Summary:

- EM Spectrum
- Spectra
- Blackbodies + Wien's Law
- Spectroscopy
- Spectral Types
- Luminosity and the inverse square law
- Variation in Luminosity

Solar Radiation

and Spectral Types

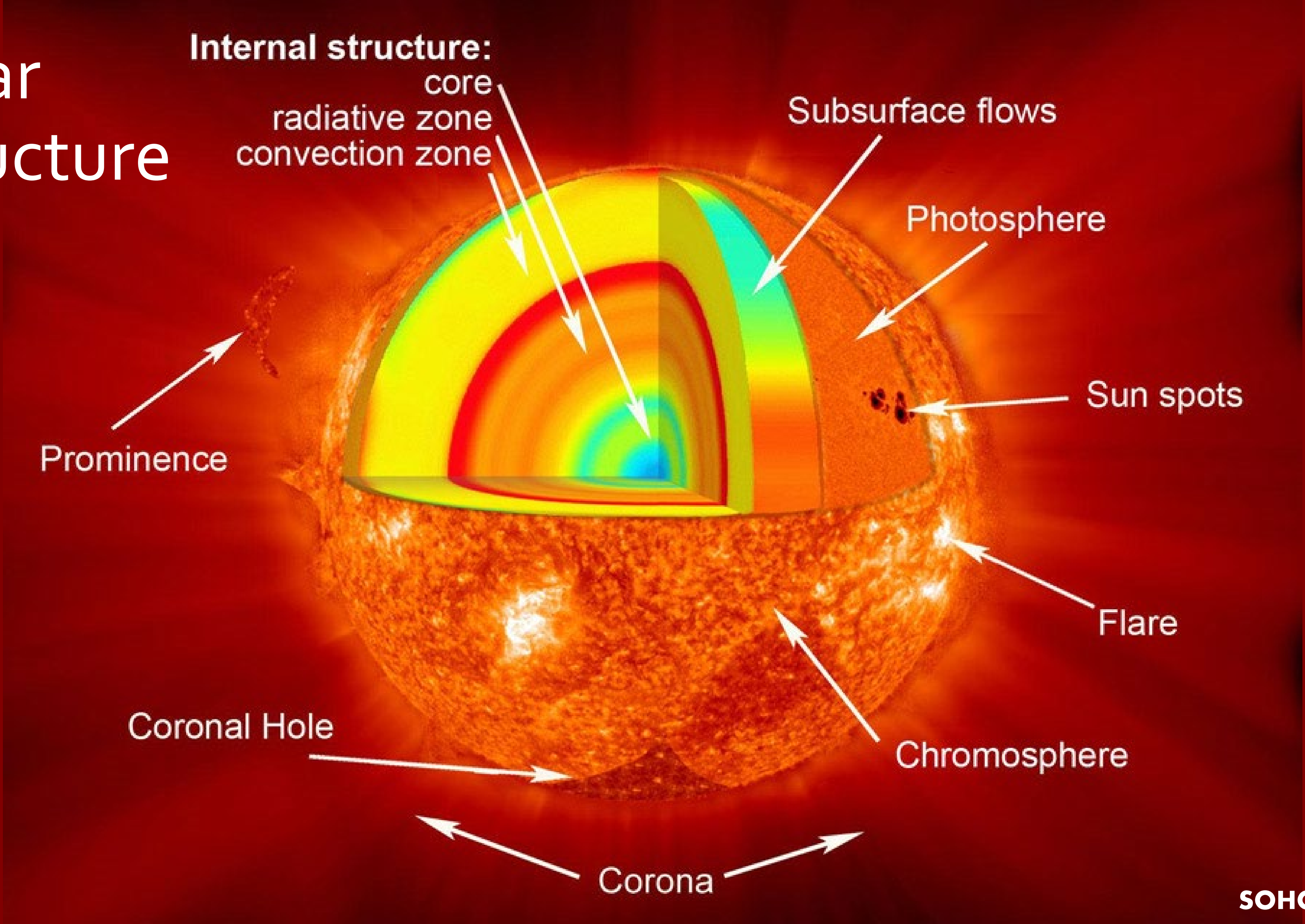
Recap

1. Name as many layers of the Sun. Deepest first.

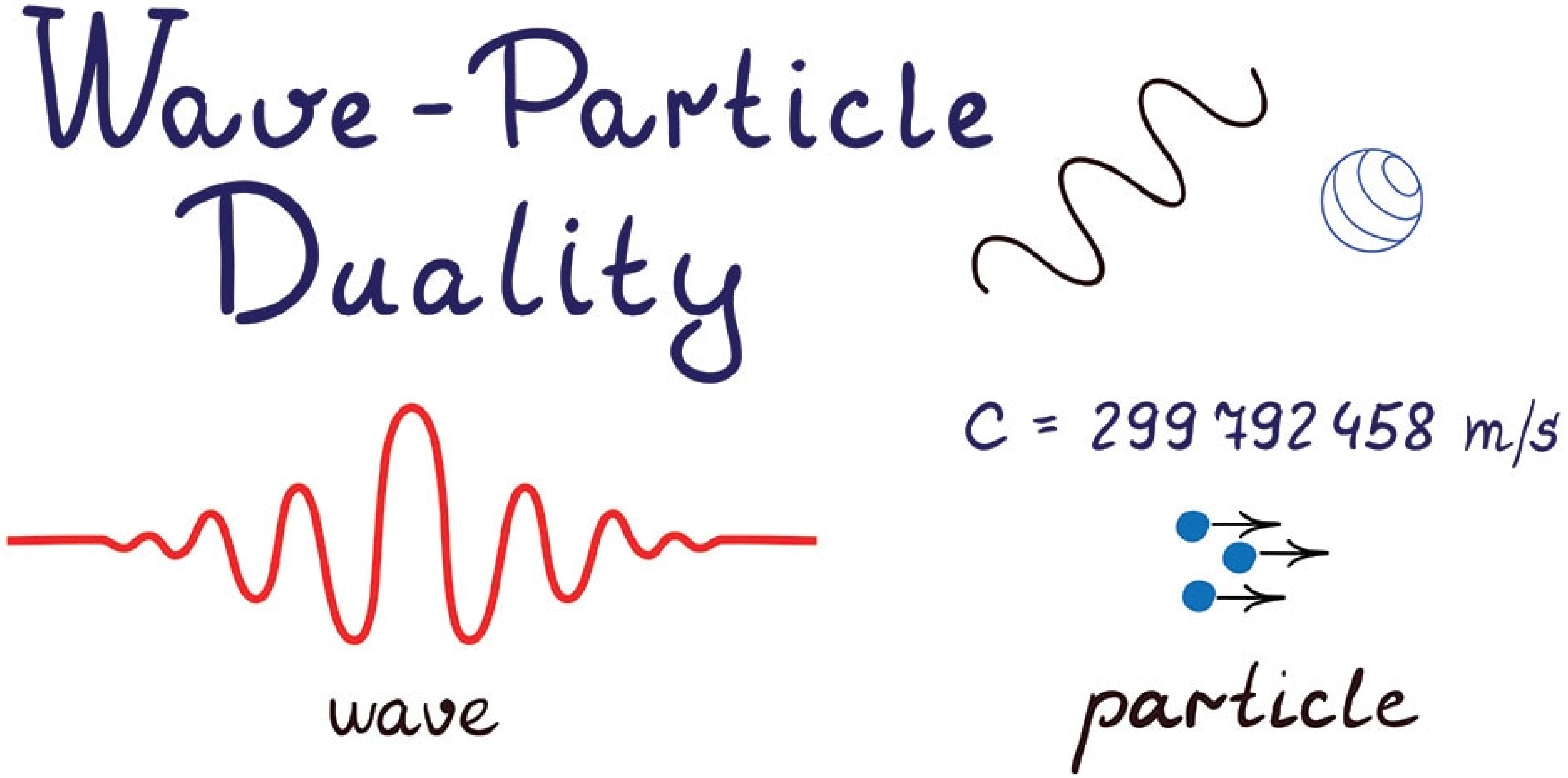
2. Name three features on the Sun’s surface.

