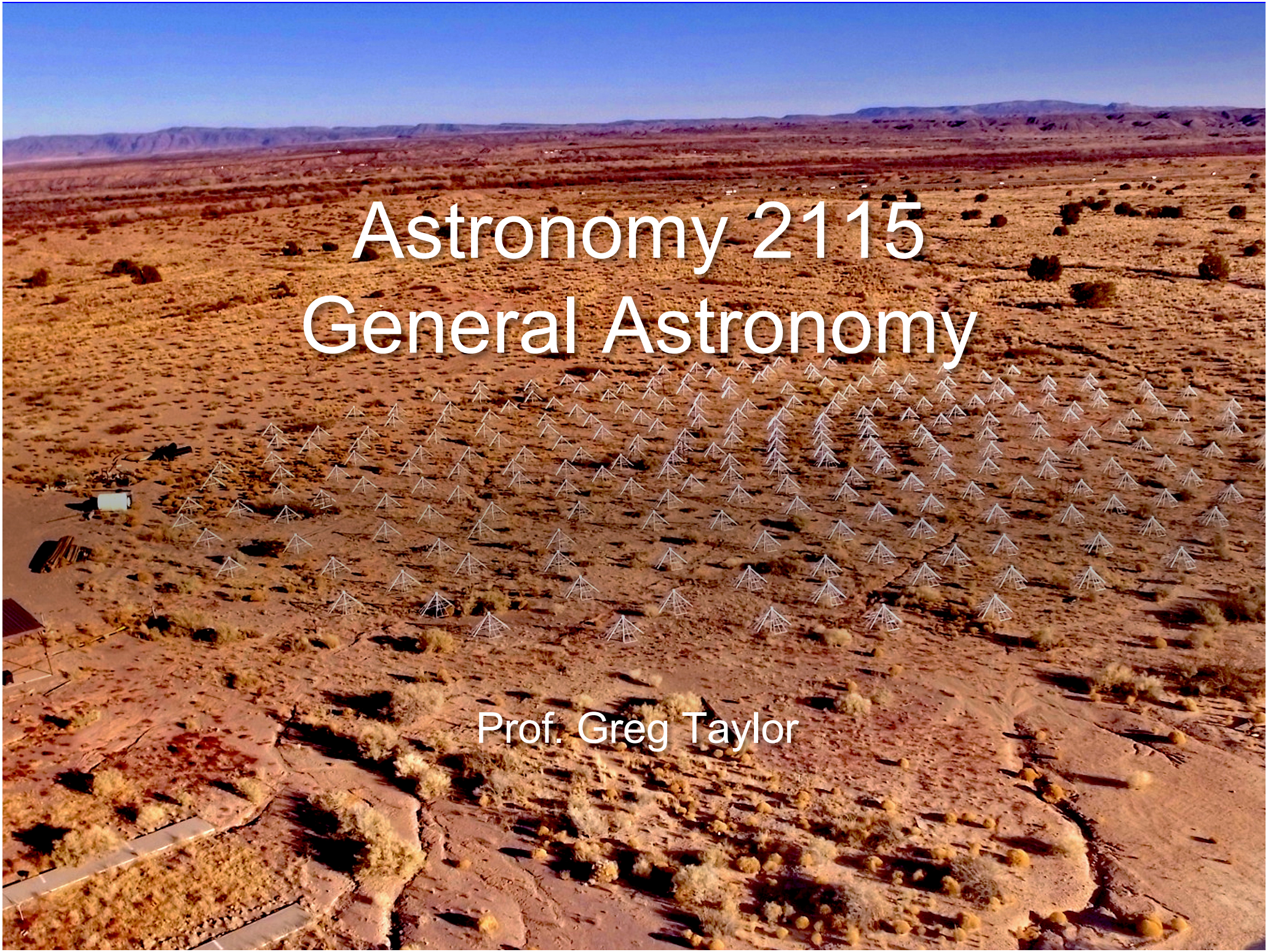


Astronomy 2115
General Astronomy

Prof. Greg Taylor

Astro News

The Dark and Quiet Skies Act
Senators Hickenlooper and Crapo

Background:
Certain scientific research and amateur astronomy activities are impacted by unintentional light and radio interference caused by orbiting satellites. Efforts to reduce interference to science by making satellites "dark" and radio signals more "quiet" is referred to as "dark and quiet skies."

Long-term observations needed to capture scientific data also captures the brightness of orbiting satellites. In 2019, there were about 2,200 satellites in orbit. Today there are 9,900. Current application estimates indicate there will be over 500,000 by the 2030s.

Course Goals

- Introduction to the science of astronomy
  - Fundamental concepts/tools of modern astronomy
  - How do we study such distant objects? How do we understand objects/processes?
- Study the Universe

Astro 2115.001

Professor: Greg Taylor

Office Hours: Tu/Th 9am – 10am, or by appt, PAIS room 3236

Class Web page: leo.phys.unm.edu/~gbtaylor/astr2115

Course Text: *Universe, 9th,10th or 11th edition*, Freedman, Geller & Kaufmann

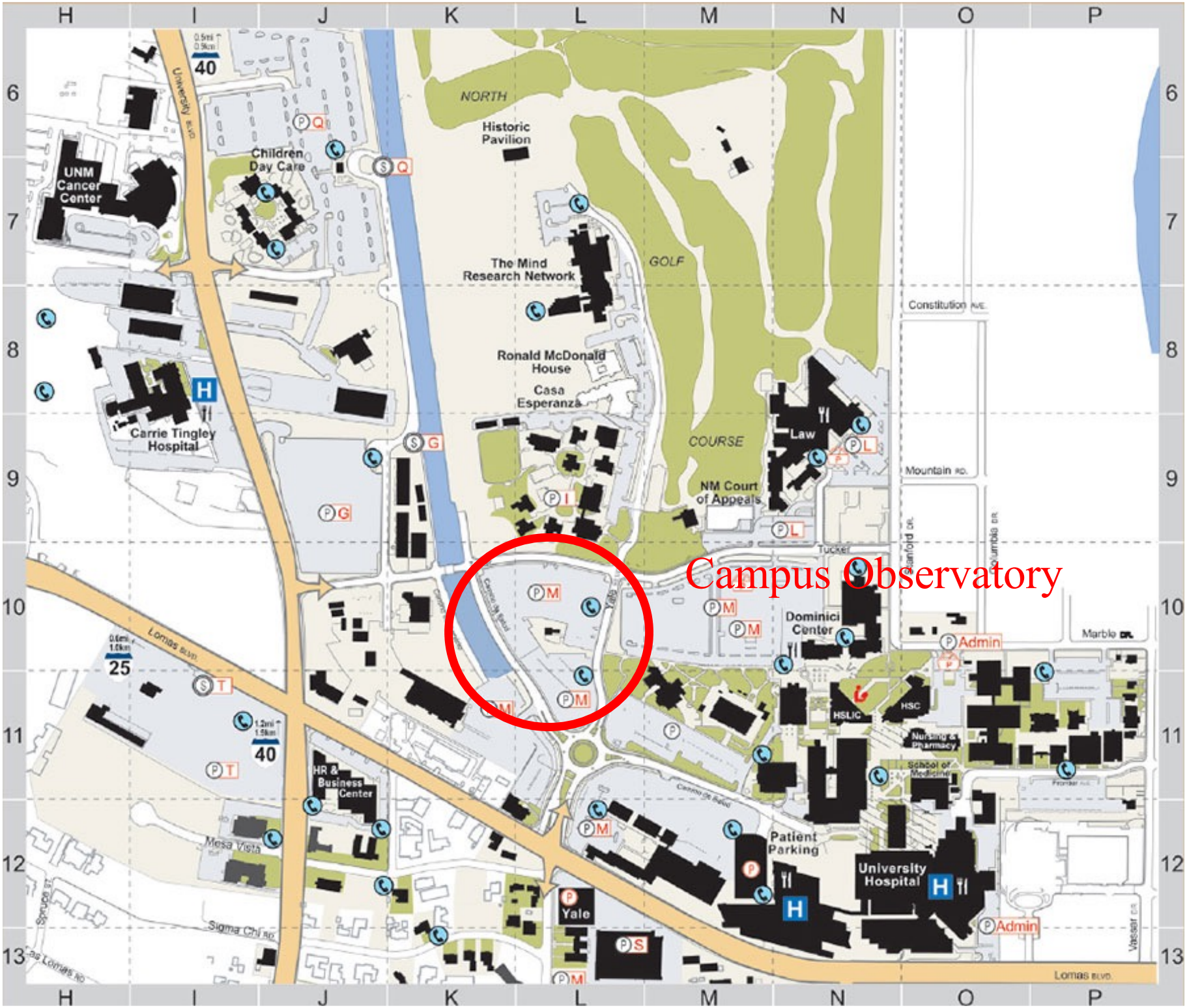
Homework: Reading and homework assignments (roughly weekly) Help is available! Due in print, in class. Do **not** mail it in.

WorkSheets: In class exercises

Grading: 20% homework; 50% based on 2 tests; 20% on final project and 10% on worksheets. NOTE: there will be NO makeup tests except by prior arrangement.

Ask Questions! Be curious about the Universe


PAÍS
114
Entrance
Duck Pond
Scholes Hall
Maxwell Museum
Alumni Memorial Chapel
Zimmerman Library
53
Smith Plaza
Union Square
University Advisement & Enrichment Center
Mitchell Hall
Carlisle Gym
Student Union
60
Mesa Vista Hall
Tennis Cou
Centennial Engineering
Terrace Mall
Yale Mall
Cornell Mall
Student Health
Art
Popejoy Hall
62
Johnson Gym
59
Visitor Parking
198
Hodgin Hall
Art Annex
Tight Grove
Parsons Grove
Yale Park
Bookstore
102
George Pearl Hall
195
Central AVE.
Mesa
Terrace
Buena Vista
Yale BLVD.
Albuquerque International Sunport
2.3mi / 3.7km
Harvard
Cornell
Stanford
158
162


Campus Observatory
UNM Cancer Center
Children Day Care
Historic Pavilion
NORTH
GOLF
COURSE
The Mind Research Network
Ronald McDonald House
Casa Esperanza
Carrie Tingley Hospital
Law
NM Court of Appeals
Dominici Center
Admin
HSLIC
HSC
Nursing & Pharmacy
School of Medicine
HR & Business Center
Mesa Vista
Patient Parking
University Hospital
Yale
Lomas BLVD.
Constitution AVE.
Mountain RD.
Marble DR.
Tucker
Sigma Chi RD.
Spruce ST.
Vassar DR.
H I J K L M N O P
6 7 8 9 10 11 12 13

Announcements

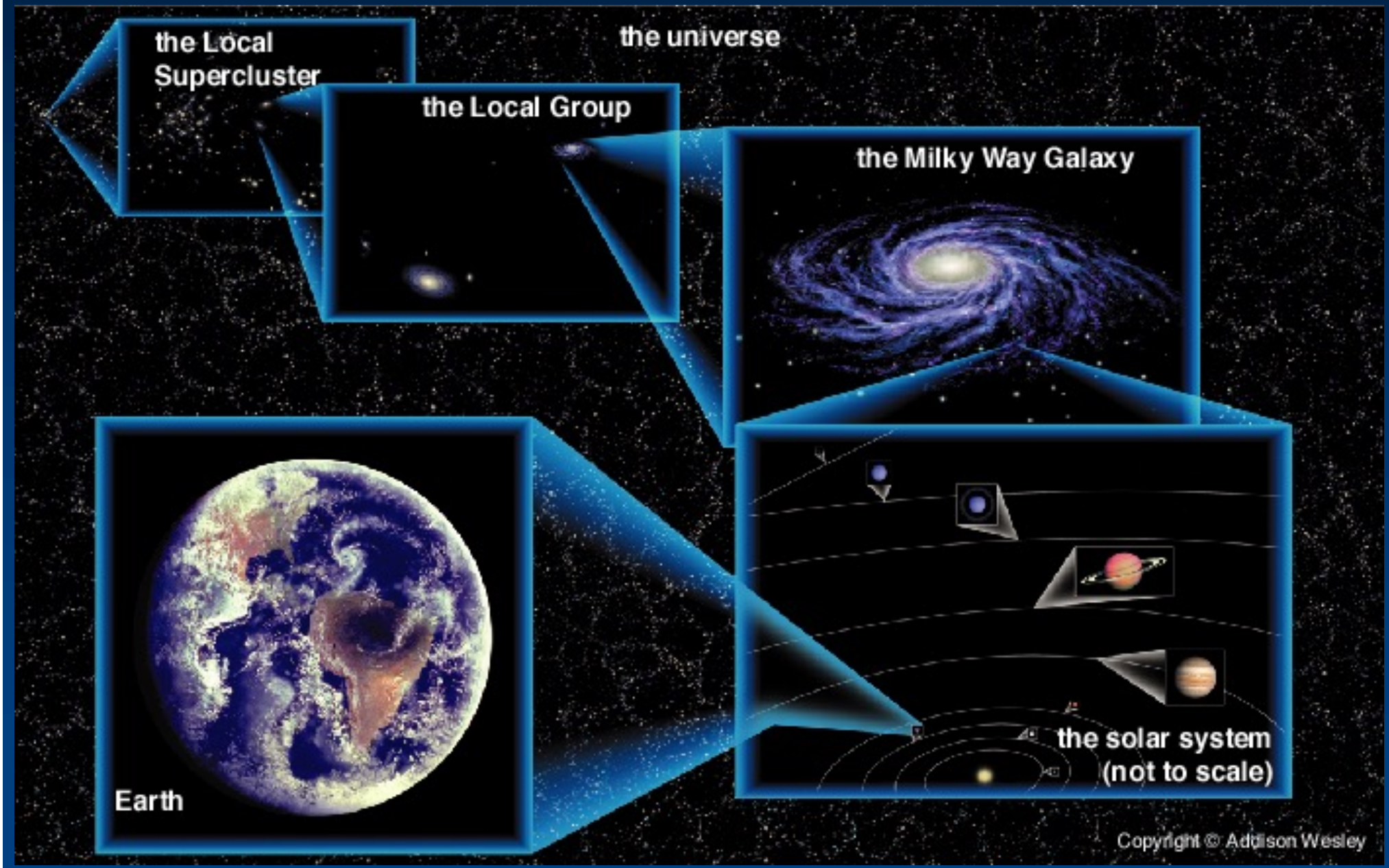
- The Lab is required for all astrophysics majors
- We do have lab this week
- We could balance out the labs a little

