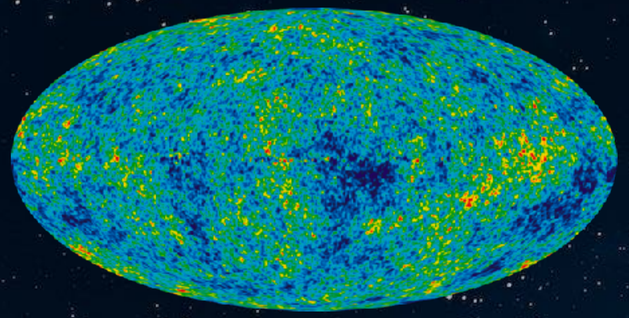
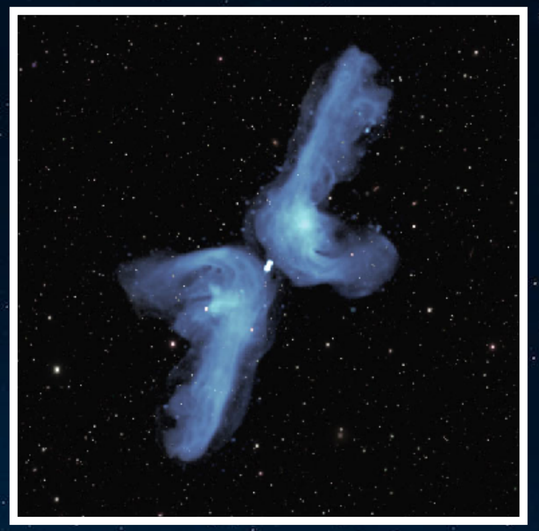
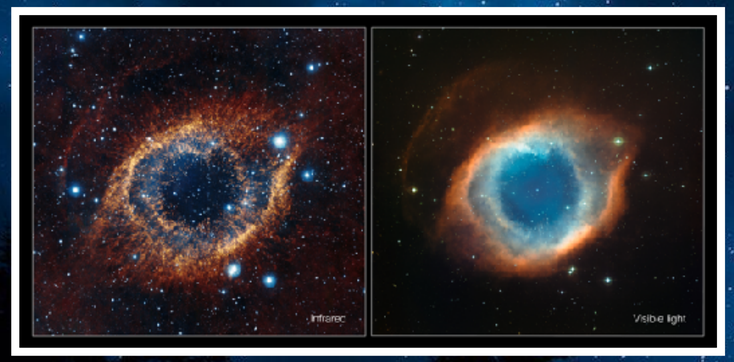


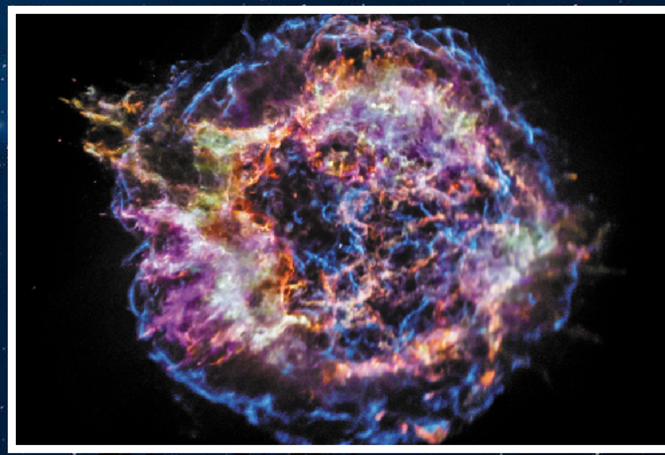
GO STARGAZING



Colours of the Universe

How astronomers look beyond the visible





Dr Emma Alexander

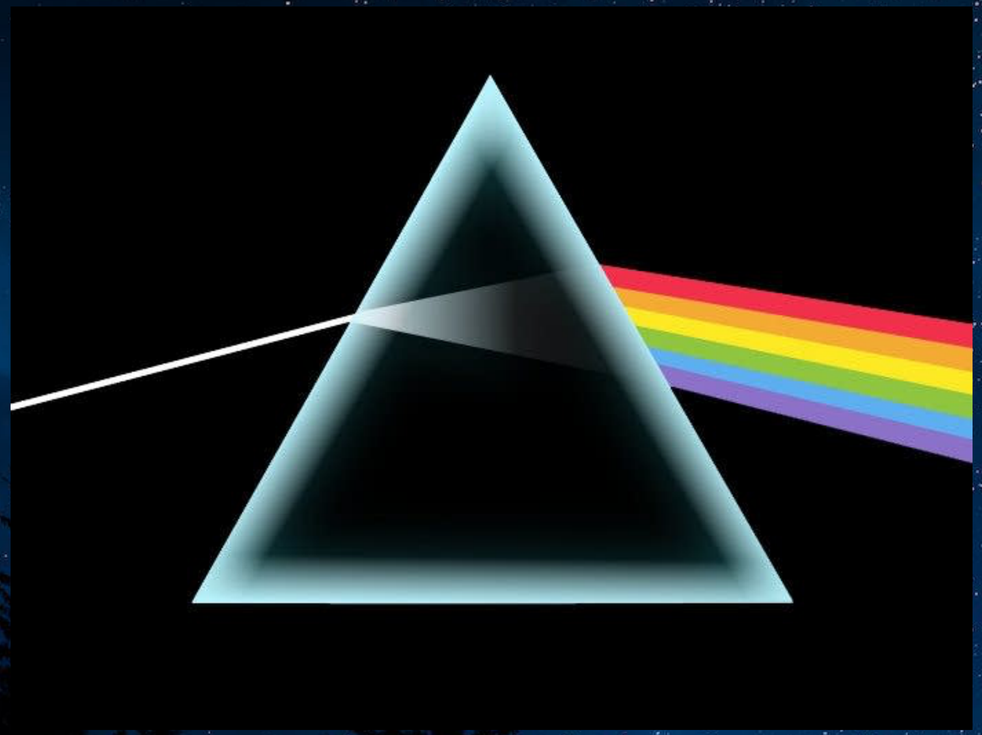
Discovering Spain and Morocco 15th - 27th Feb 2025

Colours of the Universe

- What is light? What is colour?
- Colours of the stars
- Seeing beyond the visible: different types of telescopes
- Pretty pictures!

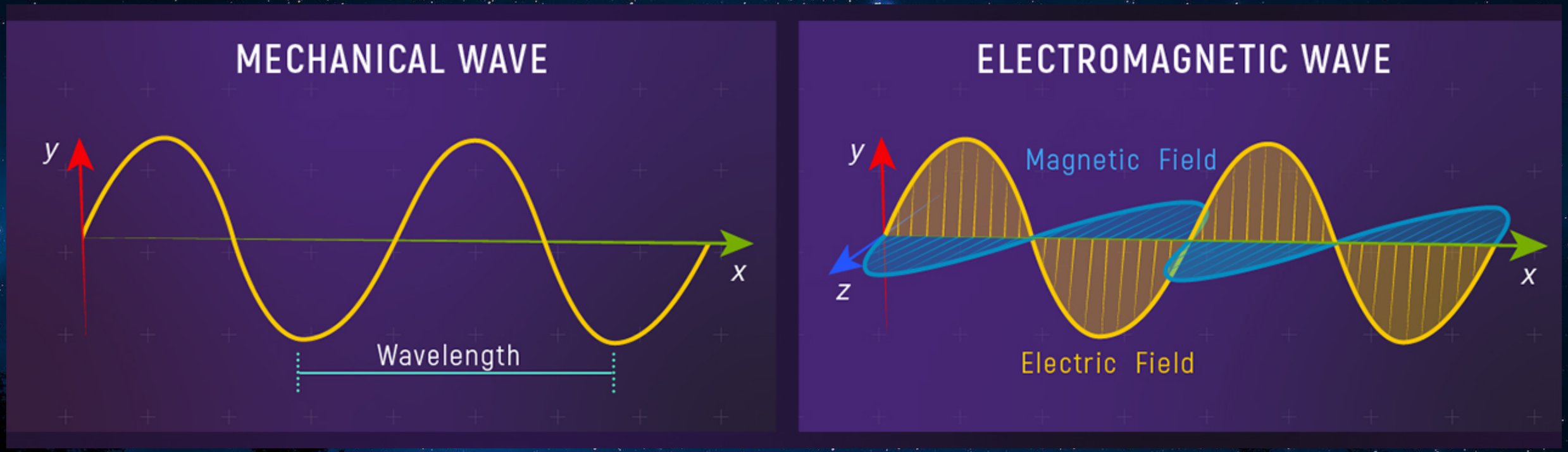
What is light? What is colour?

What is colour?



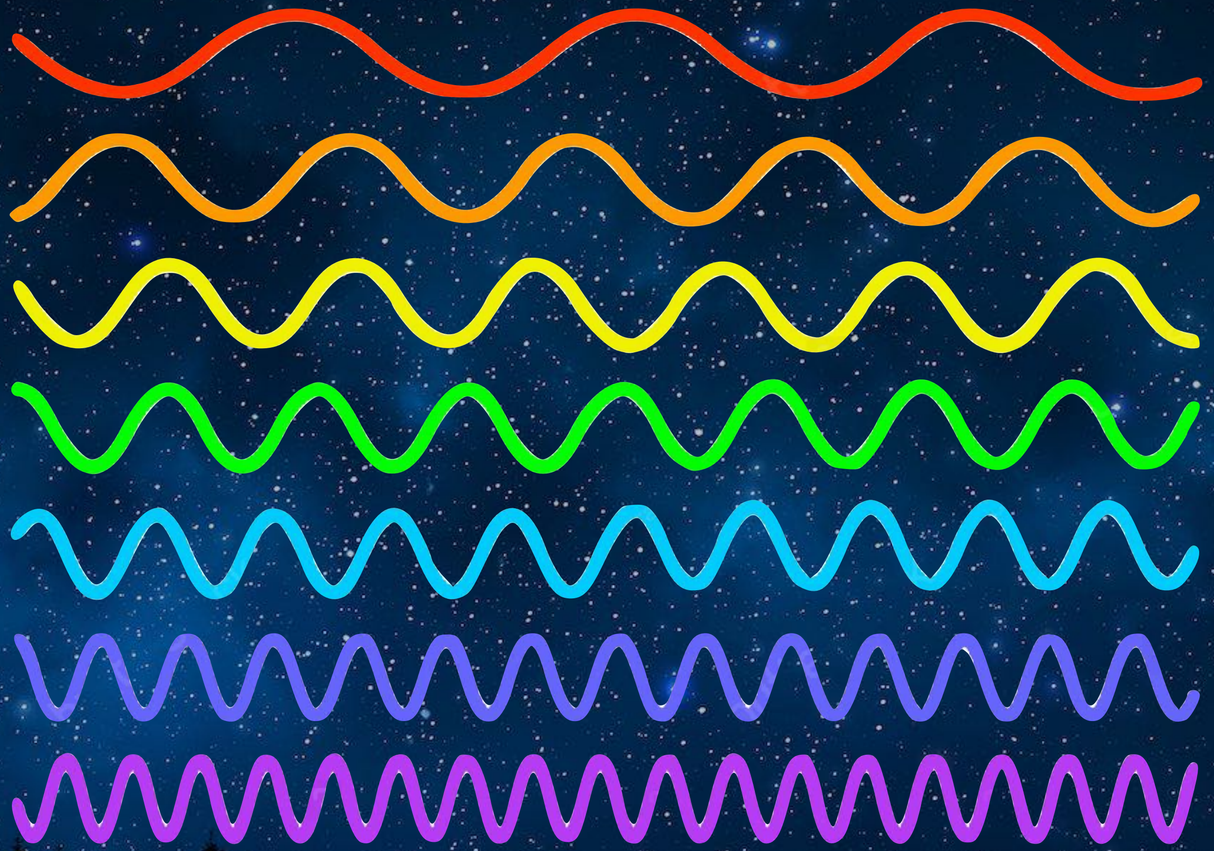
White light is a mix of all the colours of the rainbow

What is light?

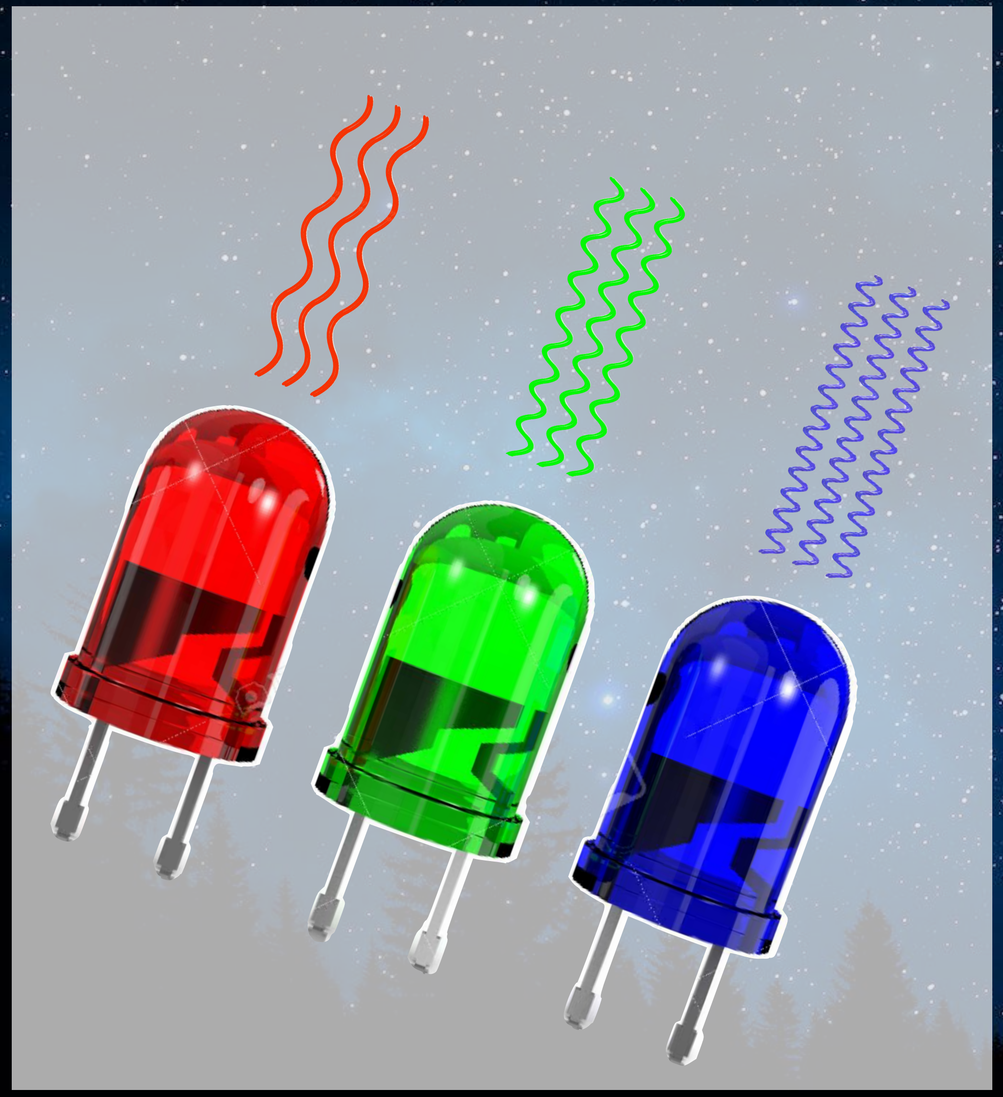


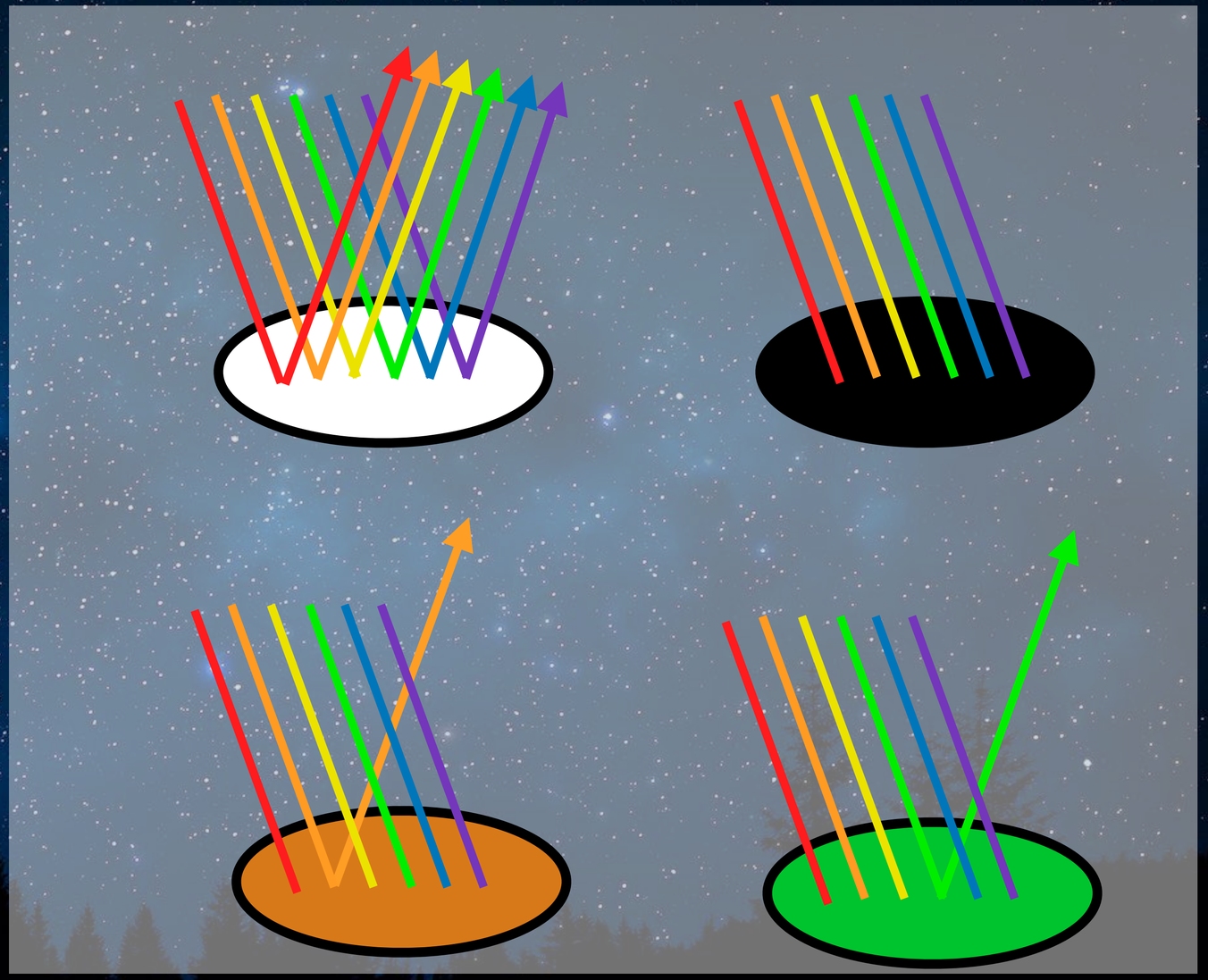
What is light?

What is colour?