3. What can we only observe during a solar eclipse?

Solar Structure

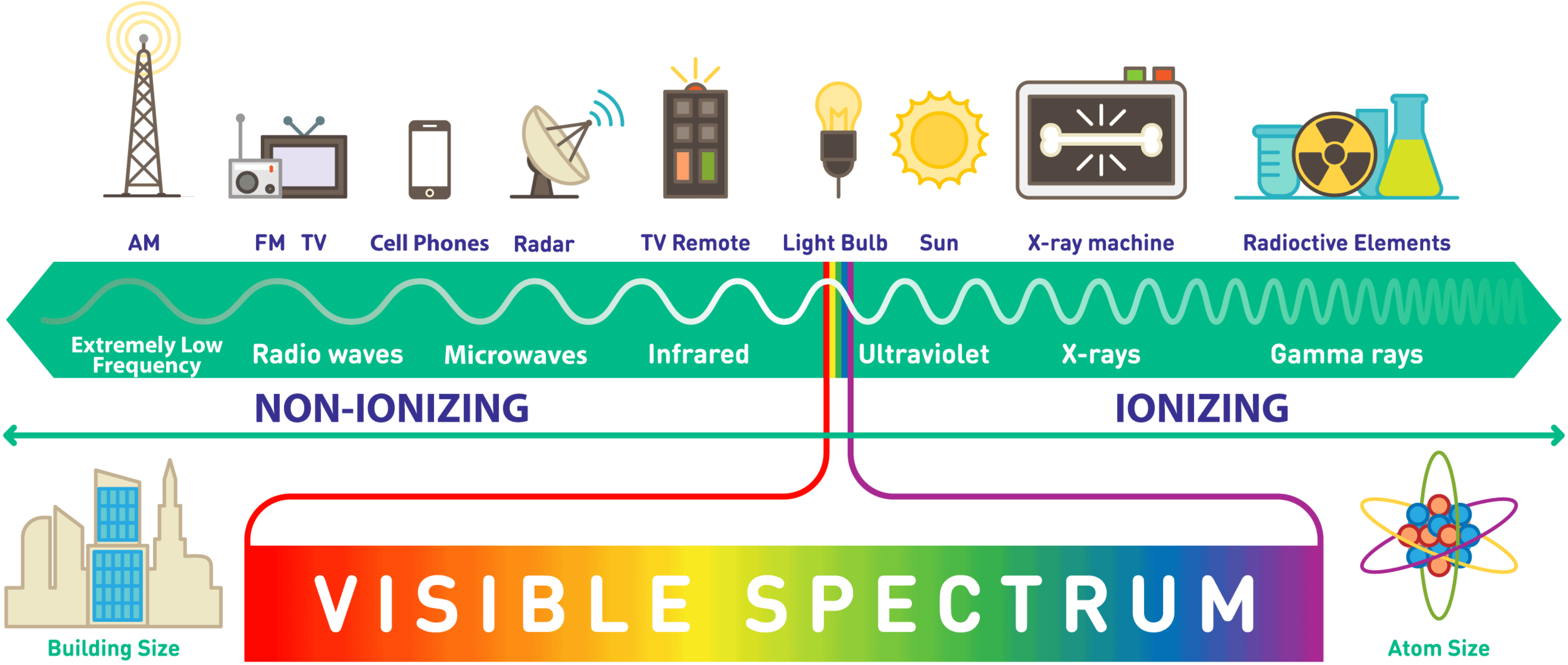


SOHO/NASA/ESA



AveNa / Shutterstock

Electromagnetic Spectrum

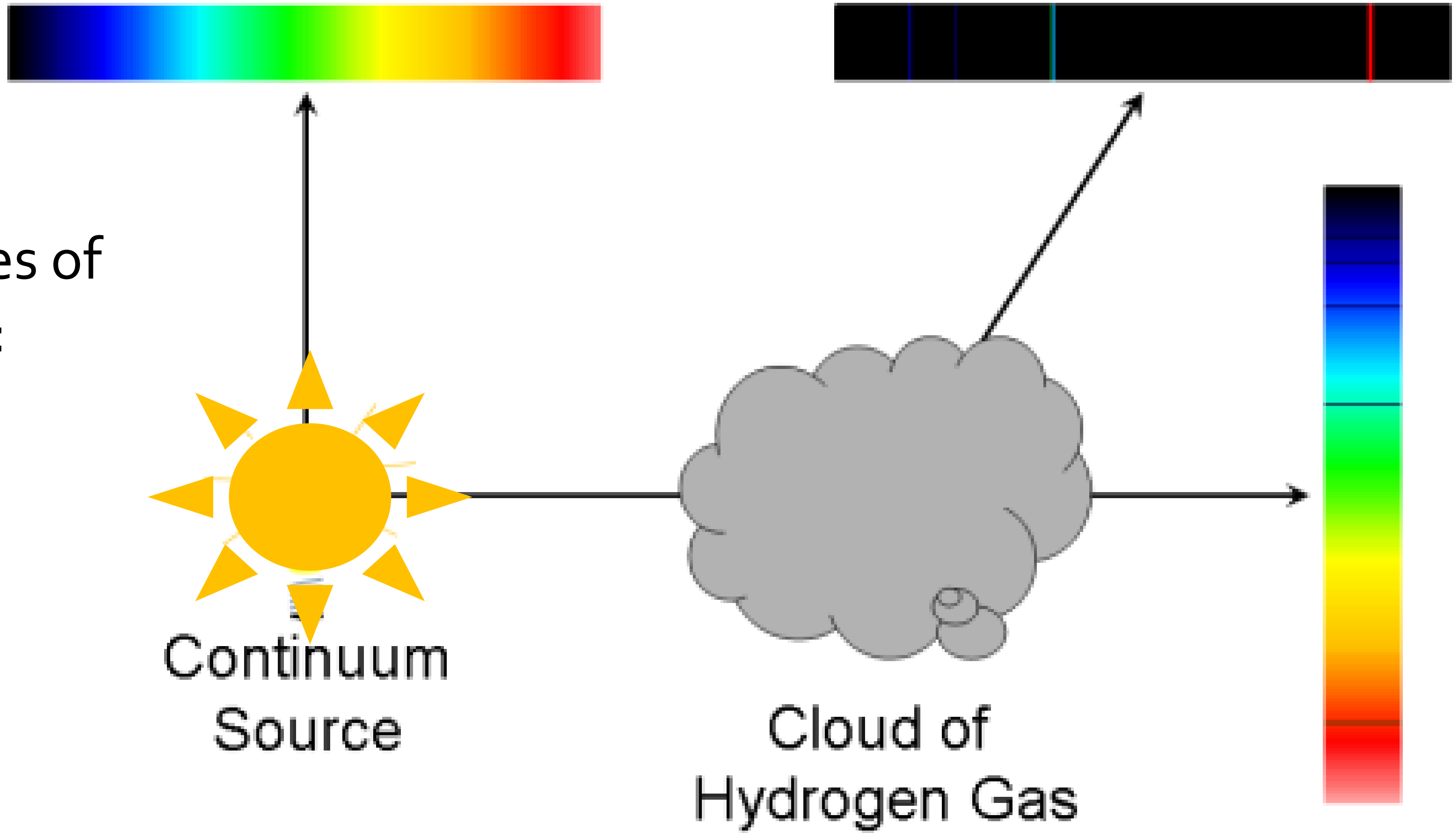


Medium.com

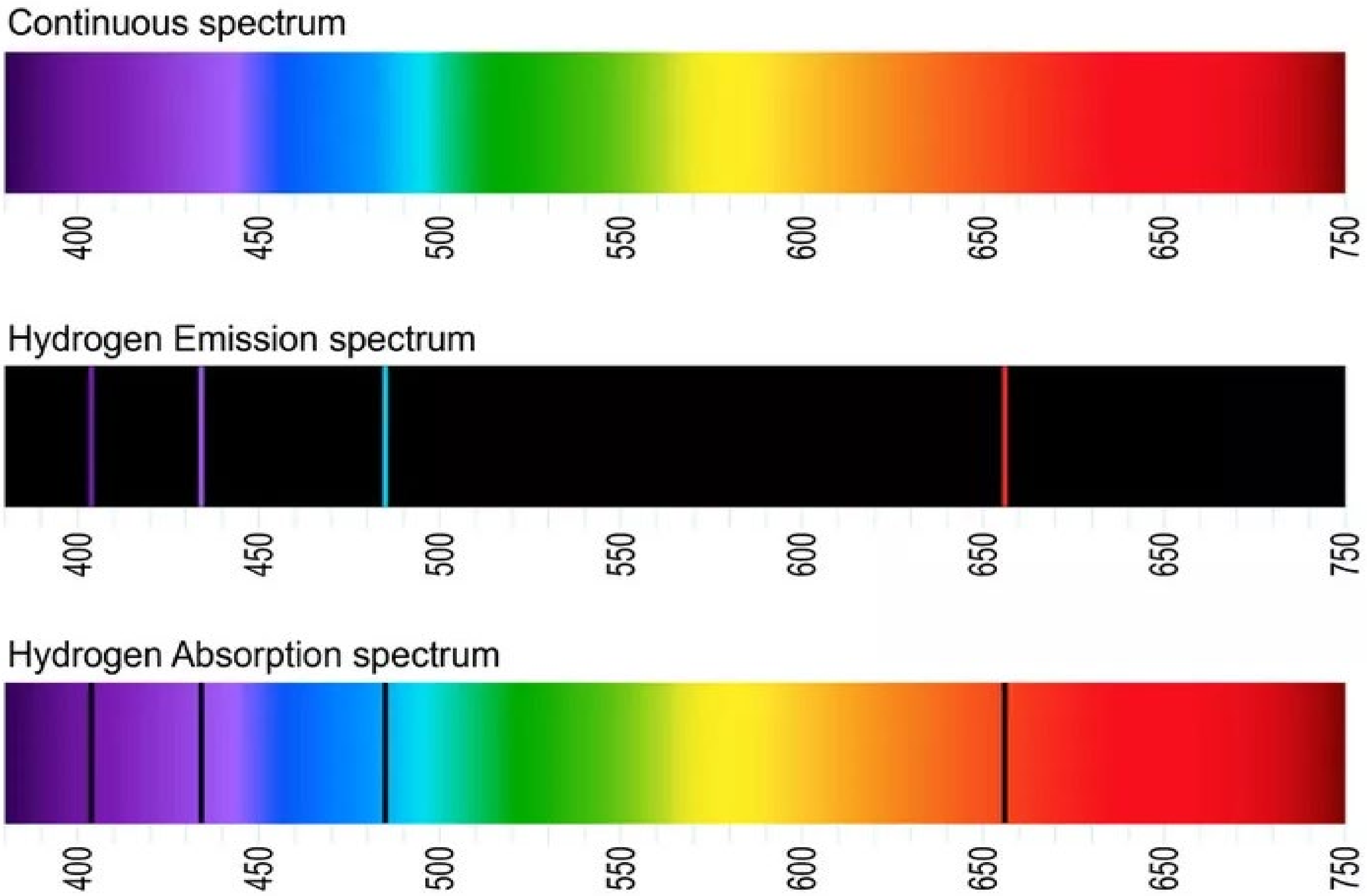
Spectra

There are three types of spectra shown here:

- Continuous
- Emission
