

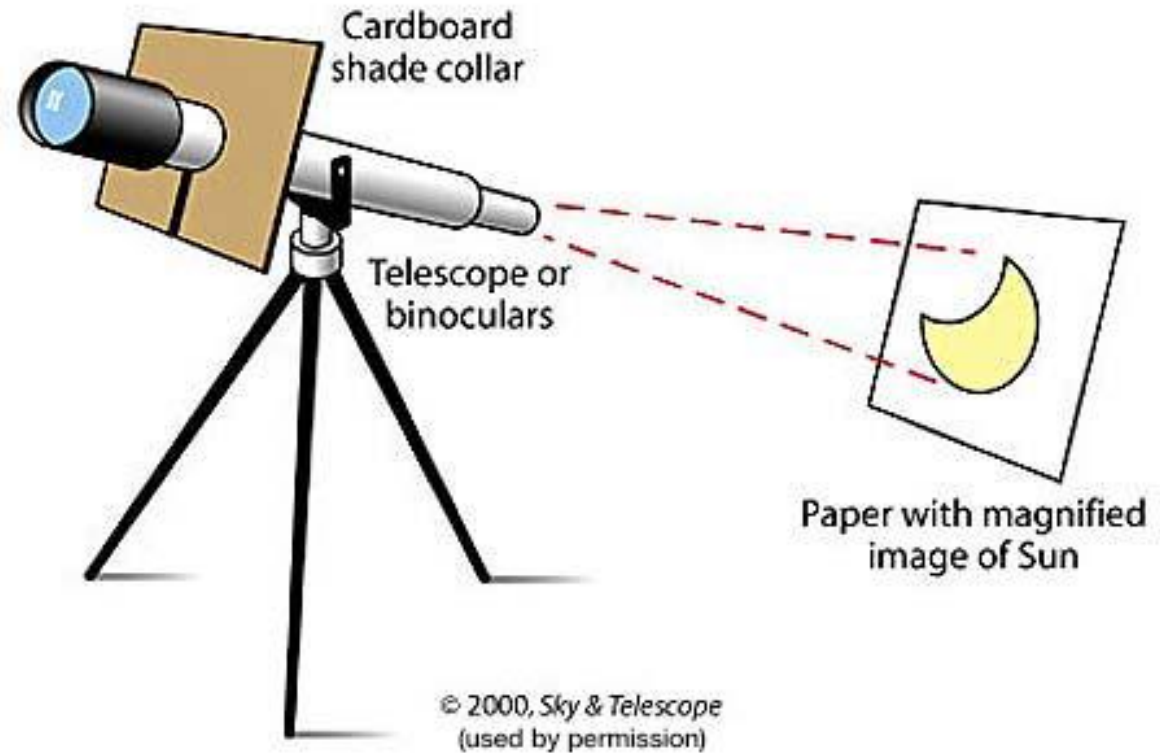


BGS
ASTRONOMY

Topic 10: Solar Astronomy

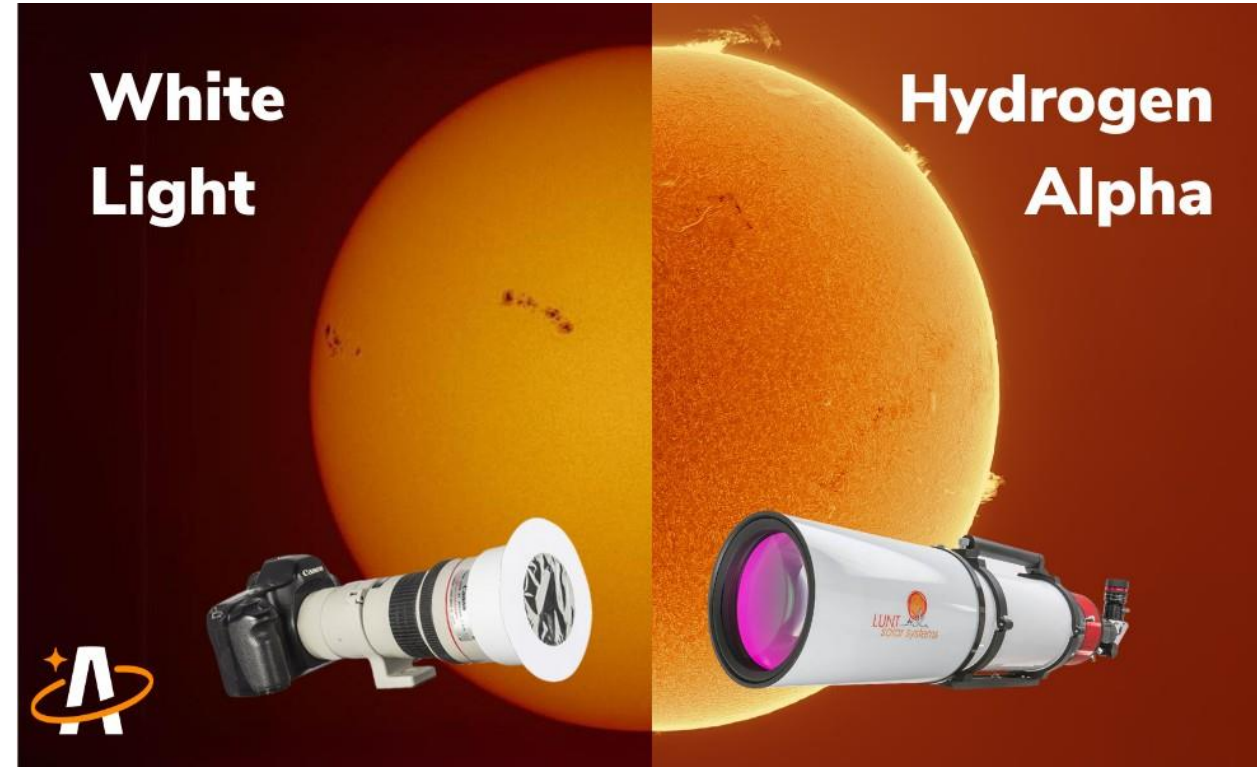
Observing the Sun Safely

- It is very dangerous to look directly at the Sun
- The Sun produces intense UV radiation, which can damage the retina (solar retinopathy)
- This can happen without you experiencing pain as the retina does not have pain receptors
- Telescopic projection can be used to observe the Sun safely