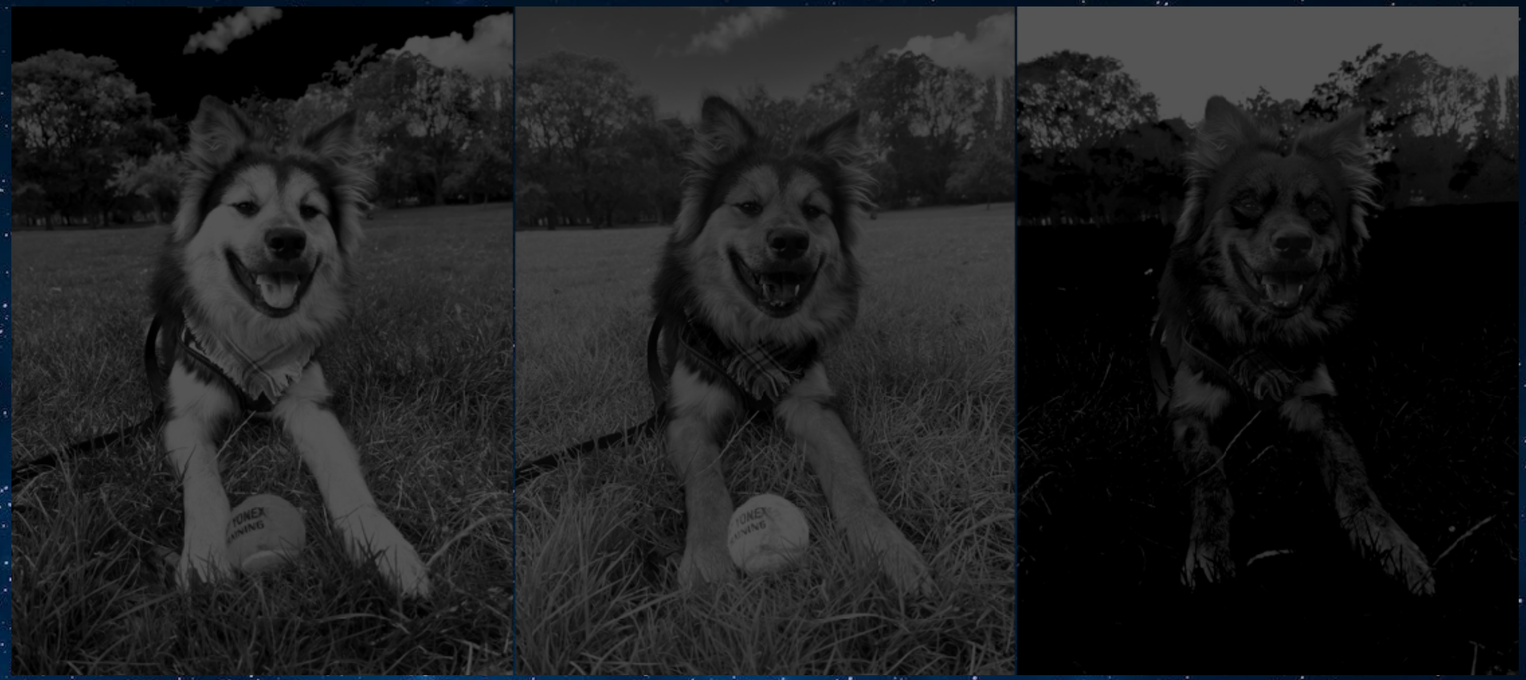


Emission vs. reflection



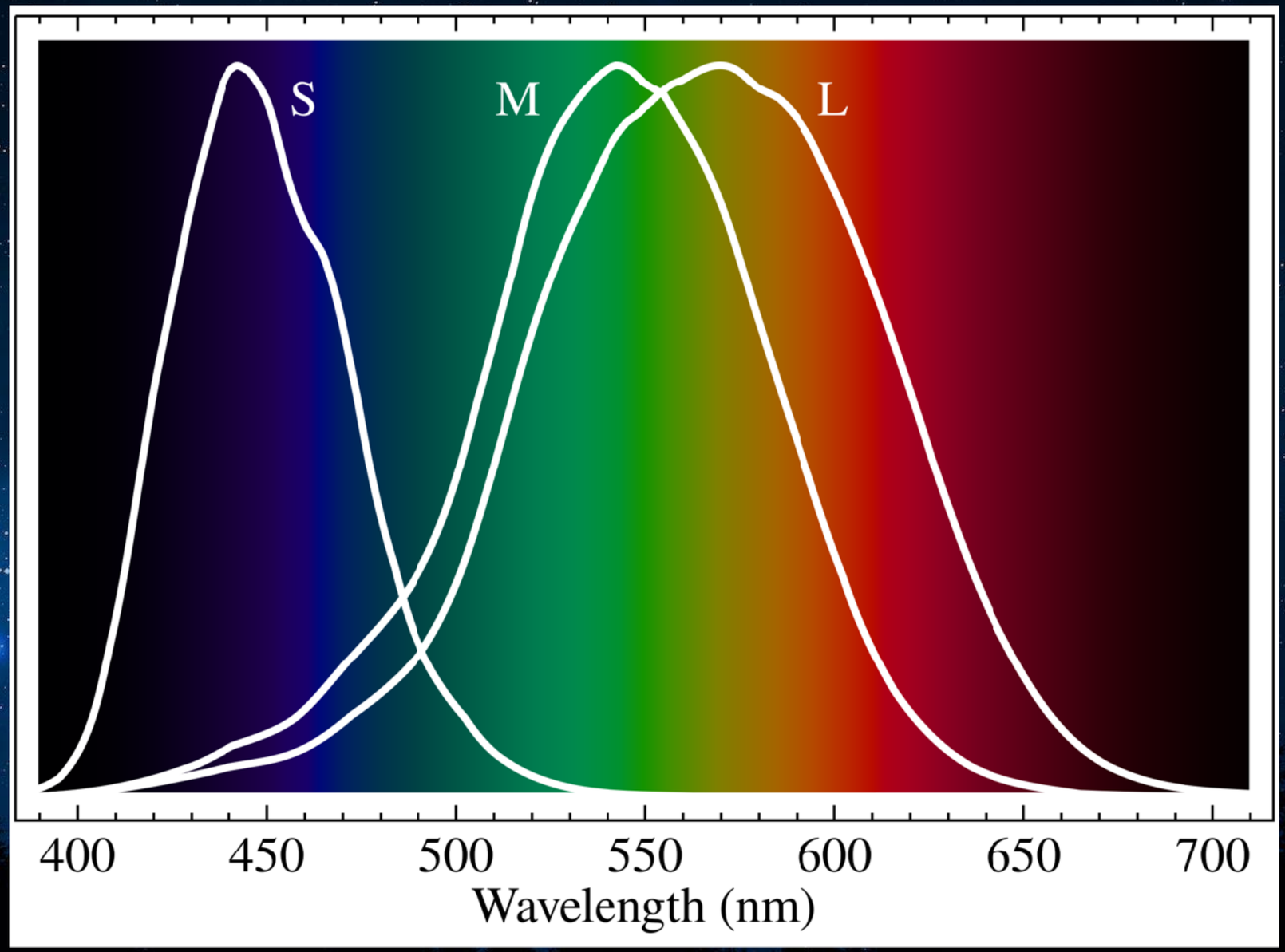


What is colour?

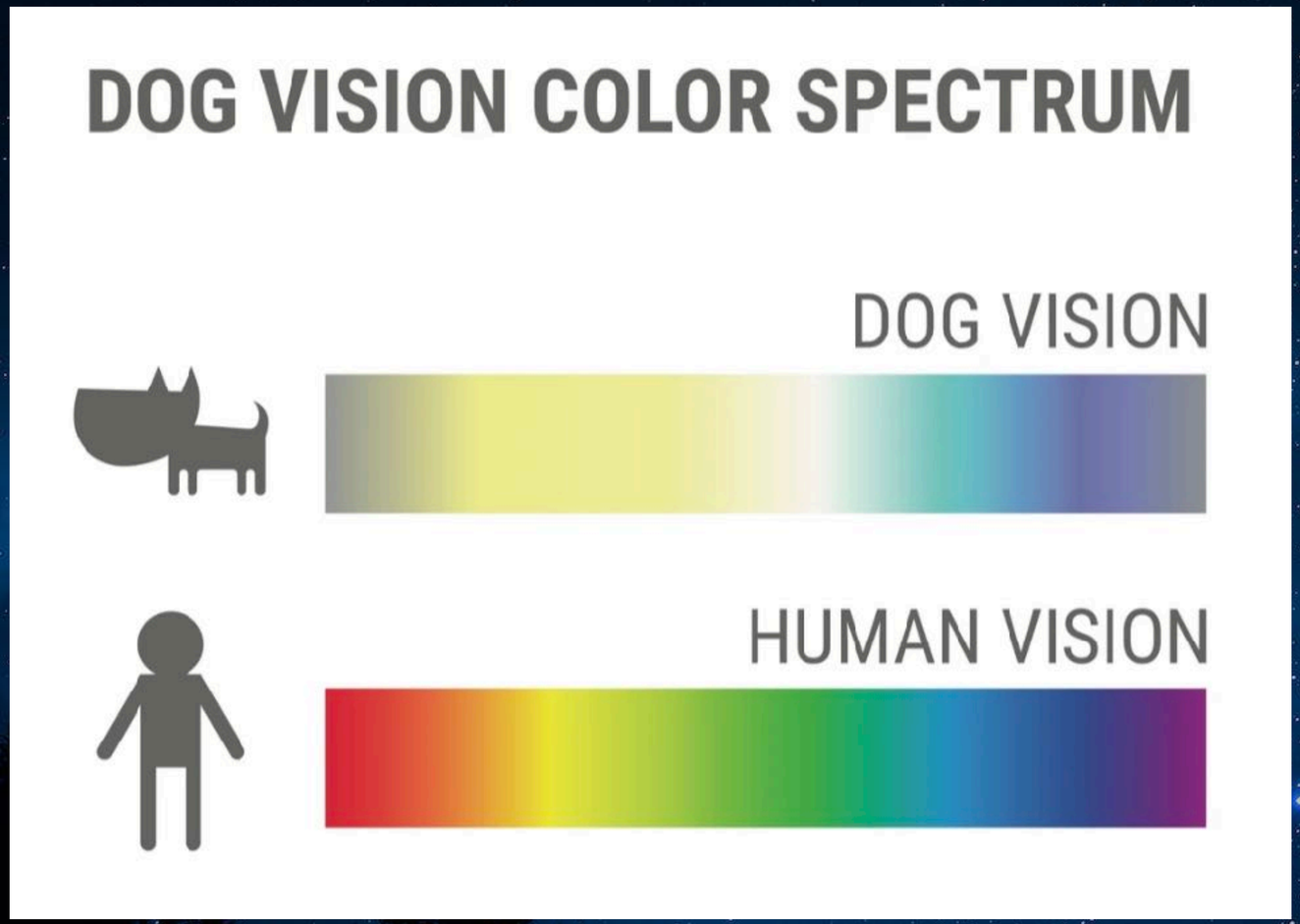


RED GREEN BLUE

What is colour?



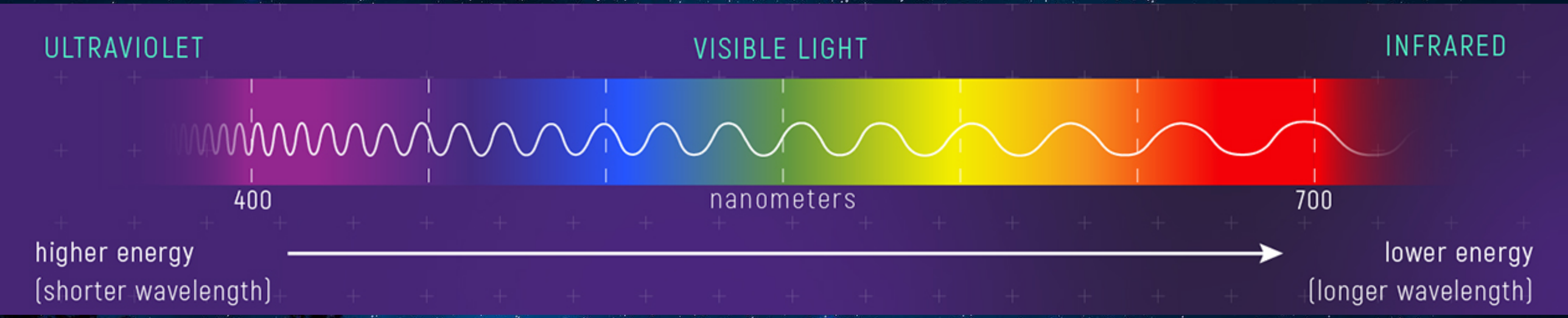
Animal vision

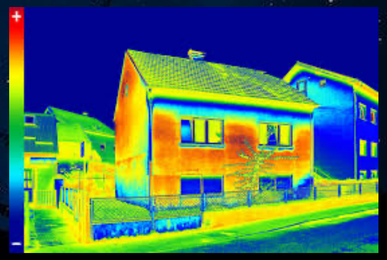


Dogs only have 2 types of colour photoreceptors.

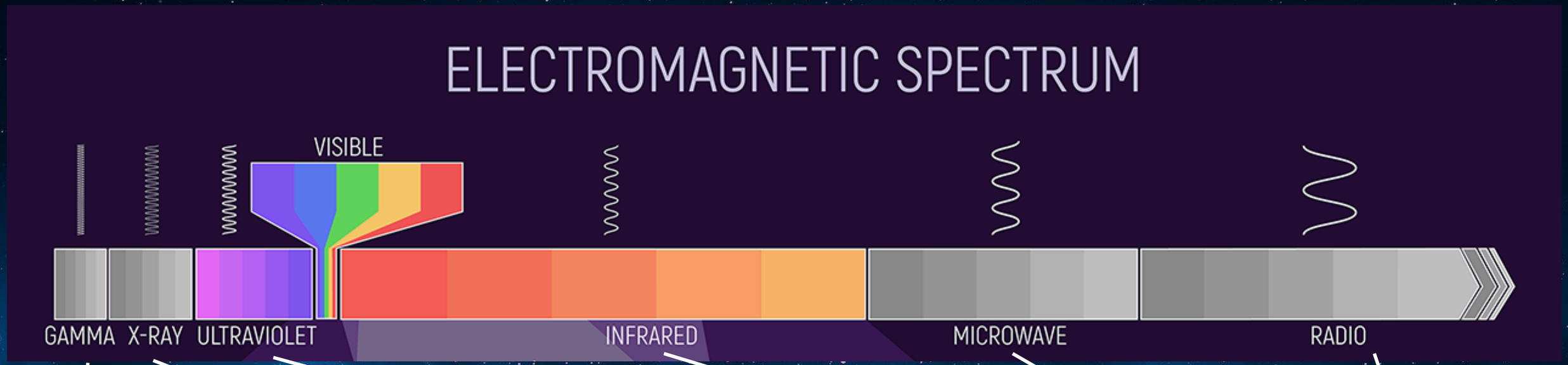
What is colour?

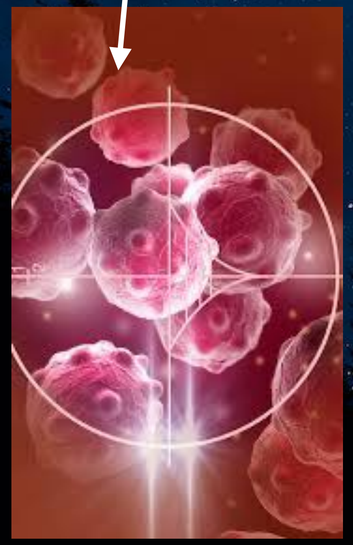
An electromagnetic wave of radiation*

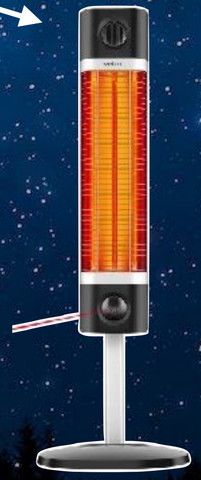




What is colour?





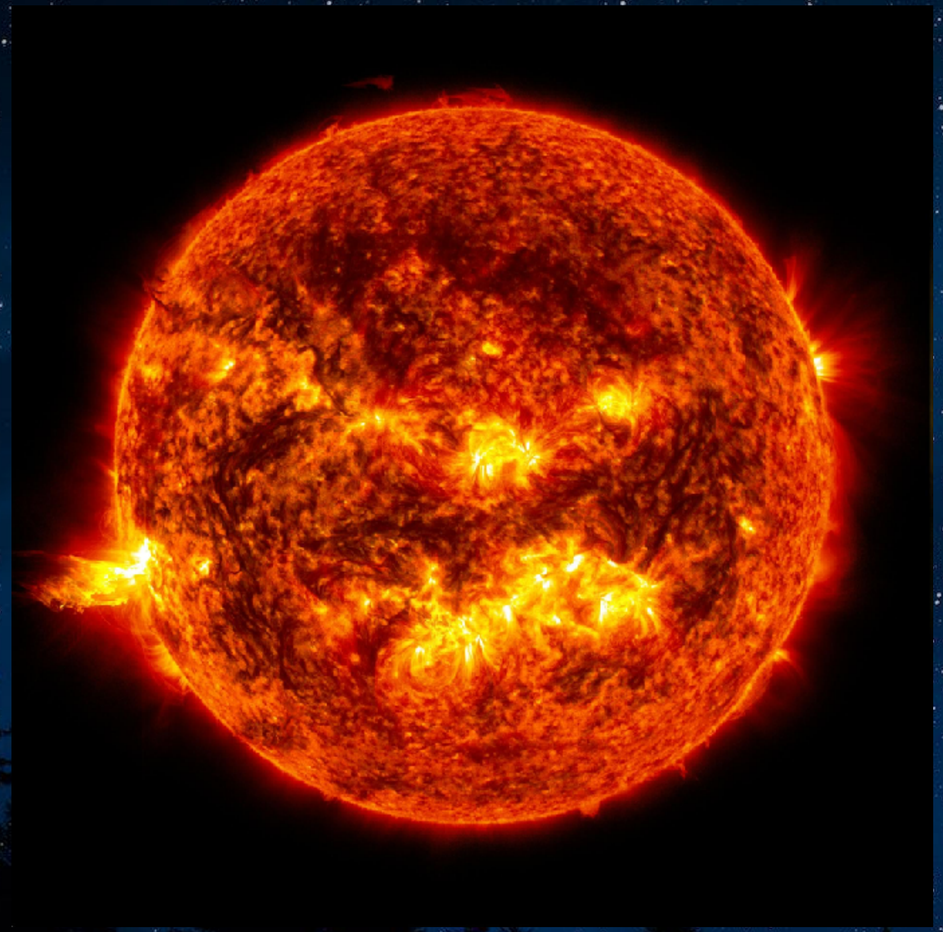


Aside: what is a light year?