- Absorption



R Pogge

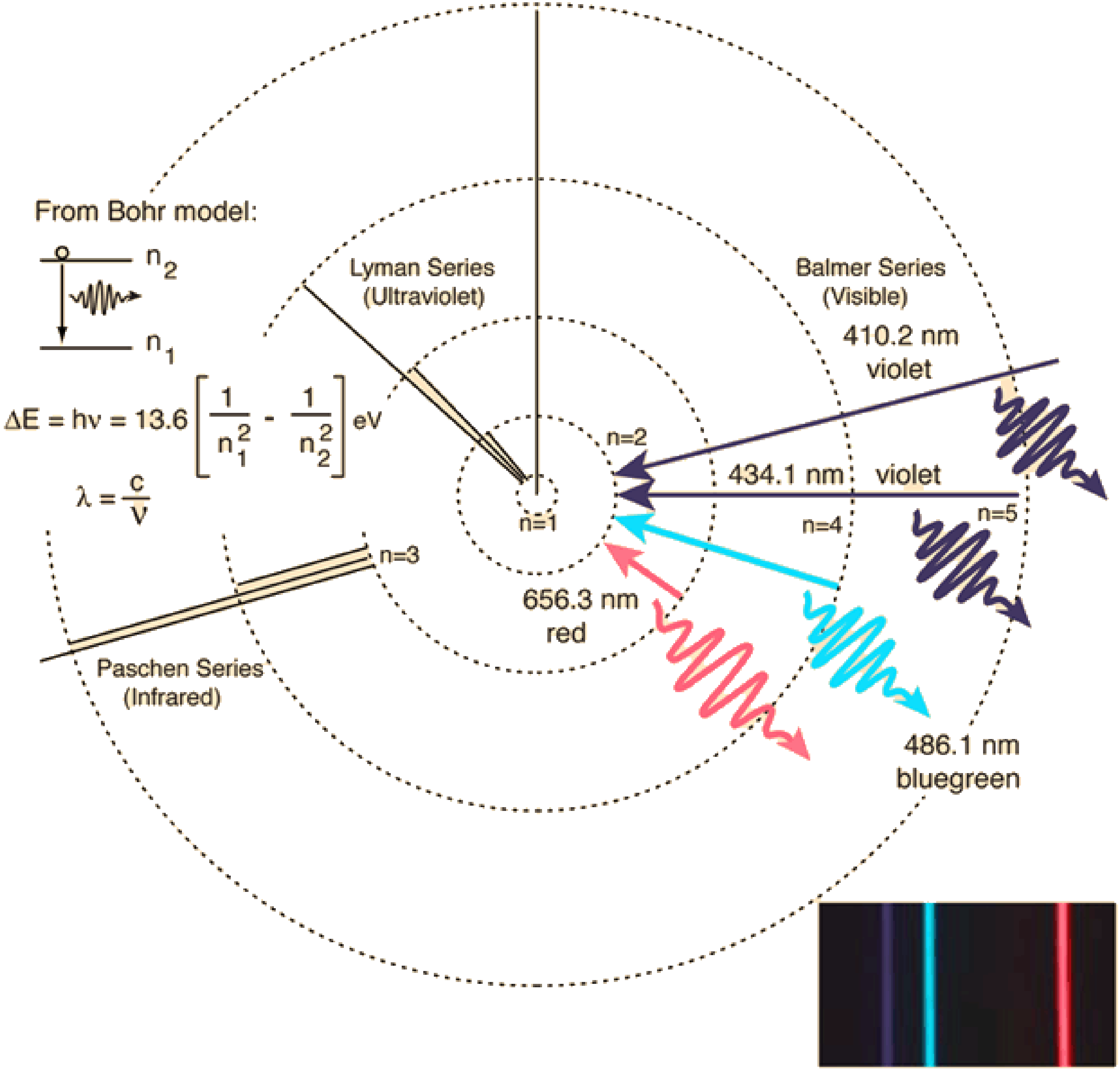

Continuous spectrum
400 450 500 550 600 650 650 750
Hydrogen Emission spectrum
400 450 500 550 600 650 650 750
Hydrogen Absorption spectrum
400 450 500 550 600 650 650 750

ttsz / Getty

Spectra

This shows the energy levels of Hydrogen.

The Balmer Series on the right is the visible light emission.

