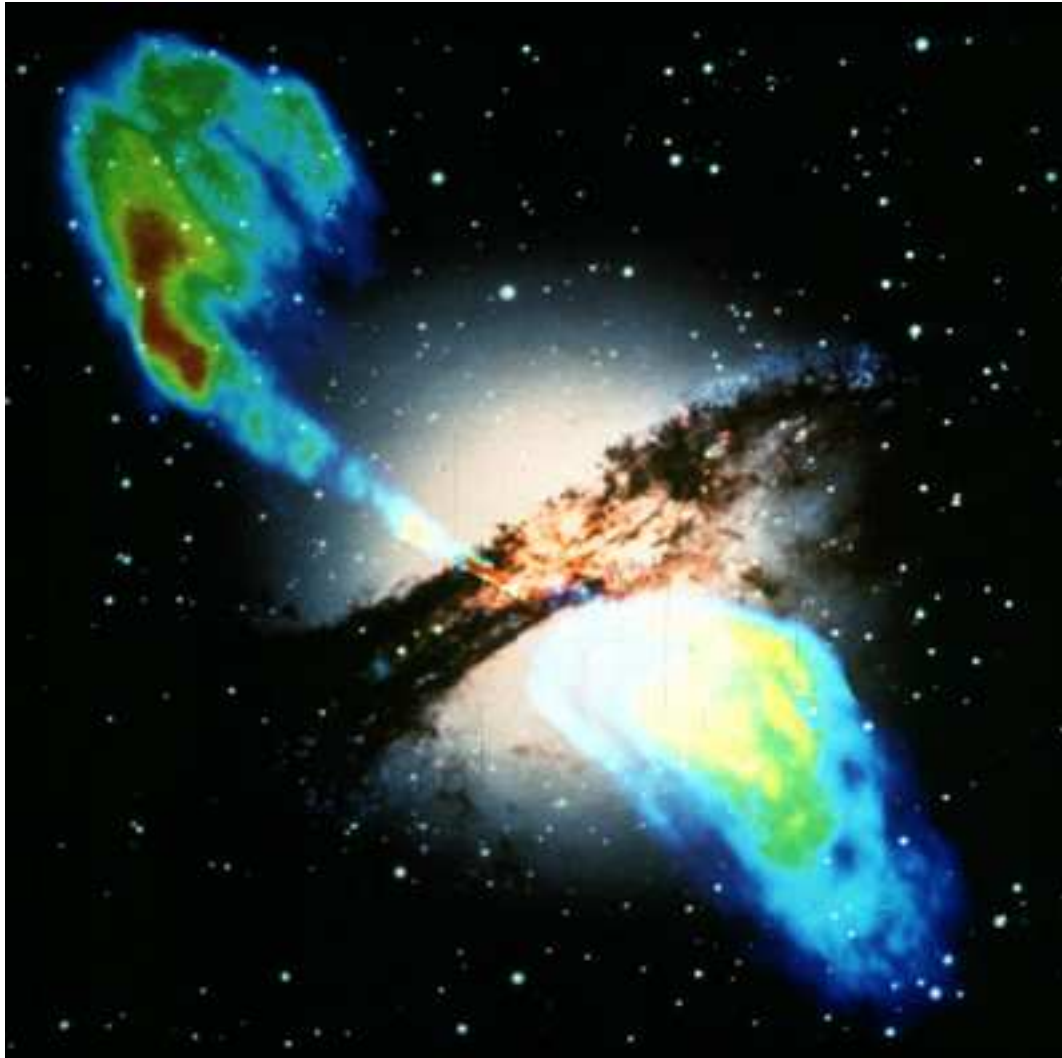


NGC 4013
Edge-on



Merging galaxies