  Tuesday (A2115/L2): 7

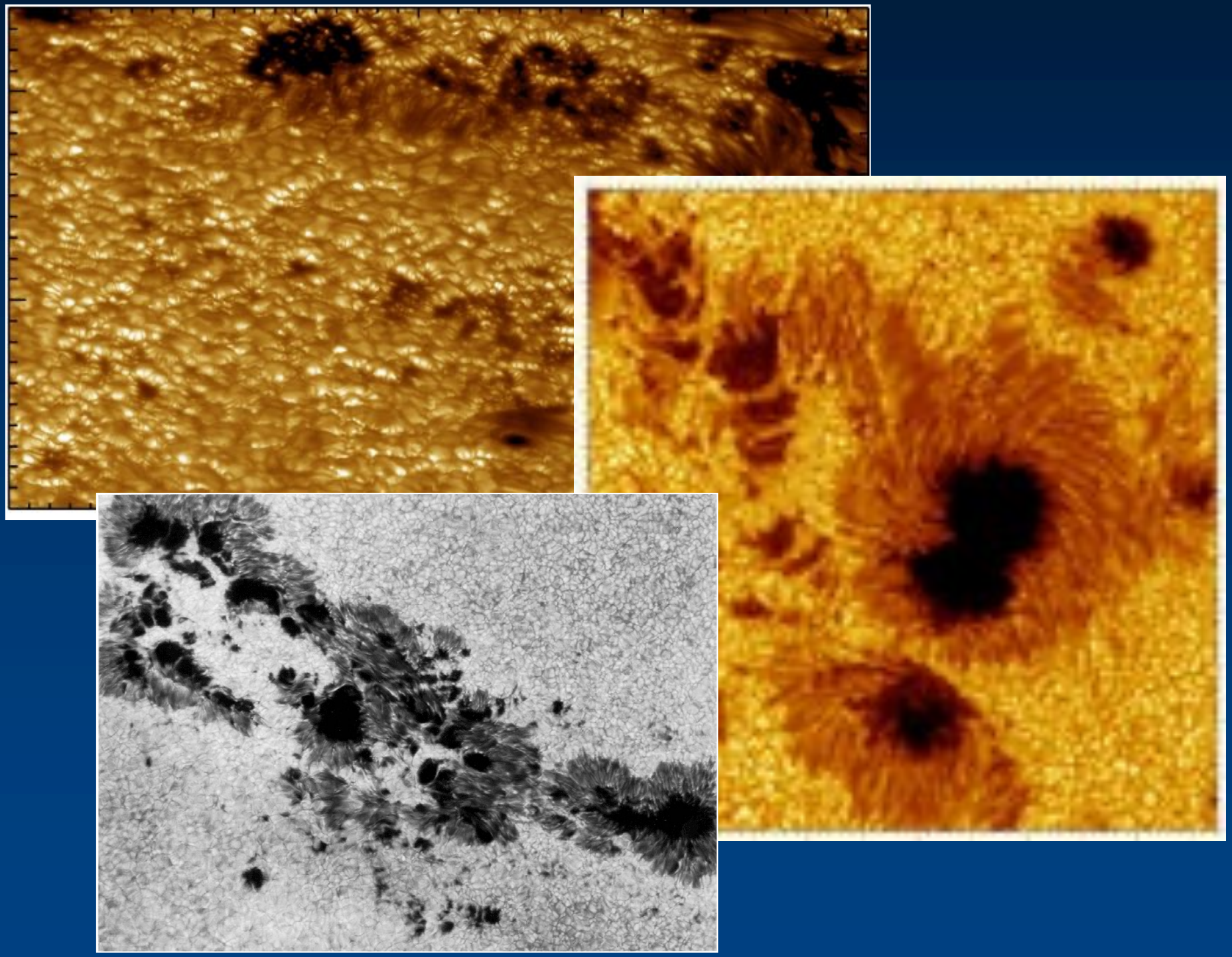
  Thursday (A2115/L1): 10

- First Homework is due August 29

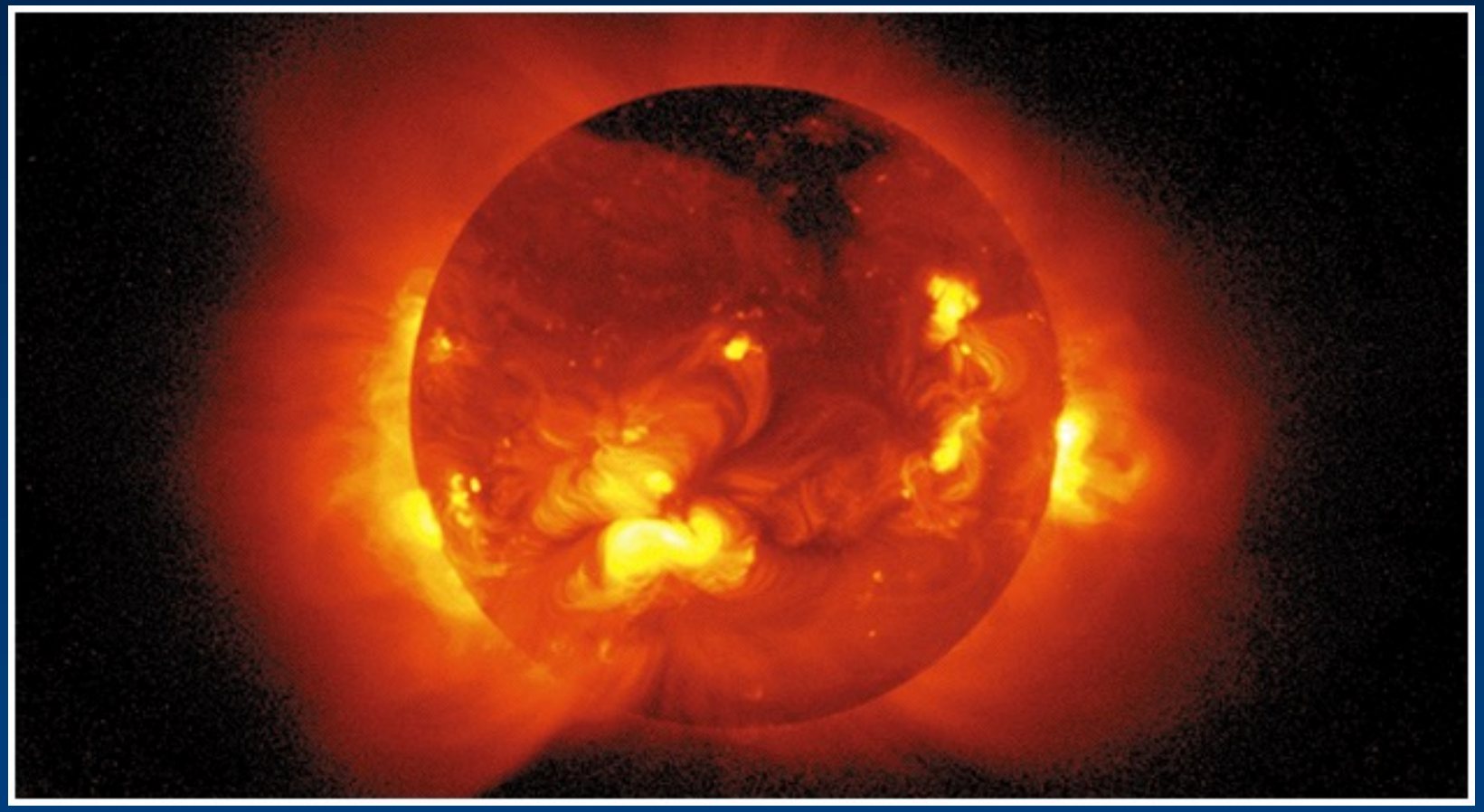
Universal Address



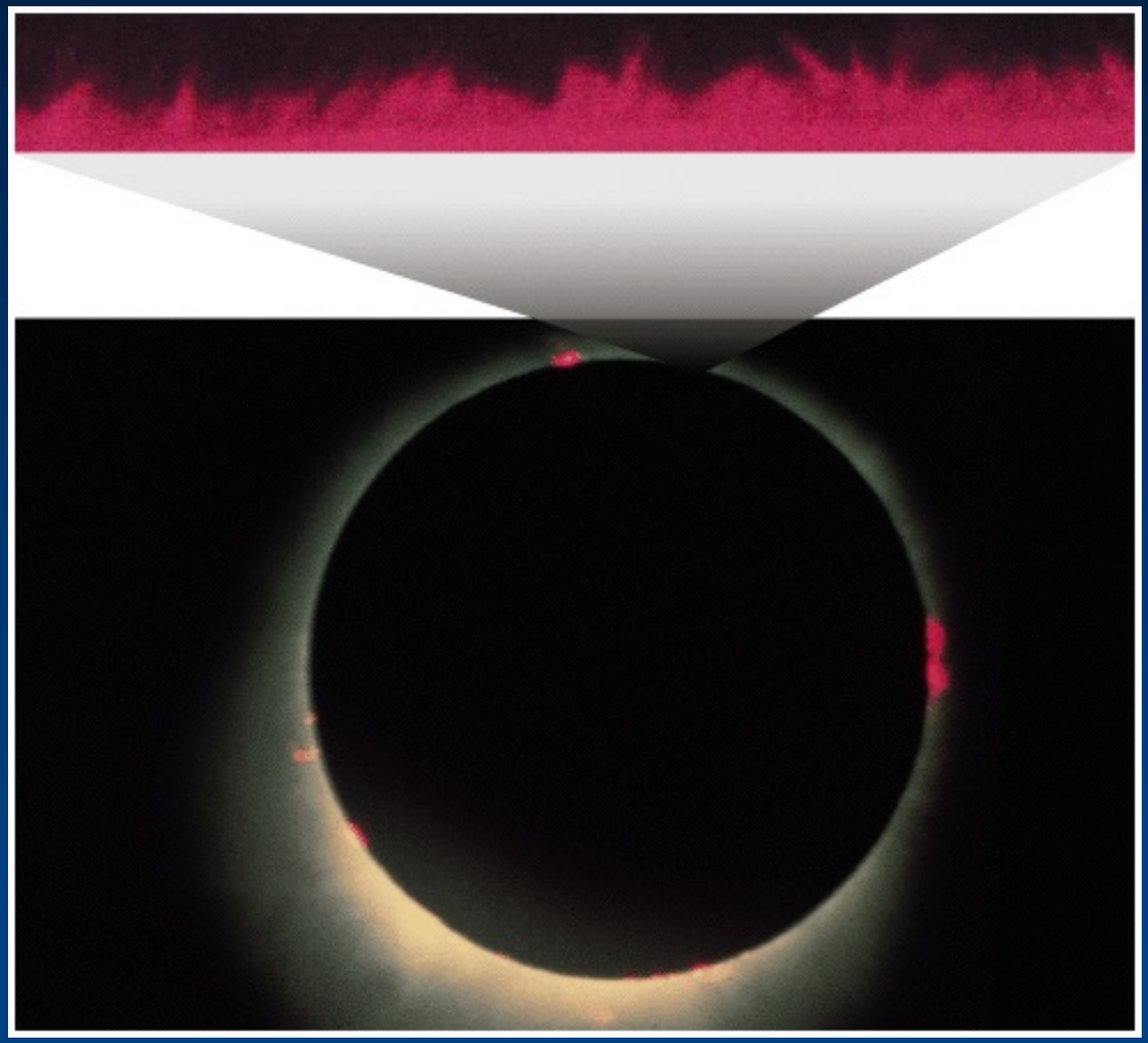
Optical telescope



X-ray
telescope



Spicules



Optical telescope With Hα filter

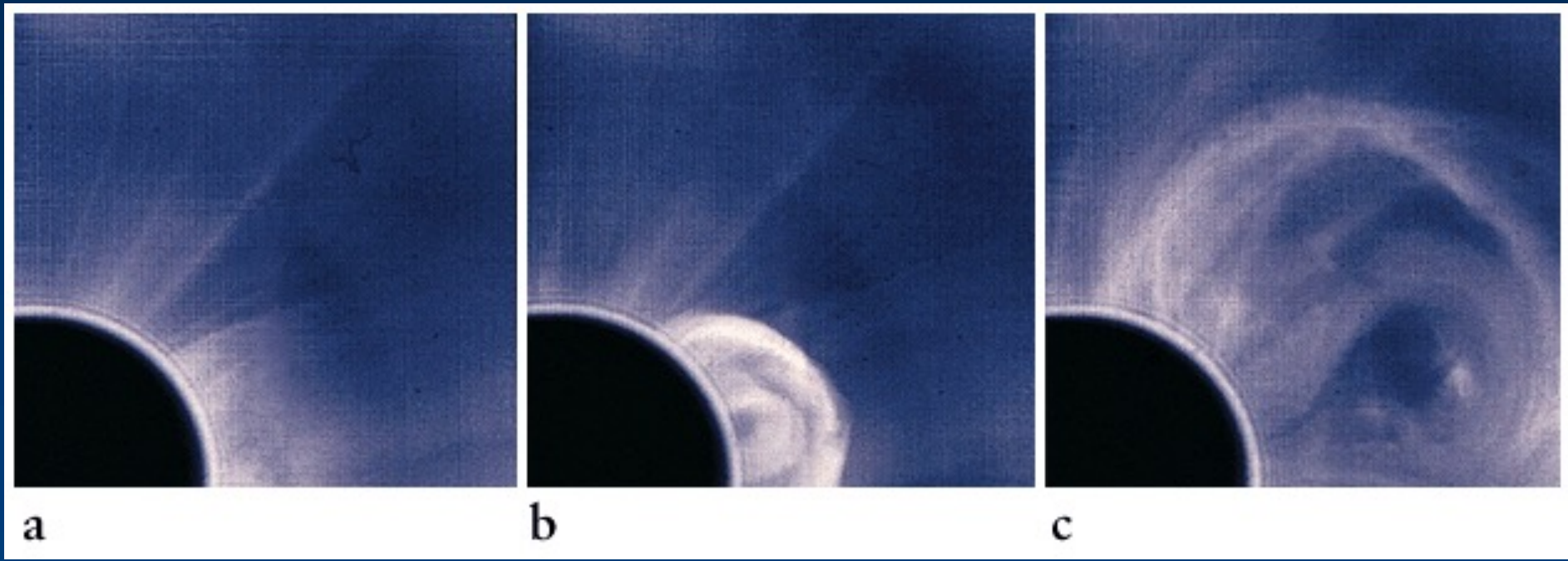
Demo – Gratings and Line Spectra

Optical telescope

High Solar activity 2017 Sept.