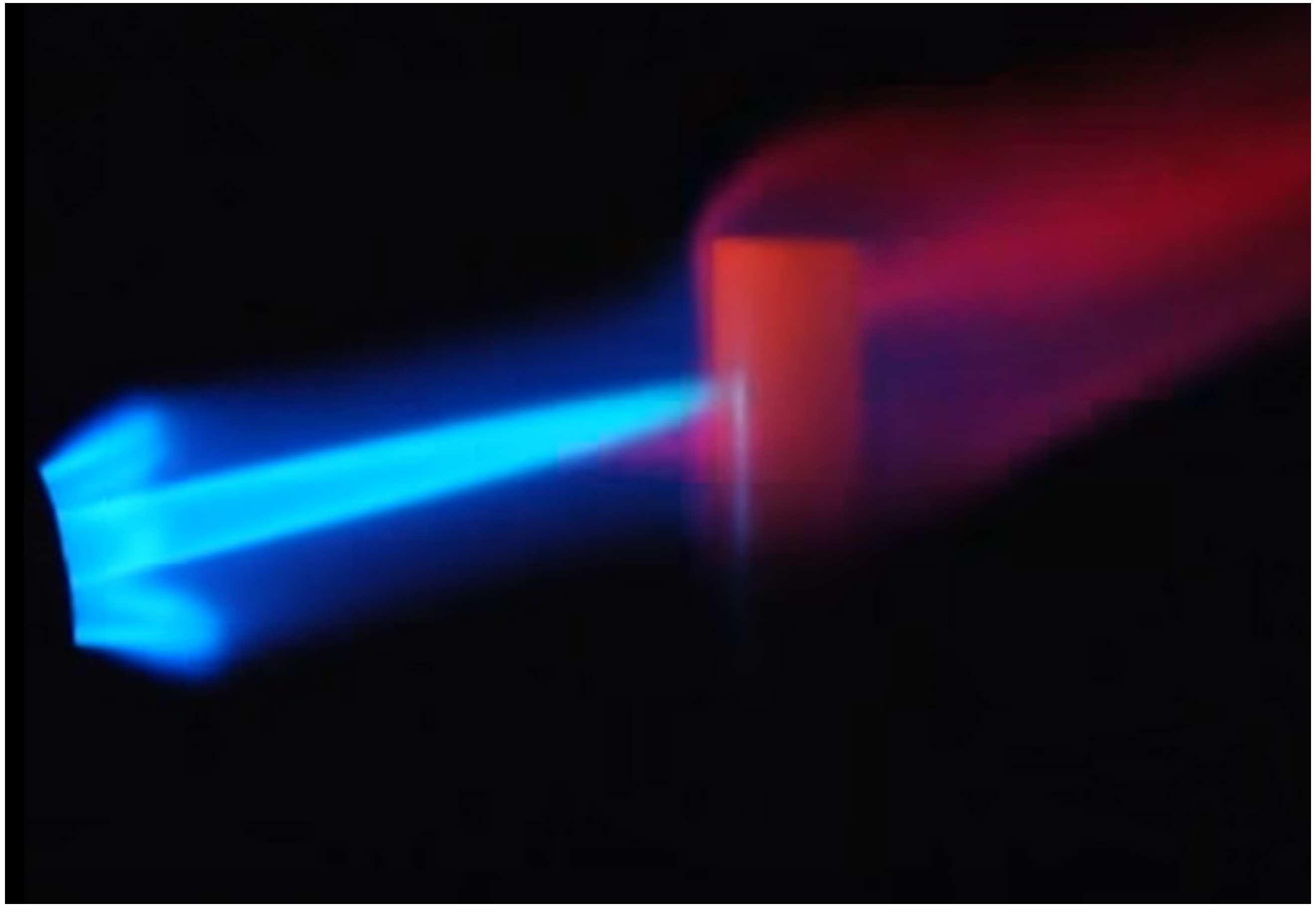


R Nave

Generating Light

Light can be generated by:

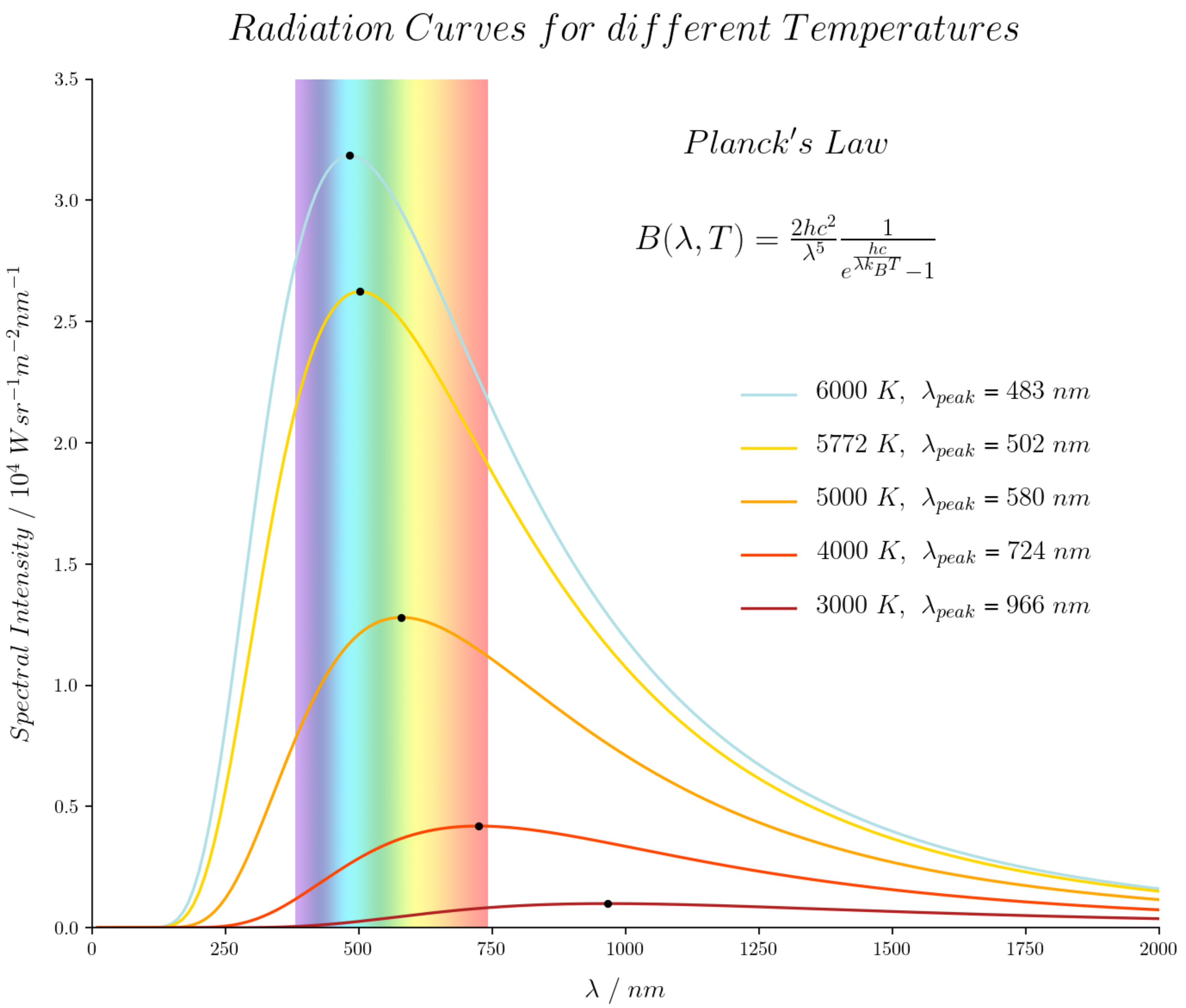
- Charges that are accelerating
- Heating an object up (Thermal Radiation)
- Fusion



Blackbody Radiation

A blackbody absorbs all incident radiation and emits all radiation perfectly.

No real object is a perfect blackbody.