Using an H-alpha Filter

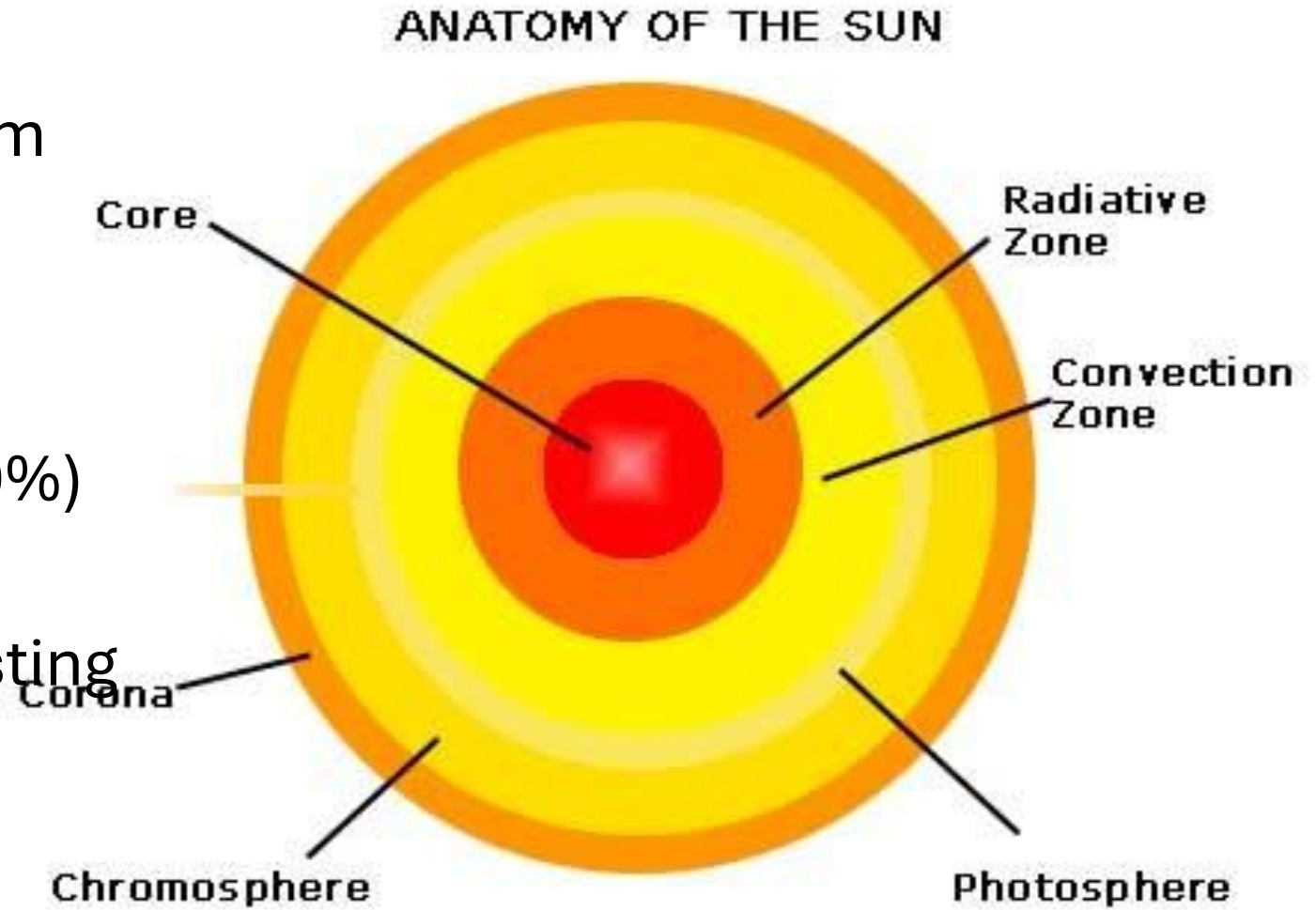
- A hydrogen alpha (or H-alpha) filter cuts out all light apart from a narrow band of wavelengths
- This band is in the region of the deep red light of wavelength 656nm
- The filter can be used to see more detail from the Sun's chromosphere (which is usually obscured by light from the outer photosphere)
- It can also be used to observe nebulae that are otherwise obscured by light pollution