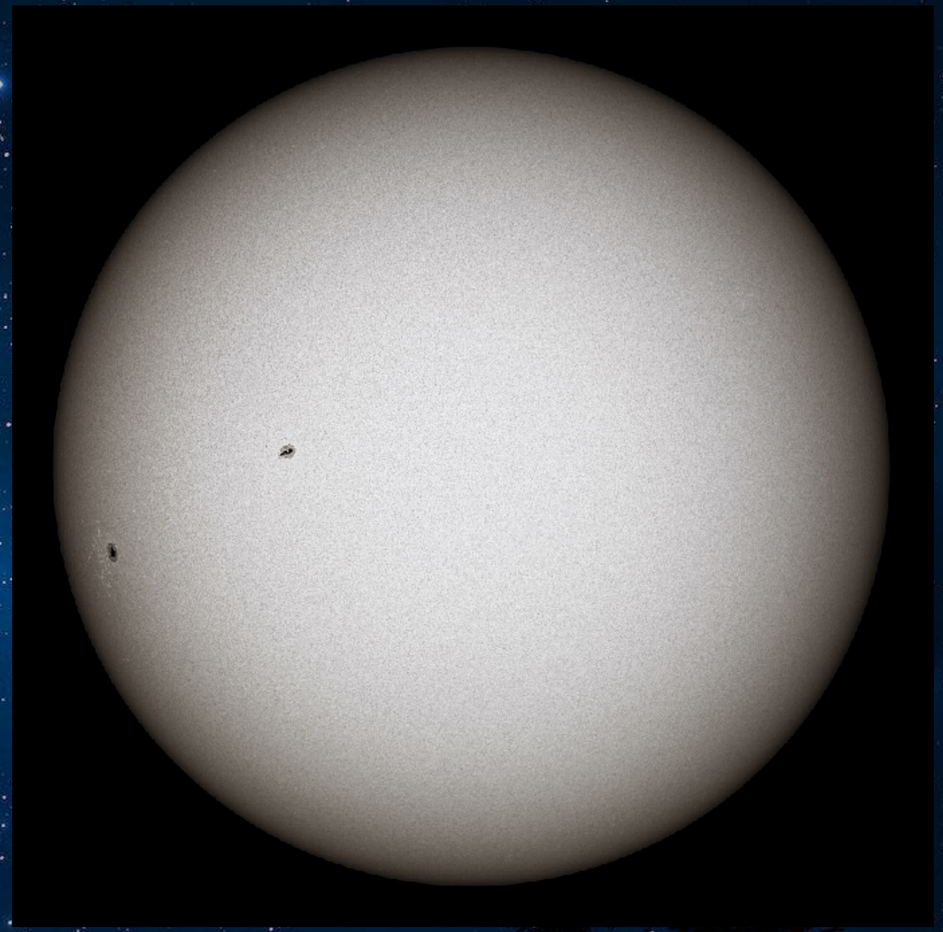

Speed of Light: 299,792 km/sec
Earth to moon: 1.29 light seconds
Earth to Sun: 8 light minutes
Earth to Mars: 12.7 light minutes
Earth to Proxima Centauri (nearest star): 4.3 light years
Earth to the other side of our own Milky Way Galaxy: 52,000 light years.

What colour is the Sun?

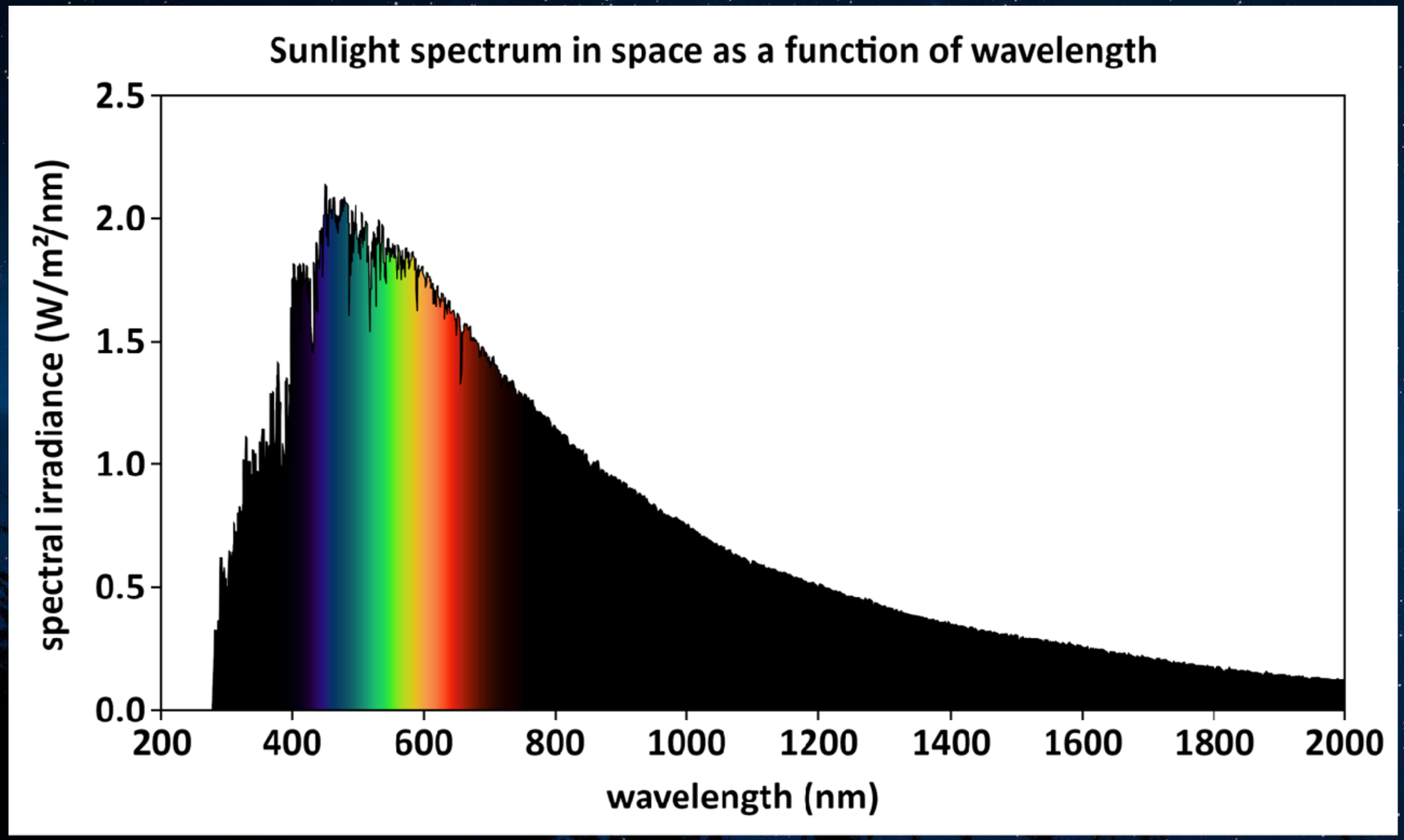
Colour of the Sun

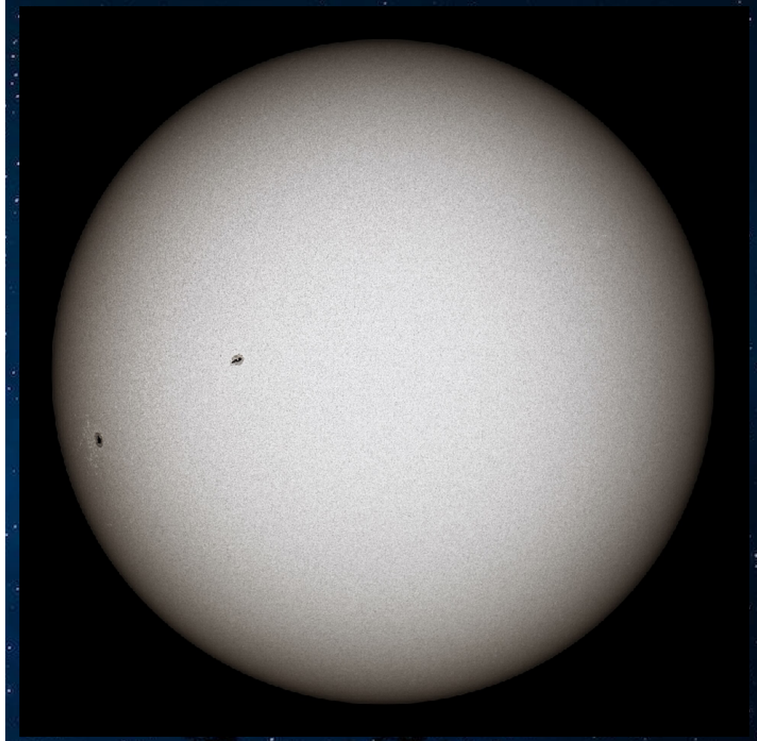


?