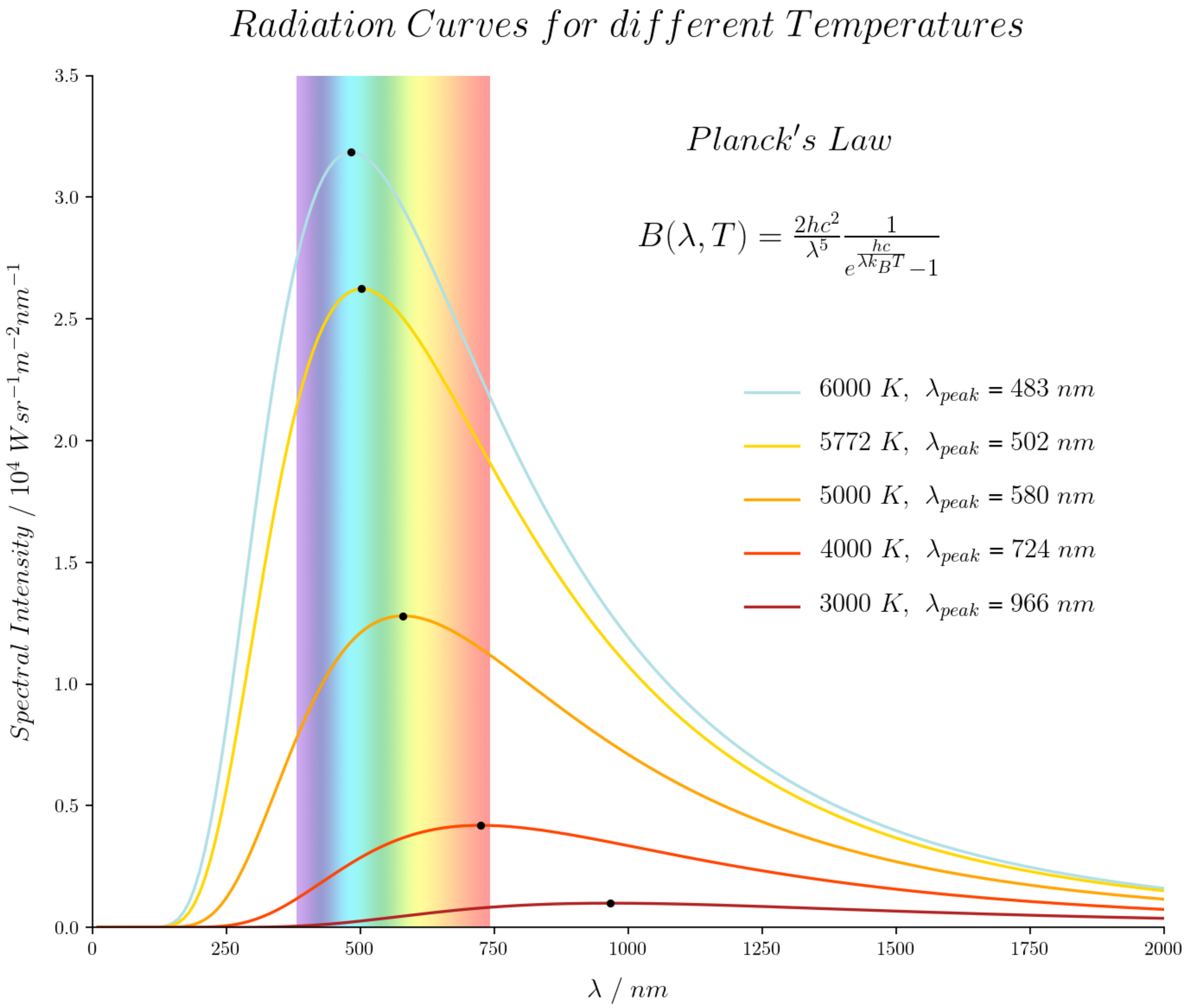


Wien's Law

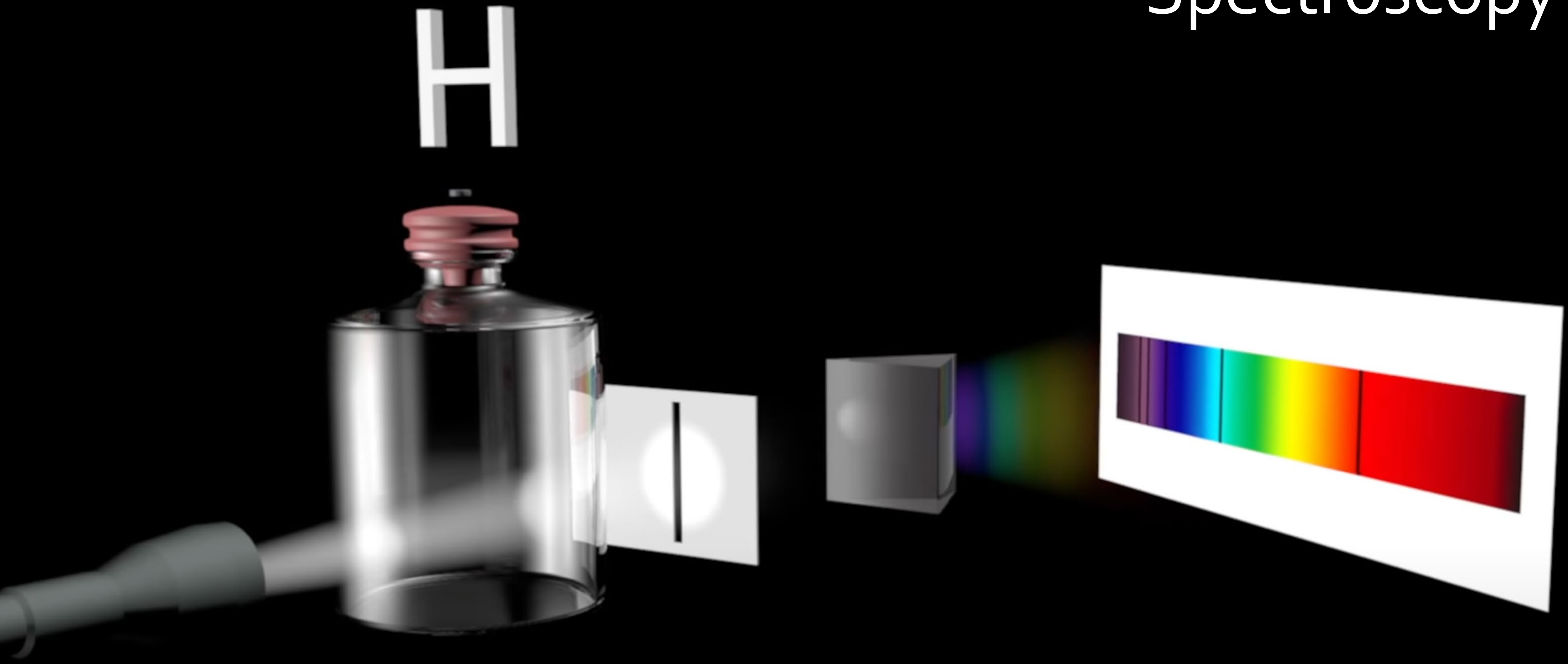
A hotter object emits more high energy radiation.

$$\lambda_{peak} = \frac{b}{T}$$

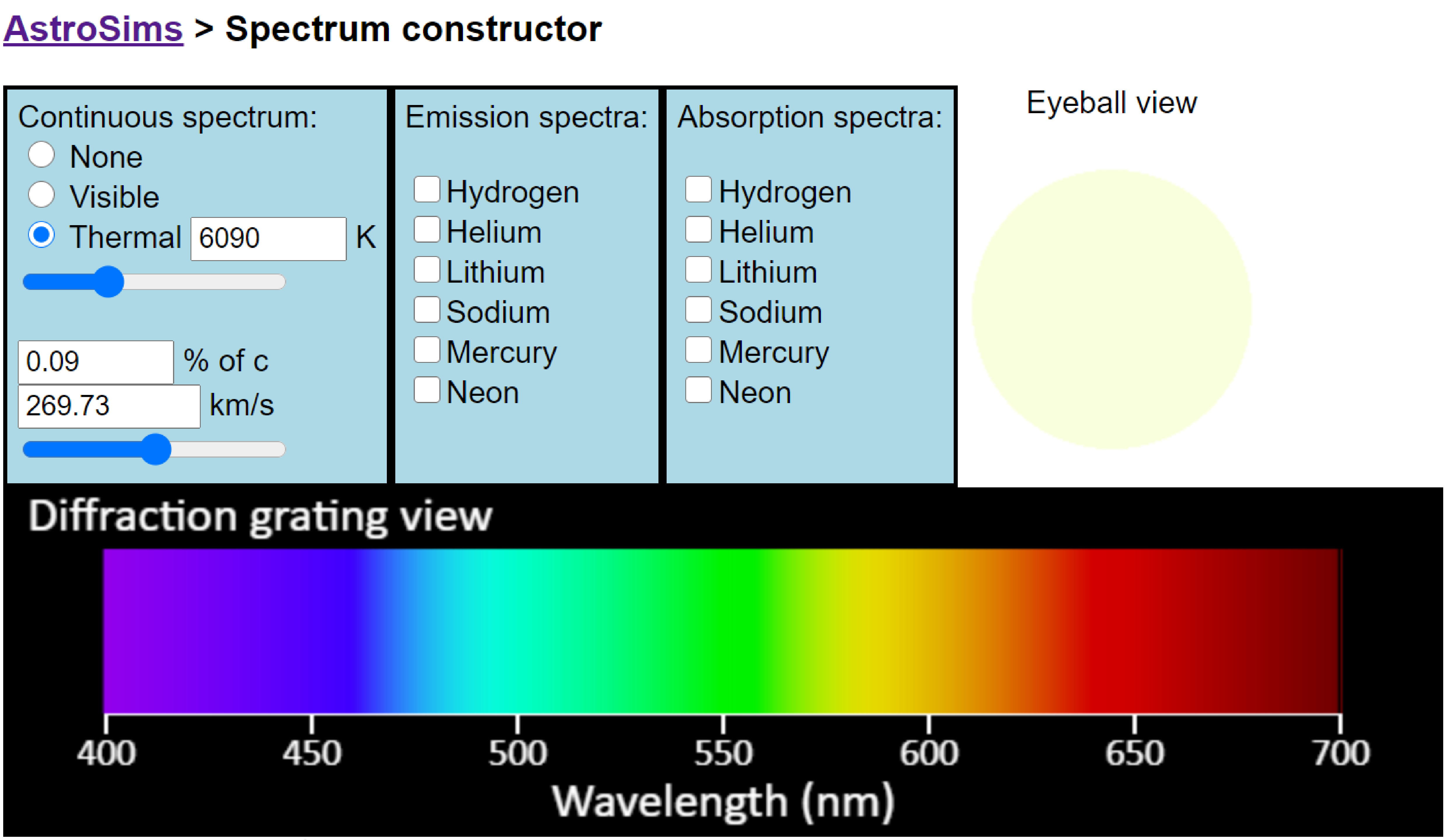
We can find the wavelength the object emits most using Wien's Law.