The Sun's Internal Divisions

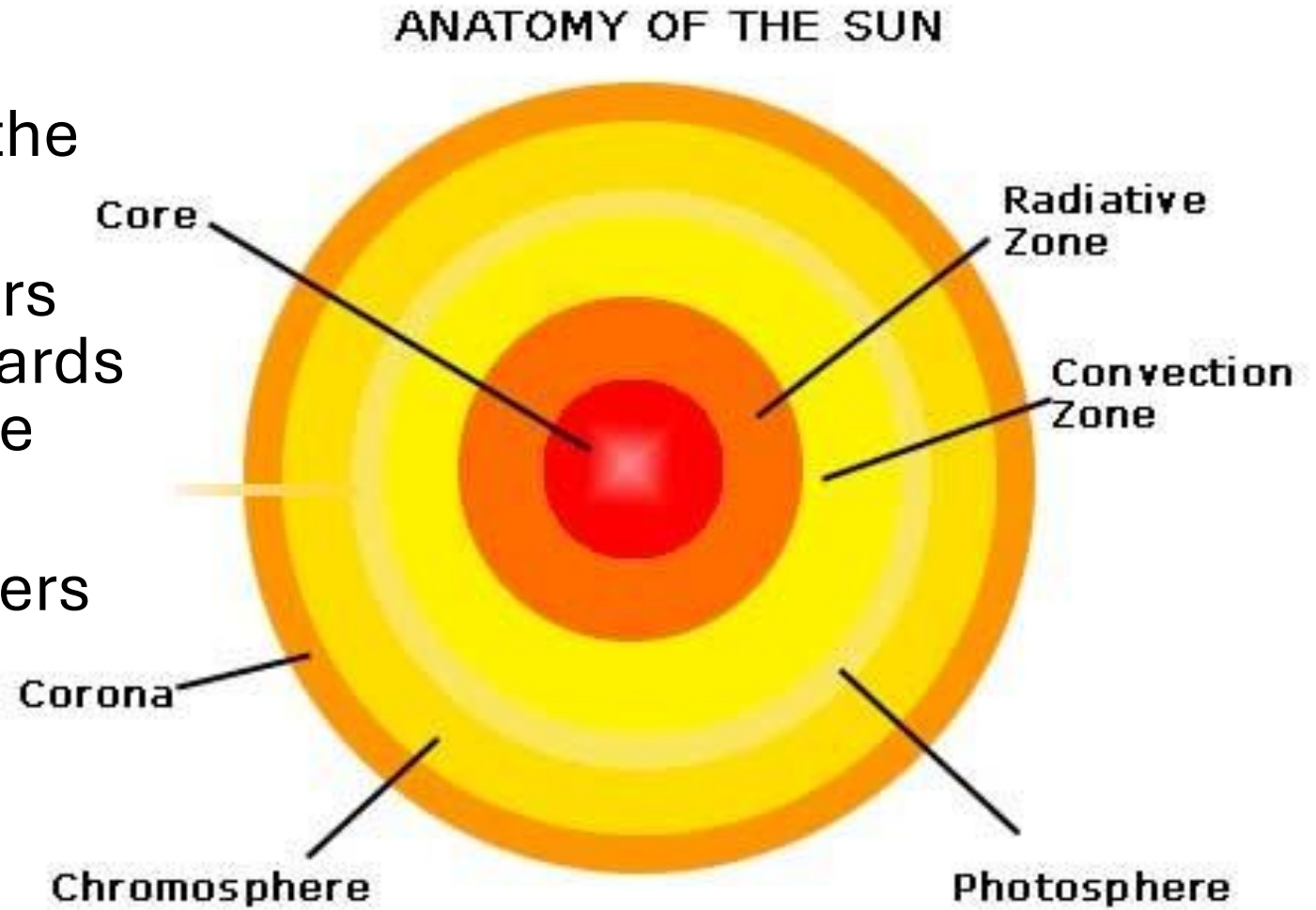
The Sun consists of the following zones, starting from the centre:

