Ast 4 Lecture 11 Notes

1 The Sun

The Sun

- The Sun is a **star**
- A star is a glowing ball of hot gas held together by its own gravity and sustains nuclear fusion in its core
- By studying the Sun we can learn about stars in general

The Sun

Some properties of the Sun

- Radius of the Sun is about 700,000 km (~ 100 $R_\oplus$)
- Mass of the Sun is 1.99×10^{30} kg ($\sim 3 \times 10^5 M_\oplus$)
- The equator rotates faster than latitudes nears the poles
- Surface temperature of 5800 K

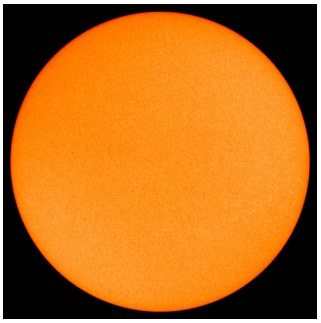
2 Structure of the Sun

2.1 Surface Layers

The Photosphere

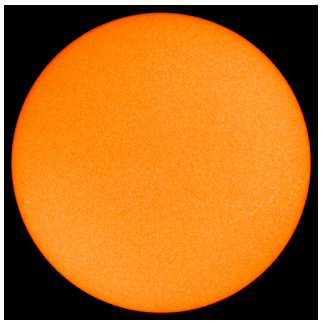
The Photosphere

- Layer of the Sun we see
- 500 km thick
- Temperature: 5800 K
- Density: 2×10^{-4} kg/m^3



The Chromosphere

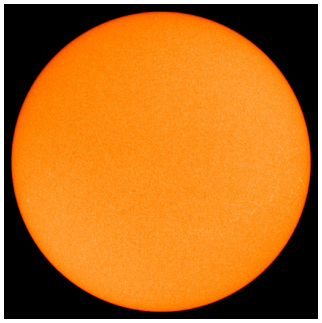
The Chromosphere



- Above the photosphere
- 1500 km thick
- Temperature: 4500 K
- Density: 5×10^{-6} kg/m^3
- *lower temperature and transparent*

Transition Zone

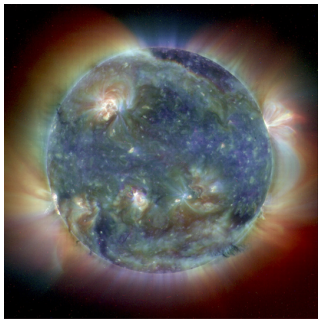
The transition zone



- Above the chromosphere
- 8500 km thick
- Temperature: 8000 K
- Density: 2×10^{-10} kg/m^3
- *Rapid increase in temperature*

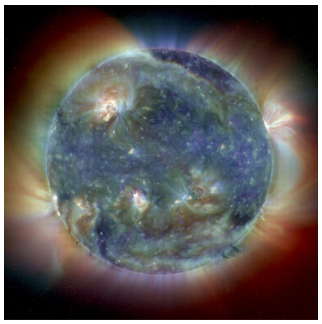
The Corona

The Corona



- *Very* hot and thin upper atmosphere
- Temperature: 1,000,000 K
- Density: 10^{-12} kg/m^3
- Visible in the far-UV and X-ray wavelengths

The Solar Wind

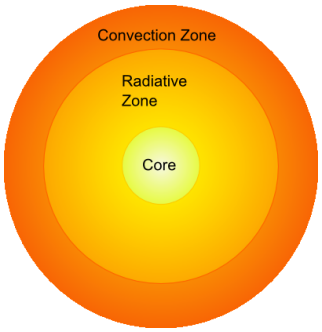


- The outer corona turns into the **solar wind**
- The solar wind flows away from the Sun into the Solar System

2.2 Inner structure

Convection Zone

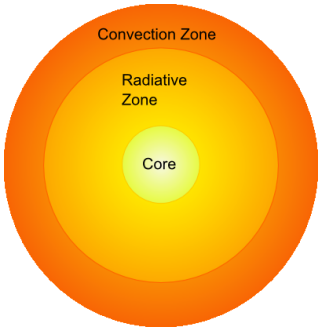
Convection Zone



- Material is in constant convective motion ("boiling")
- Consists of convection cells
- 200,000 km thick
- Temperature: 2,000,000 K
- Density: 150 kg/m^3
- *Energy transported by convection*

Radiative Zone

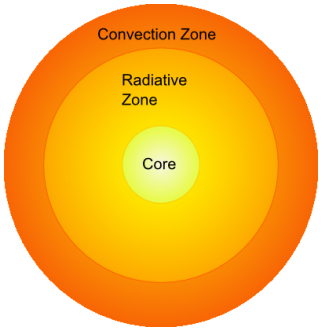
Radiative Zone



- *Energy transported through radiation*
- High density $\sim$ 15,000 kg/m^3
- High temperature $\sim$ 7,000,000 K
- Contains $\approx$ 50% of the Sun's mass

Core

The Core



- *Nuclear reaction generate the Sun's energy*
- Temperature: 15,000,000 K
- Density: 150,000 kg/m^3
- 200,000 km in radius