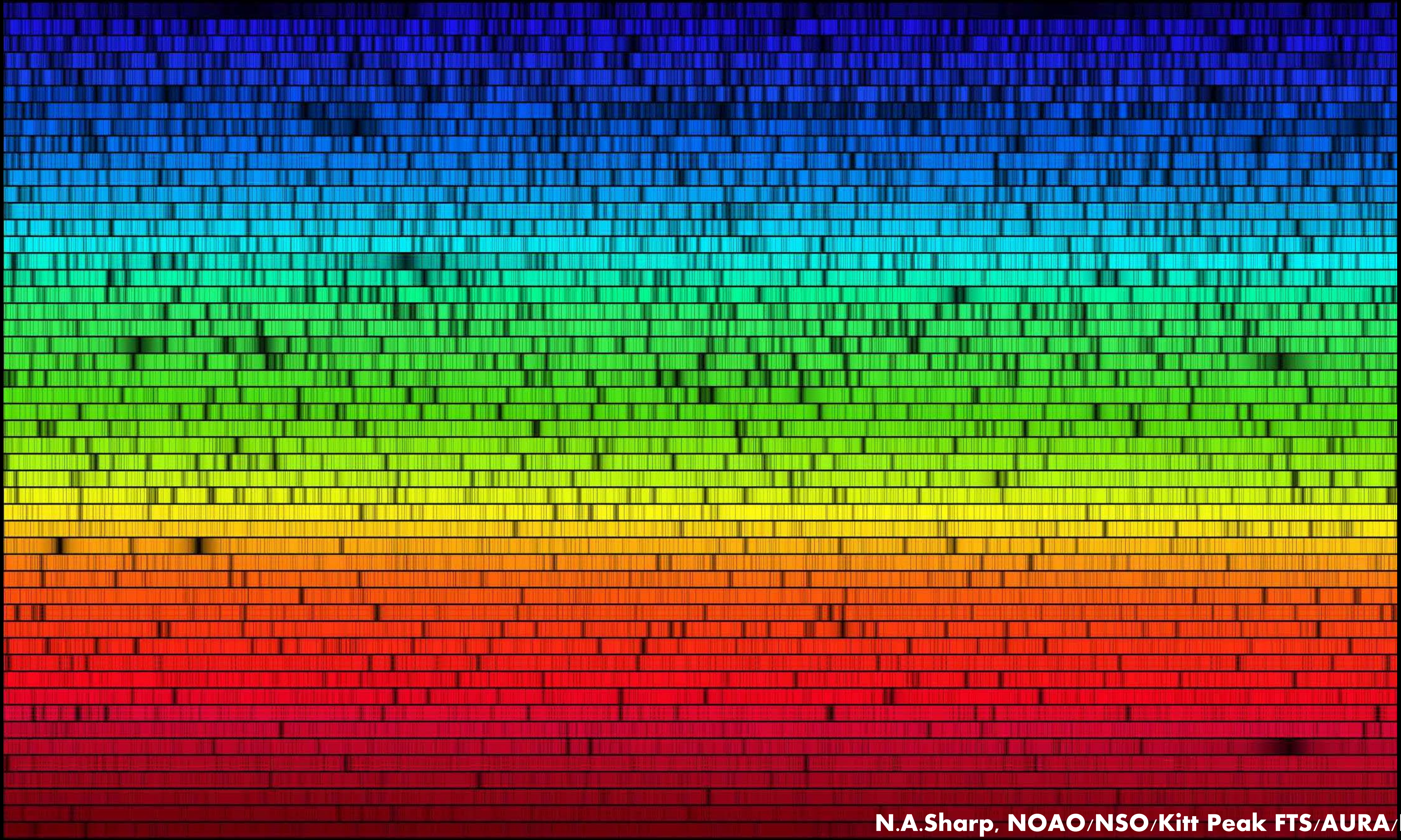


Spectroscopy



ALHAMBRAsurvey


AstroSims > Spectrum constructor
Continuous spectrum:
None
Visible
Thermal
6090
K
0.09
% of c
269.73
km/s
Emission spectra:
Hydrogen
Helium
Lithium
Sodium
Mercury
Neon
Absorption spectra:
Hydrogen
Helium
Lithium
Sodium
Mercury
Neon
Eyeball view
Diffraction grating view
400
450
500
550
600
650
700
Wavelength (nm)



N.A.Sharp, NOAO/NSO/Kitt Peak FTS/AURA/NSF

Recap

1. What is the difference between an absorption and emission spectrum?

2. How do we get the spectra of stars?

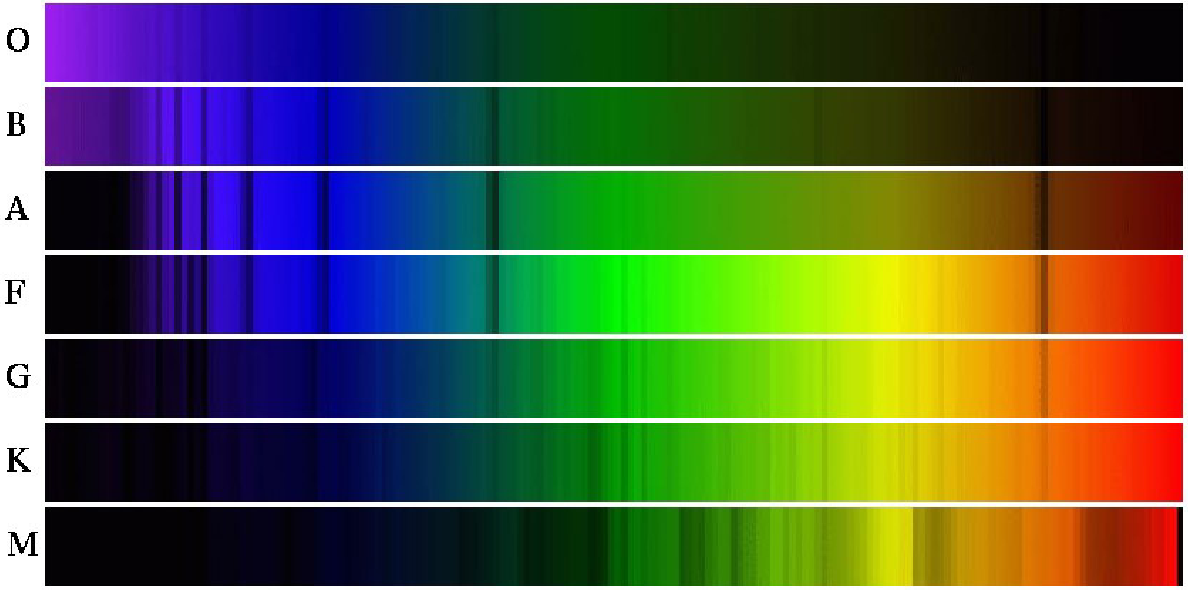
3. What does a hot object emit?

4. Describe a perfect blackbody.

Spectral Type

OBAFGKMLTY

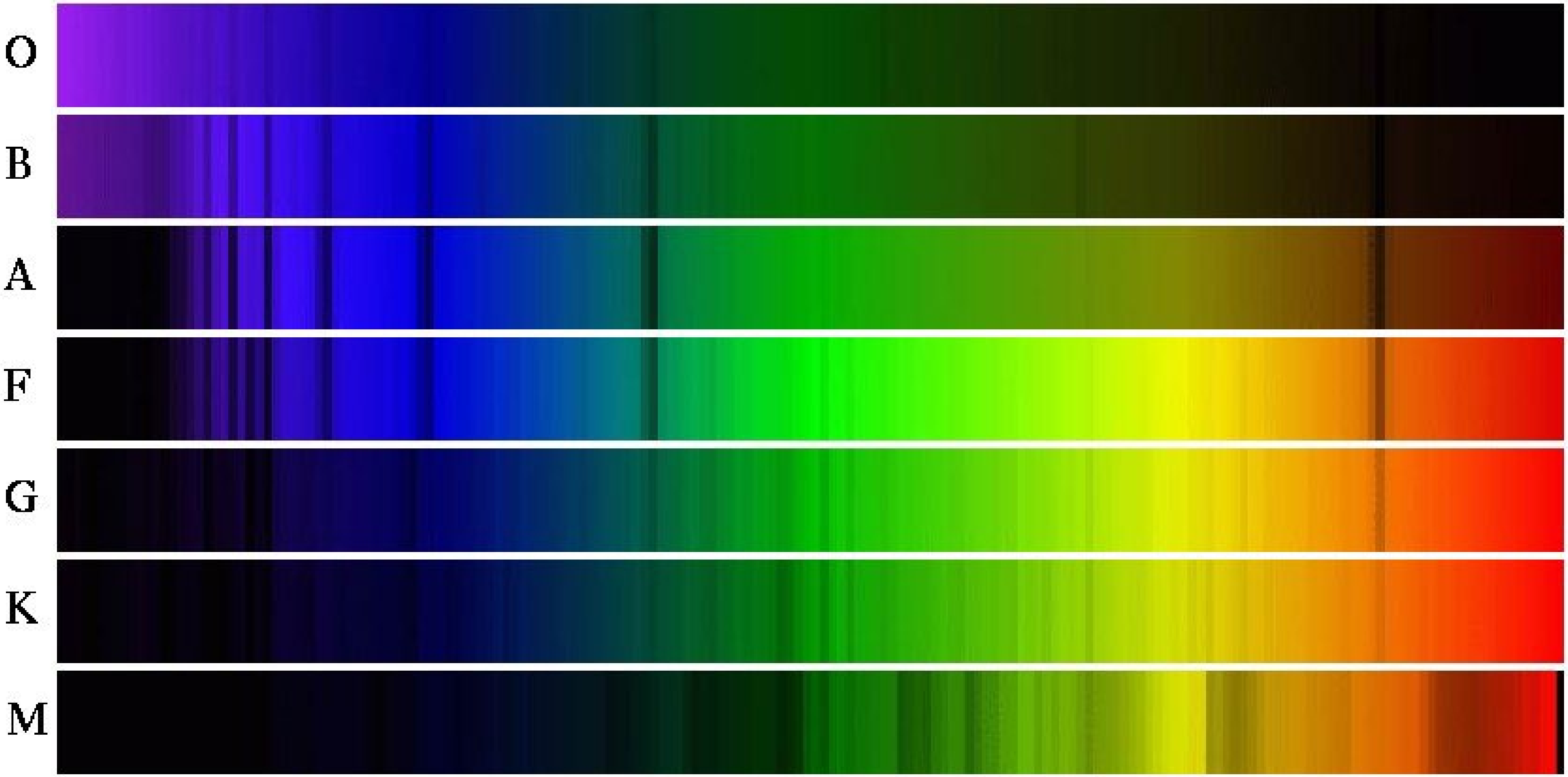
Orion **B**attles **a**cross **F**ar **G**alaxies **K**illing **M**artians