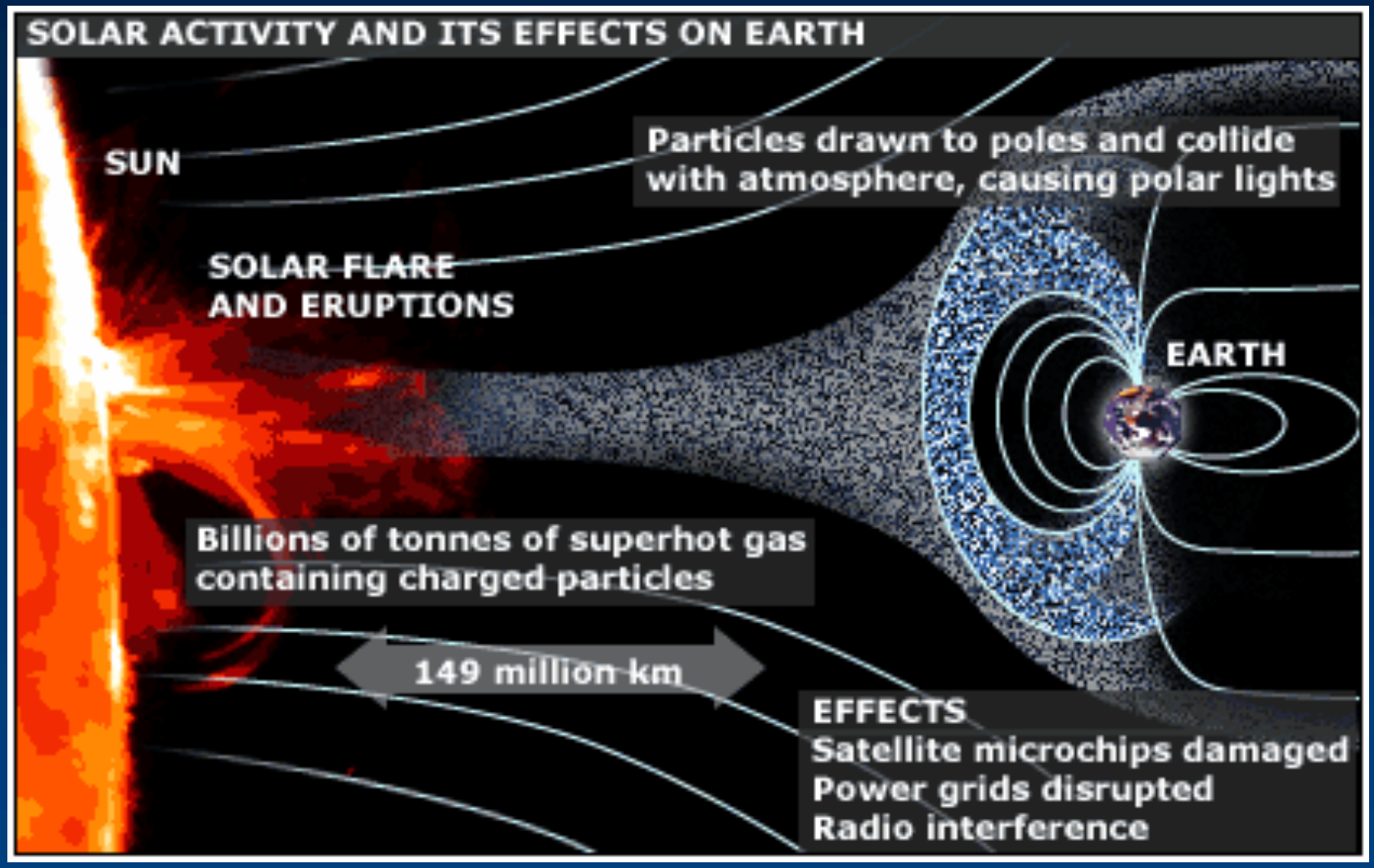
SDO UV obs on 17Sep6

Optical telescope

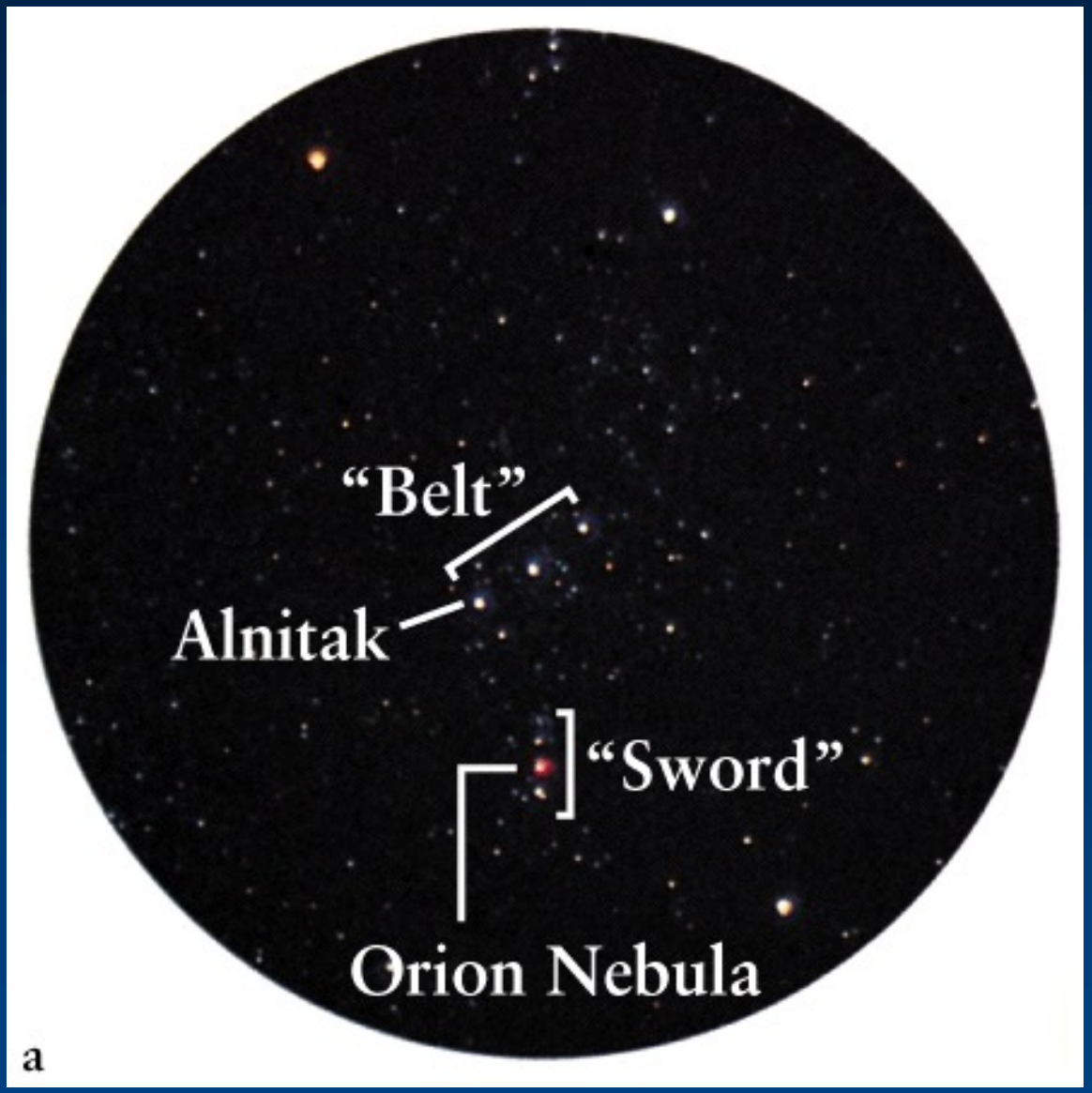


Coronal Mass Ejection (CME)

Coronal Mass Ejection



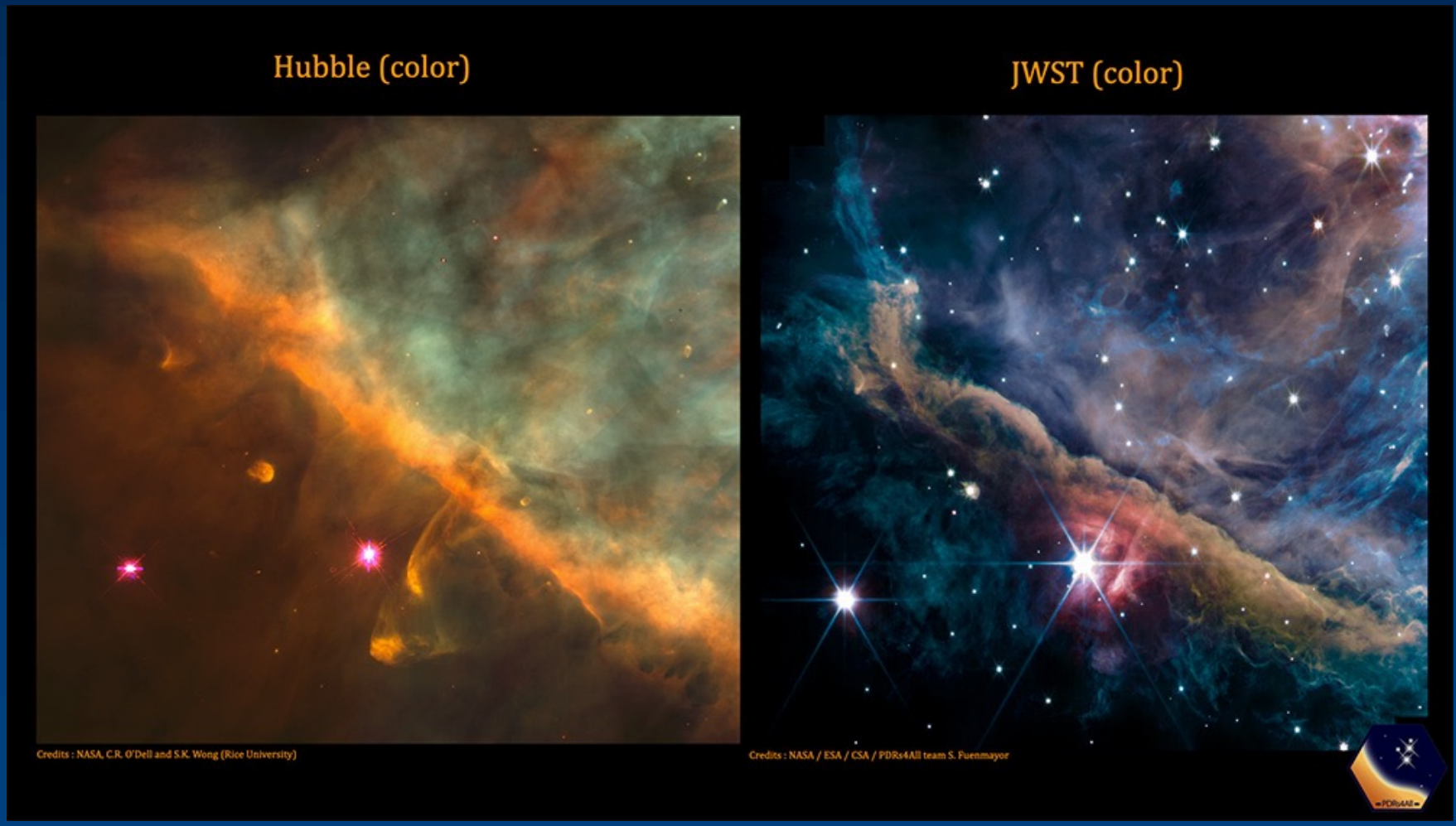
Optical telescope


"Belt"
Alnitak
"Sword"
Orion Nebula
a

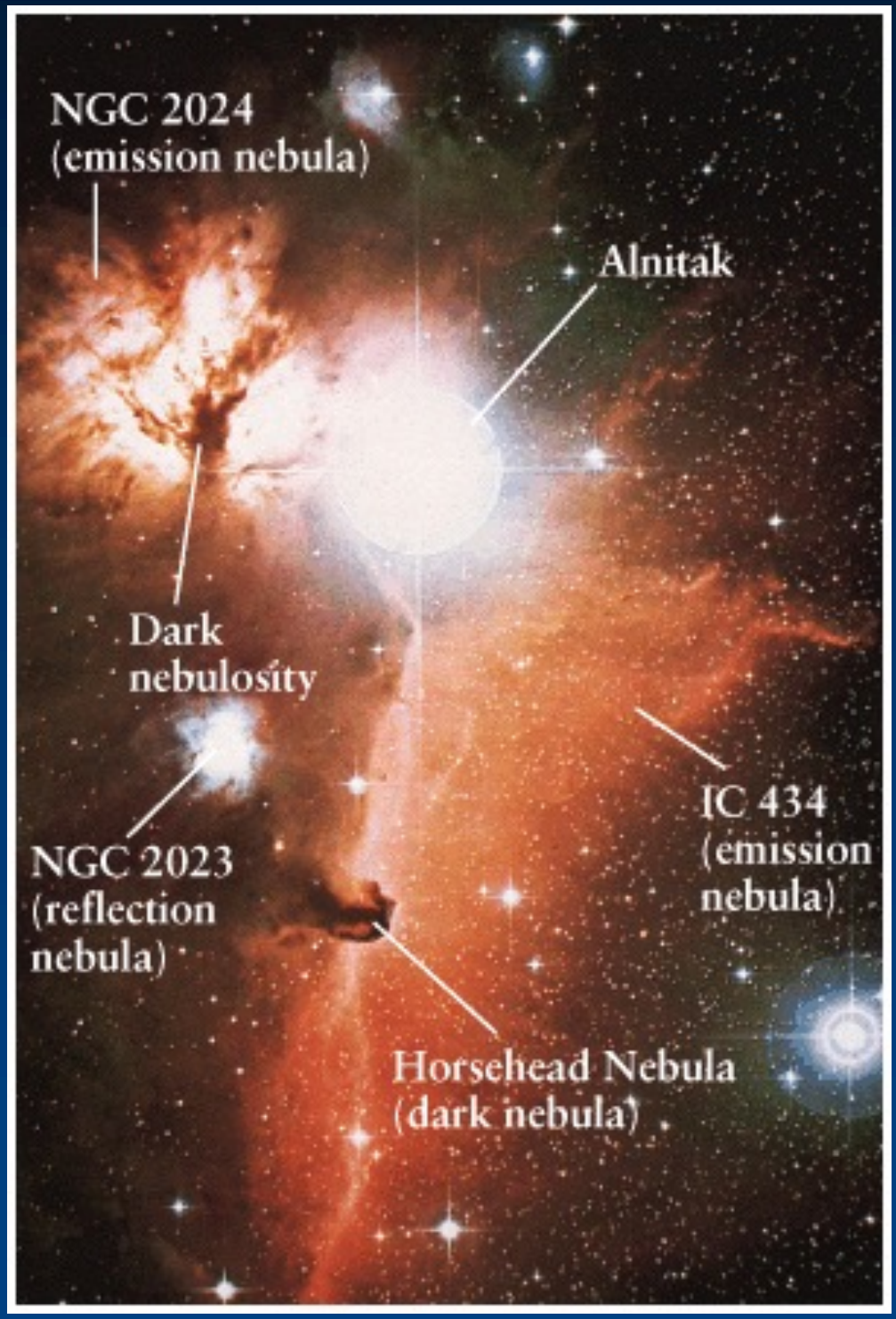
Star Formation in Orion

Optical telescope

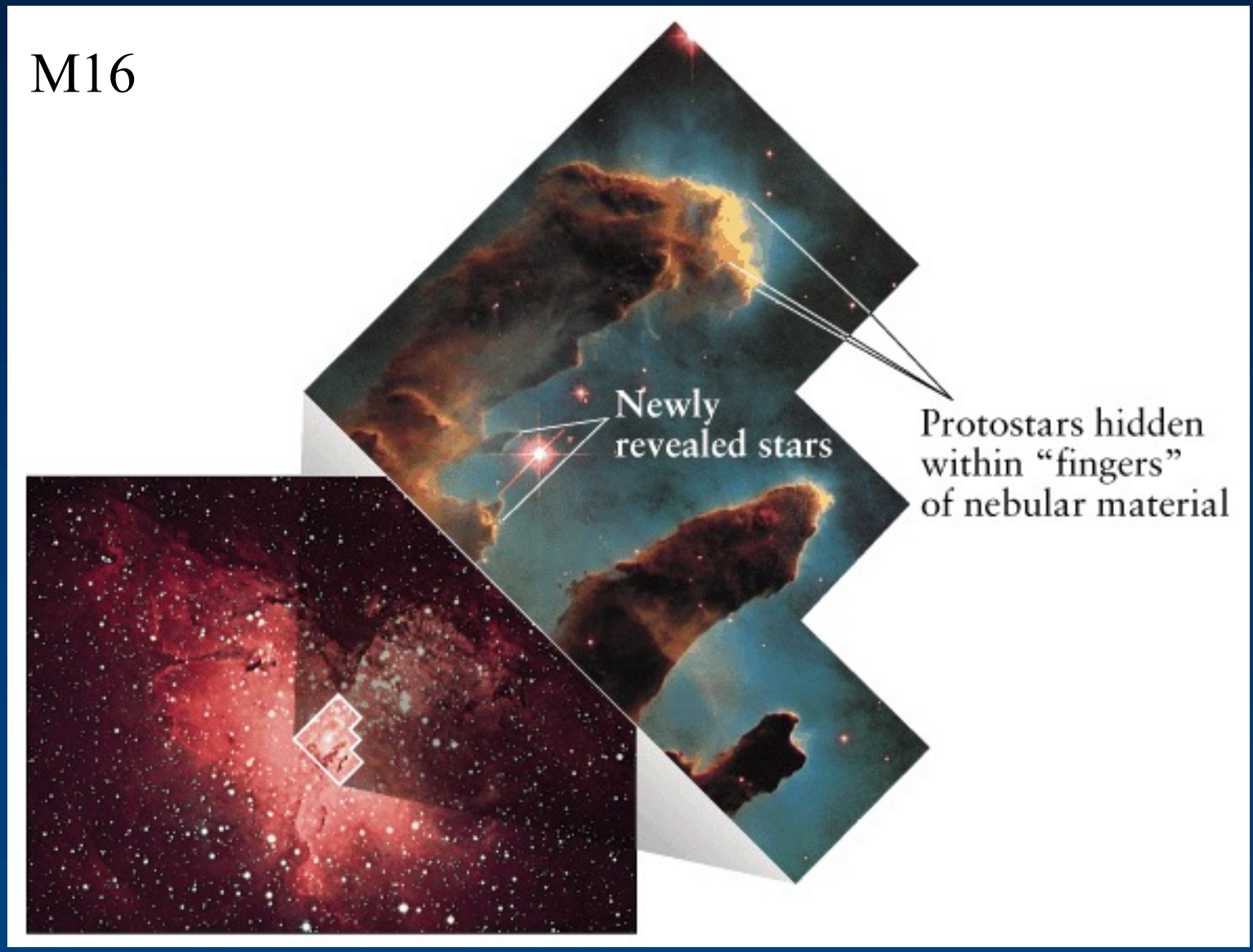
Infrared telescope



Emission nebula


NGC 2024
(emission nebula)
Alnitak
Dark
nebulosity
IC 434
(emission
nebula)
NGC 2023
(reflection
nebula)
Horsehead Nebula
(dark nebula)