NGC 2207 (on the left) and IC 2163

AGN



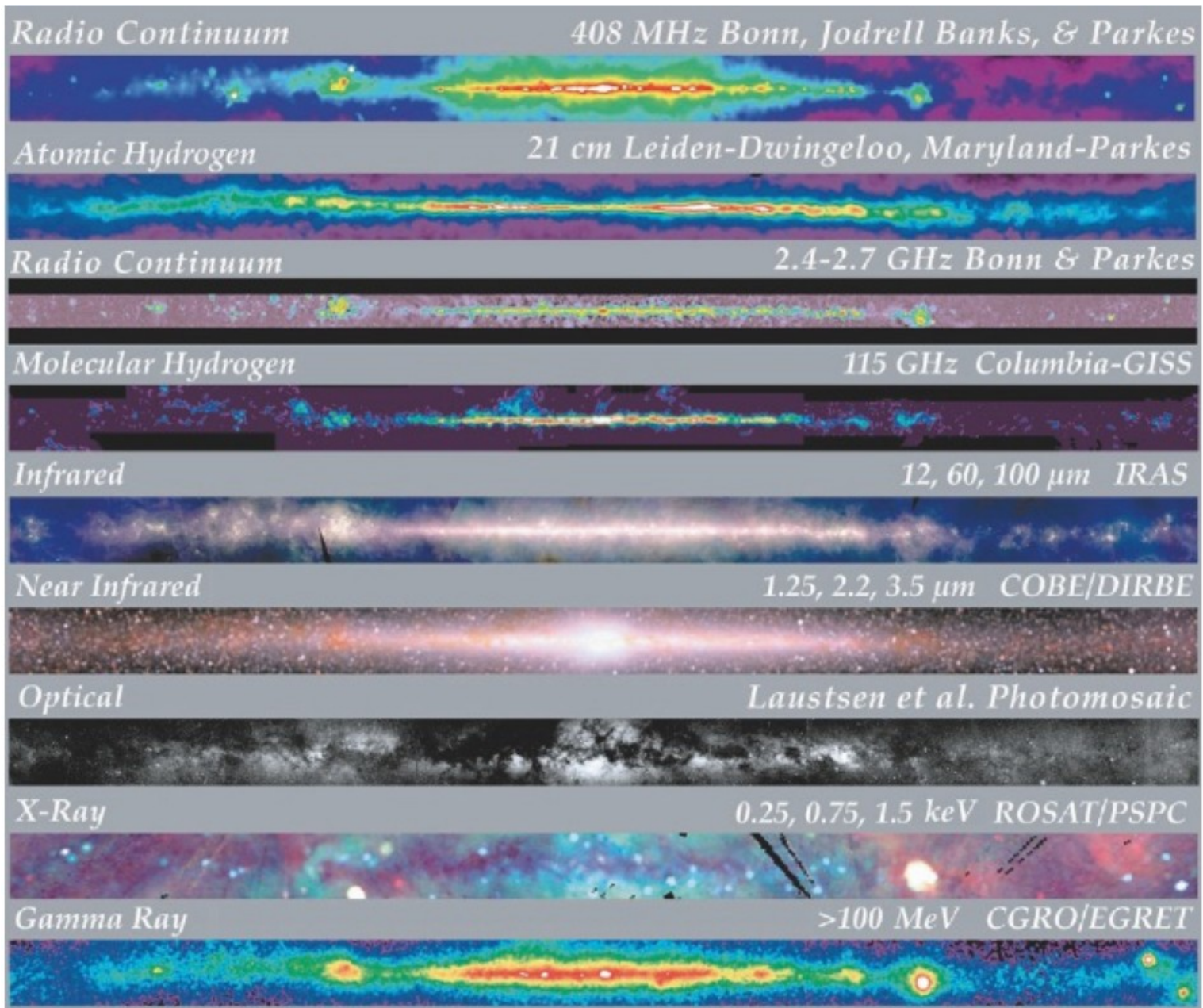