Class	Temperature	Apparent color	Hydrogen lines	Other noted spectral features
O	≥ 30,000 K	blue	Weak	ionized helium lines
B	10,000–30,000 K	blue white	Medium	neutral helium
A	7,500–10,000 K	white to blue white	Strong	ionized calcium (weak)
F	6,000–7,500 K	white	Medium	ionized calcium (weak)
G	5,200–6,000 K	yellowish white	Weak	ionized calcium (medium)
K	3,700–5,200 K	yellow orange	Very weak	ionized calcium (strong)
M	≤ 3,700 K	orange red	Very weak	Titanium oxide lines

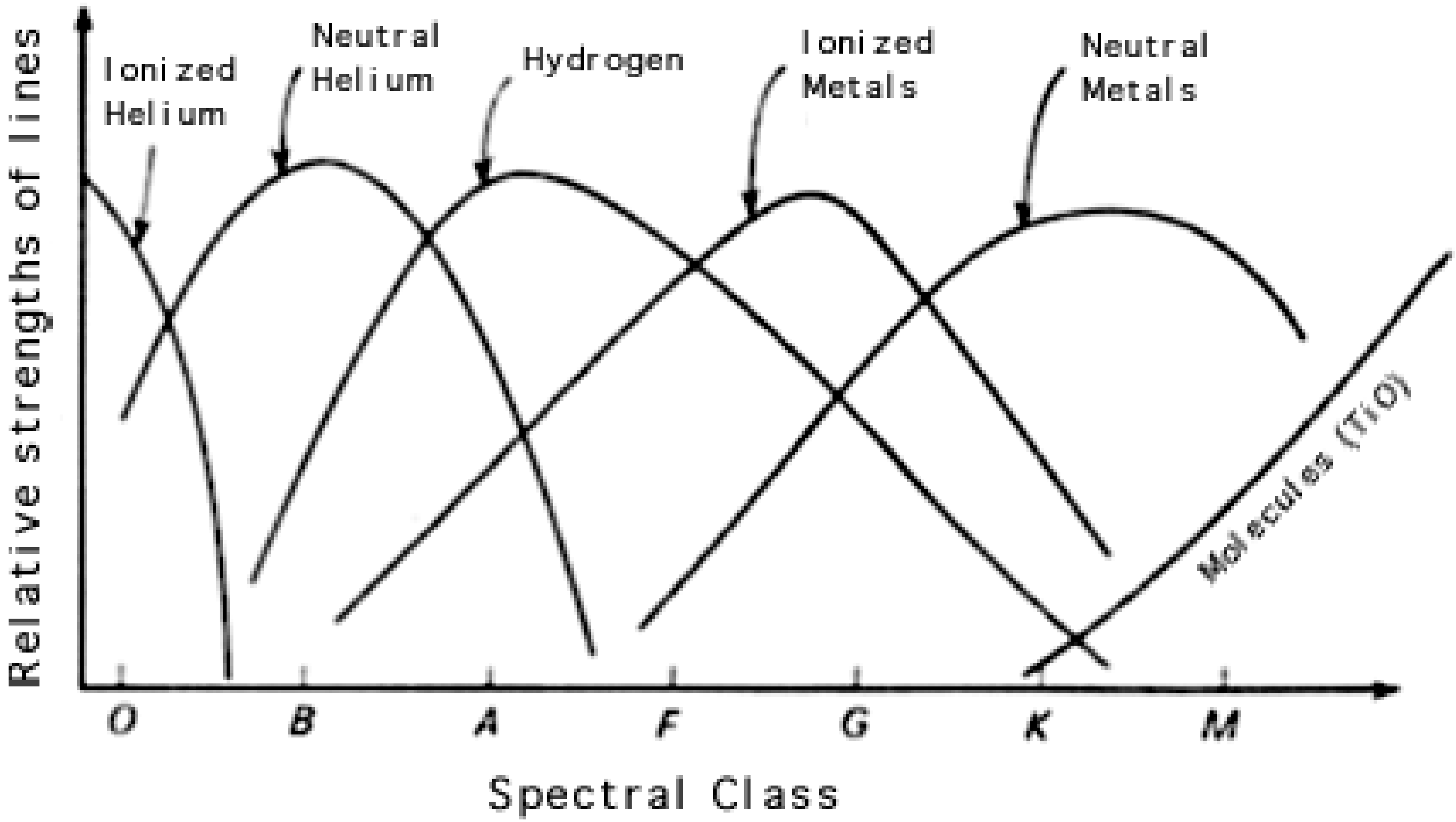
Spectral Type

OBAFGKMLTY



writescience

Spectral Type



P Crowther

Luminosity

$$L = A\sigma T^4$$

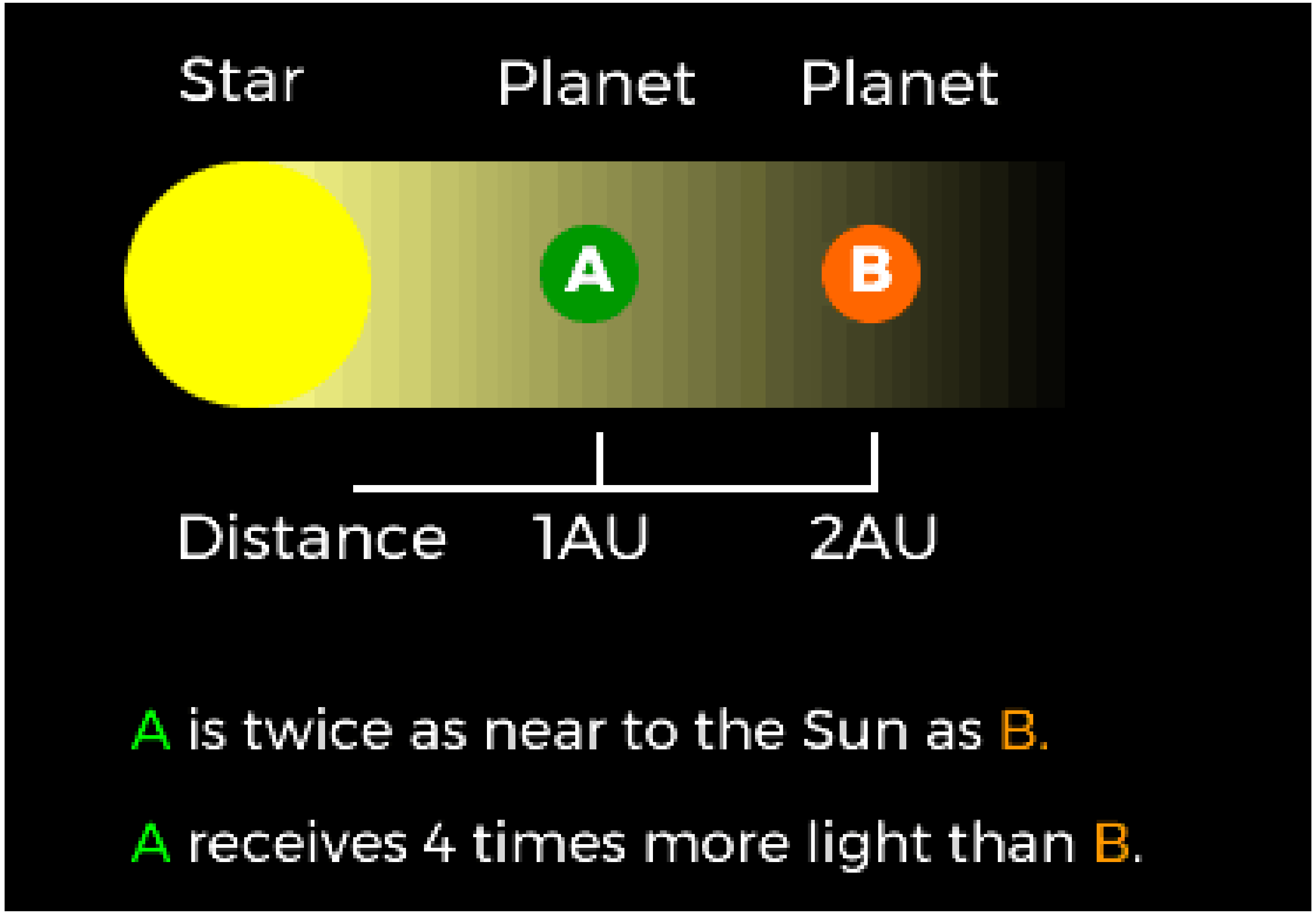
Luminosity, L is measured in Watts (W). Think of it as the Power of the star.