The Eagle nebula



The Eagle nebula

JWST mid-infrared

JWST near-infrared

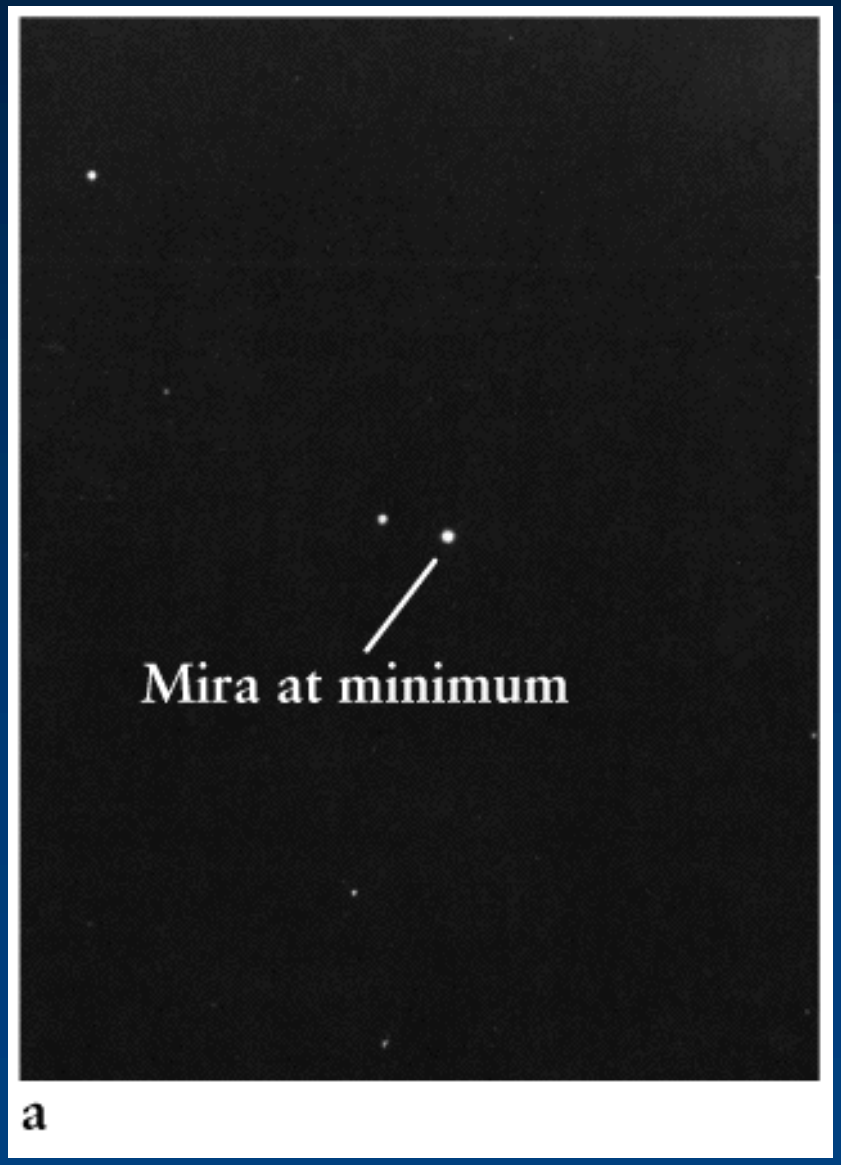
M35

NGC2158

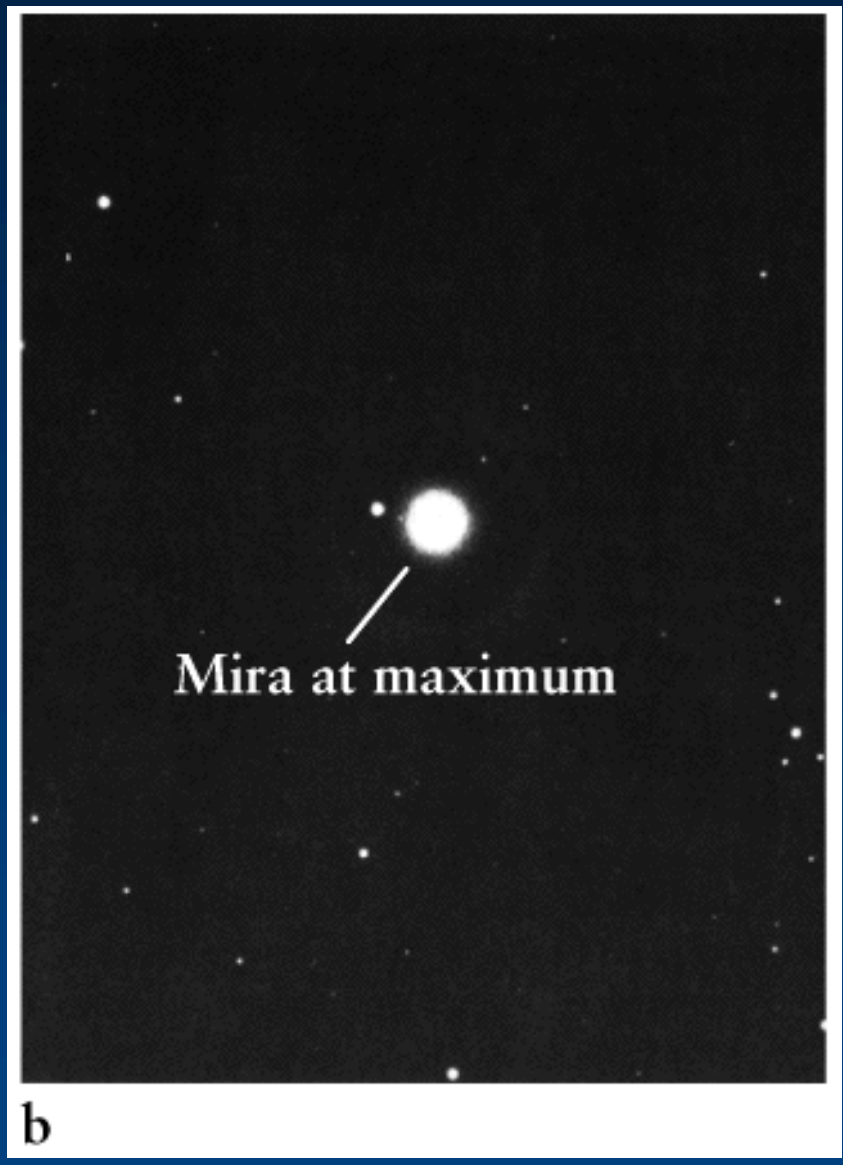
NGC2244 -The Rosette Nebula

Interstellar reddening

b



a

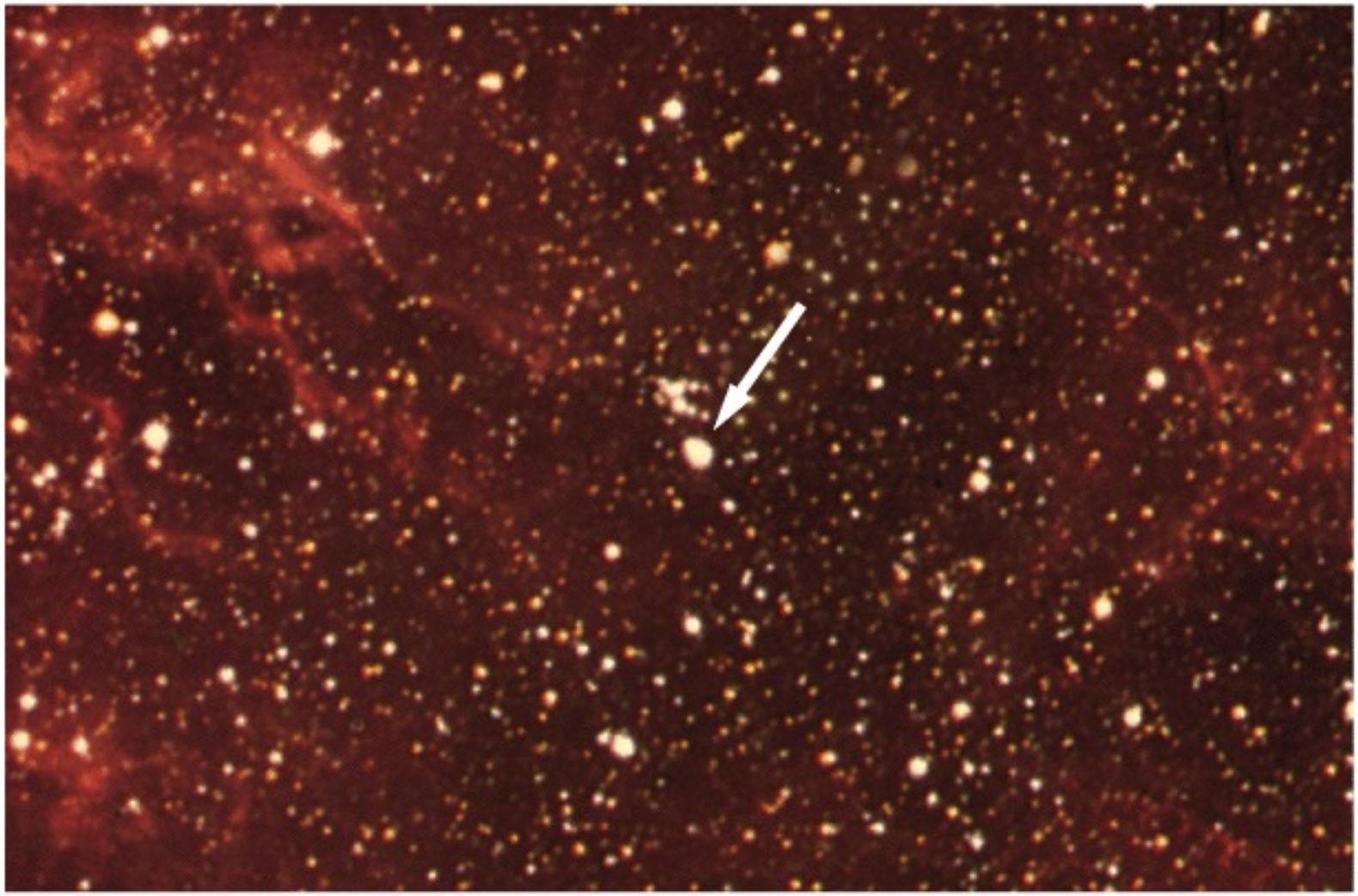


b

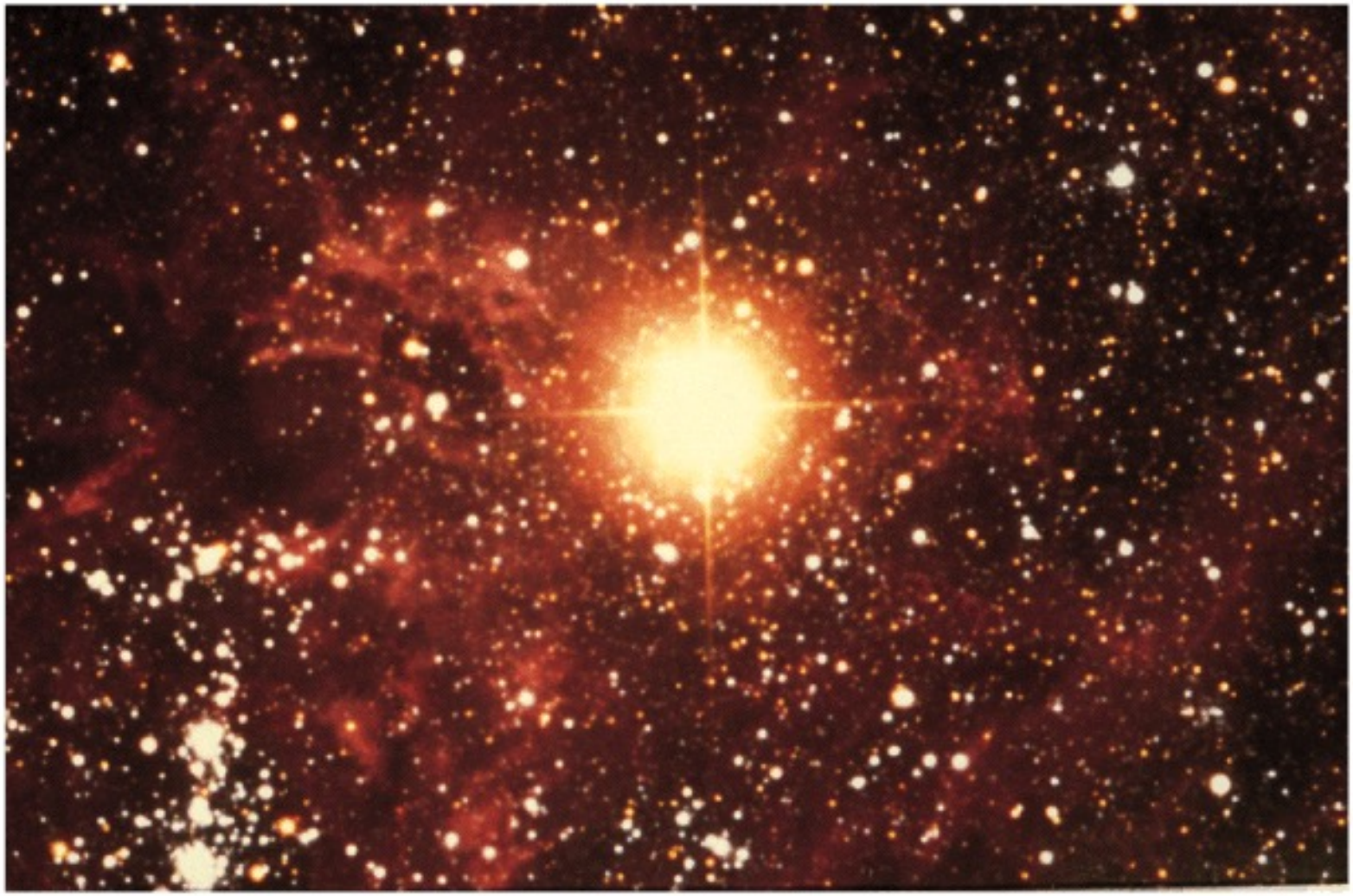
The Helix planetary nebula (closest PN)