- Core (0-25% of radius)
- Radiative Zone (25-70%)
- Convection Zone (outer 30%)
- Photosphere
- Solar atmosphere – consisting of the chromosphere and corona



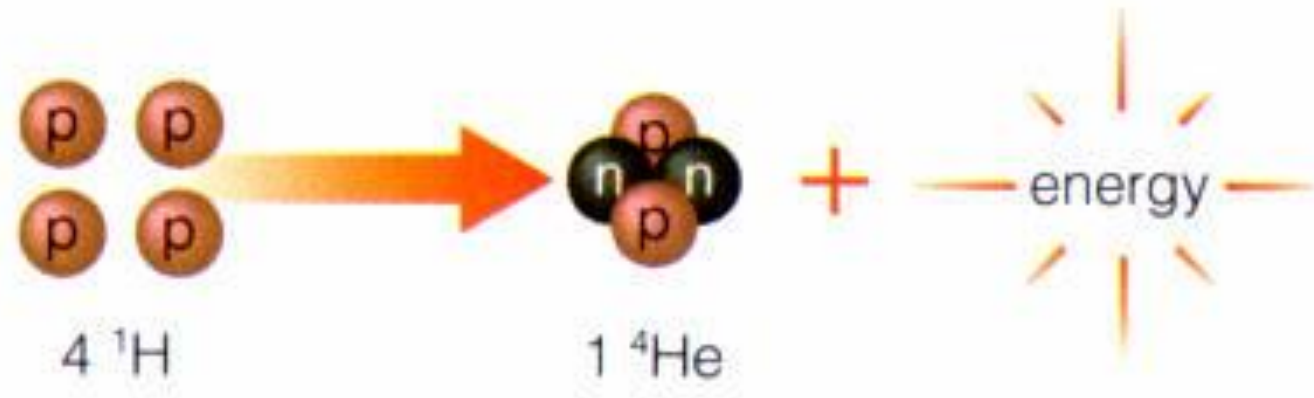
Energy Release and Transfer in the Sun

- Energy release by nuclear fusion takes place only in the Core
- The Radiative Zone transfers energy from the core outwards via photons, rather than the movement of material
- The Convection Zone transfers energy to the surface by convection currents (movement of the plasma)