A is the surface area of the star in m^2
σ is the Stefan-Boltzmann Constant, 5.67 $Wm^{-2}K^{-4}$
T is the temperature in Kelvin (K)

Inverse-square law

The further away from a light emitting object the less light you receive.

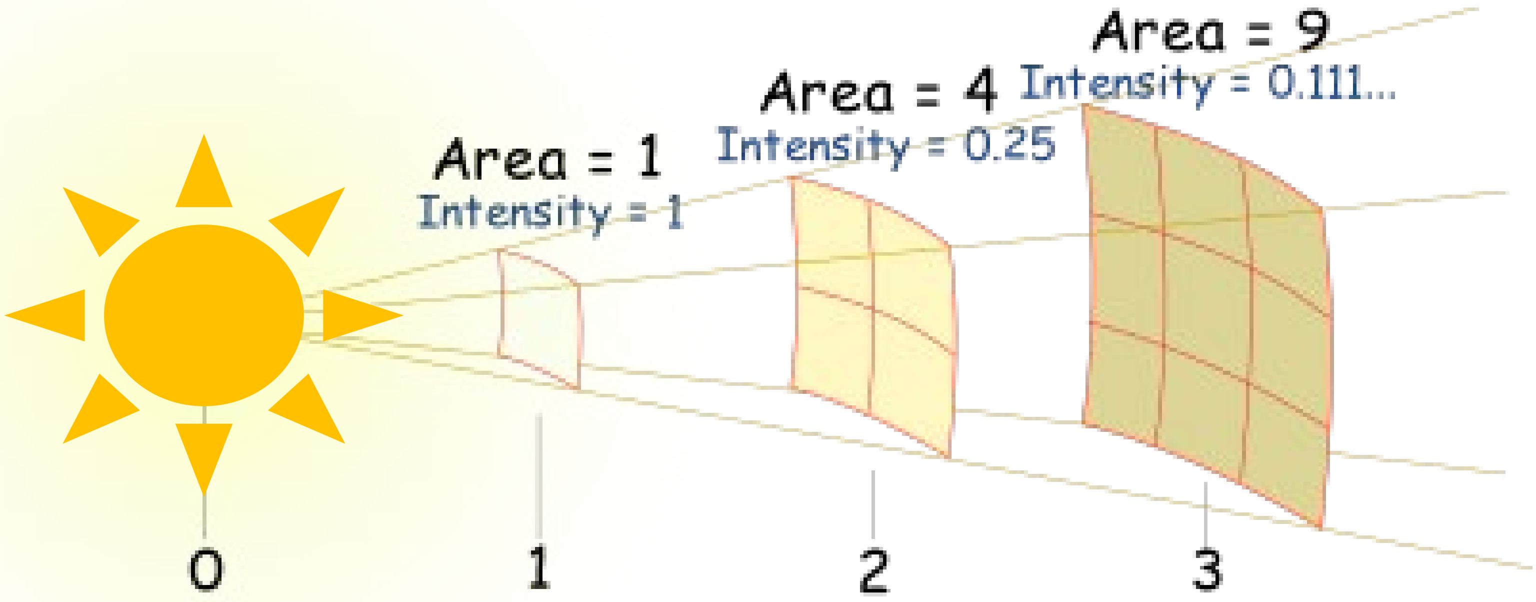
If you double the distance you receive four times less light.



Inverse-square law

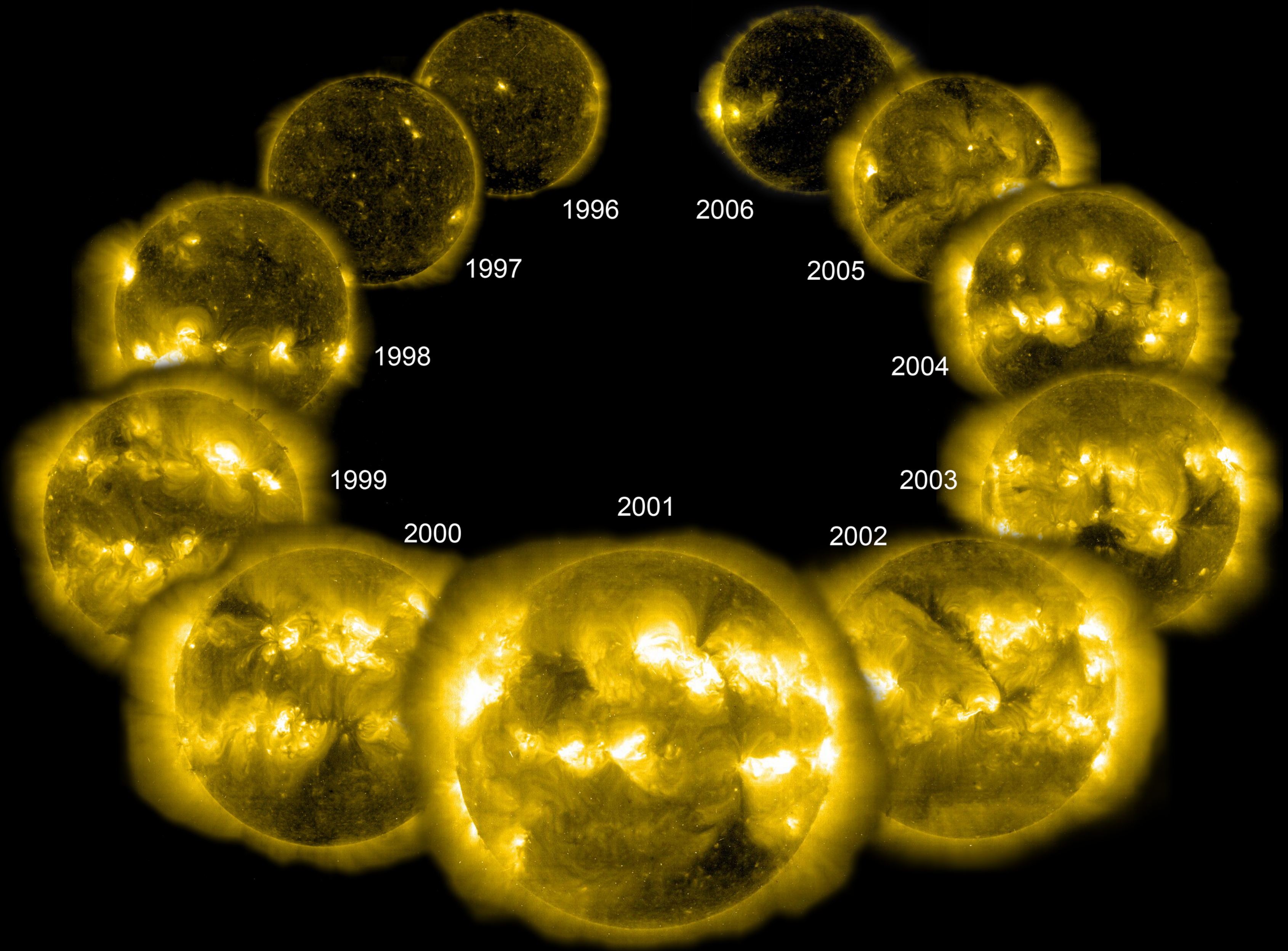
The brightness (intensity) of light is given by:

$$b = \frac{L}{4\pi d^2}$$



It has units of Wm^{-2}.
d is the distance you are from the star.

mathsisfun



Steele Hill, SOHO, NASA/ESA

Recap

1. What are the spectral types in order?

2. What spectral type is our Sun?

3. Describe the inverse square law for light.

4. How has the luminosity of the Sun changed?

Up next:

Nuclear Fusion