The Hourglass nebula

LMC: old supergiant, pre-1987



a

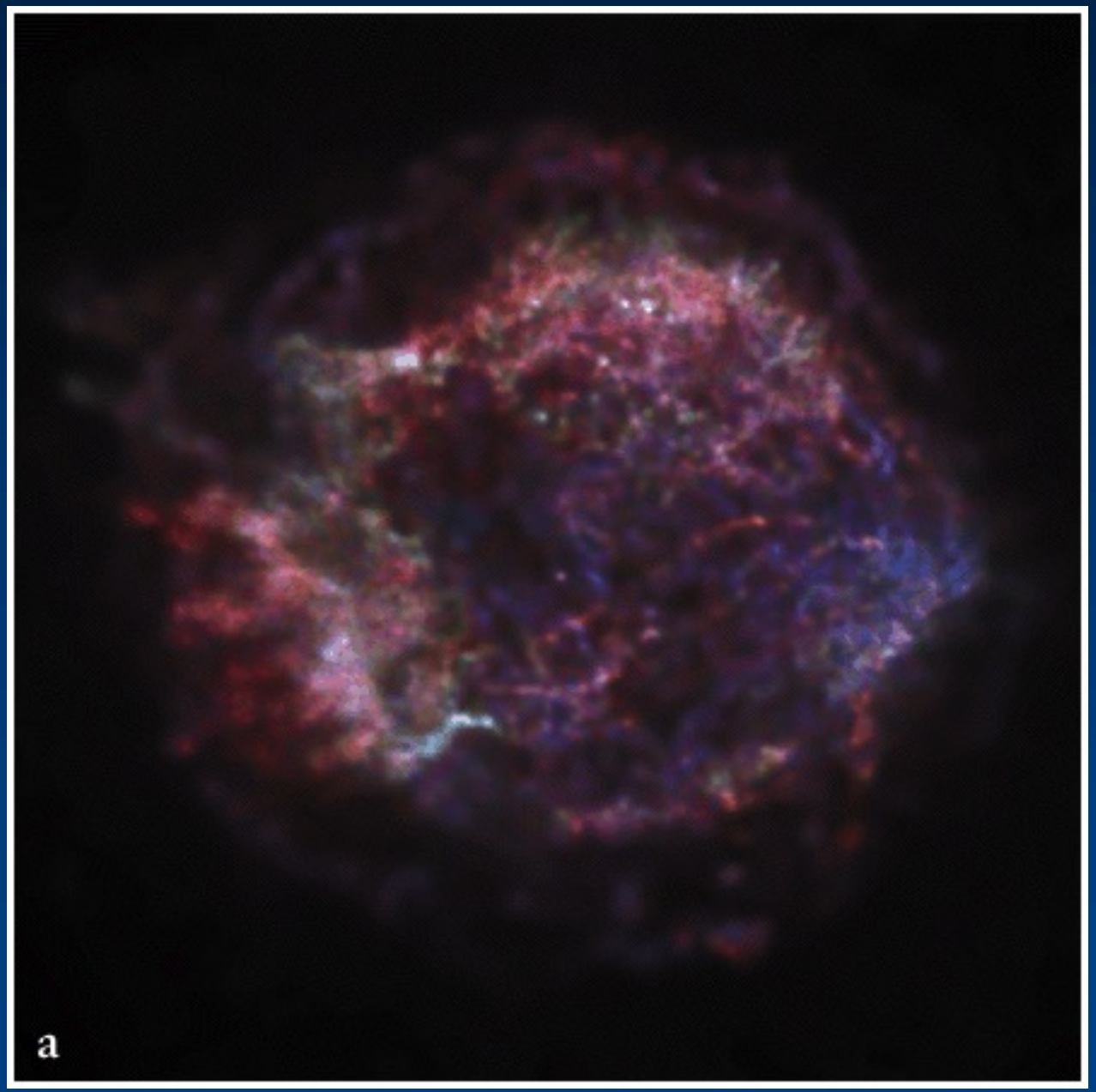


b

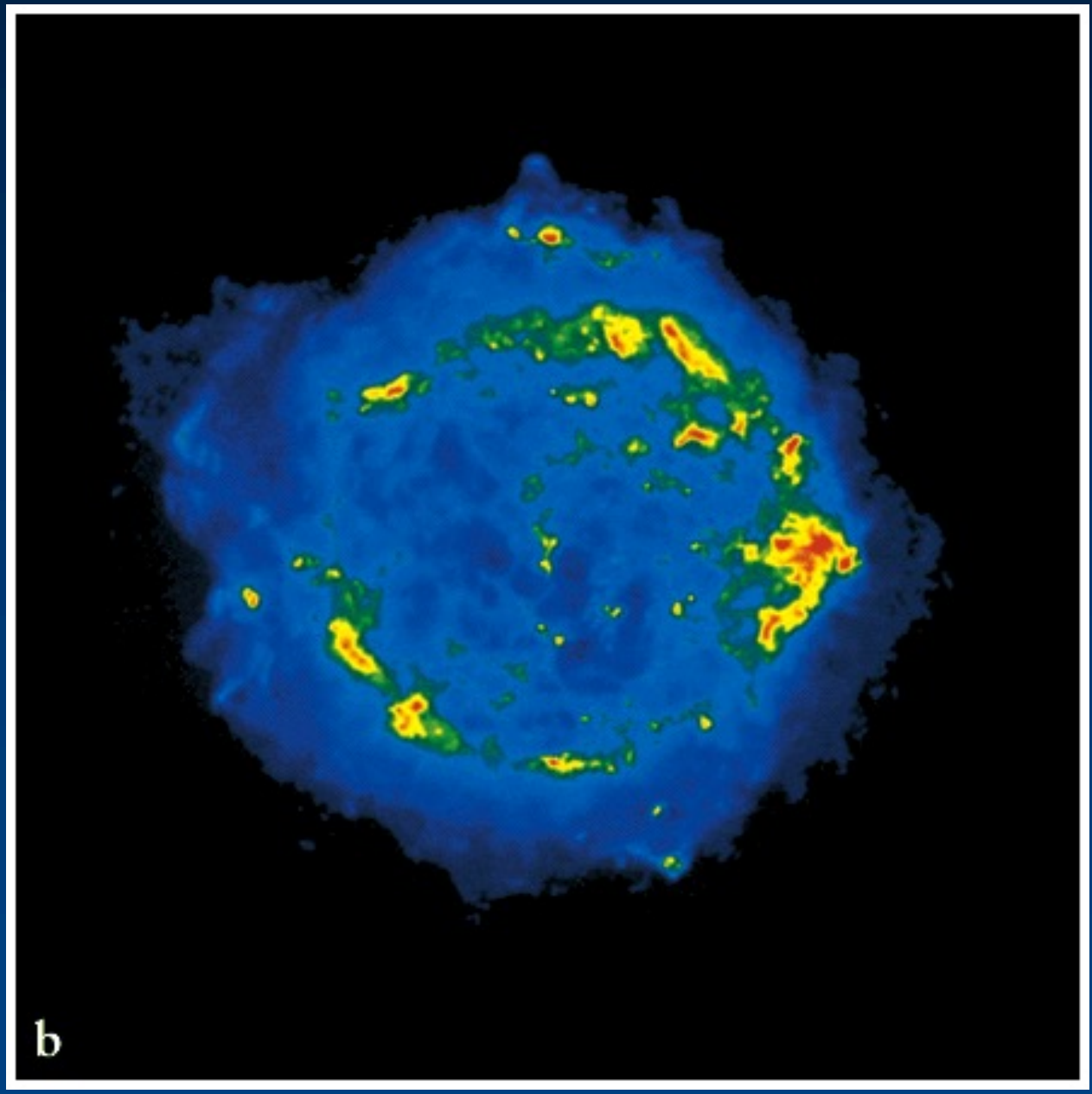

SN 1987A

Gum Nebula - a supernova remnant

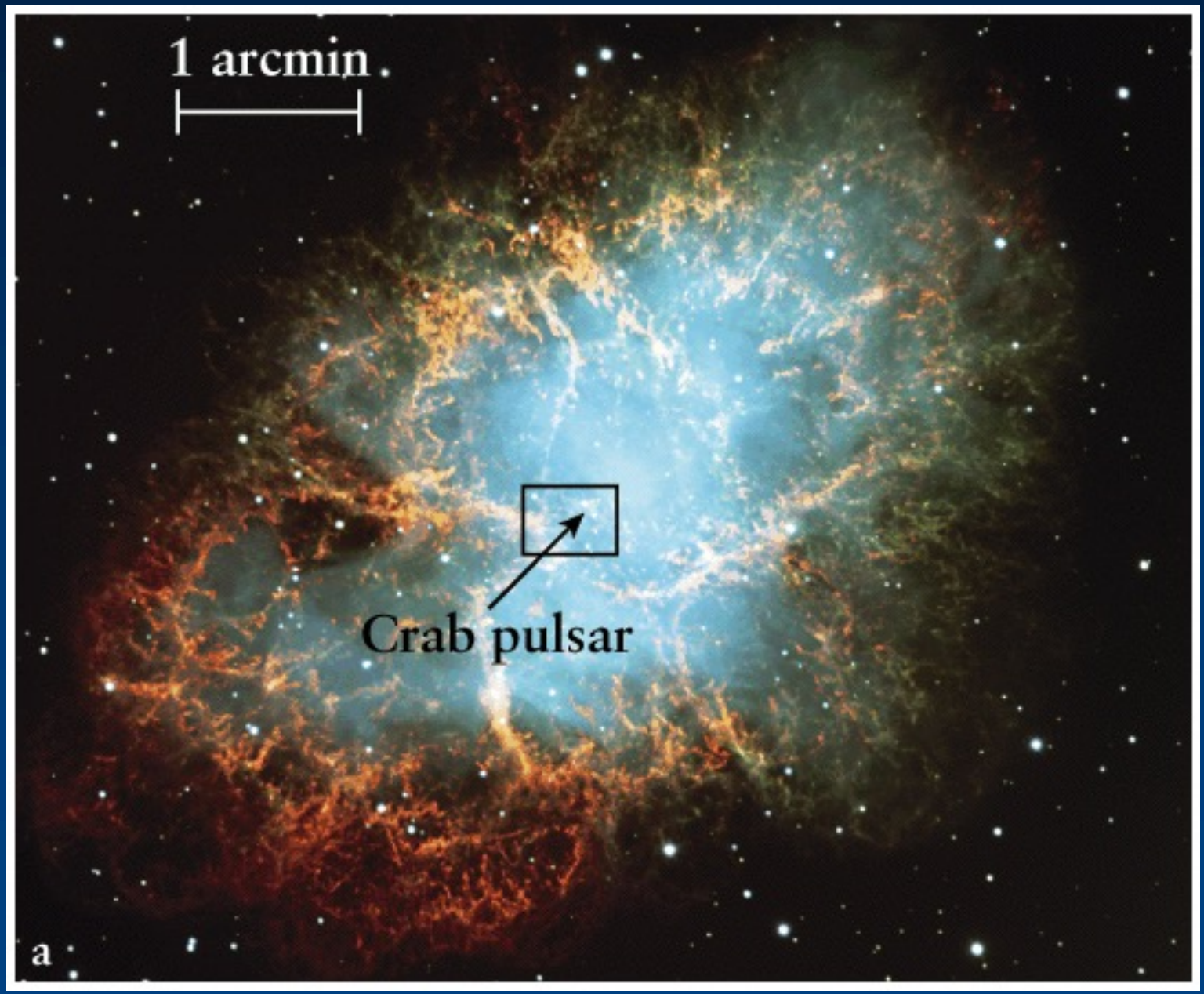
Cas A in X-rays

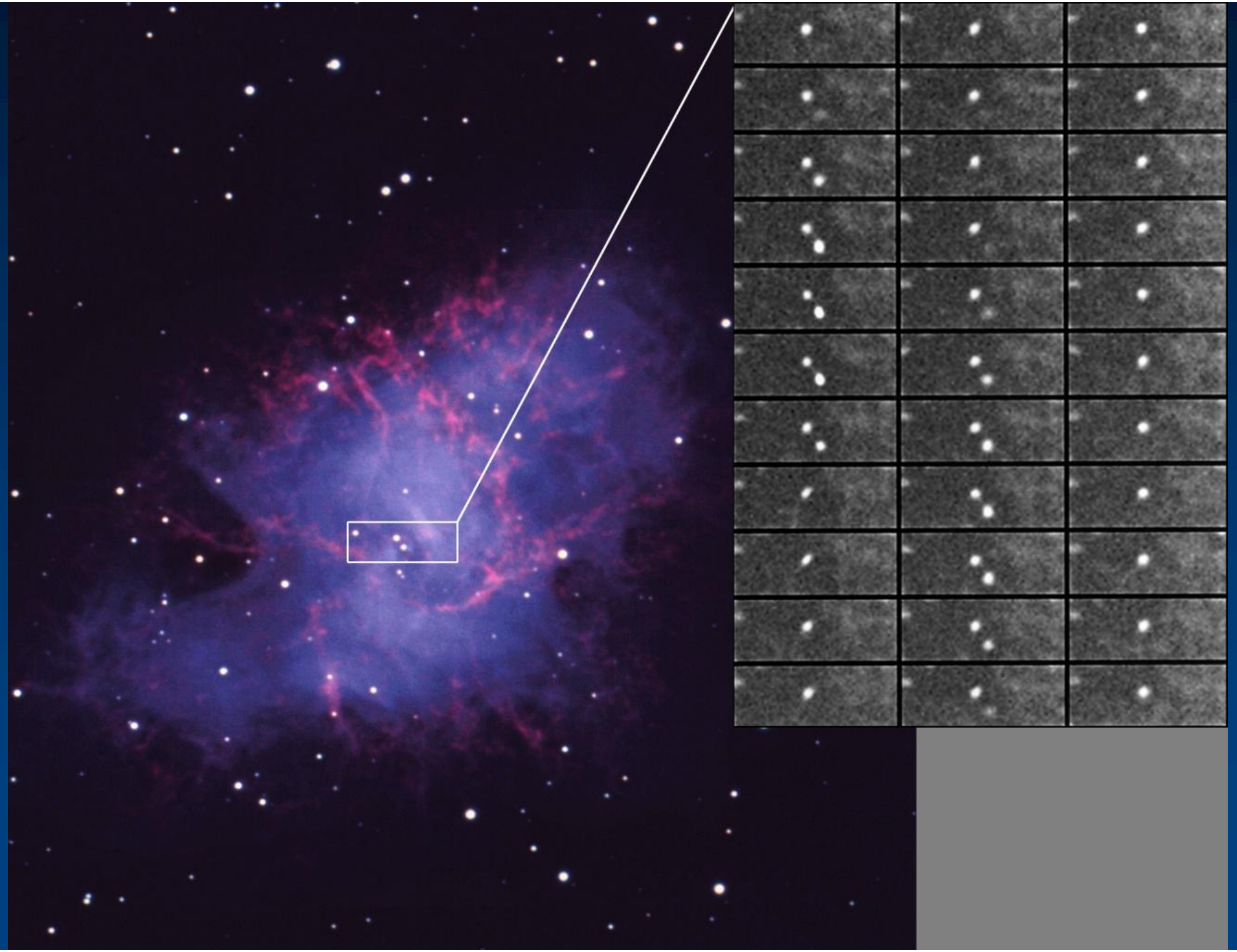


Cas A in radio



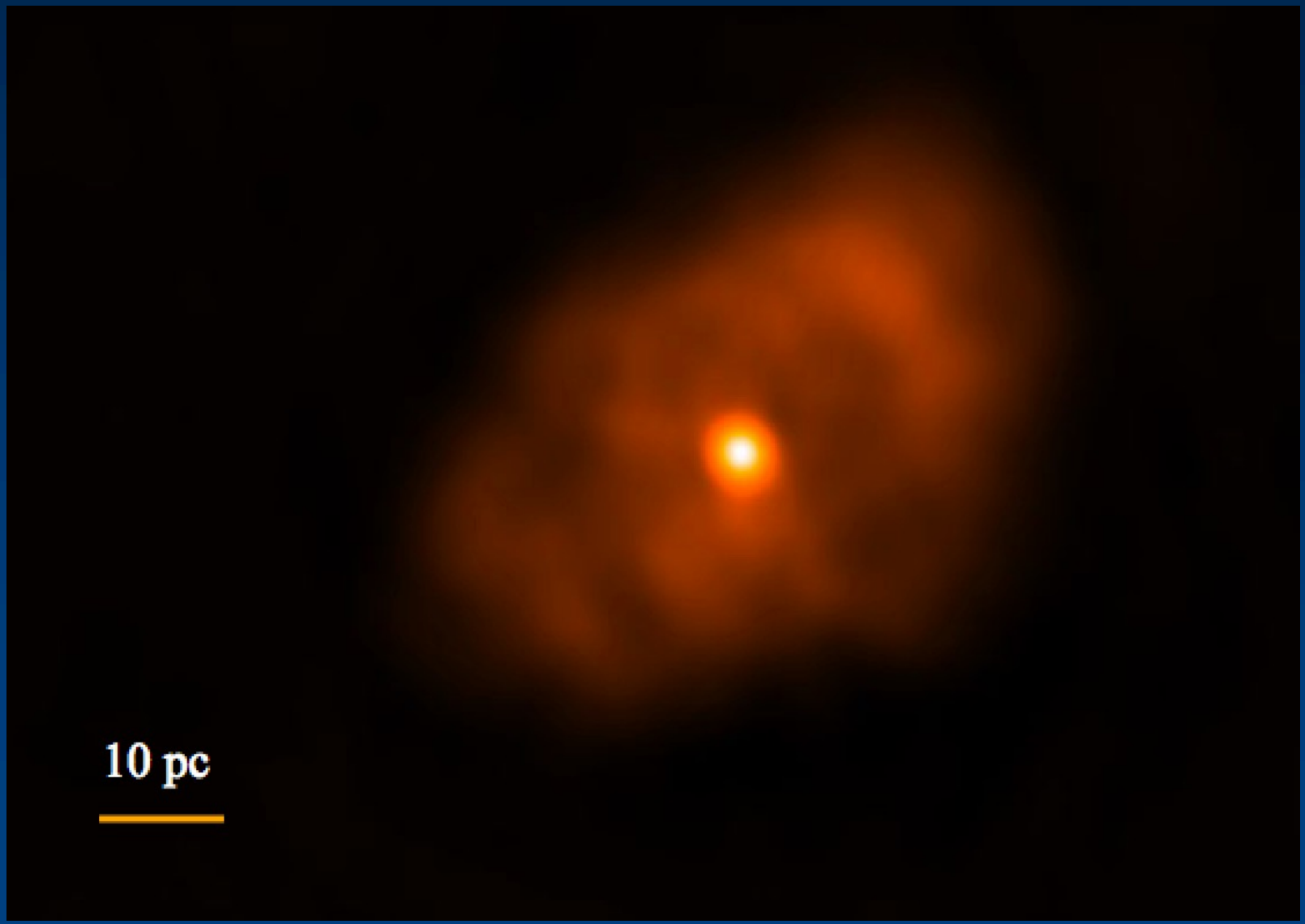
Crab nebular and neutron star



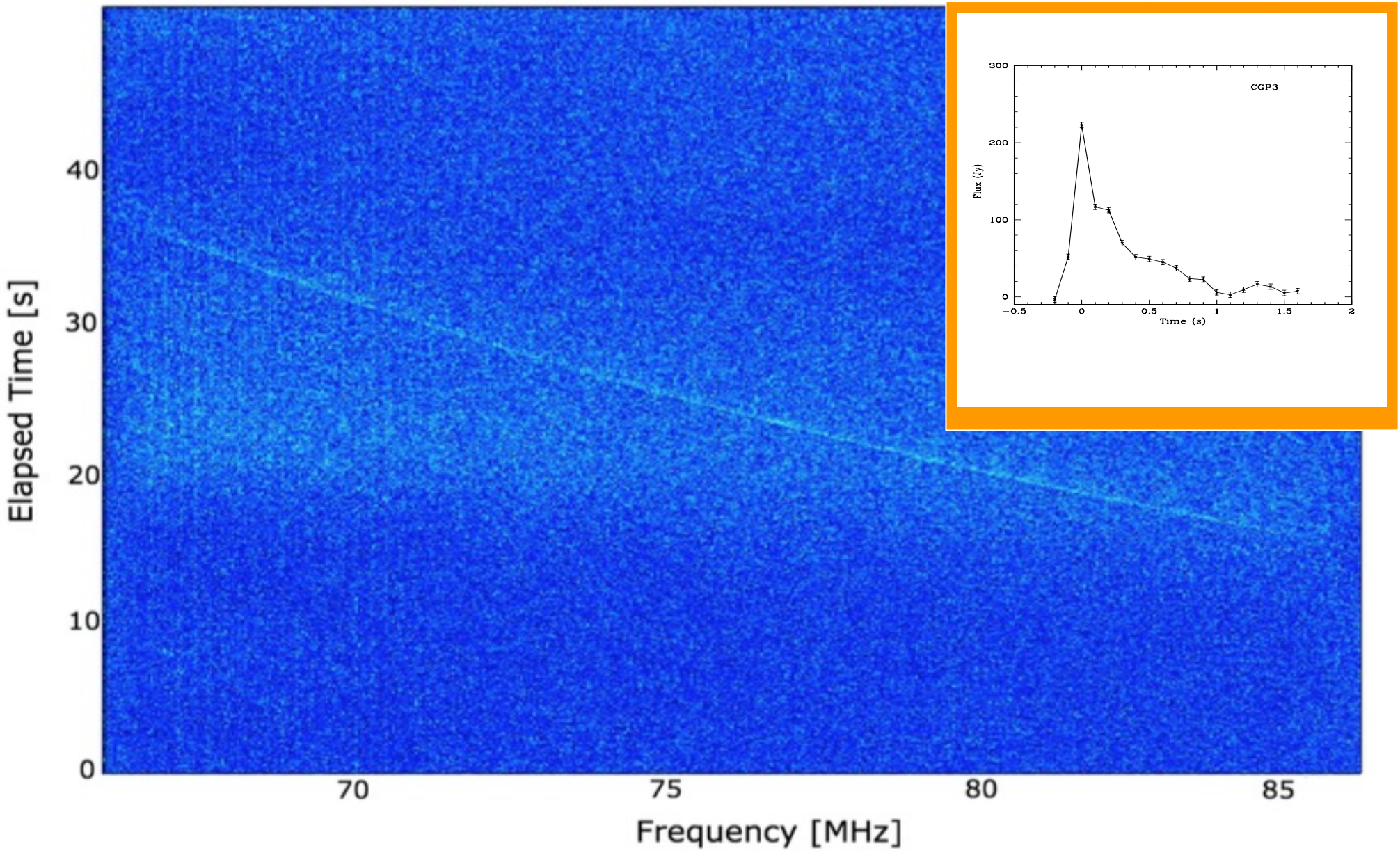


