## Agenda for Ast 309N, Sep. 4

- Comments on Background Survey
- Feedback on card of 8/30 (posted separately)
- The Sun's energy source & internal structure
- Video segment: solar interior, energy transport
- [The Sun's surface, outer layers, activity cycle]
- [Video: what causes solar activity & storms]
- Index card: solar composition
- Thursday: nuclear fusion and solar neutrinos



## Results from Background Survey

- 93% of you have the prerequisite (78% took Ast 301 at UT, 16% took it elsewhere)
- 85% have viewed a telescope/planetarium, or read articles/watched programs; 45% have done both
- Almost half don't remember who wrote the text they used in Ast 301 (many texts have similar titles)
- About 50% said they learned only "a fair amount."
- Average score on graded questions was ≈ 6/15 (40%)
- Weakest areas: End stages of stars (Ast 309N subject matter), also Properties of light (we'll review this!)



## Card, 8/30

- Feedback files for the index card activities will be posted separately, on the "Cards" page of the class website.

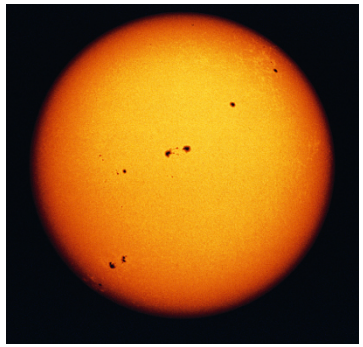


## The Sun: Vital Statistics

Luminosity: $3.8 \times 10^{26}$ Watts

Radius: $6.96 \times 10^5$ km
(109 × Earth)

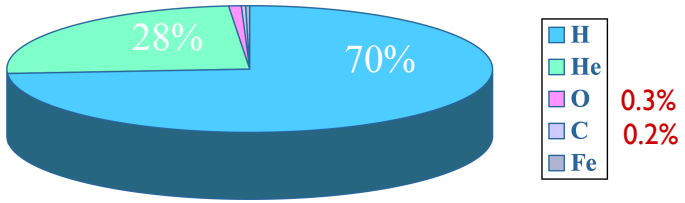
Mass: $1.99 \times 10^{30}$ kg
(300,000 × Earth)
(1000 × Jupiter)



Average Density: 1410 kg/m$^3$

(Actual density varies greatly from core to surface)

# The Sun: Surface Composition




How do we know this?
By identifying and measuring the **absorption lines** in the Sun's spectrum.



# What is the Sun's Source of Energy?

1. Ordinary chemical reactions?

$$\frac{\text{Chemical Energy Available}}{\text{Luminosity (rate of using fuel)}}$$ only lasts ~ 10,000 years

2. Contraction, which yields gravitational potential energy?

$$\frac{\text{Gravitational Potential Energy}}{\text{Luminosity}}$$ lasts ~ 25 million years

Eventually the shrinking would become noticeable.



# The Sun's Source of Energy

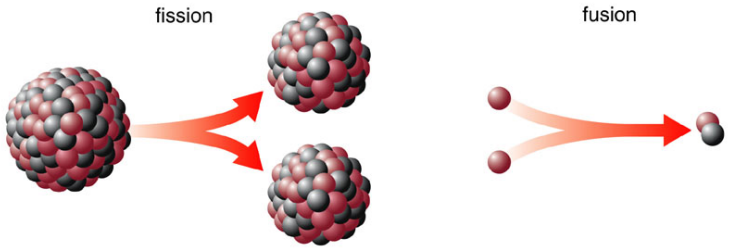
3. It is powered by nuclear fusion reactions; these lead to the conversion of a little bit of mass into energy: $E = mc^2$ .

$$\frac{\text{Energy stored in Mass (core)}}{\text{Luminosity}}$$ could last ~ 10 billion years !

Nuclear energy seemed the 'best bet' to keep the Sun producing energy over several billion years, although there was no direct proof of this idea for quite a while.



# Types of Nuclear Reactions




**Fission:** a bigger nucleus splits into smaller pieces.
Examples: radioactive decay, nuclear power plants

**Fusion:** Small nuclei join ("fuse") together to make a bigger nucleus.
Example: H → He