

The Sun's Properties

In the lecture we have learned about the Sun's properties and how scientists were able to discover them. To help you internalize and retain this information, I want you to revisit the main issues by answering the following questions.

1. How do we know how big the sun is?

We know how big it appears (0.5°) and how far away it is : $1 \text{ AU} = 150 \text{ mill km} \Rightarrow$ absolute size.

2. How do we know how much mass the sun has?

From Newton's law of gravity (and knowing distance & gravitational constant G). The faster the Earth (the shorter the year) the more mass the sun must have.

3. What is the Sun made of?

Hydrogen & helium.

4. How do we know that?

From spectral lines (fingerprints of the elements)

5. What is the temperature of the sun on its surface and how do we know?

$T \approx 5800 \text{ K} \approx 6000 \text{ K}$.

Sun sends out visible light $\approx 500 \text{ nm} \Rightarrow$ Wien's law : $\lambda_{\text{peak}} \cdot T = \text{const}$

or: Stefan-Boltzmann law: know Power output $\Rightarrow T = \left(\frac{P_{\text{sun}}}{\sigma A} \right)^{1/4}$

6. What is the temperature of the sun at its center and how do we know?

15 million K, we know from modeling the sun and requiring that it is 6000 K on the surface.

7. Is the pressure of the sun higher at its center or its surface? Explain how you know. Use an analogy: water pressure experienced when scuba diving.

Pressure is higher at the center, because all the other (outer) layers press down on the center

8. Based on your answers above: Is the sun's core denser, less dense or has the same density compared to regions close to its surface?

Core is the densest.

9. How do we know that the sun produces energy?

Sunshine warms up the earth's surface, so energy must be deposited from the sun.

10. How can we measure or compute how much energy the sun produces?

Measure power distributed per square meter (area), then multiply by the area of the earth's "orbital sphere" ($4\pi R^2 = 4\pi (1AU)^2$)

11. What are the outer layers of the sun?

Photosphere,
Chromosphere,
Corona

12. How can we observe them?

At solar eclipses or with a solar filter!