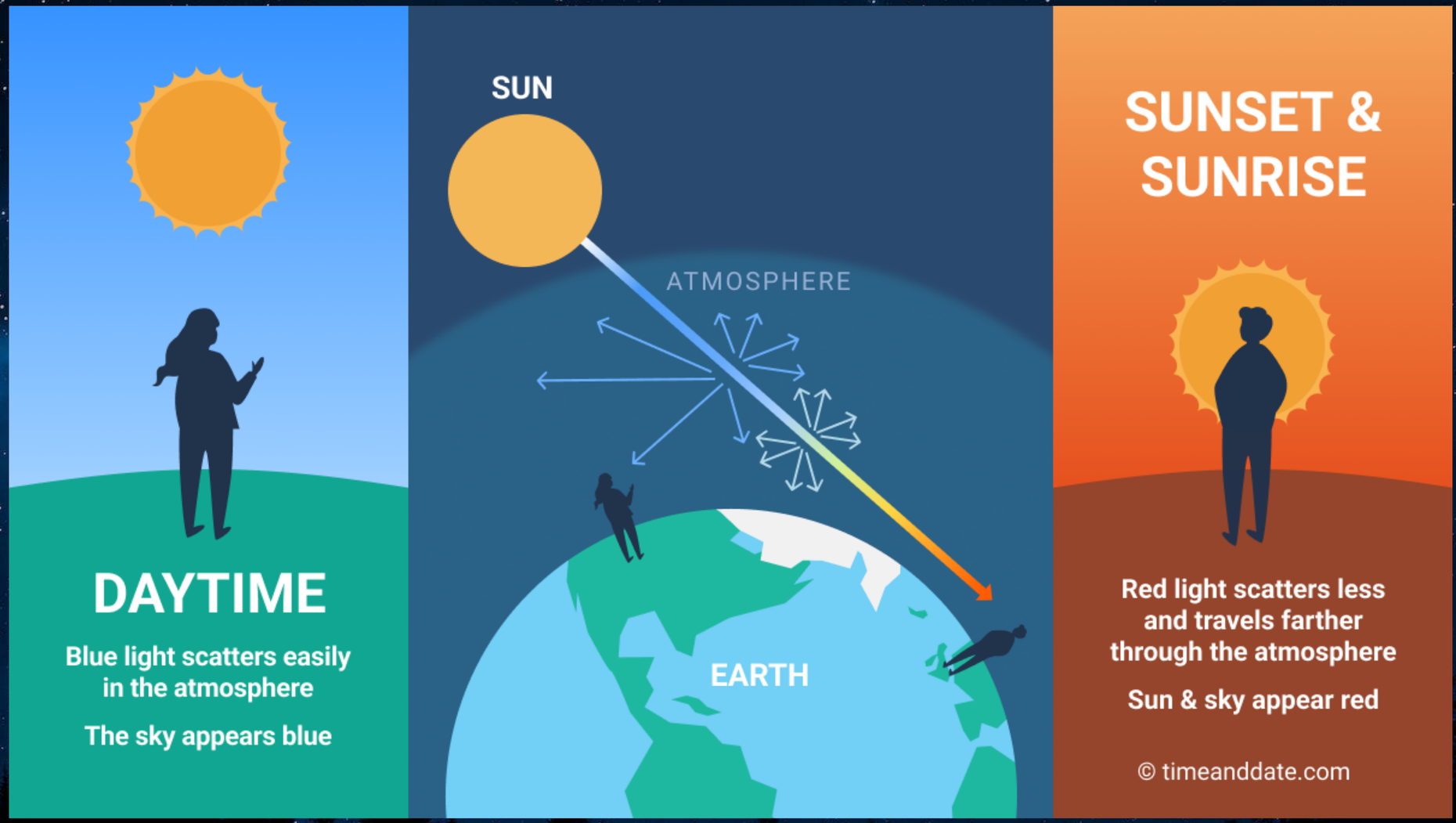


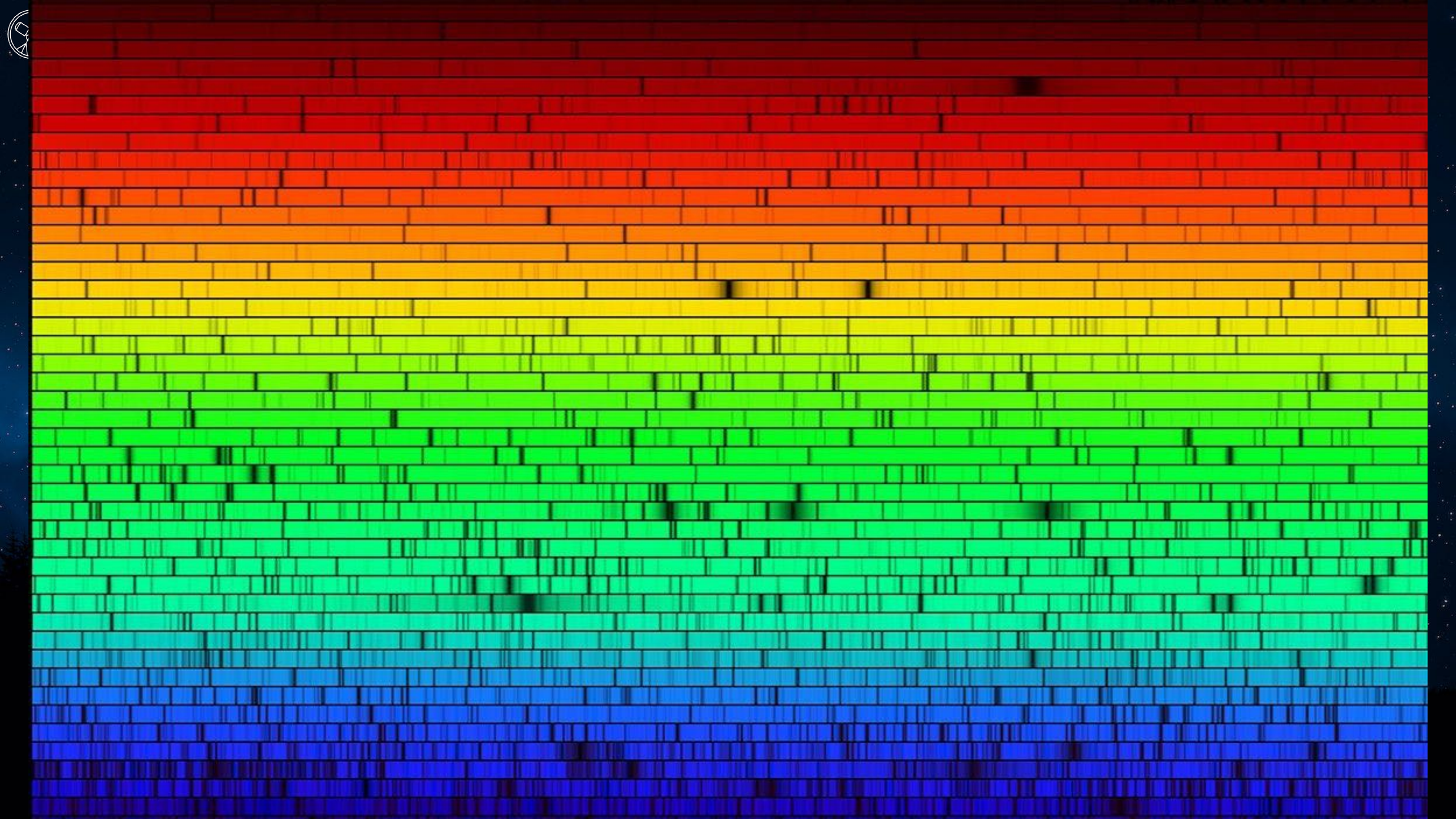
Colour of the Sun



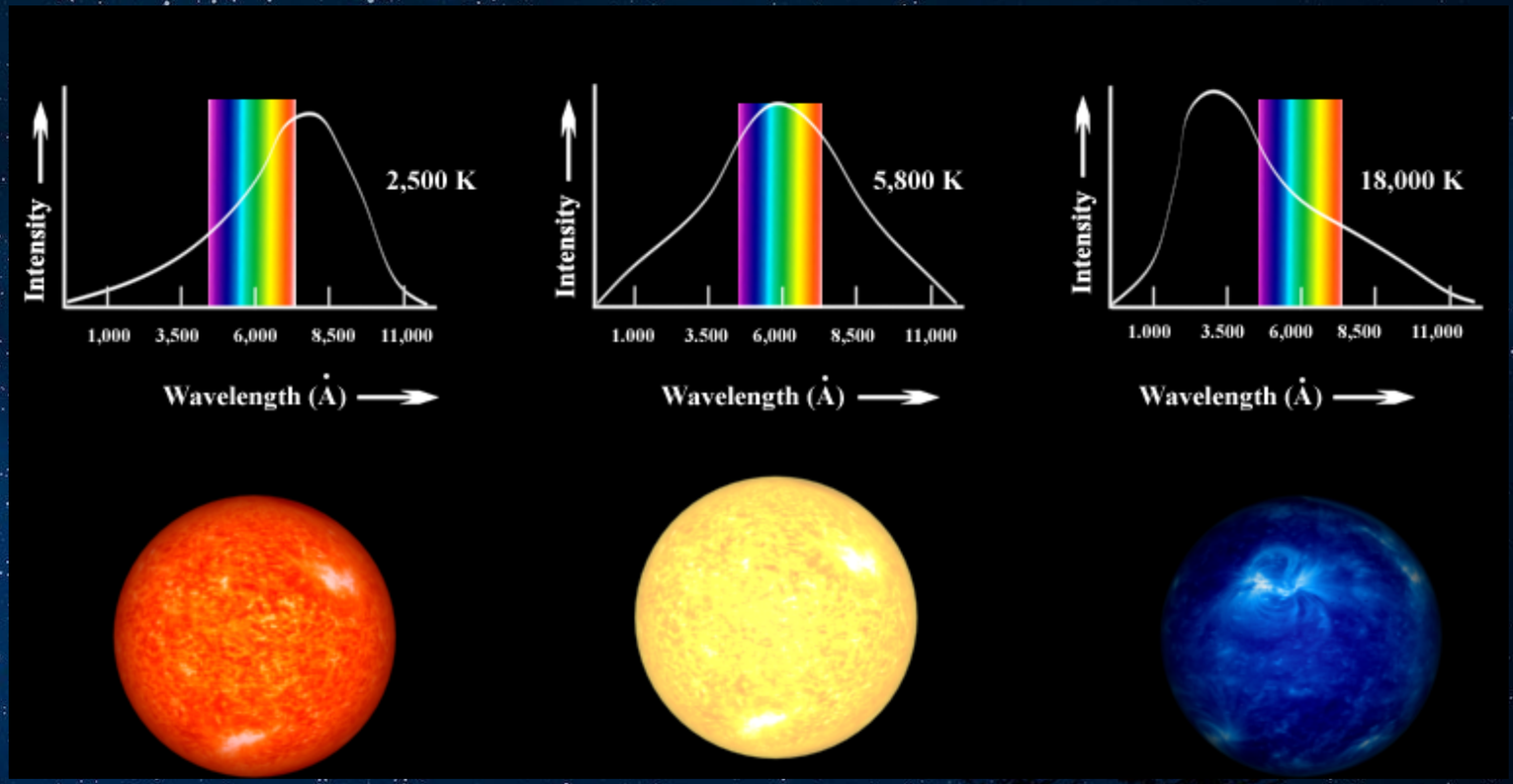


Skies are blue, sunsets are red

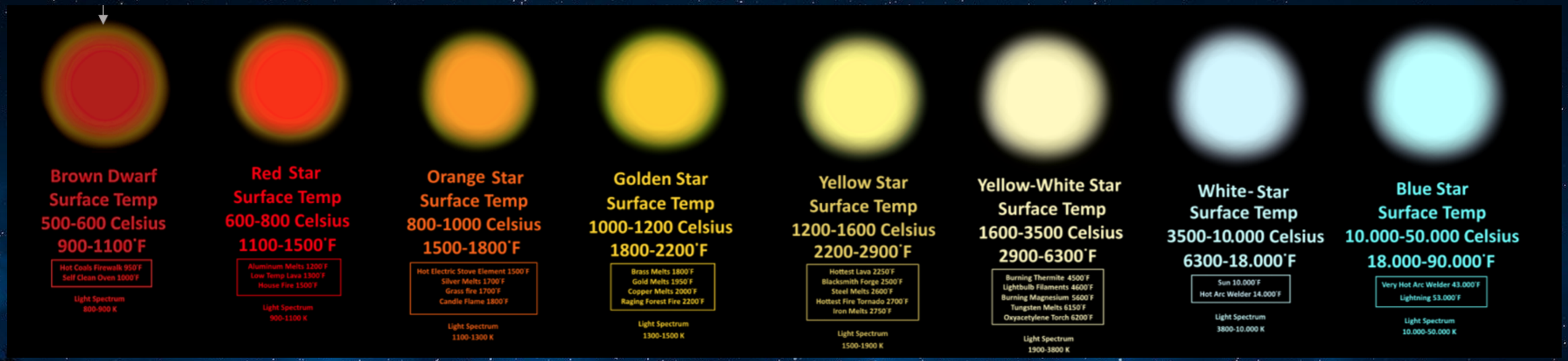




Colours of the stars



Colours of the stars



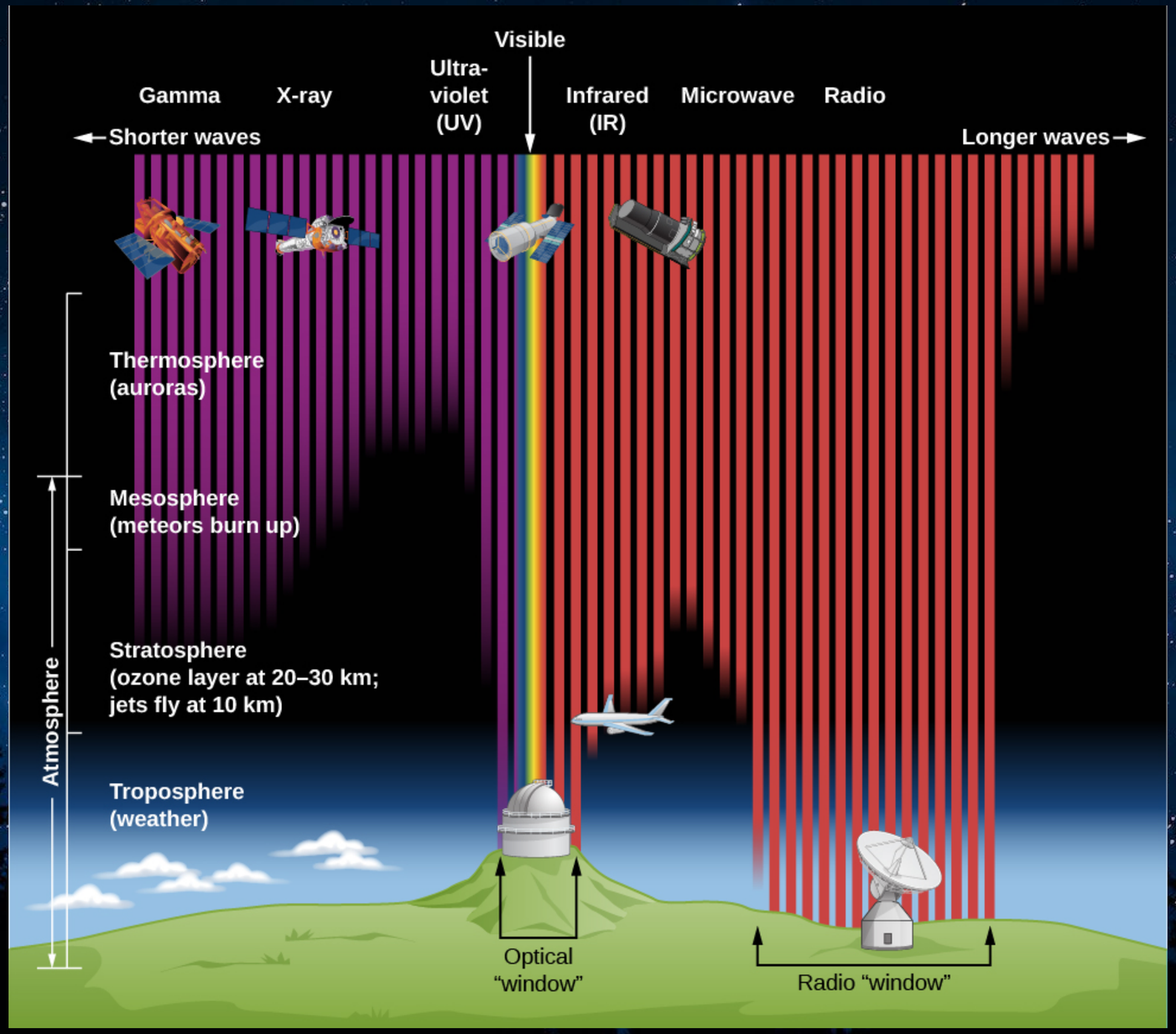
Bluer star = higher temperature = ‘burns’ brighter and faster

‘False’ colour

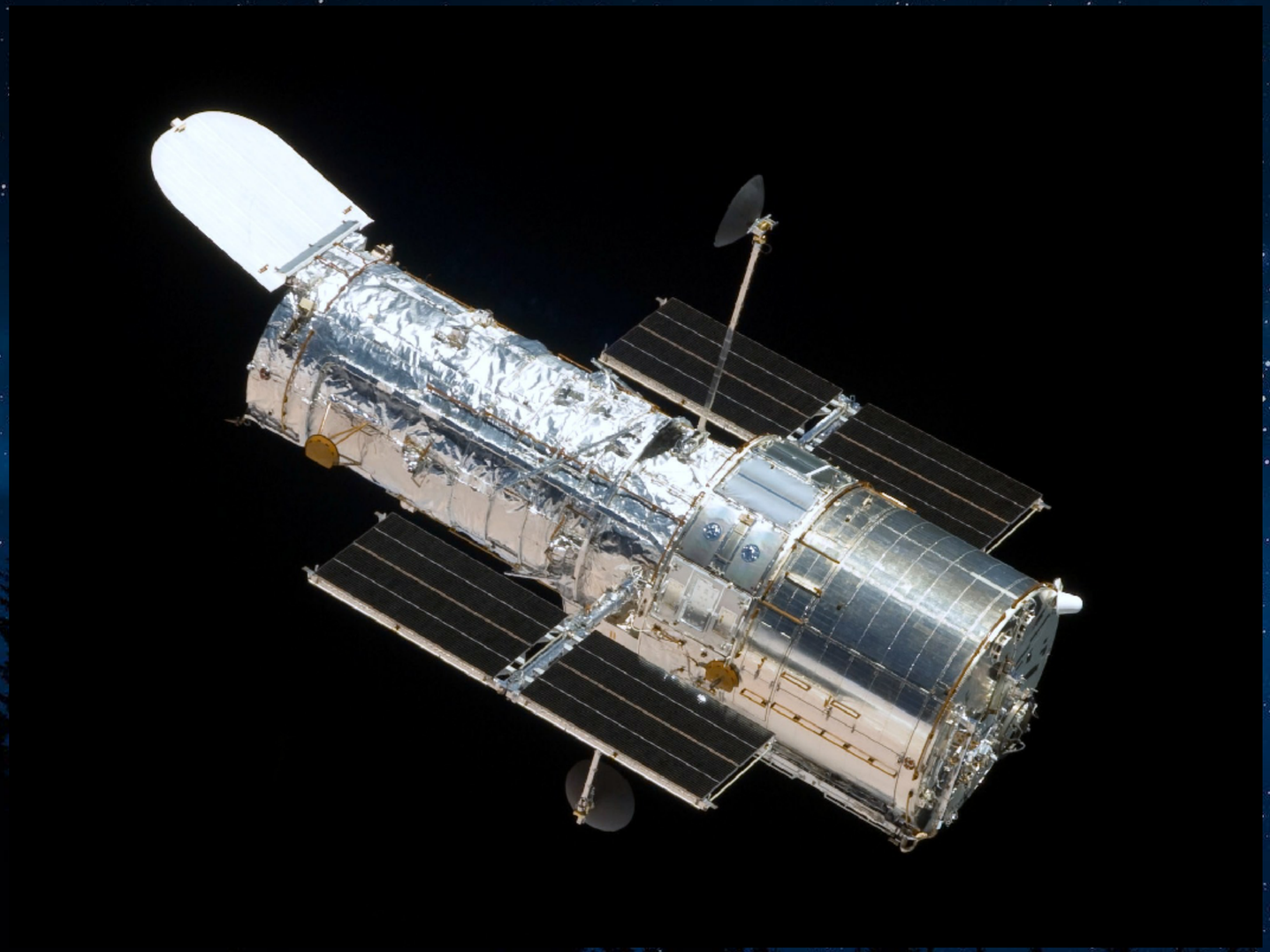
NASA/University of Chicago

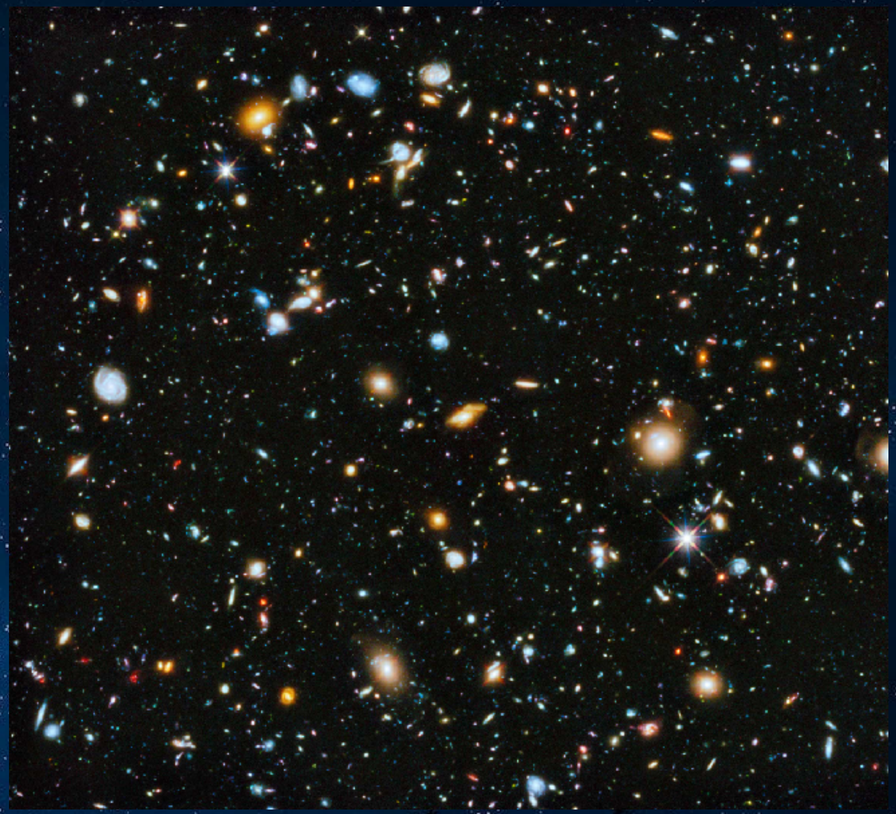
How do telescopes ‘see’ beyond the rainbow?

Seeing the Universe

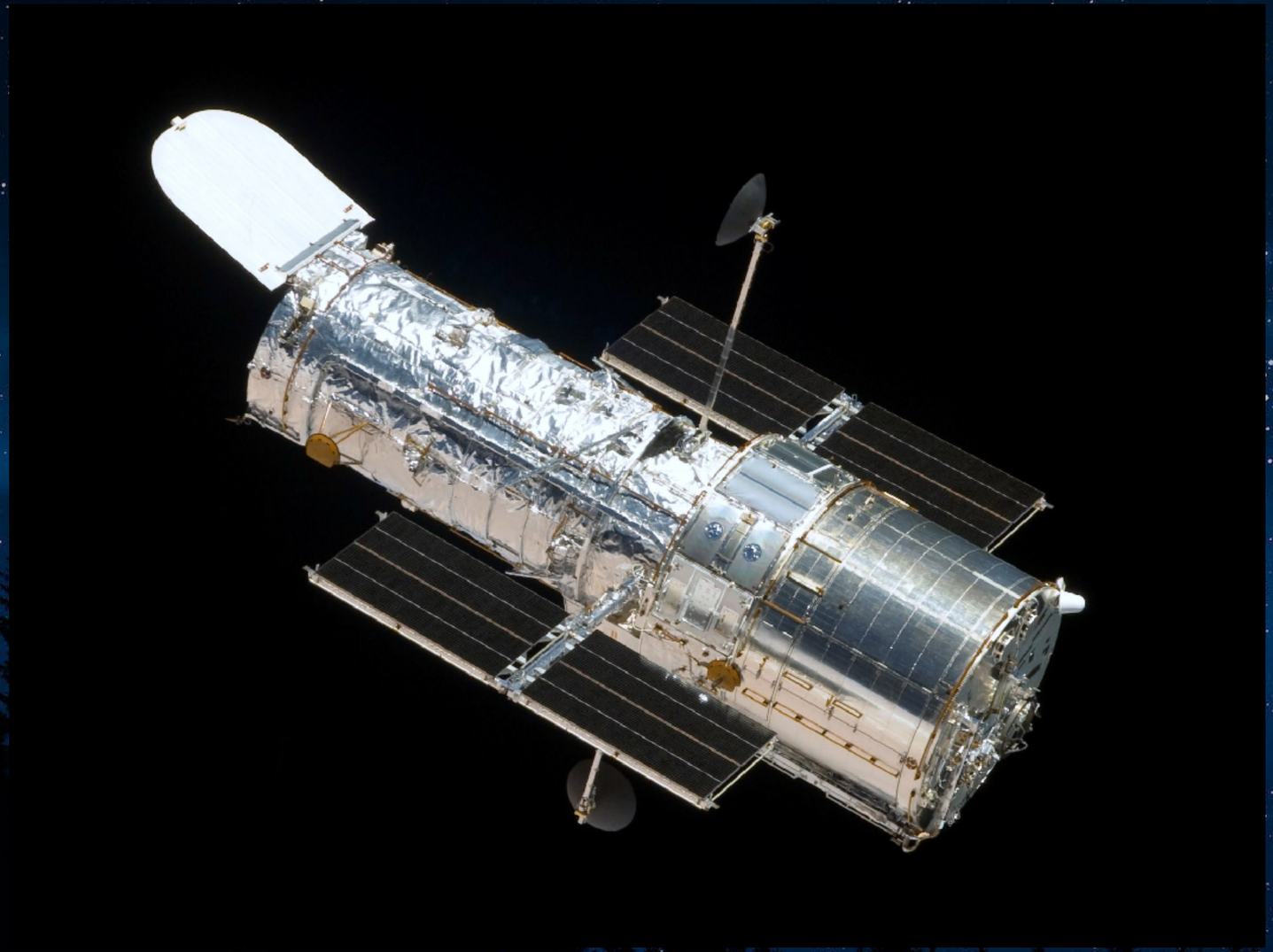


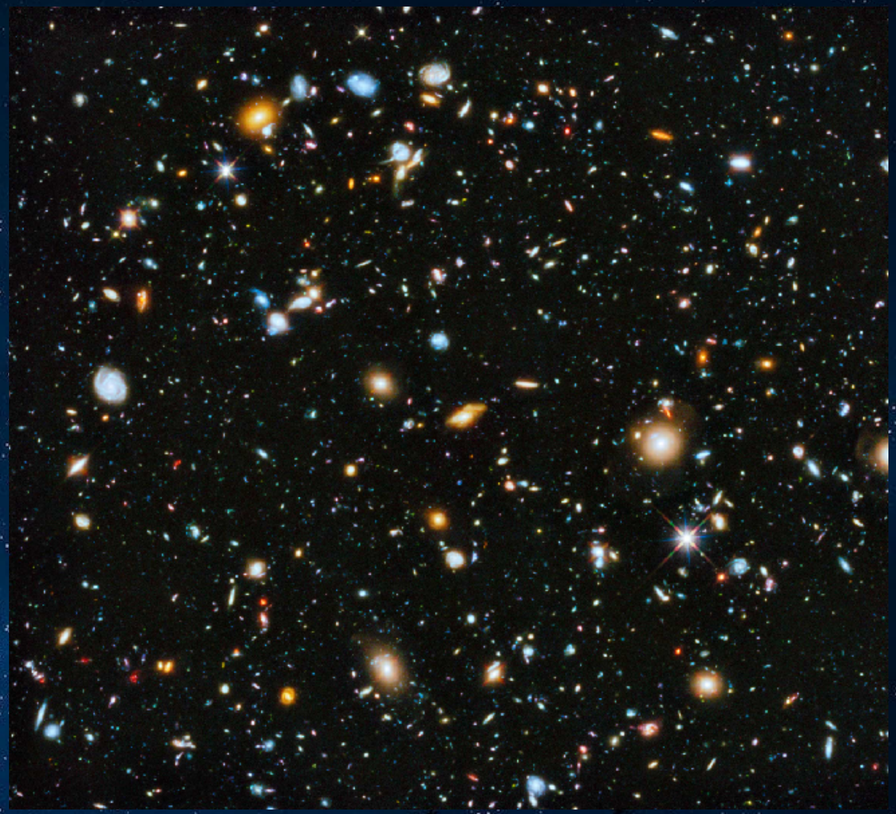
Name that telescope!