Central object: neutron star

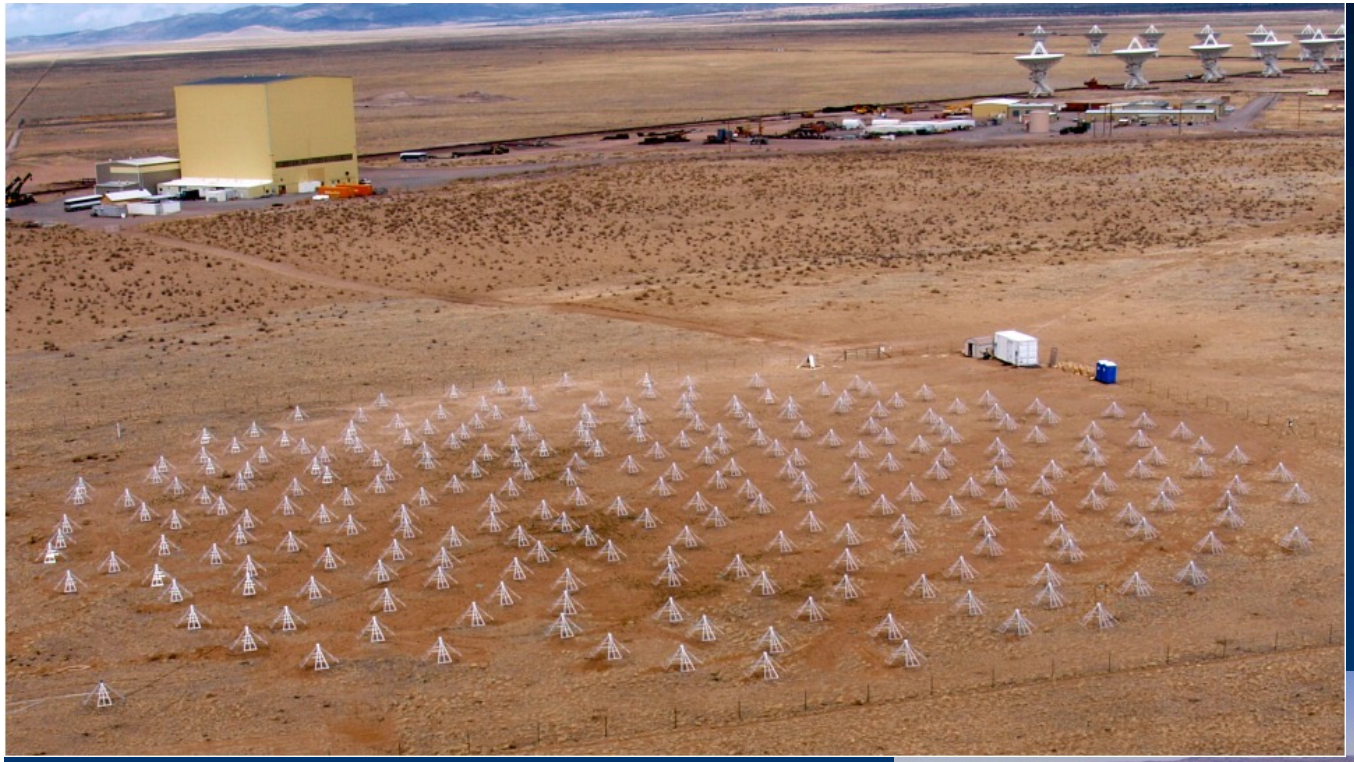
Crab pulsar imaged with LWA+VLA at 74 MHz



Dispersion of a Crab Giant Pulse



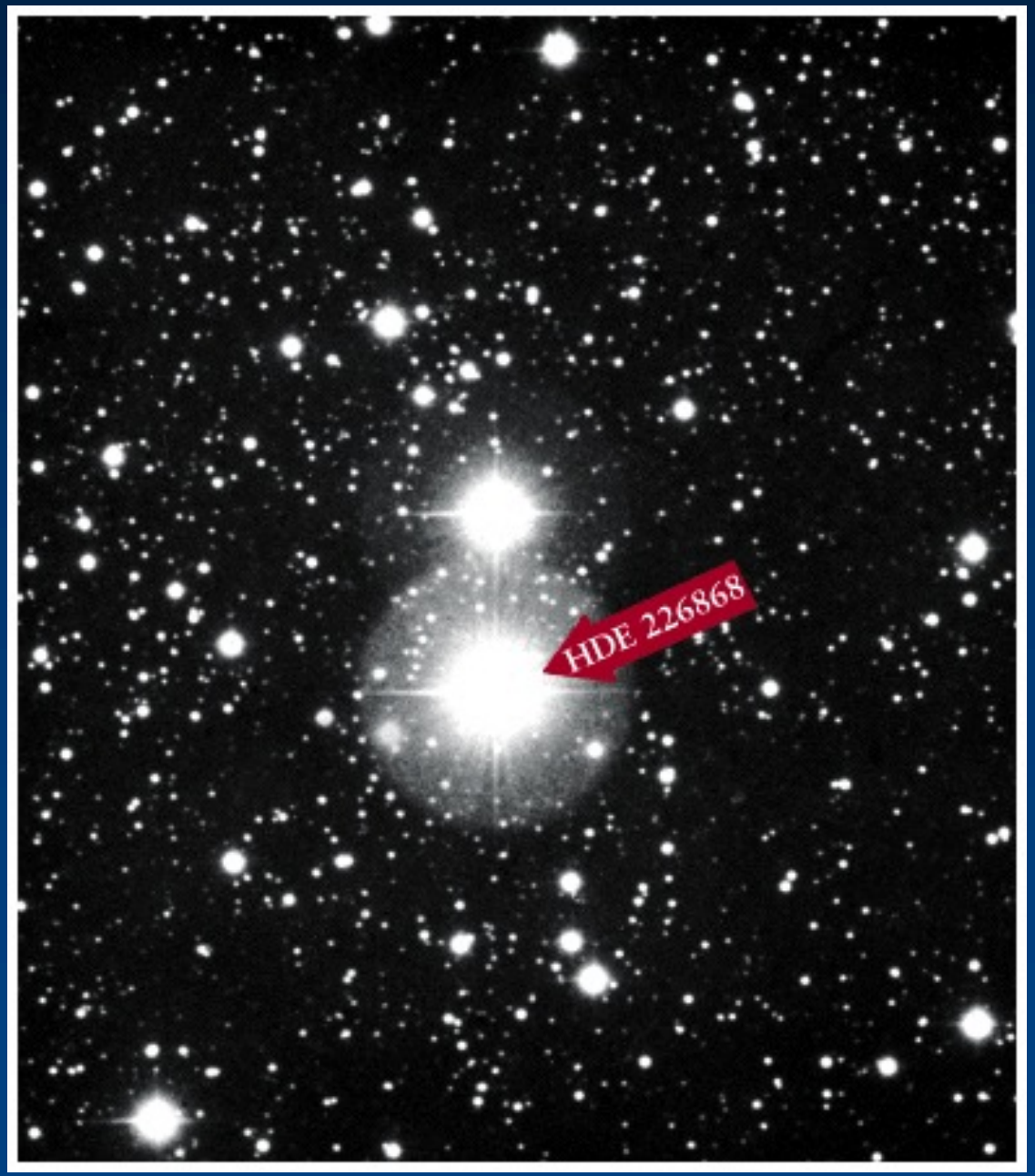
Eftekhari et al. (2016)

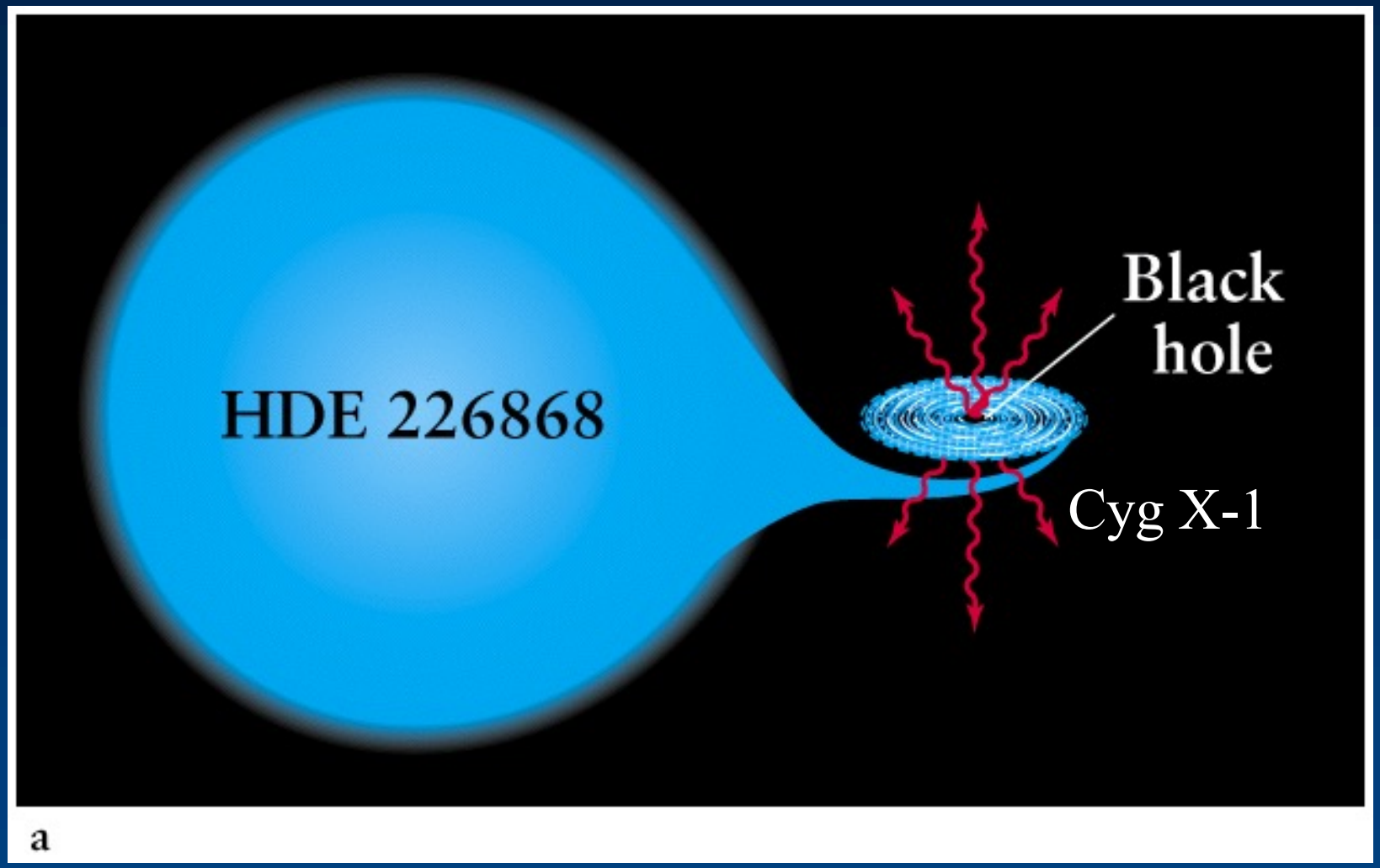


Long Wavelength Array first station (LWA1)

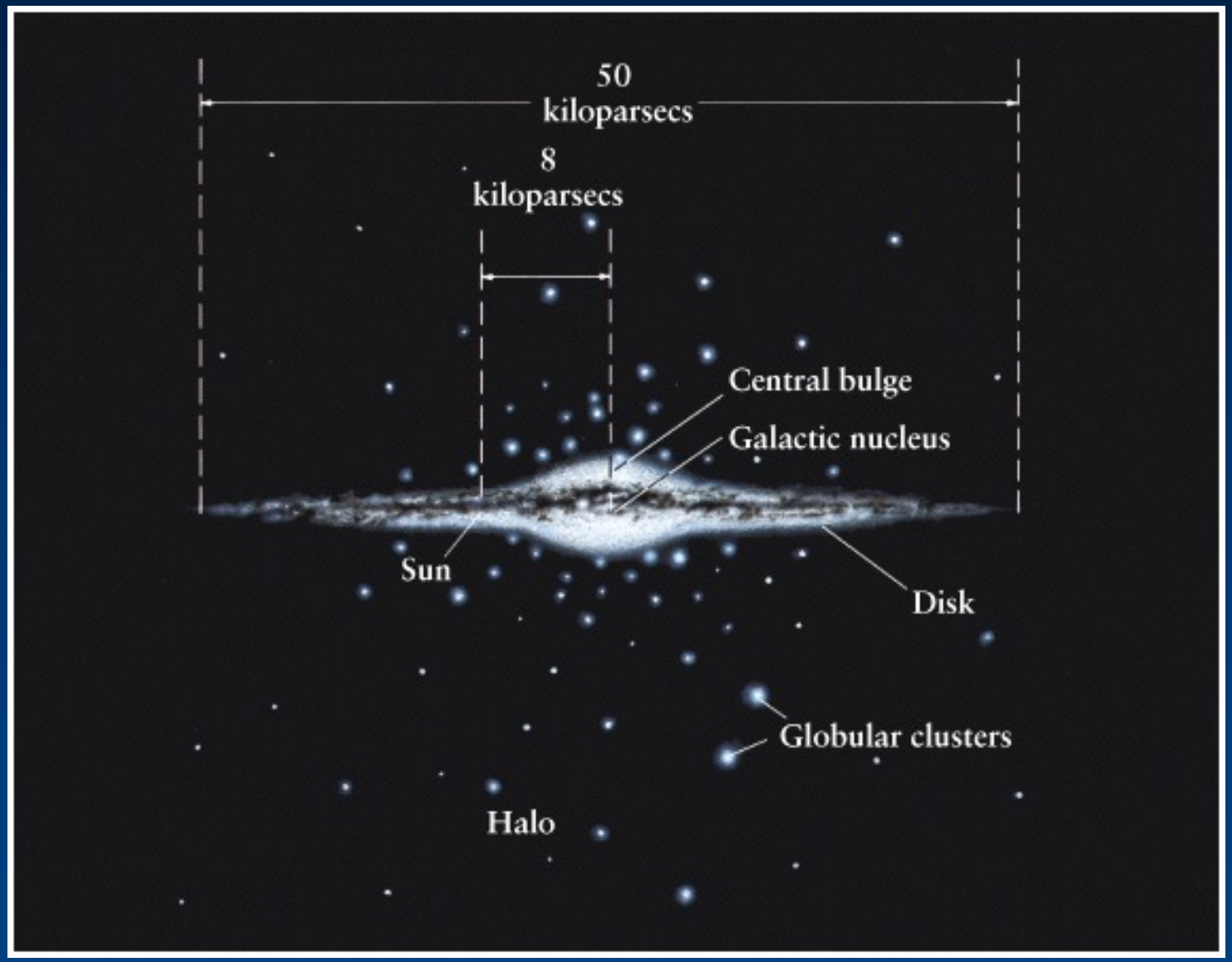
Long Wavelength Array Sevilleta station (LWA-SV)