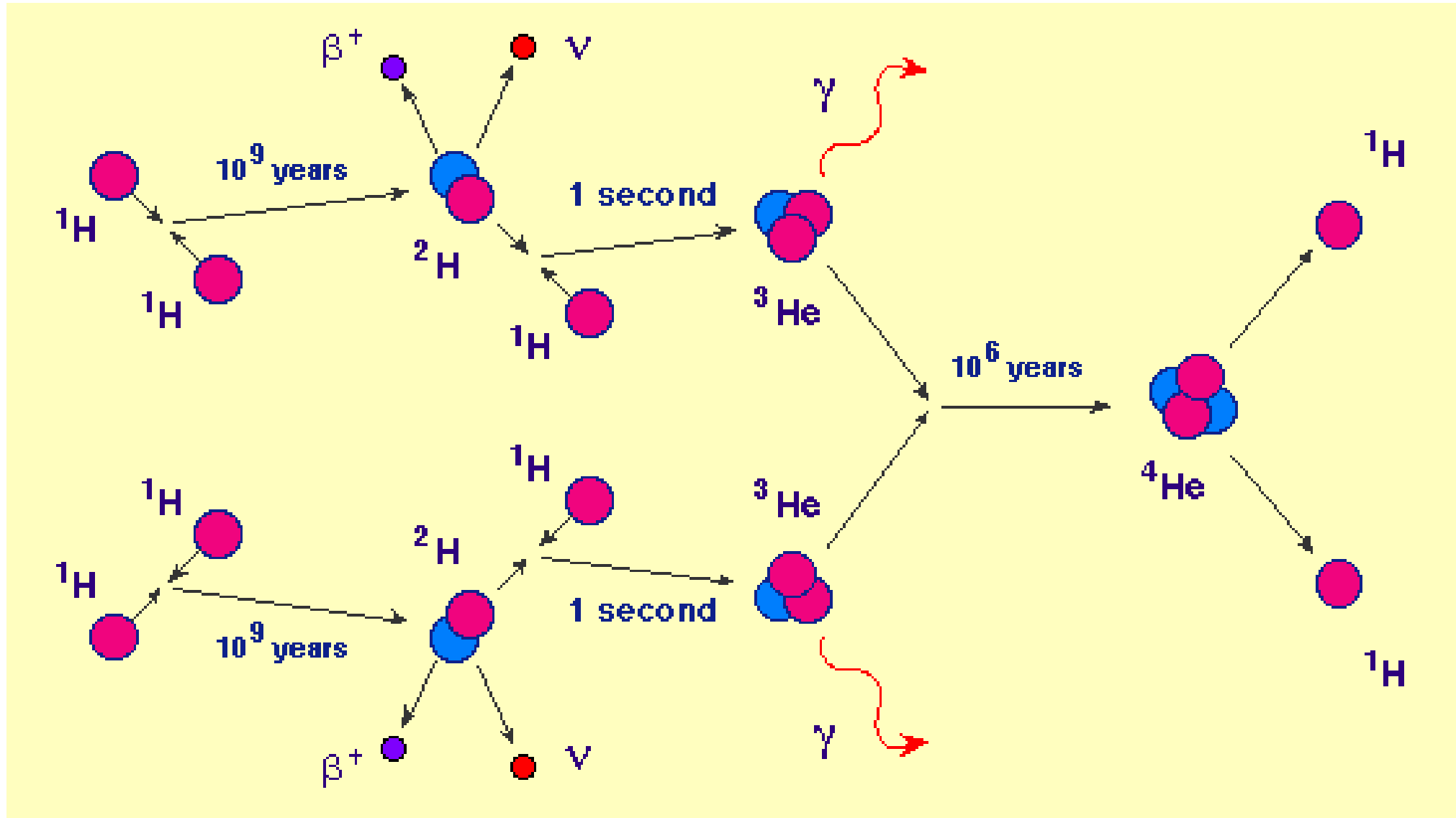


Nuclear Fusion in the Core

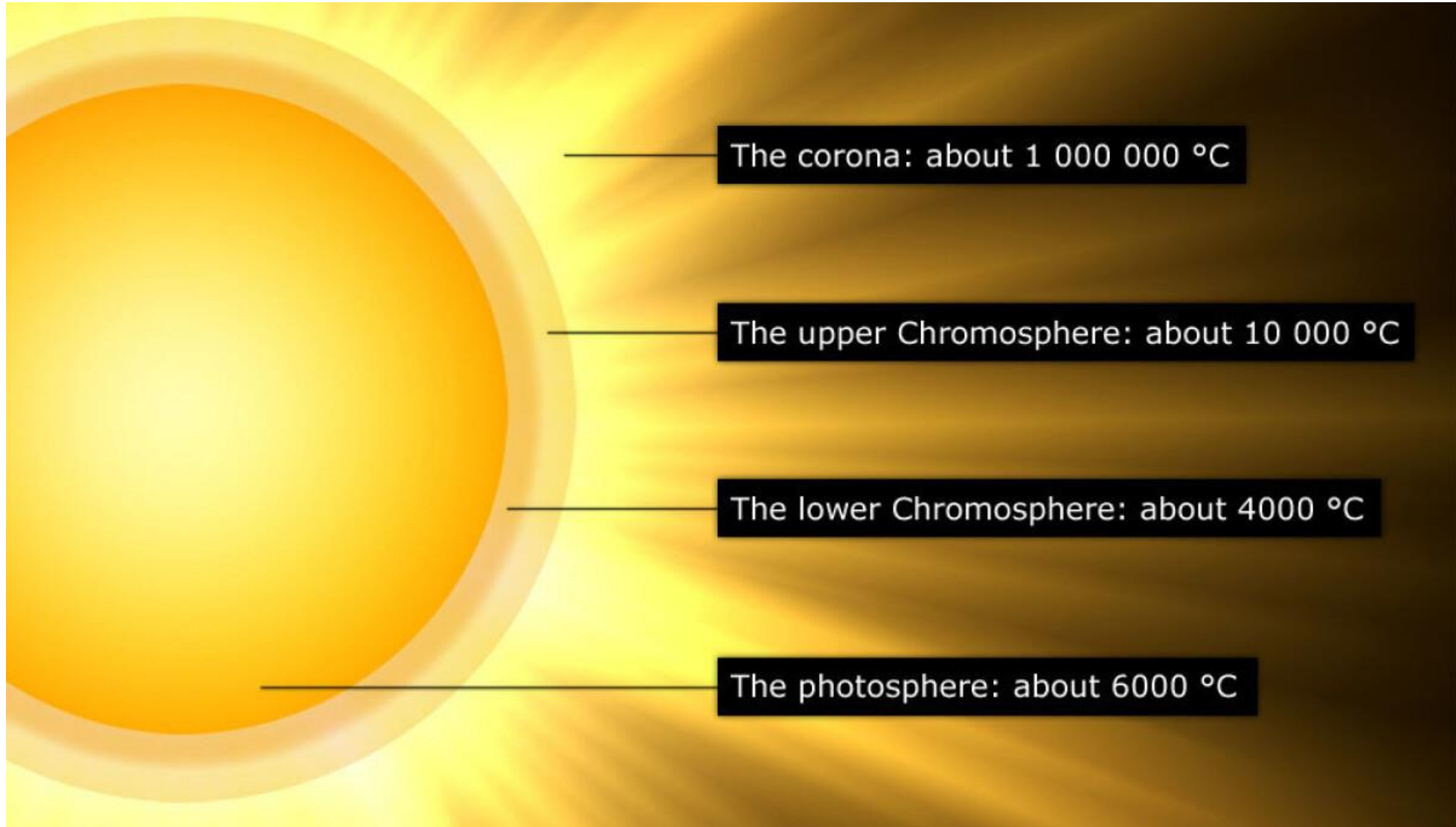
- The enormous pressure and temperature in the Core (15 million °C) allows hydrogen nuclei to fuse together to form helium nuclei
- The main process in the Sun is the proton-proton (p-p) chain
- 4 hydrogen nuclei (protons) fuse together to form one nucleus of helium-4