Centaurus A

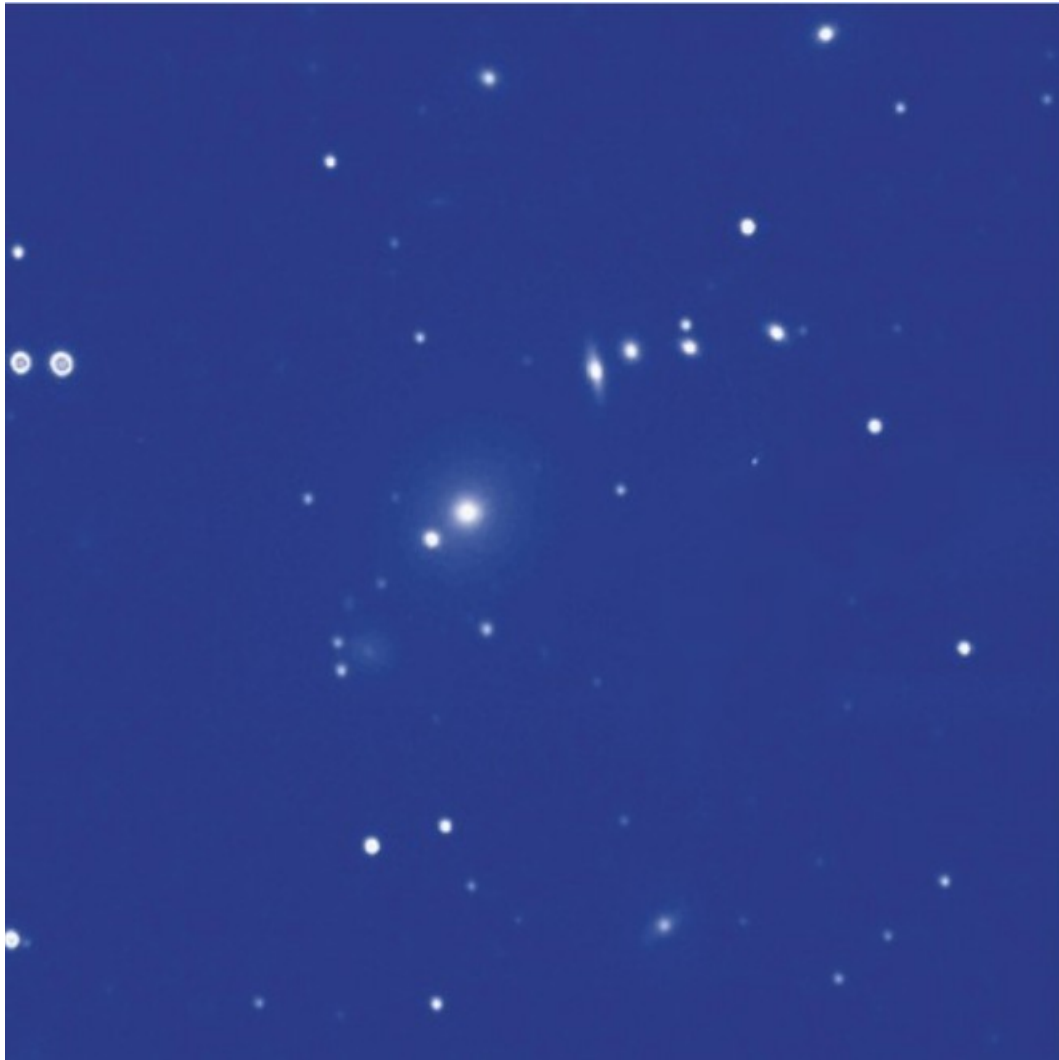
Credits: STScI/NASA