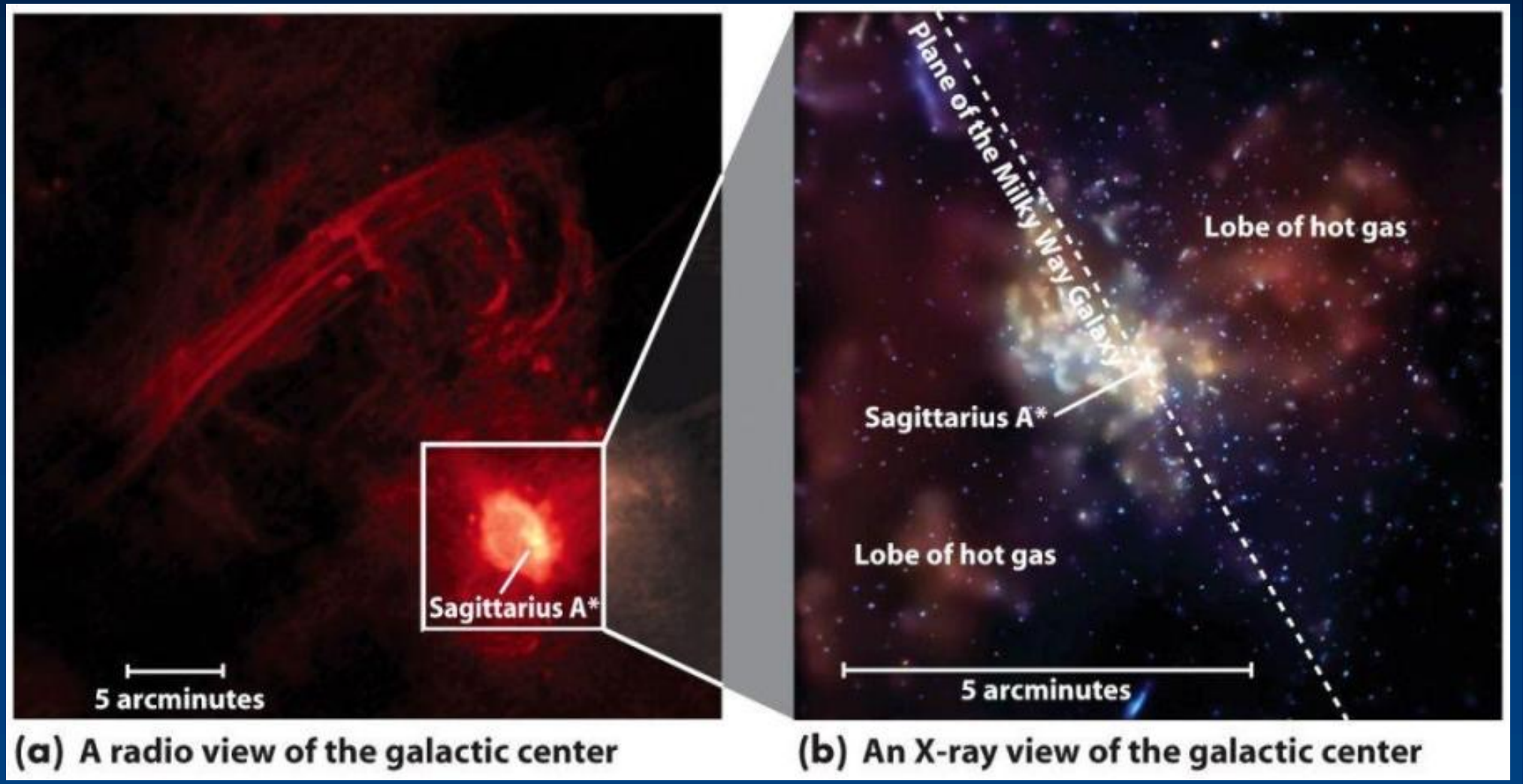
Even more exotic objects:





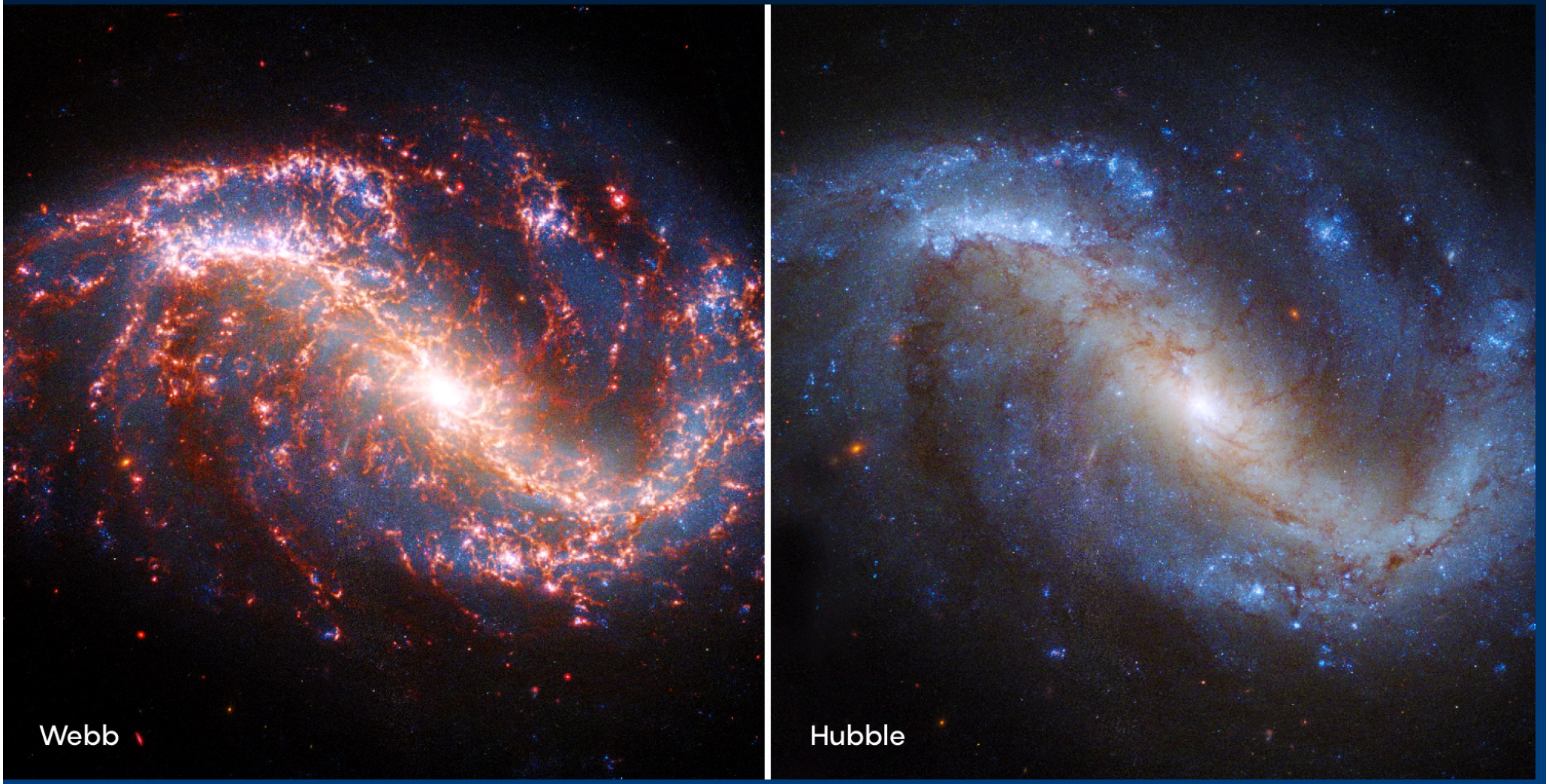
a


50
kiloparsecs
8
kiloparsecs
Central bulge
Galactic nucleus
Sun
Disk
Globular clusters
Halo

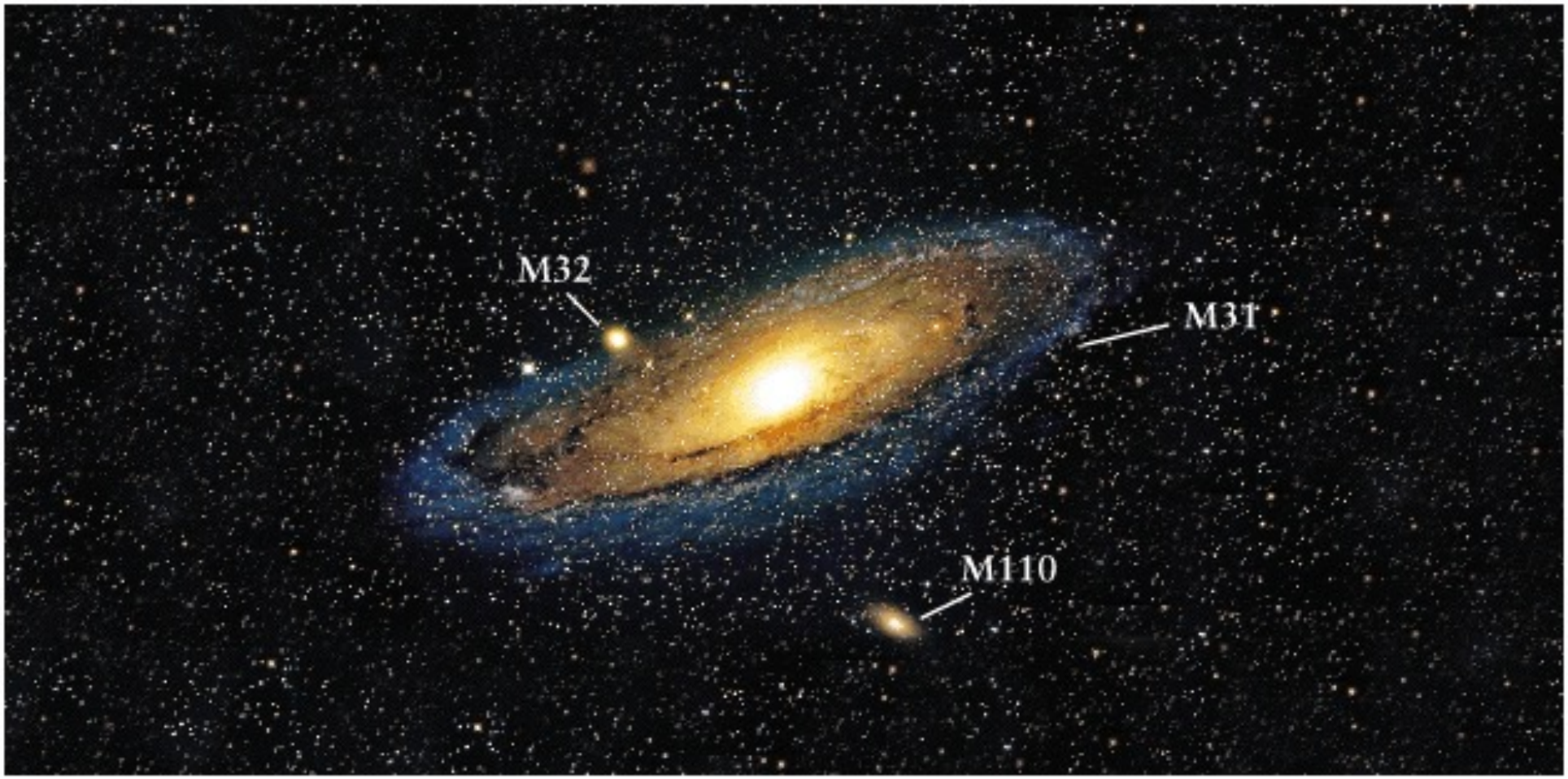


(a) A radio view of the galactic center

(b) An X-ray view of the galactic center



JWST and Hubble images of spiral galaxy NGC 7496

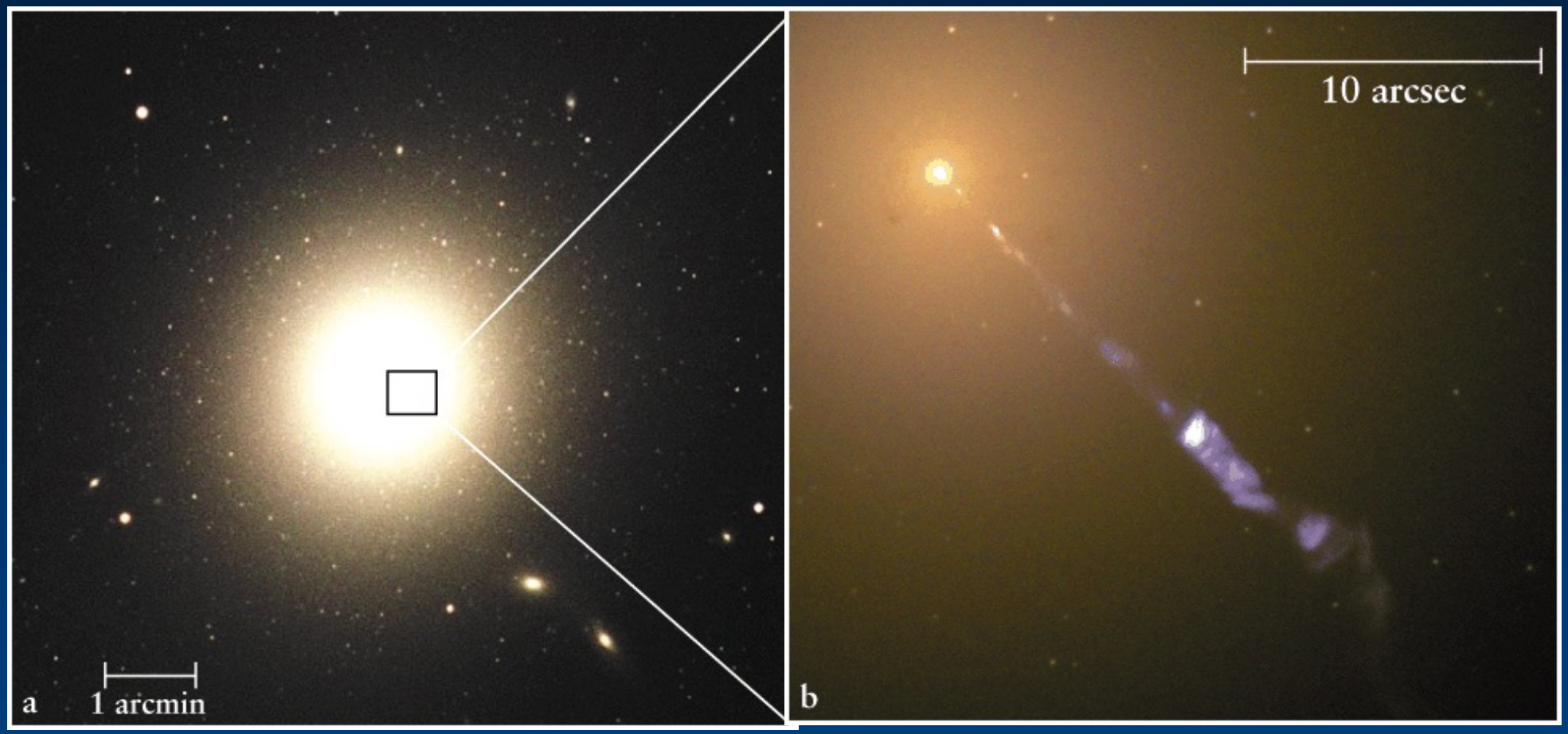

M32
M31
M110

Whirlpool galaxy

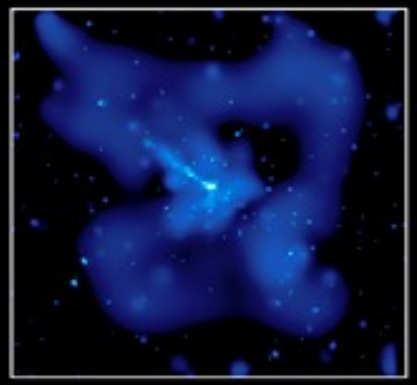
NGC3377

Clues to the evolution of the Universe!