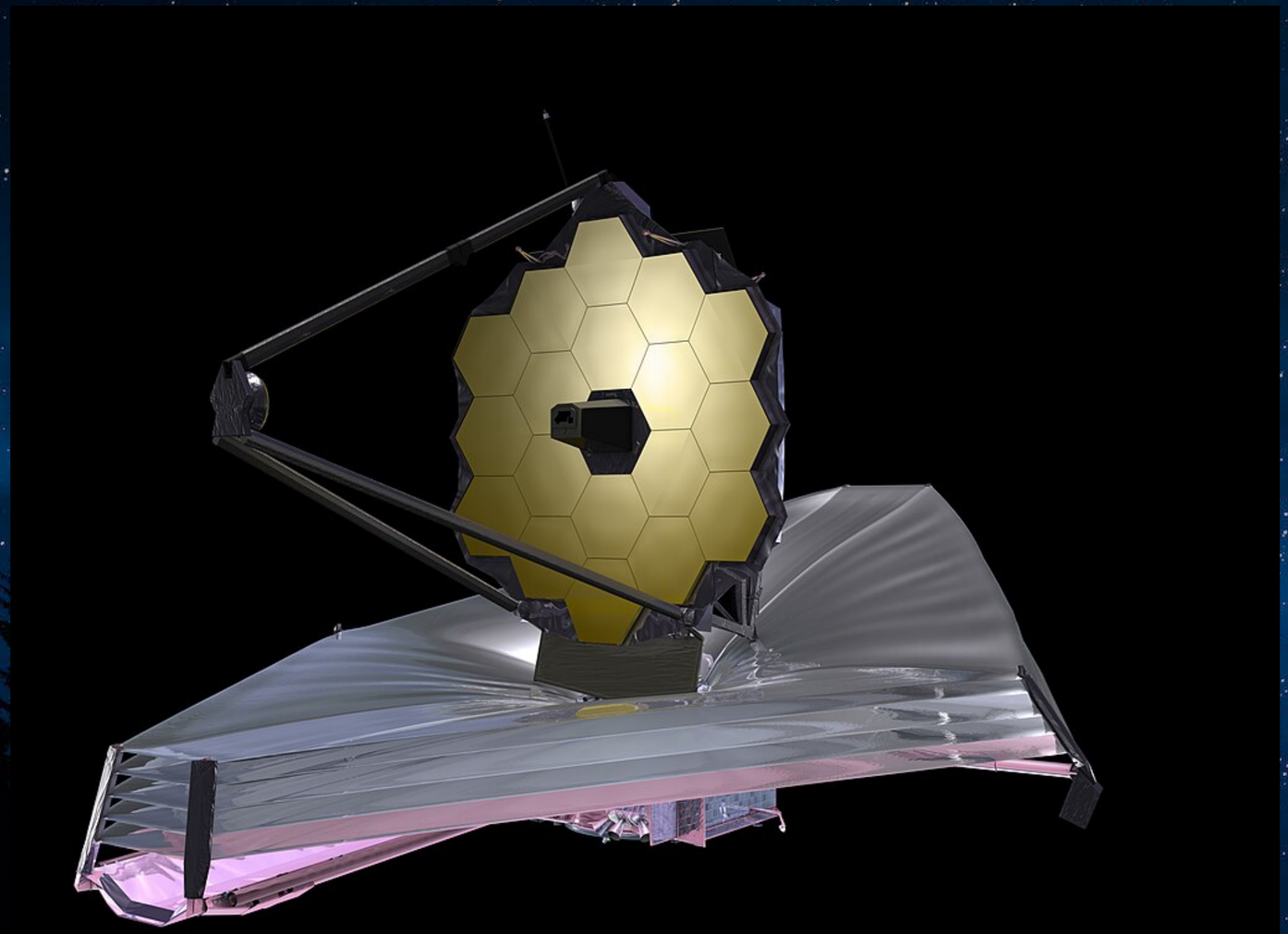
Name that telescope!



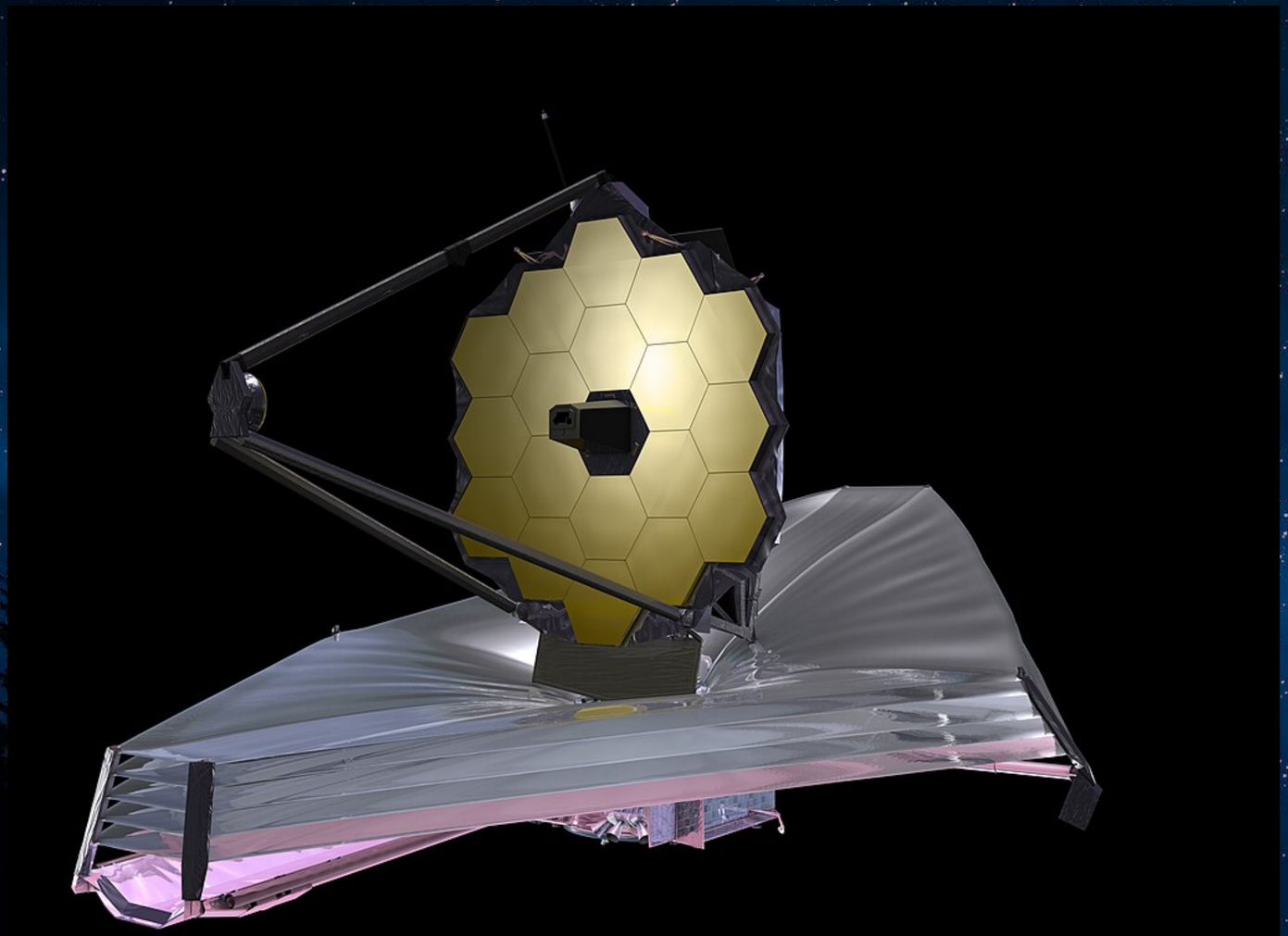


Hubble Space Telescope
(Optical)

Name that telescope!

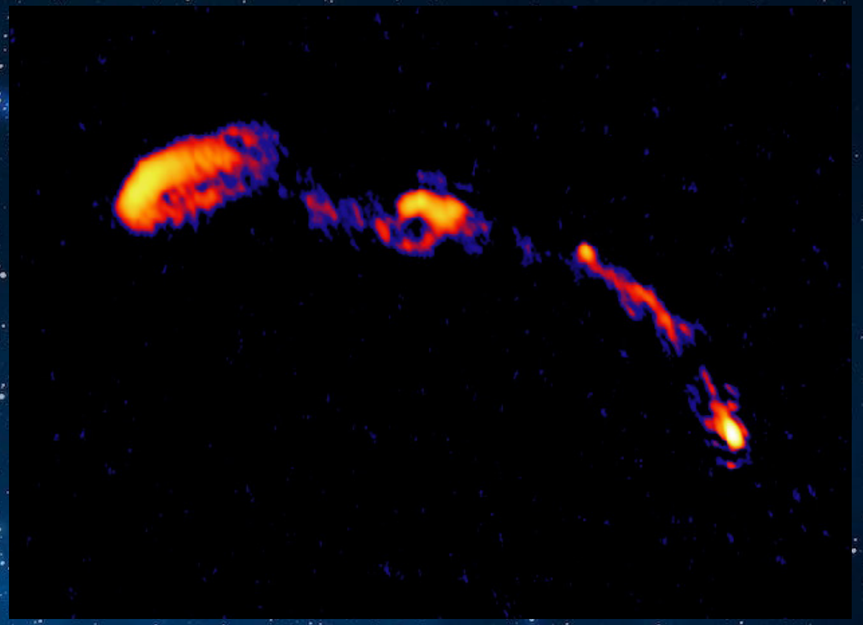


Name that telescope!

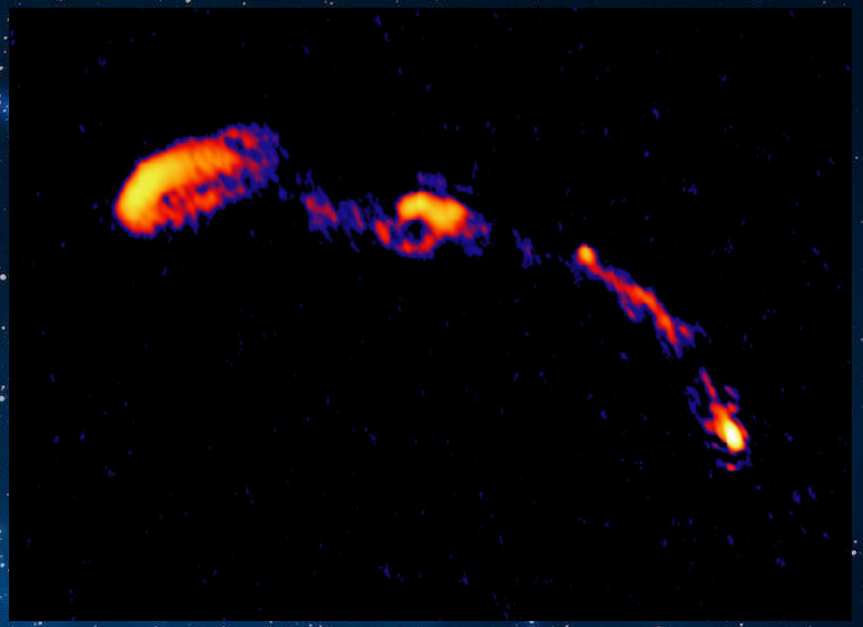


JWST (infrared)

Name that telescope!

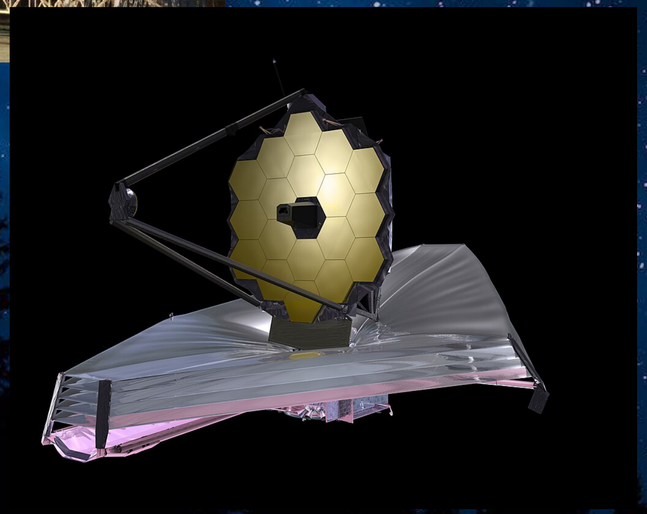


Name that telescope!



Lovell Telescope, Jodrell Bank
(Radio)

How is this a telescope??

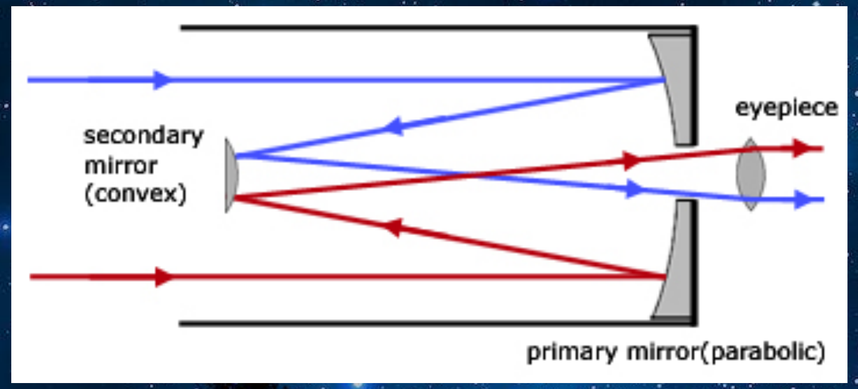


≠

?

Detecting electromagnetic waves

Collecting light with reflectors (or lenses)



Optical telescope
(Cassegrain)

Radio dish

Detecting electromagnetic waves

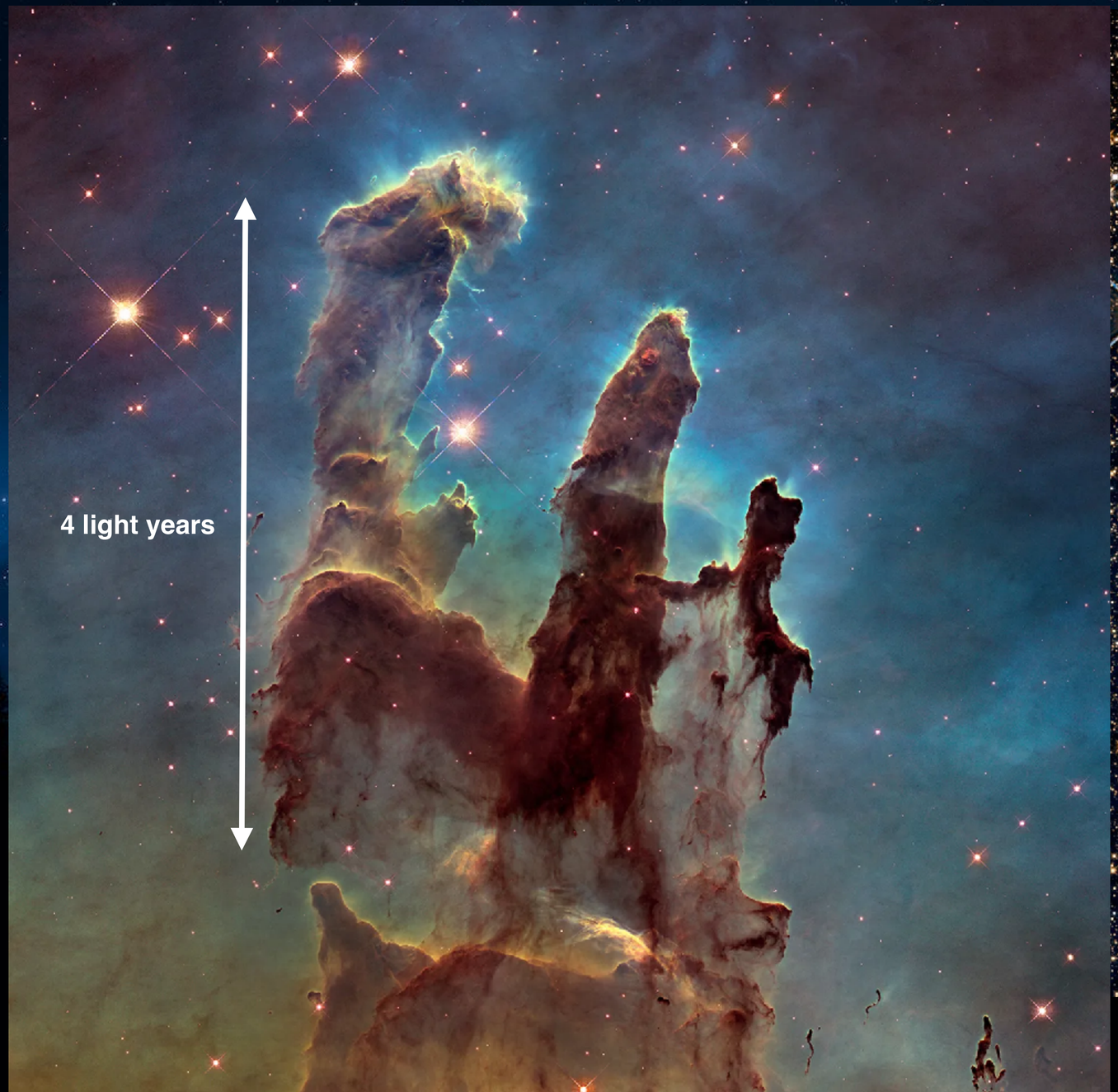
Same technology!

Also a telescope!

Show us the pretty pictures!!