The proton-proton chain reaction

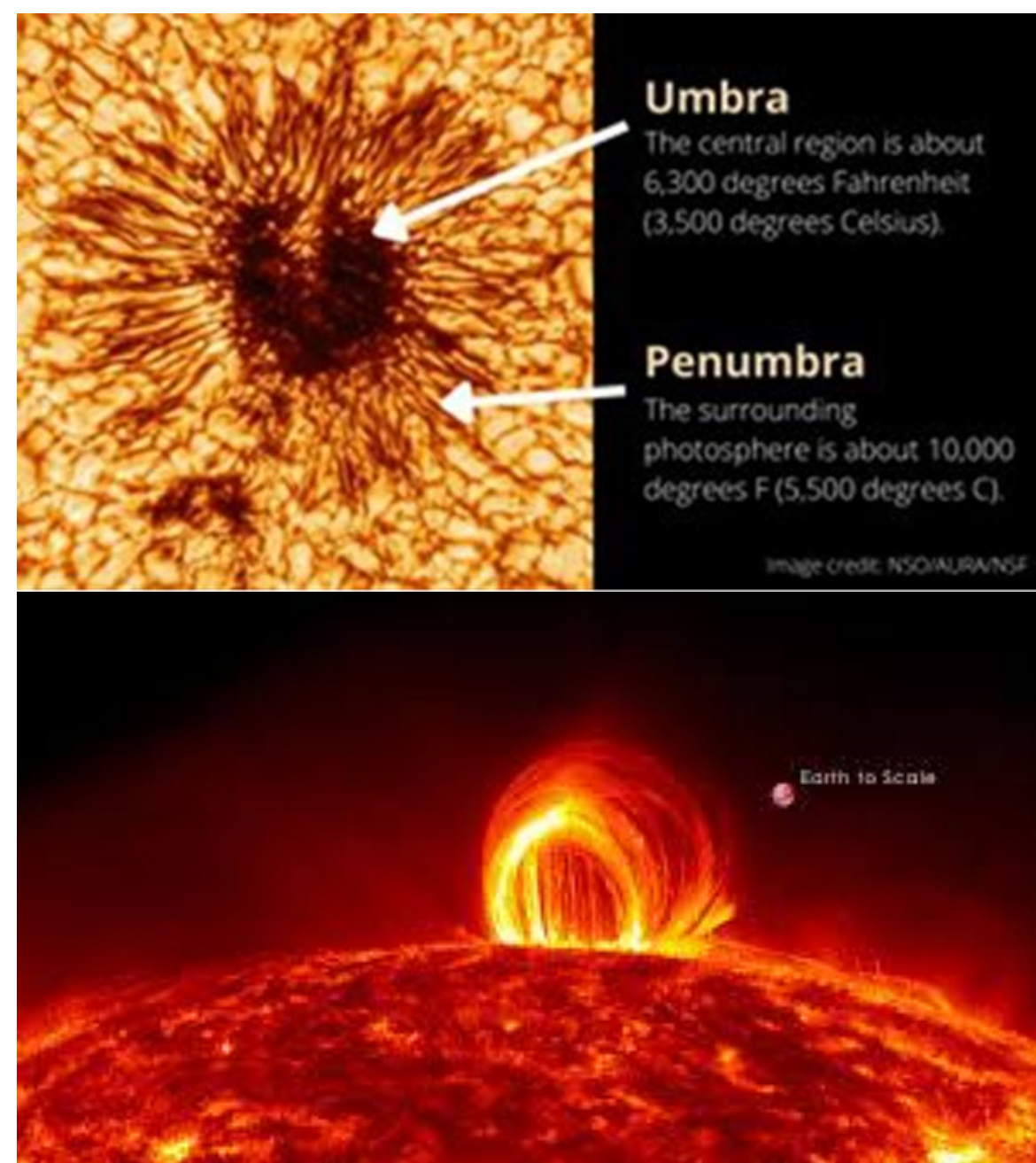


The Sun's Atmosphere



Sunspots

- **Sunspots** are dark, cooler regions on the Sun caused by intense magnetic activity.
- They consist of a dark centre called the **umbra**, where magnetic fields are strongest and vertical, surrounded by a lighter, filamentary halo called the **penumbra**, where fields are weaker and inclined
- The **Solar Cycle** (~11 years) describes changes in sunspot activity.
- Sunspot data can be used to calculate the Sun's **mean rotation period**.
- Sunspot activity is related to **solar flares**, **solar prominences** and **coronal mass ejections** (CMEs)



The Solar Wind and Its Effects

- The **solar wind** is a stream of charged particles emitted by the Sun.
- **Effects of Solar Wind:**
- **Aurorae:** Interaction with Earth's atmosphere produces the **Northern and Southern Lights**.
- **Cometary Tails:** Comet tails always point away from the Sun due to solar wind pressure.
- **Geomagnetic Storms:** Disrupt Earth's magnetic field, affecting power grids and communication systems.
- **Impact on Satellites & Space Missions:** Can damage electronics and pose risks to astronauts.



The Solar Wind and Its Effects

- The **magnetosphere** is Earth's protective magnetic shield, deflecting solar wind.
- The **Van Allen Belts** are zones of charged particles trapped by Earth's magnetic field.
- During solar storms, the magnetosphere is disturbed, increasing radiation risks.

