The Sun

Our Star
What we know about the Sun

- **Angular Diameter** \( \theta = 32 \text{ arcmin} \) (from observations)
- **Solar Constant** \( f = 1.4 \times 10^6 \text{ erg/sec/cm}^2 \) (from observations)
- **Distance** \( d = 1.5 \times 10^8 \text{ km} \) (1 AU).
  - (from Kepler's Third Law and the trigonometric parallax of Venus)
- **Luminosity** \( L = 4 \times 10^{33} \text{ erg/s} \)
  - (from the inverse-square law: \( L = 4\pi \ d^2 \ f \))
- **Radius** \( R = 7 \times 10^5 \text{ km} \).  (from geometry: \( R = \theta \ d \))
- **Mass** \( M = 2 \times 10^{33} \text{ gm} \).  (from Newton's version of Kepler's Third Law,
  - \( M = (4\pi^2/G) \ d^3 / P^2 \))
- **Temperature** \( T = 5800 \text{ K} \).  (from the black body law: \( L = 4\pi R^2 \sigma T^4 \))
- **Composition** about 74% Hydrogen, 24% Helium, and 2% everything
  - else (by mass).  (from spectroscopy)
The Solar Surface

The photosphere. The visible light disk.

Galileo observed sunspots (earlier noted by Chinese observers)
• Sunspots are regions of intense magnetic fields
• Sunspots appear dark because they are cooler than the photosphere
• A large sunspot is brighter than the full moon.
The Magnetic Cycle

Sunspots come and go in a regular pattern during the 11 year magnetic activity cycle.
The Magnetic Cycle

DAILY SUNSPOT AREA AVERAGED OVER INDIVIDUAL SOLAR ROTATIONS

The Butterfly Diagram
The Chromosphere

• First noticed in total solar eclipses.
• Name from the red color (from an emission line of Hydrogen)
• Hot (8000-20,000K) gas heated by magnetic fields.
• Bright regions known as plage.
The Corona
The diffuse outer atmospheres of the Sun.

The X-ray corona

The white-light corona

Also, the K corona - sunlight scattered from interplanetary dust