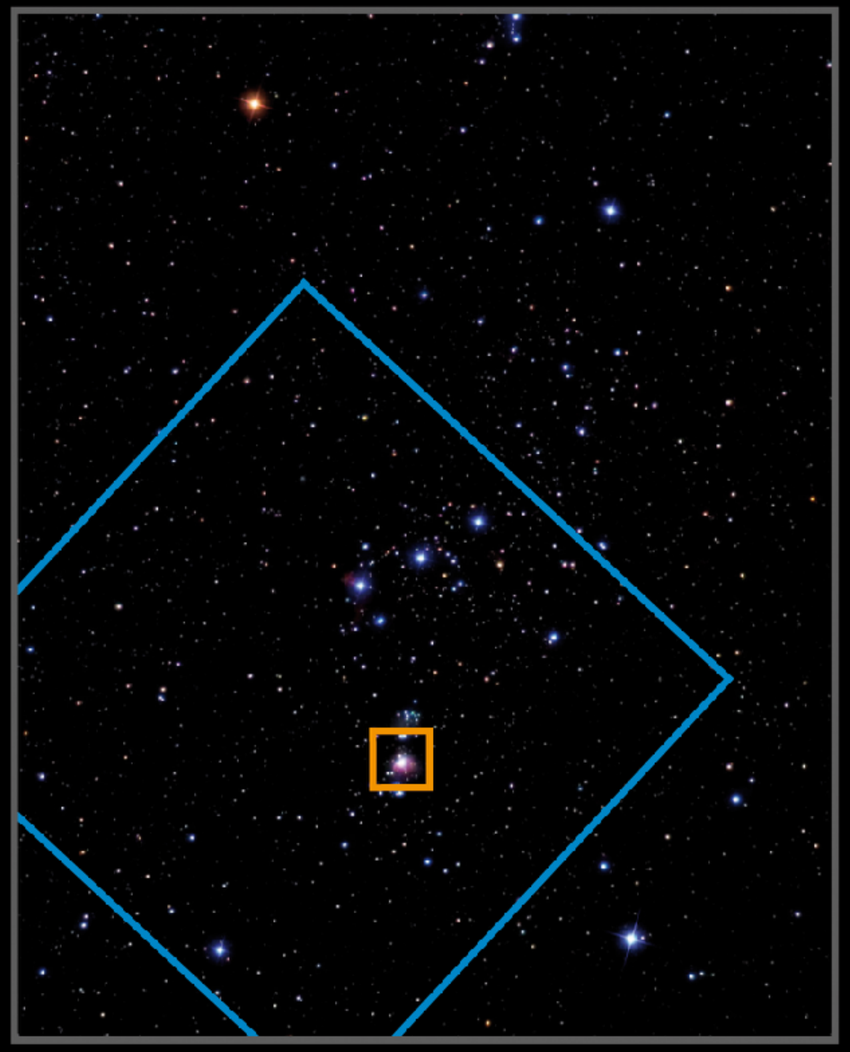
Pillars of Creation

Pillars of Creation



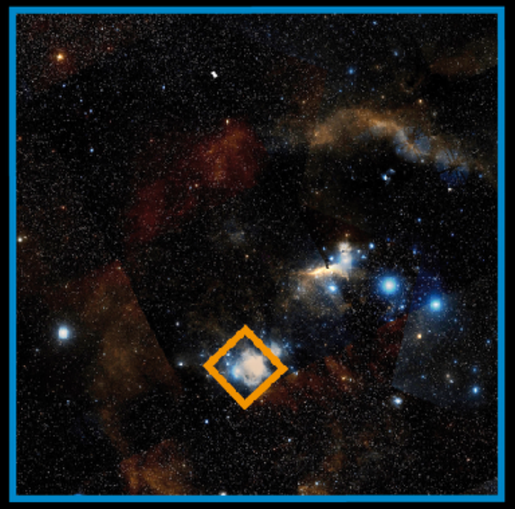
GO STARGA

The Orion Nebula

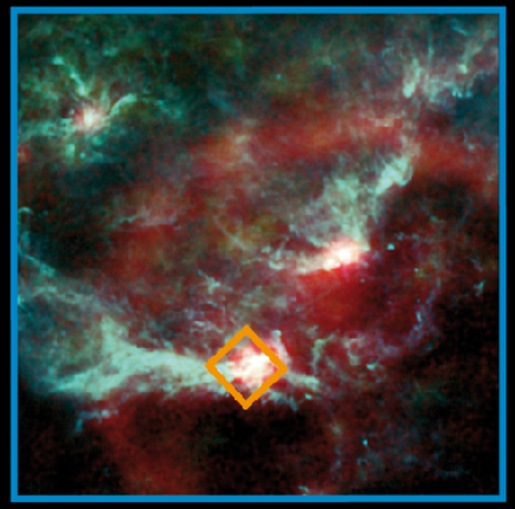


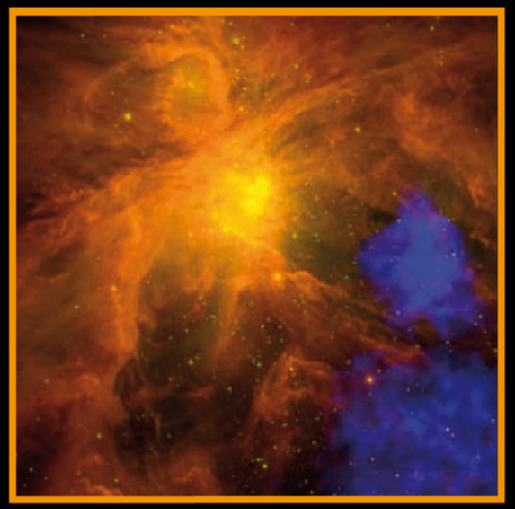
VISIBLE
ground-based observatory (Kosmas Gazeas)

VISIBLE
ground-based observatory
Digitized Sky Survey



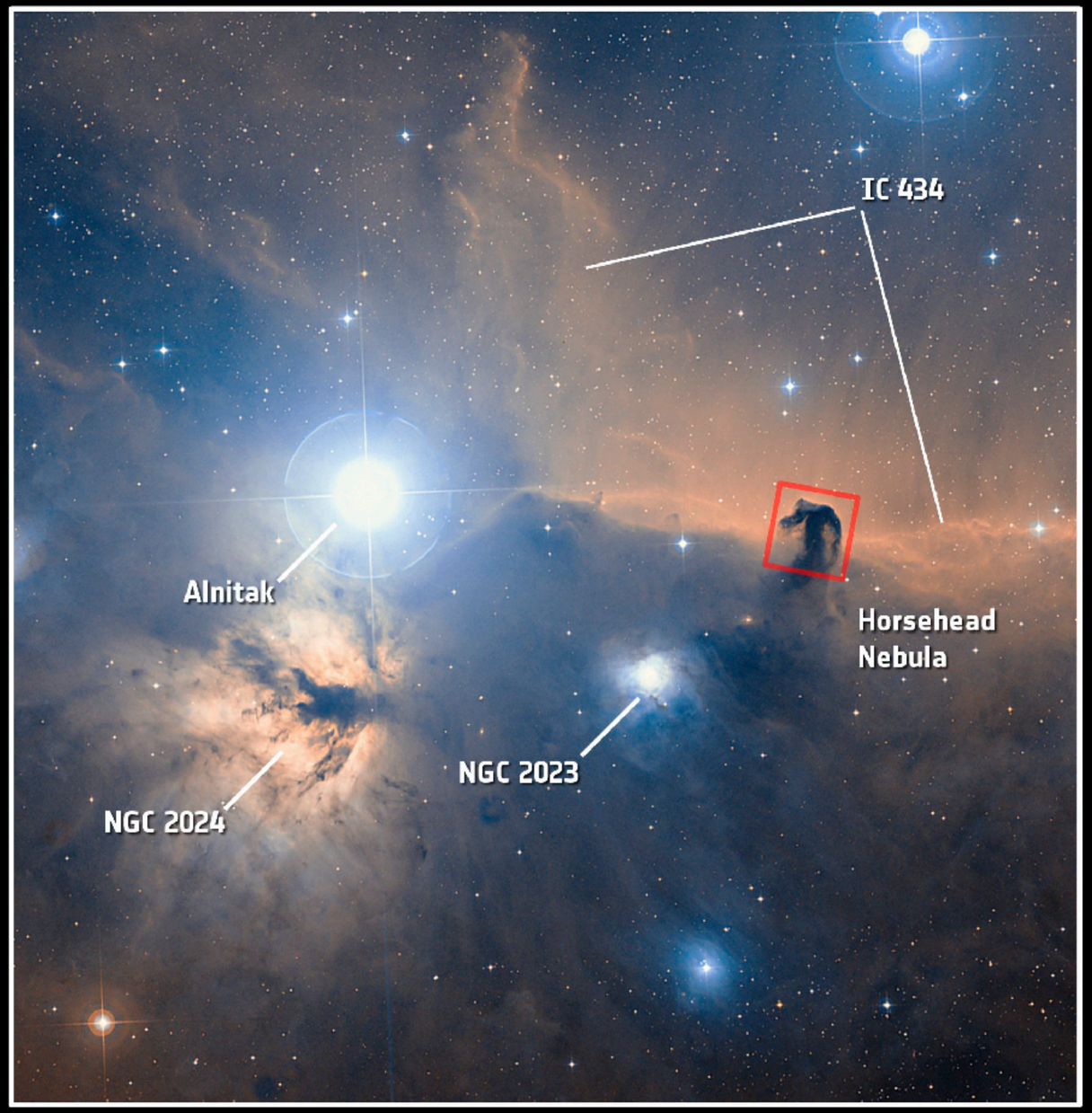
MICROWAVE & SUB-MM
Planck satellite





MID-INFRARED (orange/yellow)
Spitzer Space Telescope
X-RAY (blue)
XMM-Newton space observatory

VISIBLE & NEAR-INFRARED
Hubble Space Telescope



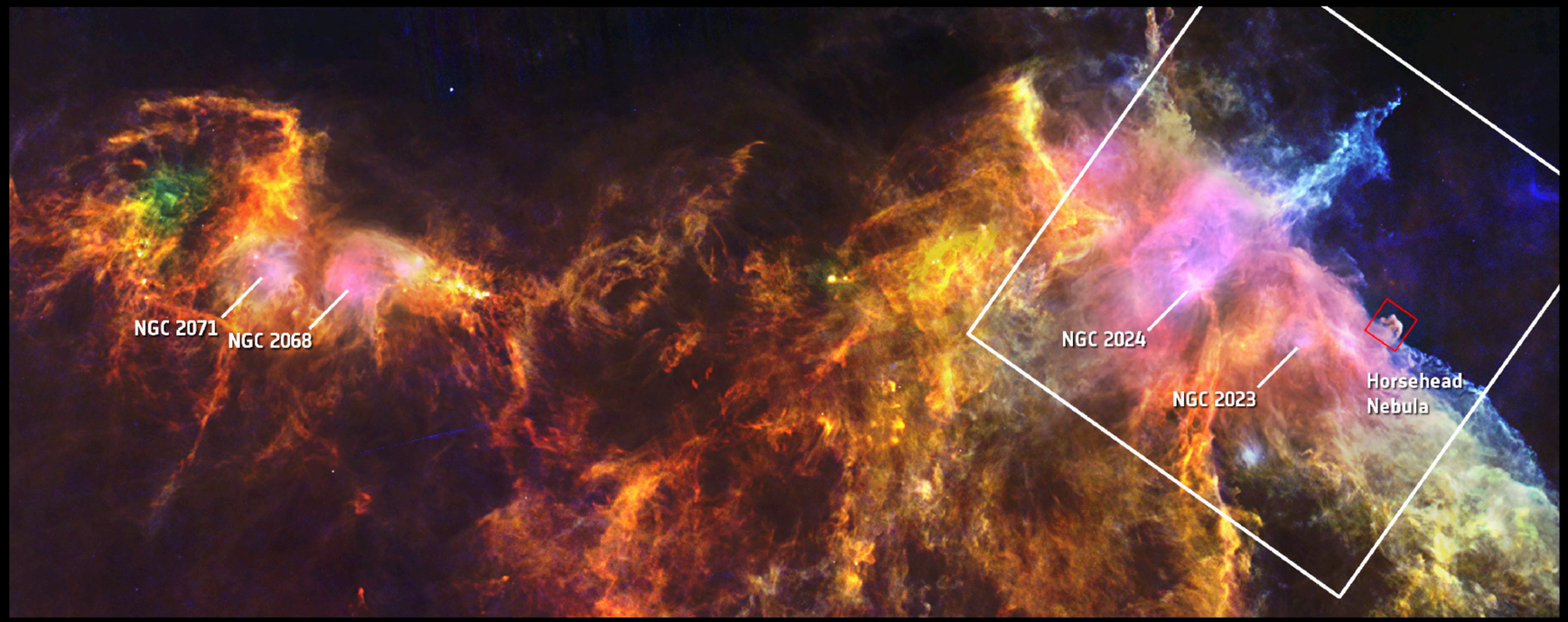
Visible

dss2

Near-infrared

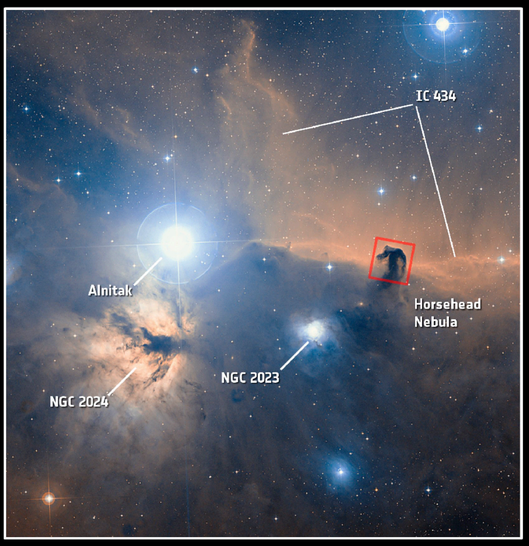
hubble space telescope

→THE ORION B MOLECULAR CLOUD AND THE HORSEHEAD NEBULA



Far-infrared

herschel



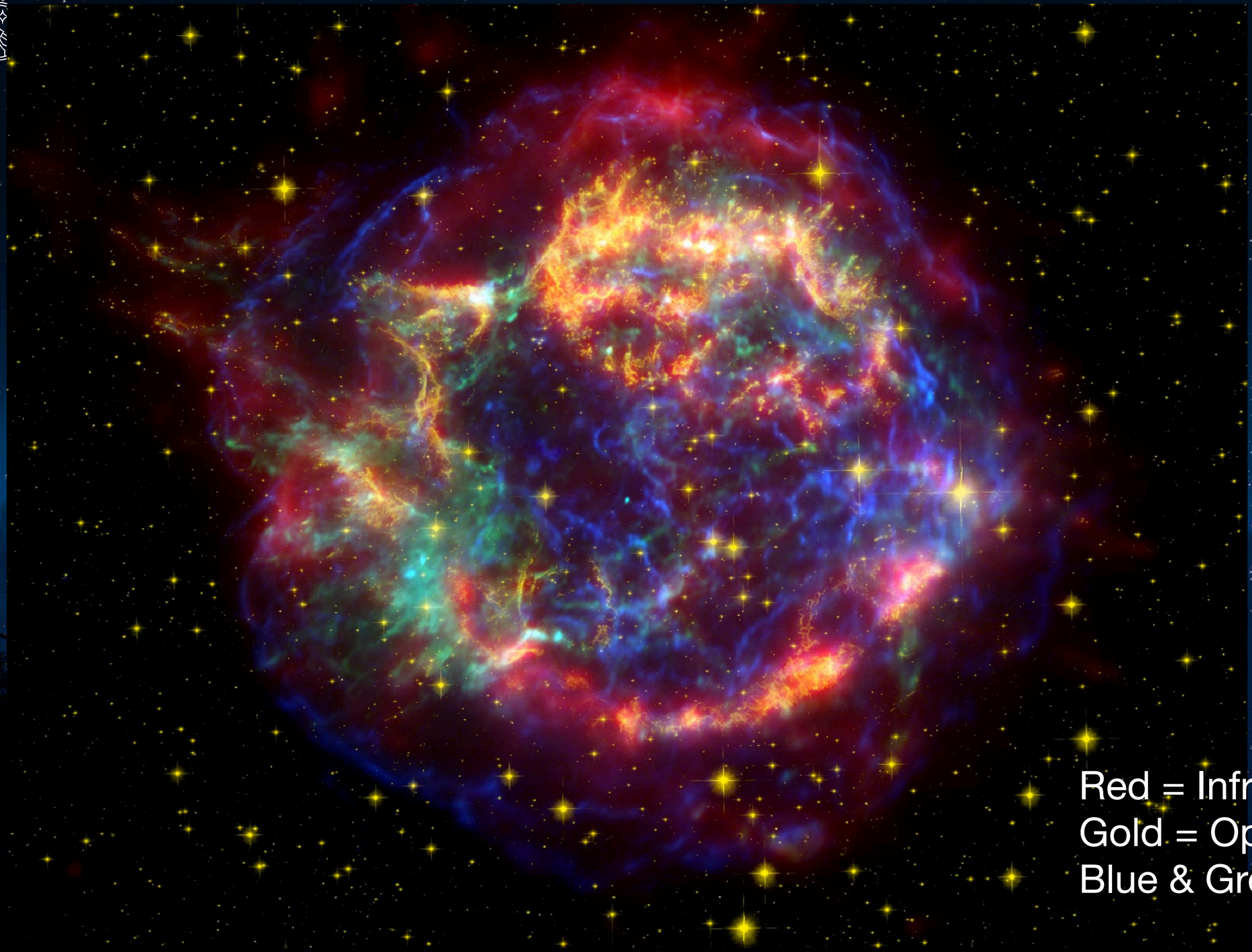
Visible

dss2

Near-infrared

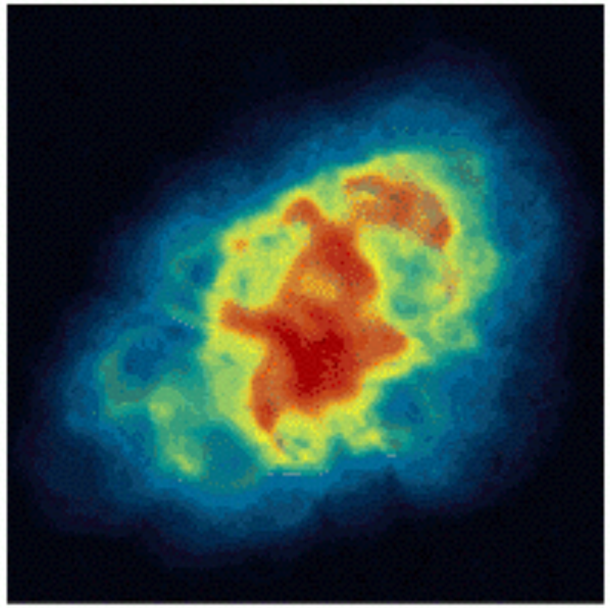
hubble space telescope

Cassiopea A



Red = Infrared (Spitzer)
Gold = Optical (HST)
Blue & Green = X-Ray (Chandra)