The Hercules cluster


a
1 arcmin
b
10 arcsec

Centaurus A



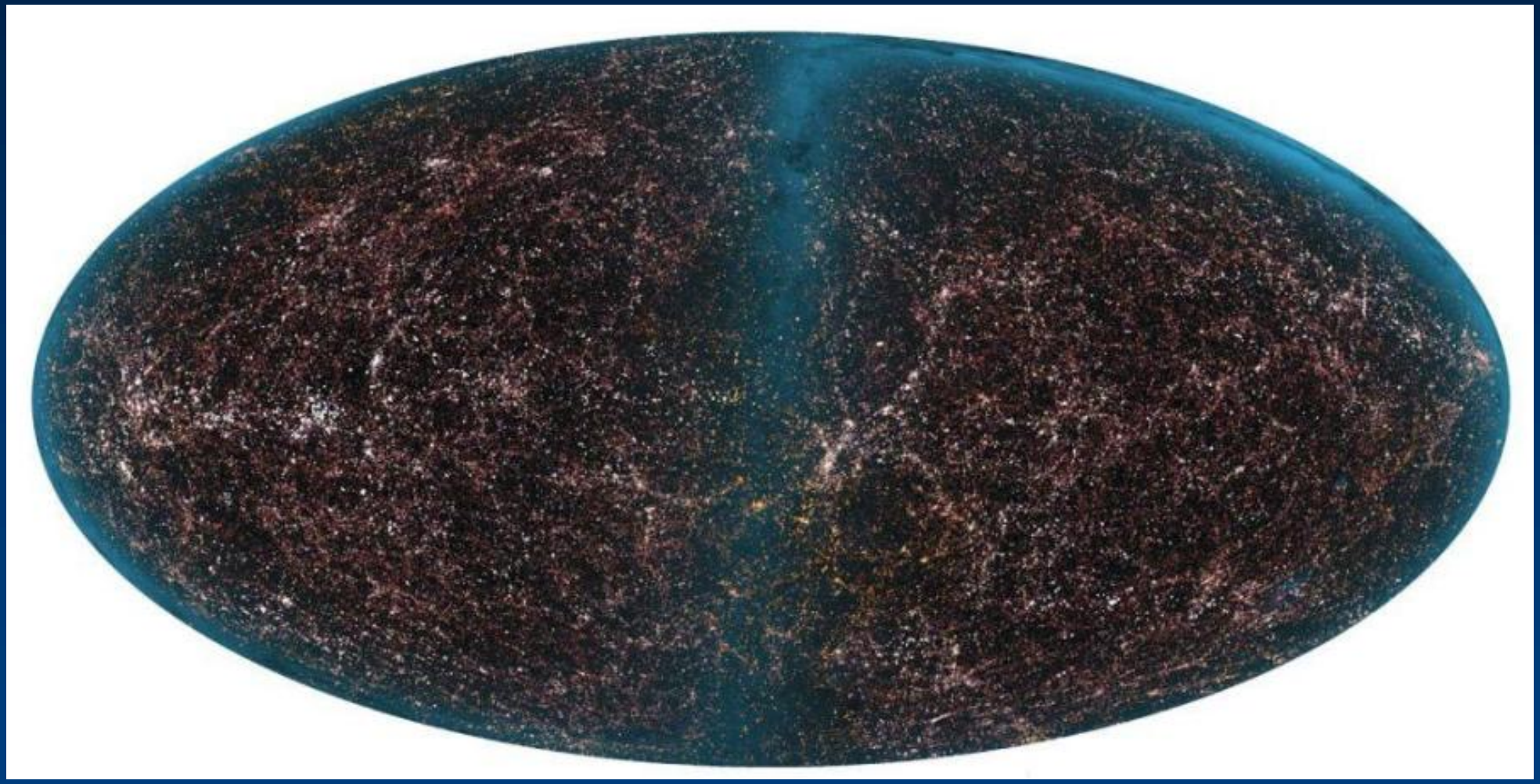
CHANDRA X-RAY

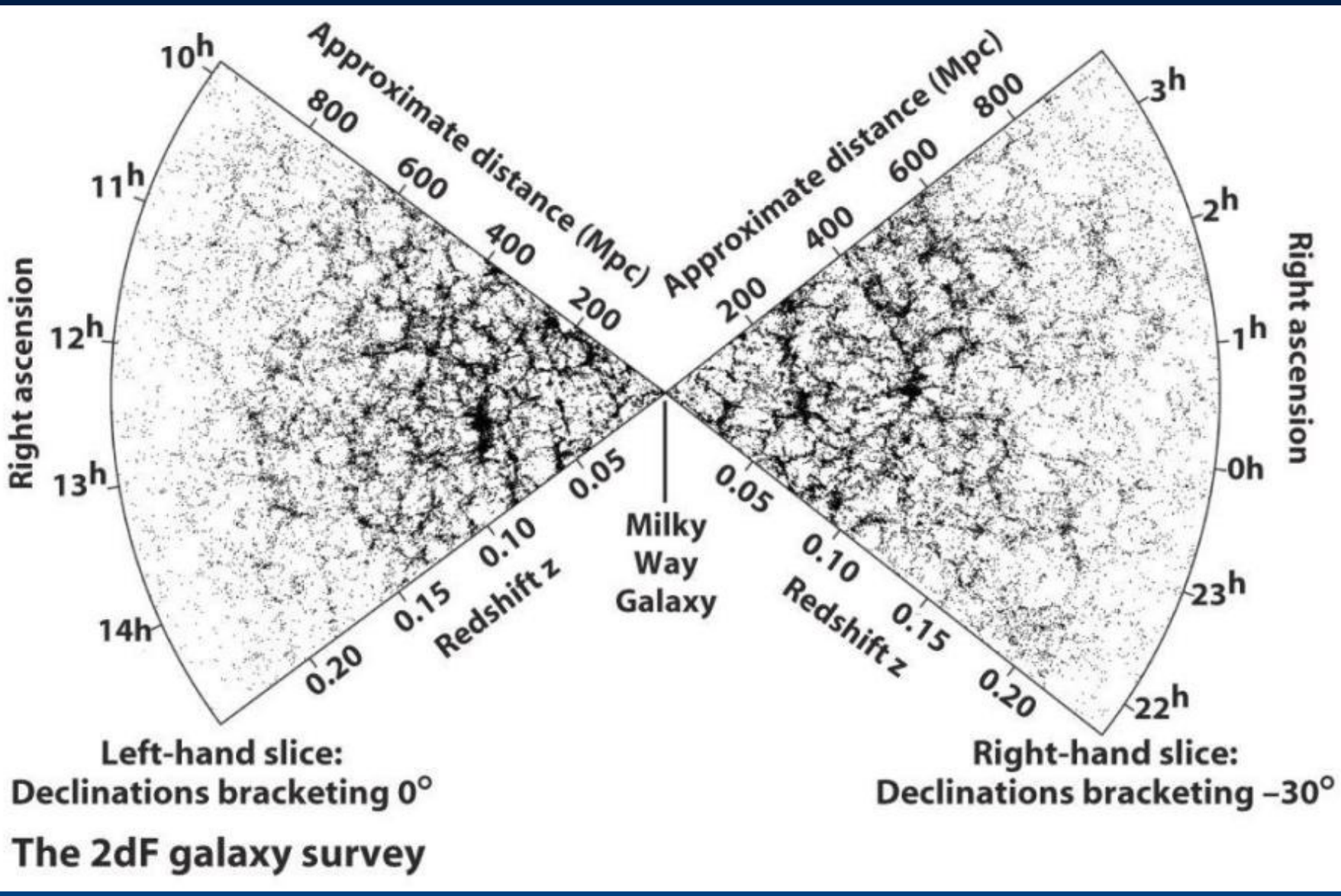
DSS OPTICAL

NRAO RADIO CONTINUUM

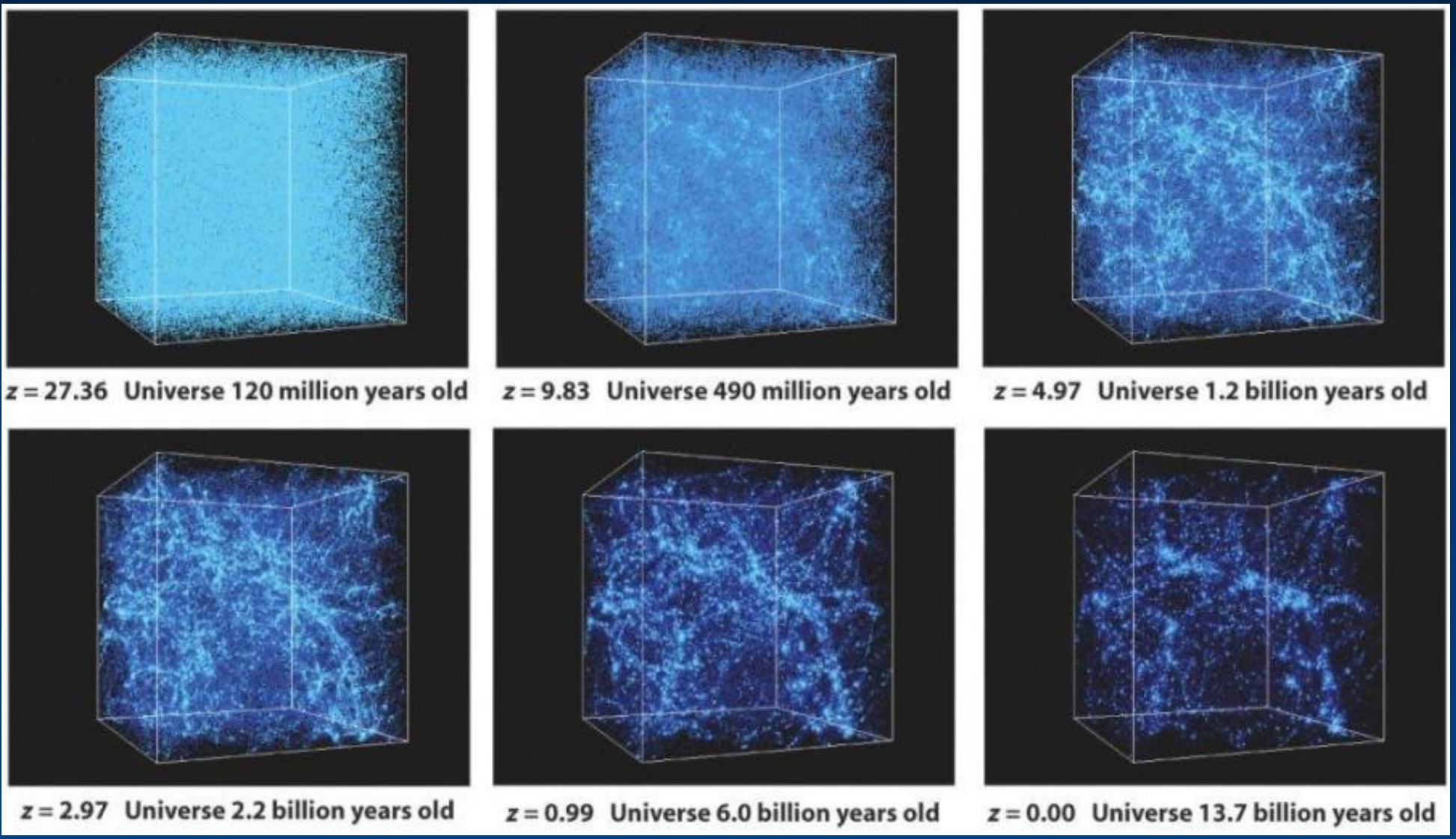
NRAO RADIO (21-CM)

Large scale structure

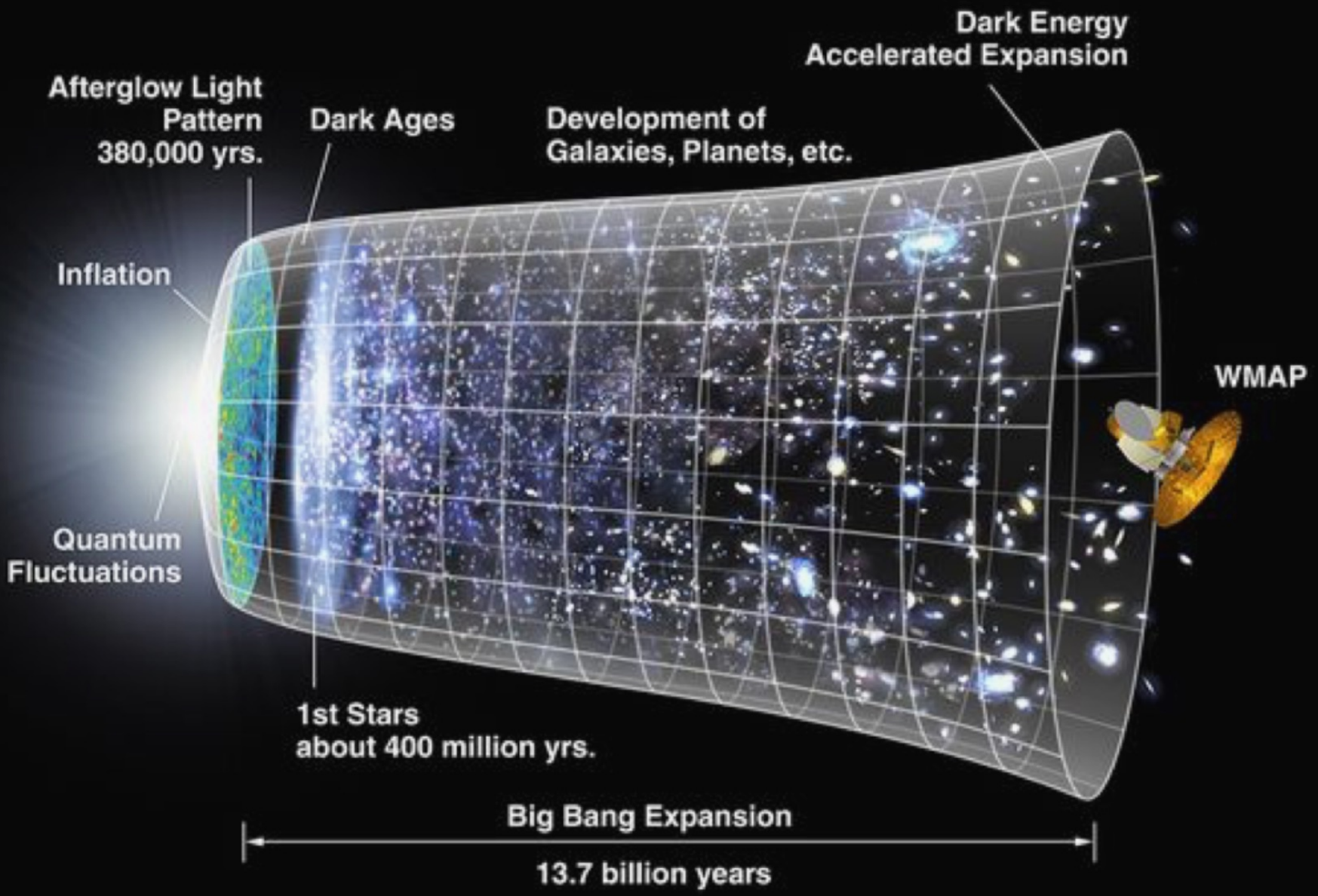



10h
11h
12h
13h
14h
Right ascension
Approximate distance (Mpc)
800
600
400
200
0.05
0.10
0.15
0.20
Redshift z
Milky
Way
Galaxy
Approximate distance (Mpc)
800
600
400
200
0.05
0.10
0.15
0.20
Redshift z
3h
2h
1h
0h
23h
22h
Right ascension
Left-hand slice:
Declinations bracketing 0°
Right-hand slice:
Declinations bracketing –30°
The 2dF galaxy survey

How did this structure form?



Cosmology


Dark Energy
Accelerated Expansion
Afterglow Light
Pattern
380,000 yrs.
Dark Ages
Development of
Galaxies, Planets, etc.
Inflation
WMAP
Quantum
Fluctuations
1st Stars
about 400 million yrs.
Big Bang Expansion
13.7 billion years