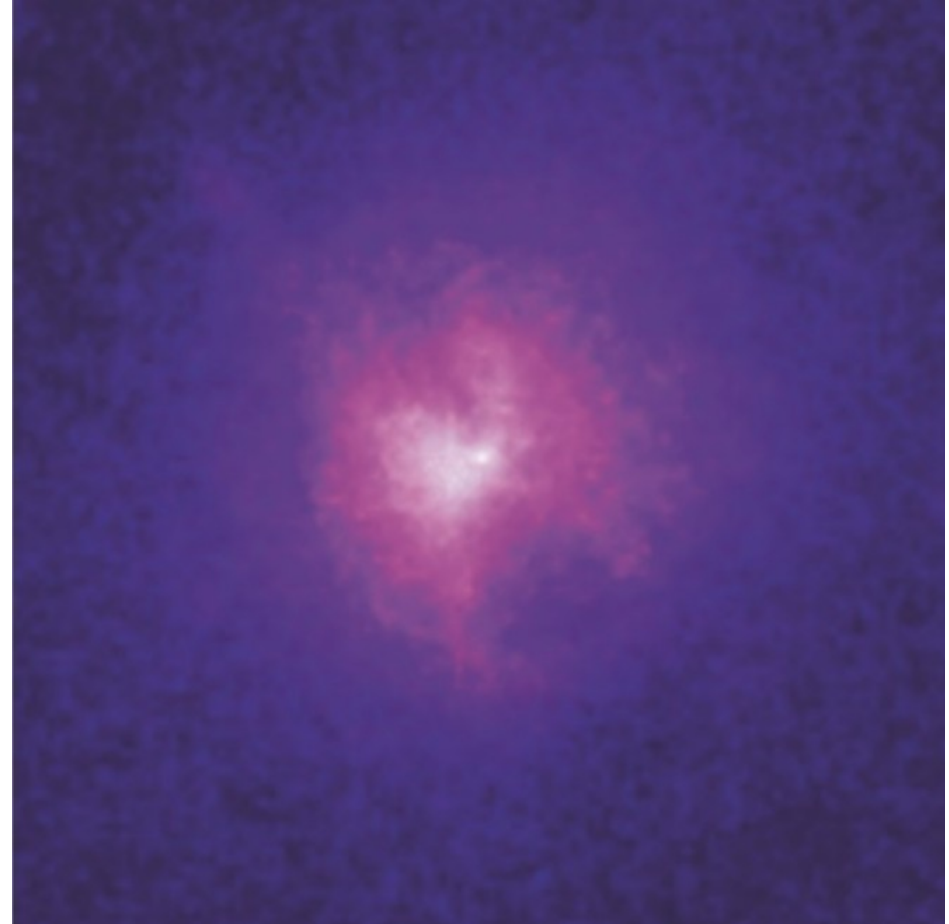
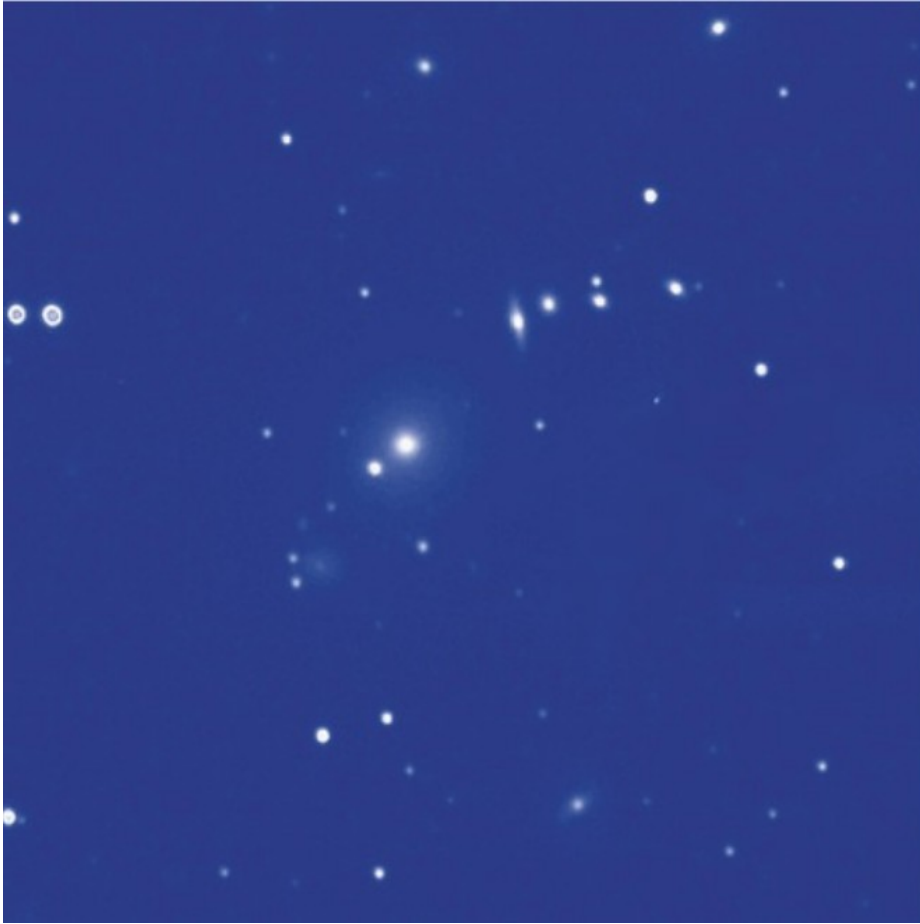
Galaxy Cluster