GO STARGAZING

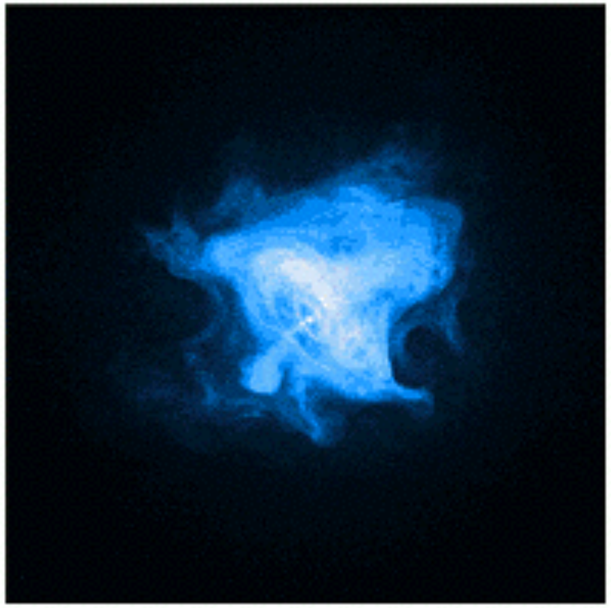


RADIO

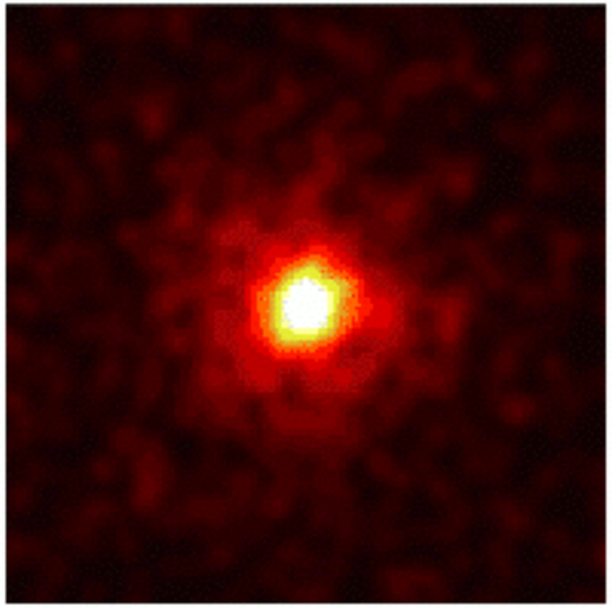
INFRARED

VISIBLE LIGHT

ULTRAVIOLET

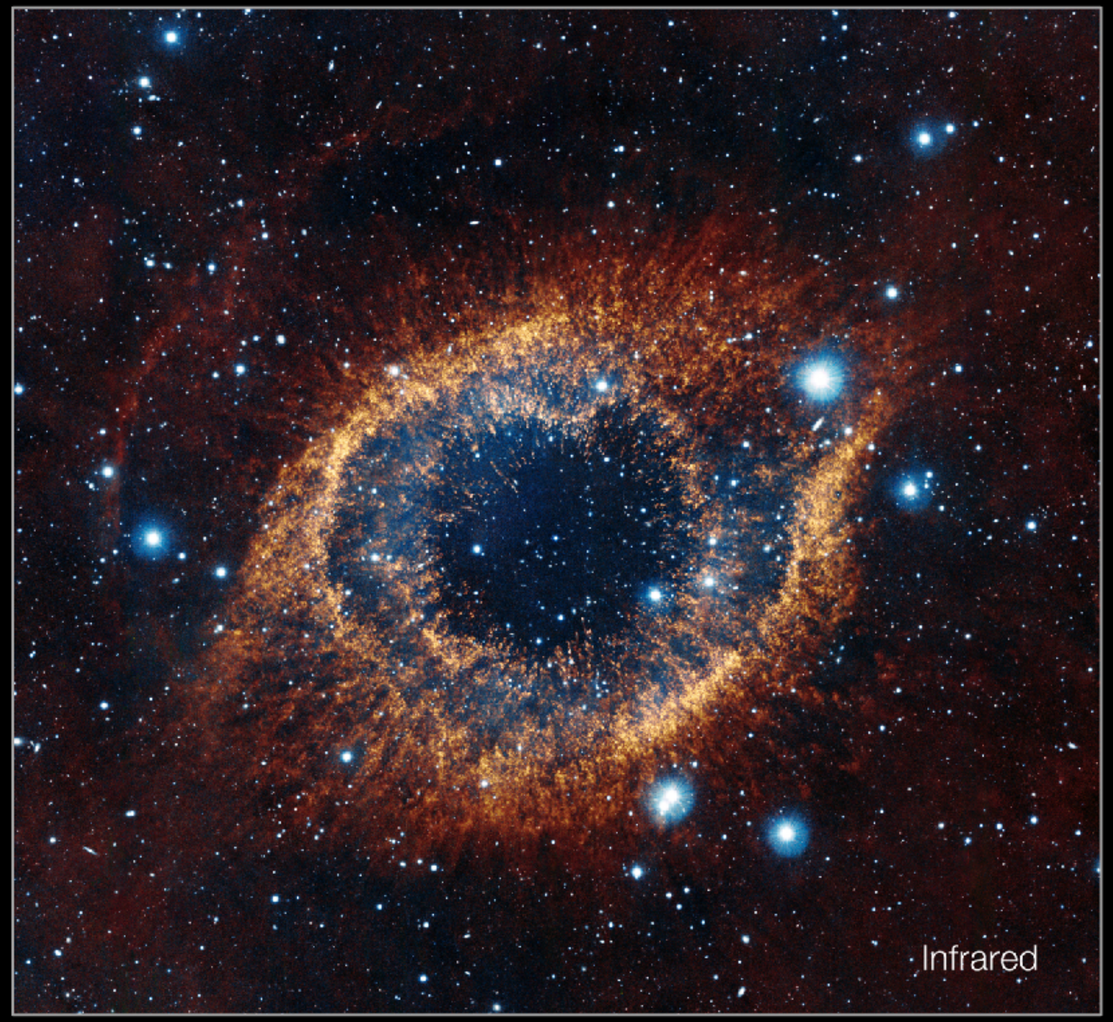


X-RAYS



GAMMA RAYS

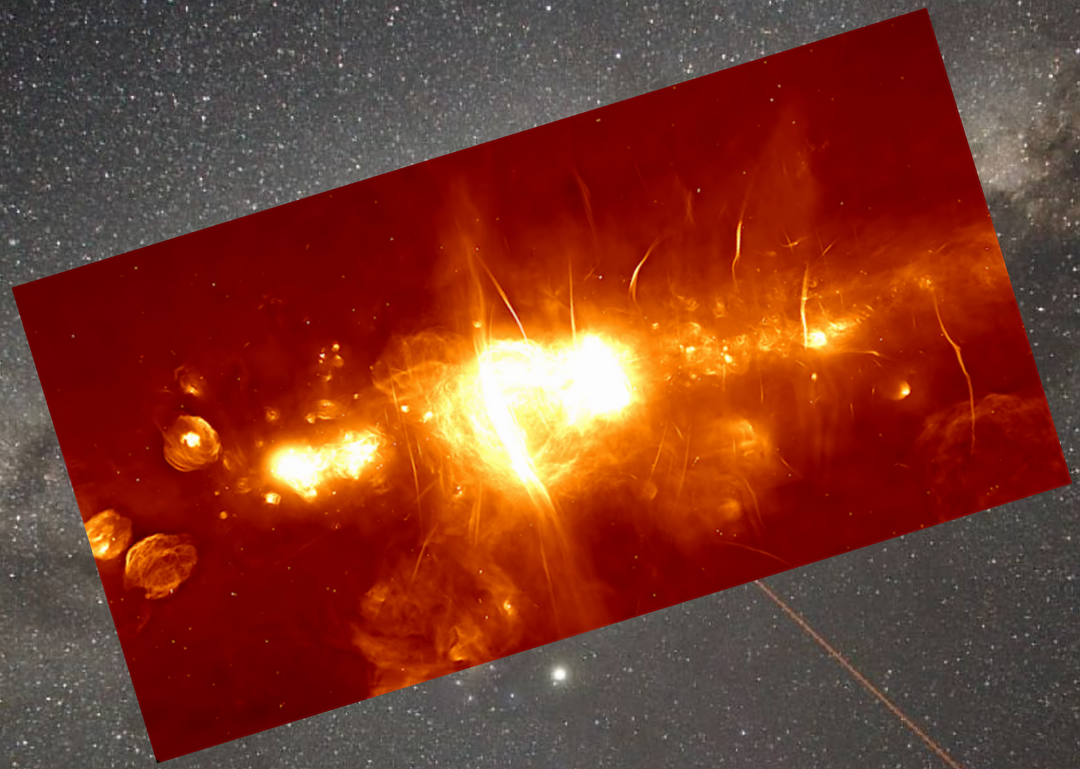
Ring nebula

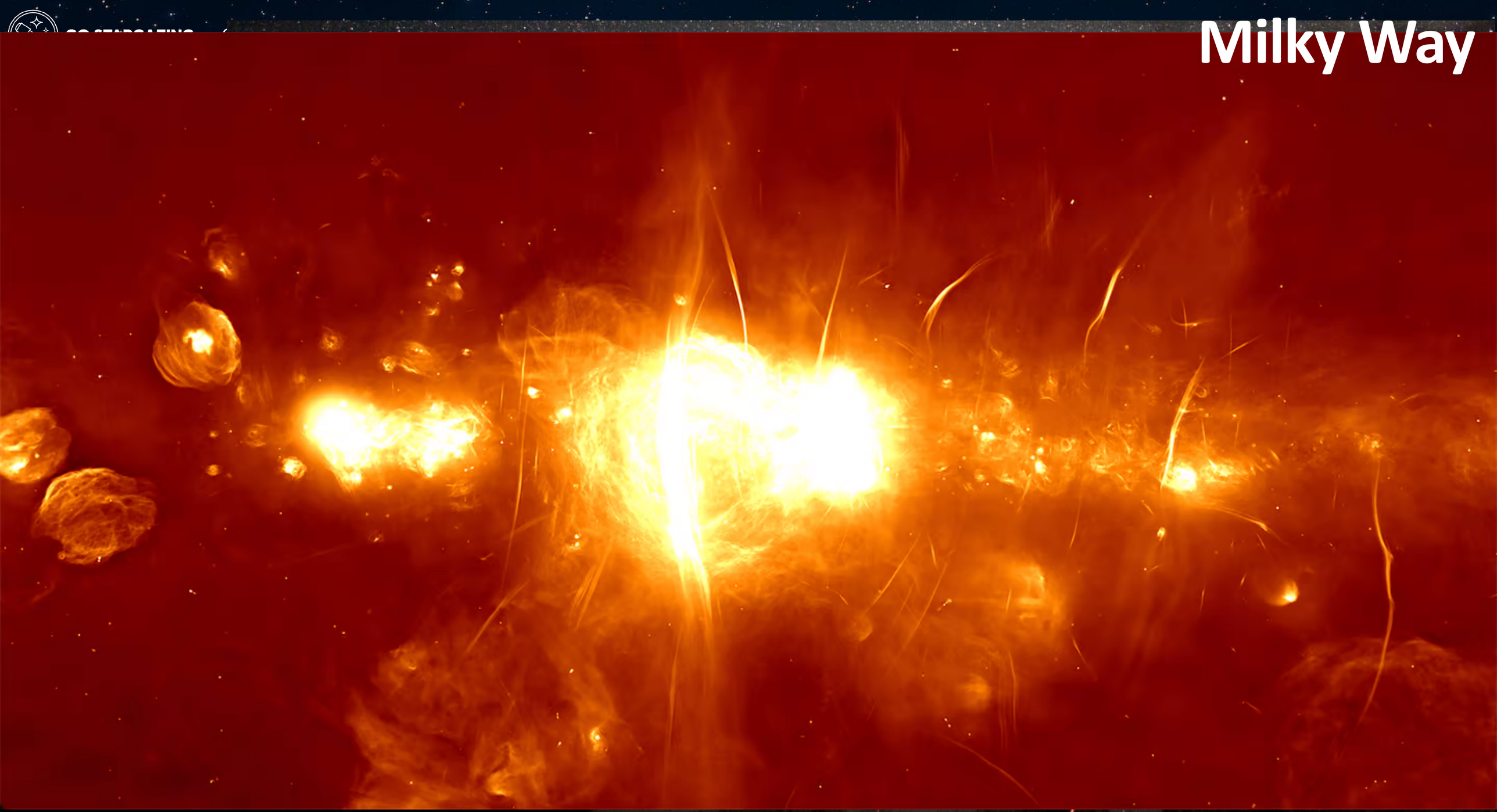

Infrared


Dark Blue = helium
Light Blue = hydrogen and oxygen
Red = nitrogen and sulfur
Visible light

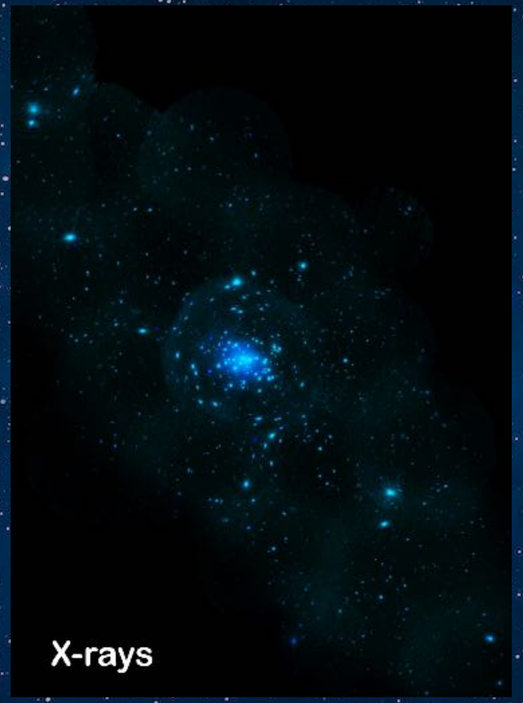
Milky Way

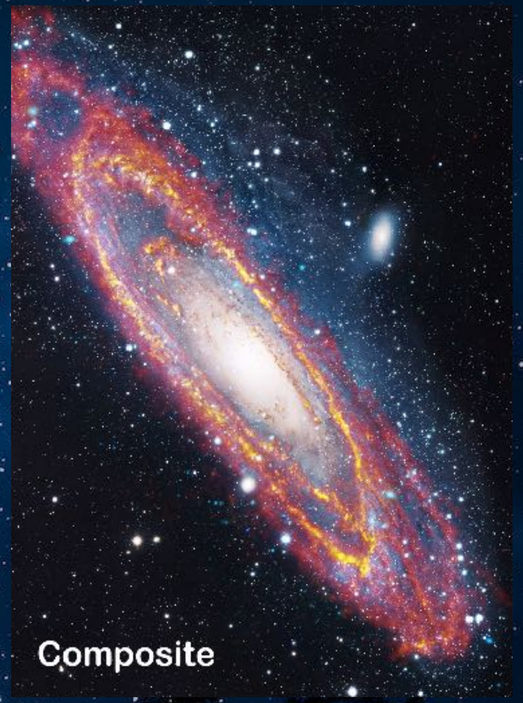
Milky Way



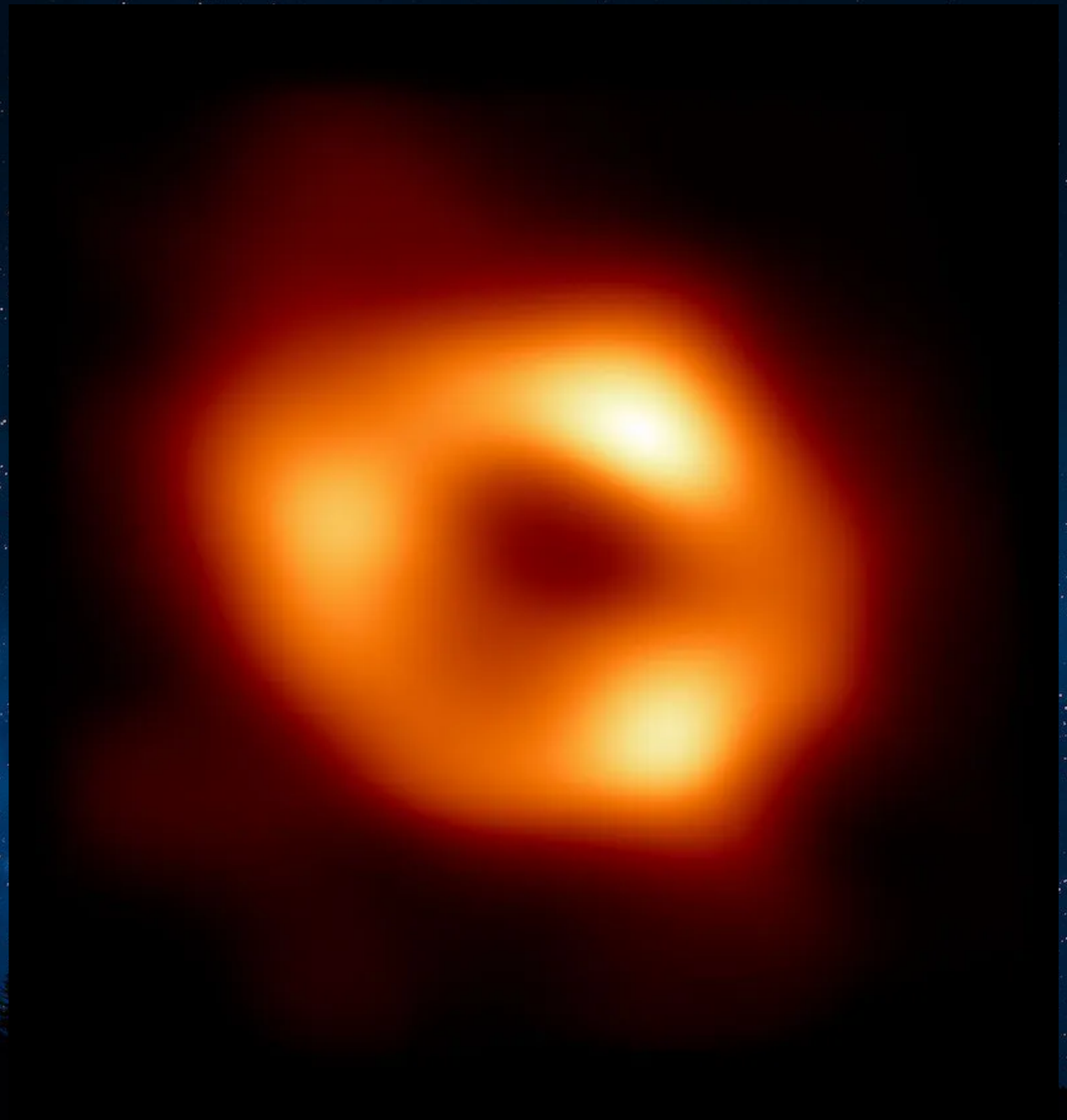

Milky Way

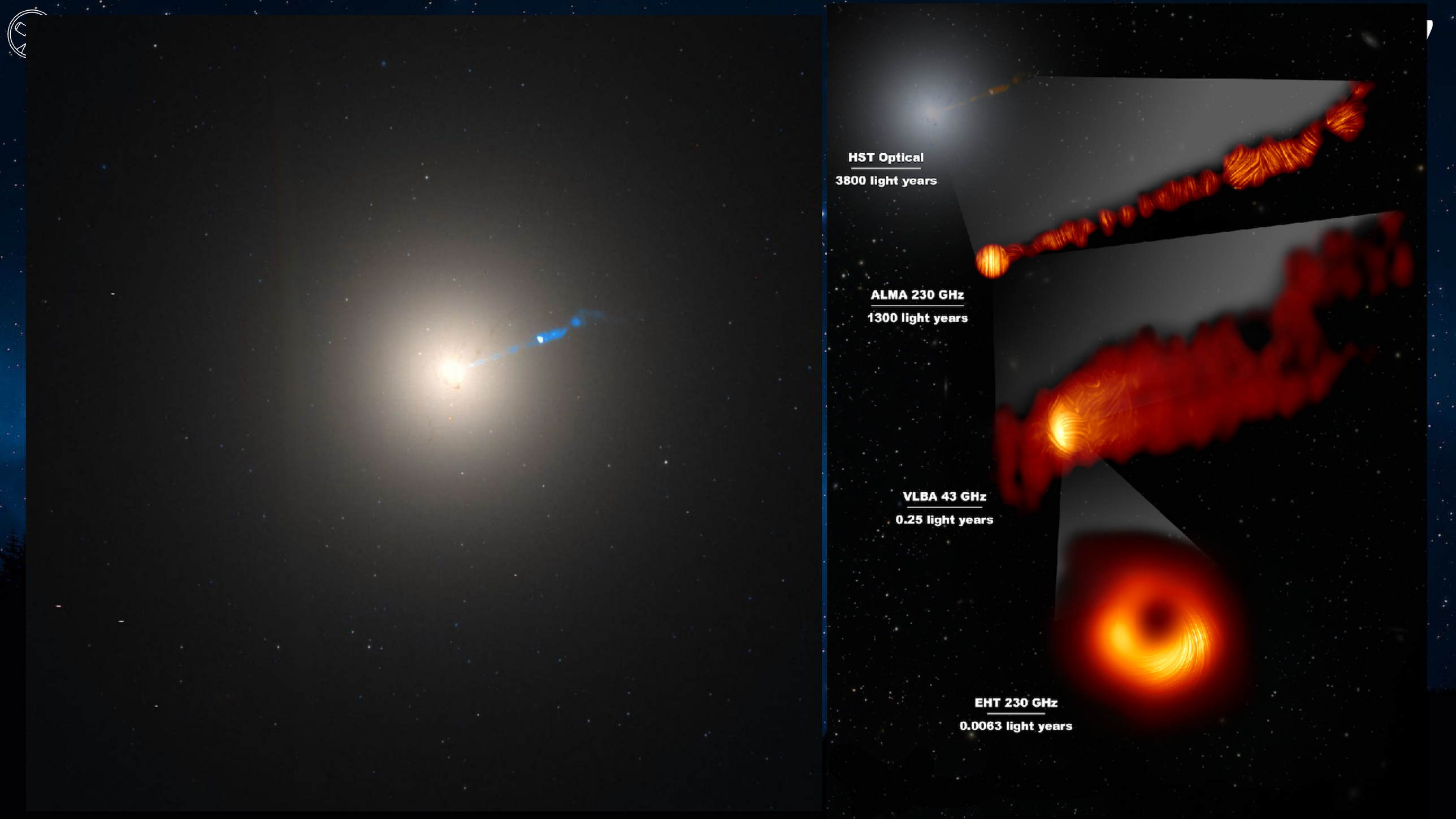
Andromeda Galaxy



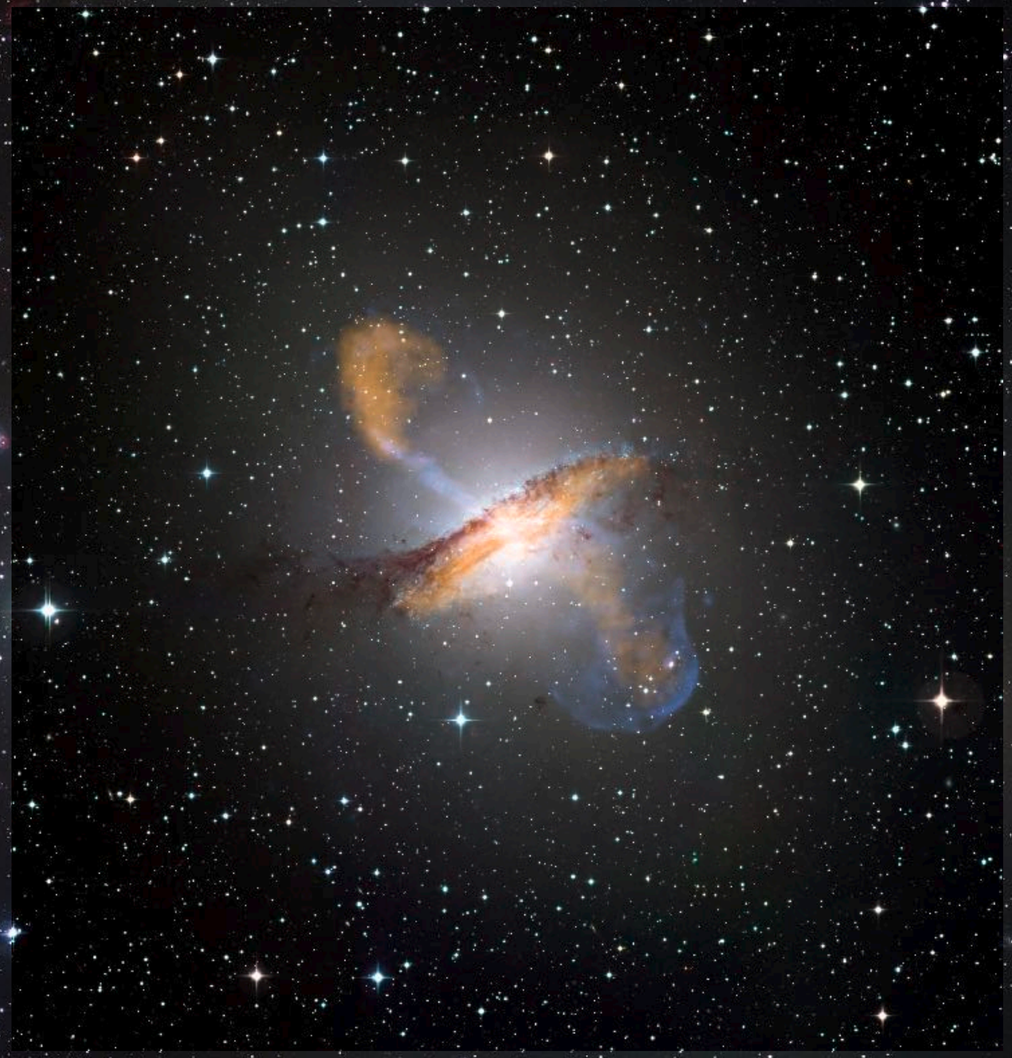


M87



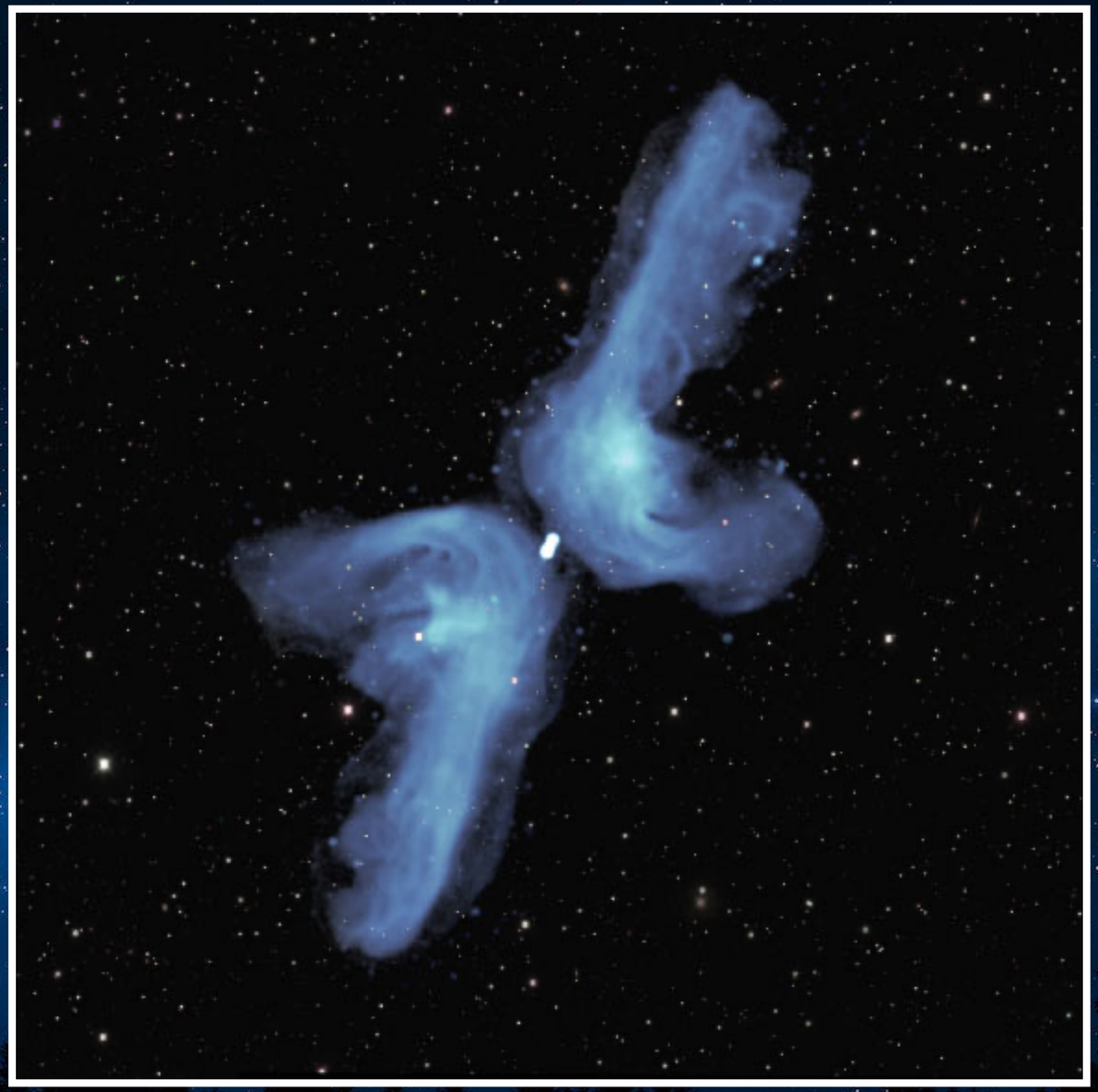

HST Optical
3800 light years
ALMA 230 GHz
1300 light years
VLBA 43 GHz
0.25 light years
EHT 230 GHz
0.0063 light years

Centaurus A

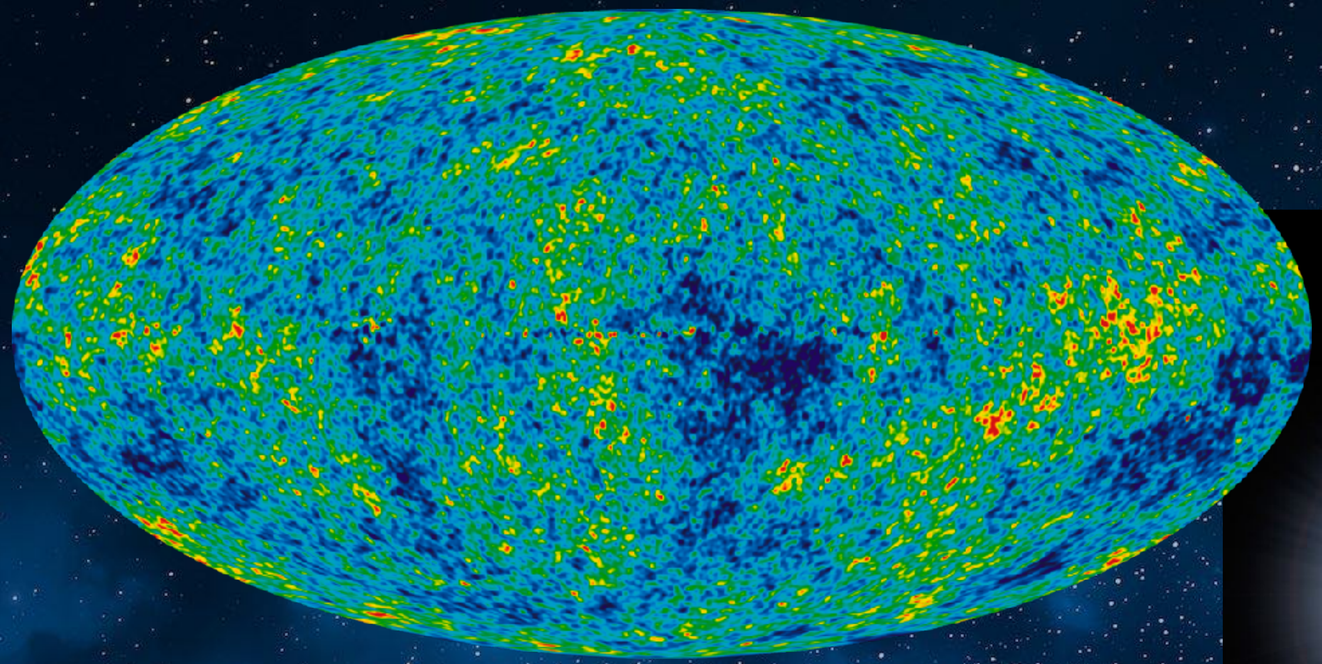


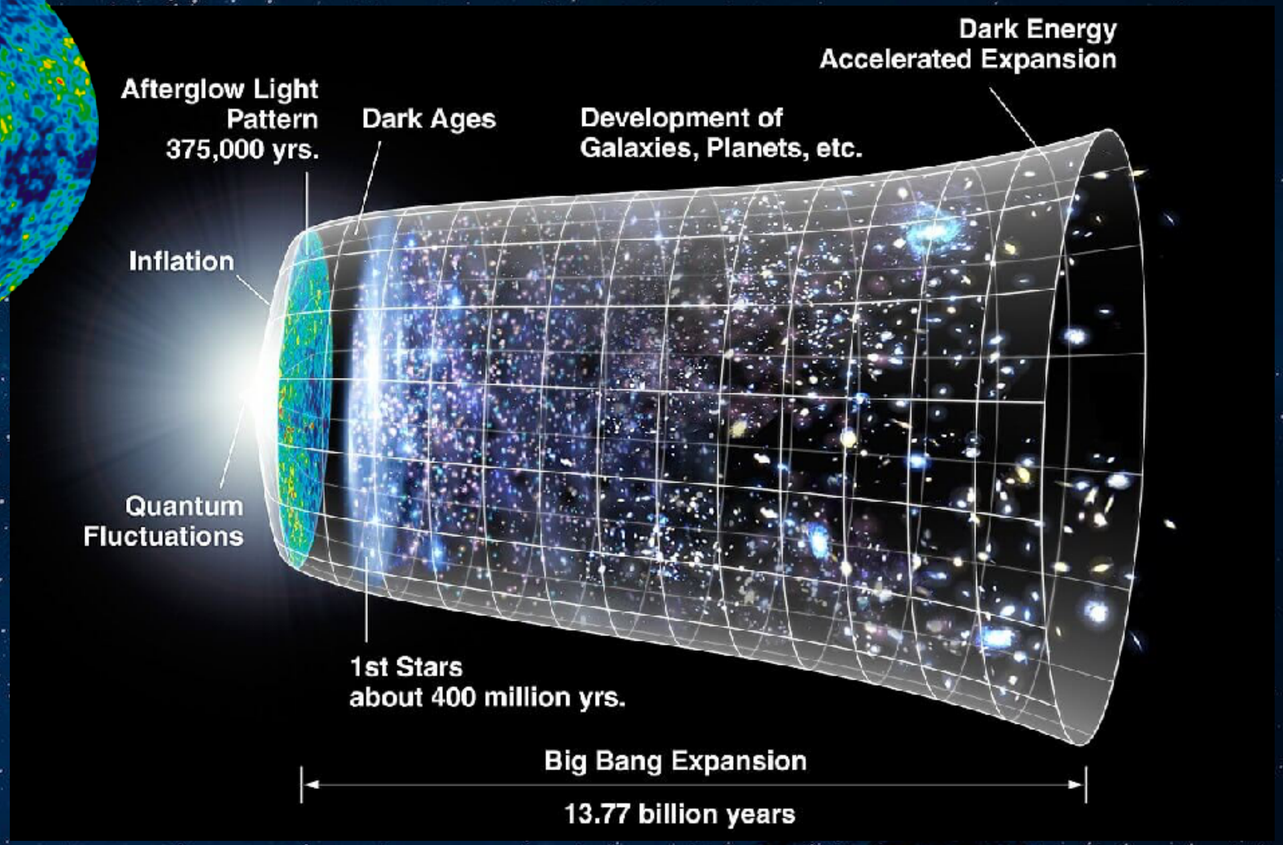
ESO

Image credit: Ilana Feain, Tim Cornwell & Ron Ekers (CSIRO/ ATNF).
ATCA northern middle lobe pointing courtesy R. Morganti (ASTRON).
Parkes data courtesy N. Junkes (MPIfR).
ATCA & Moon photo: Shaun Amy, CSIRO

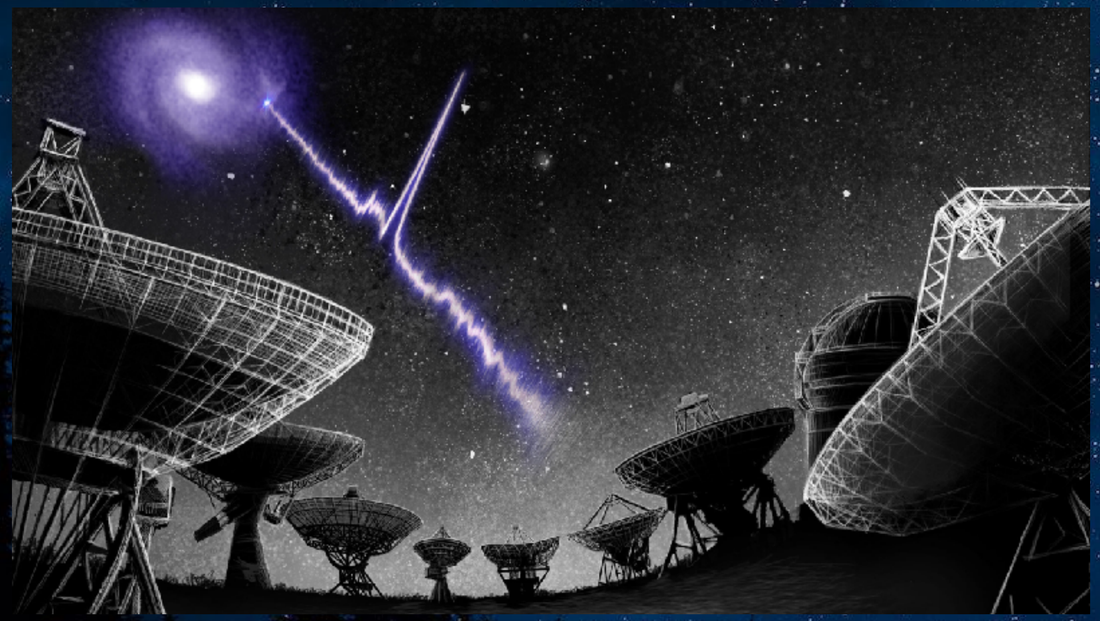


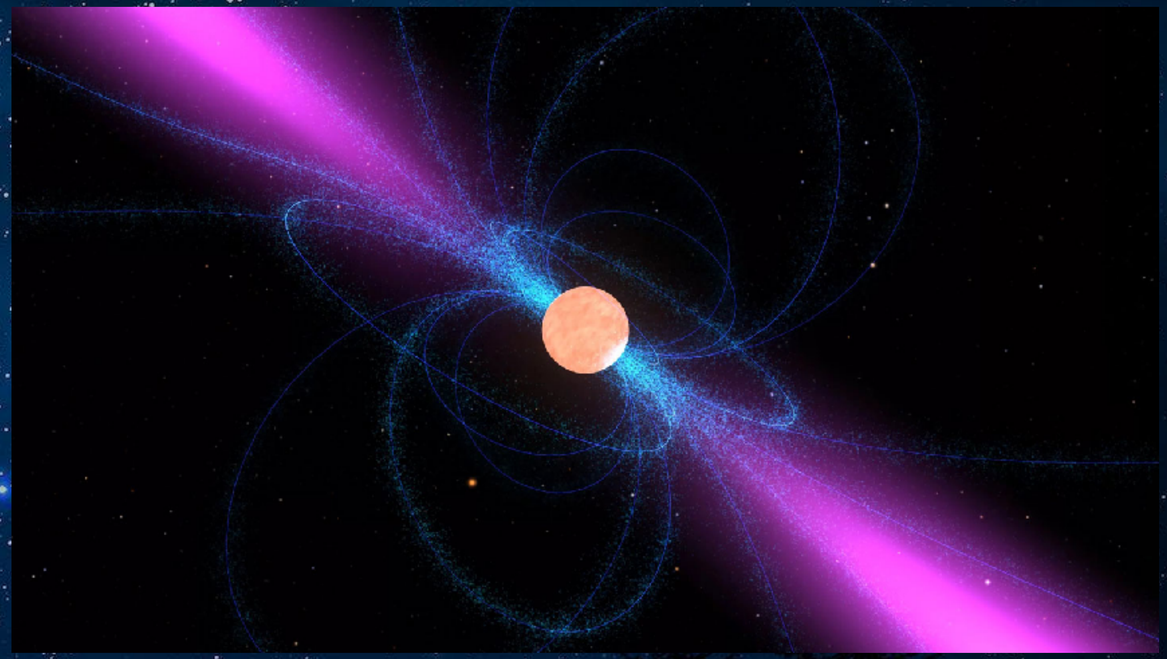
Microwaves




Dark Energy
Accelerated Expansion
Afterglow Light
Pattern
375,000 yrs.
Dark Ages
Development of
Galaxies, Planets, etc.
Inflation
Quantum
Fluctuations
1st Stars
about 400 million yrs.
Big Bang Expansion
13.77 billion years

Transient astronomy



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