Coma cluster







Hydra A cluster of galaxies
~250 Mpc, $T \sim 10^7$ K



Arecibo (Diameter : 305 m)

Radio

Radio



Effelsberg (3.5 mm to 35 cm)



GBT

Radio



VLA (27 antenna with a diameter of 25 m)

mm range



30-m telescope on Pico Veleta

Sub-mm (far-infrared to microwave)



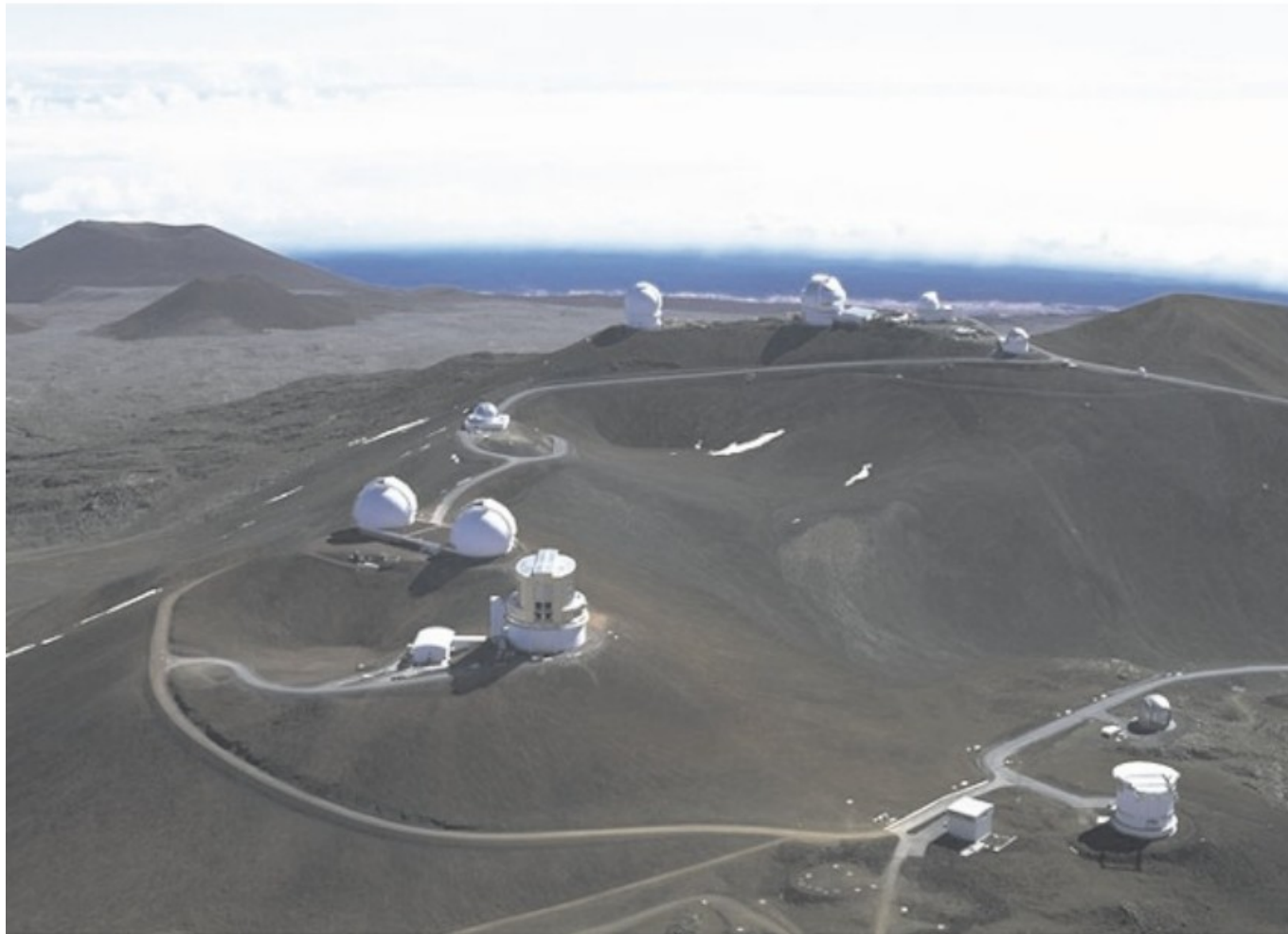
JCMT

IR



IRAS

Optical



Series of optical telescopes at Mauna Kea, Hawaii
(Keck, Subaru, CFHT)

Optical



HST

UV



GALEX
Credits: JPL NASA

X-ray



Chandra

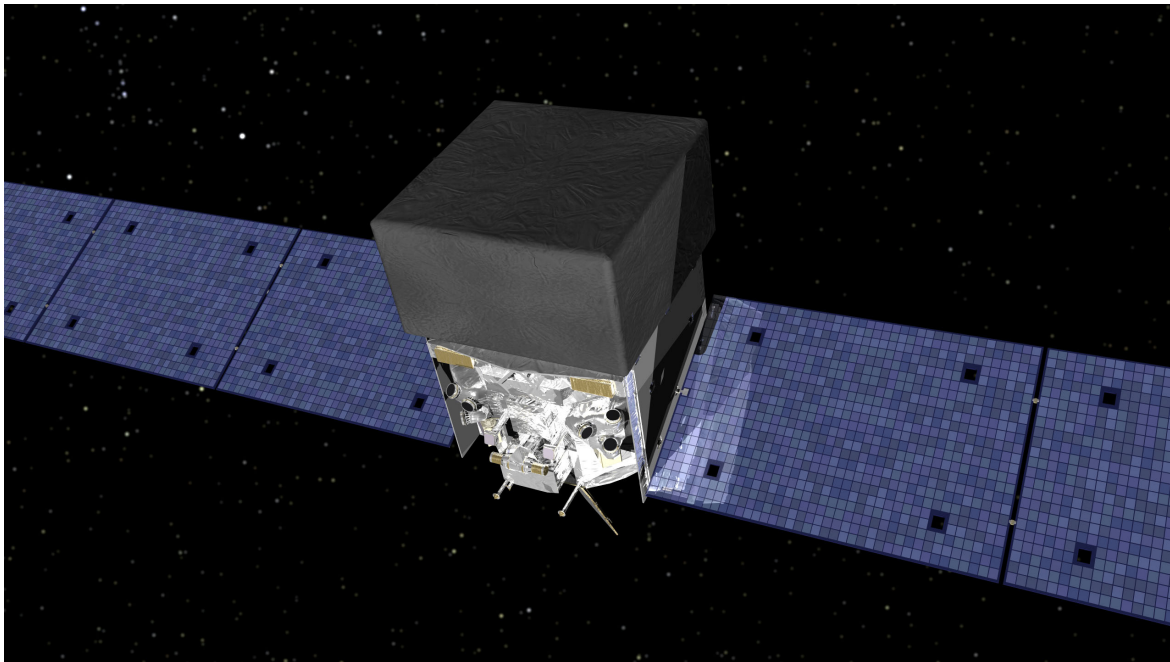


XMM-Newton

Gamma-ray



Integral



Fermi

Credits: NASA