

The Sun, the closest star



Background for next week's lab

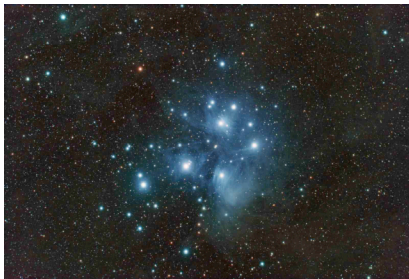
What are the absolute magnitudes of some stars

Star	M (abs. mag)
Sun	4.8
Tau Ceti	5.8
Altair	2.2
Vega	0.5
Deneb	-6.9
UV Ceti A	+15.3

Apparent magnitude of Jupiter right now: -2.9

Remember: this is how bright they would be if they were all lined up at the same distance

What is the meaning of this huge range in the intrinsic brightness (absolute magnitudes) of stars?

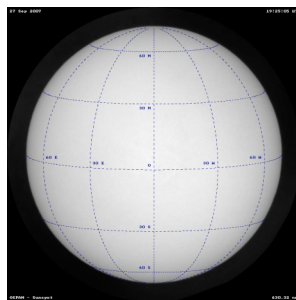


The Sun...our chance to see a star up close



The Sun: Basic physical properties

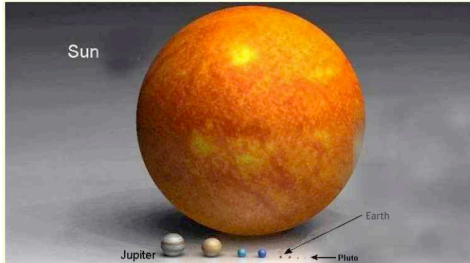
- Mass: 1.989×10^{30} kg (330,000 mass of Earth)
- Radius: 696,000 km (109 times than of Earth)
- Density: 1.5 g/cc
- Surface temperature 5800K



A question (no clickers this time)

- How do we know the radius (or diameter) of the Sun?
- How do we know the mass of the Sun?

The Sun and the other stars are in a different class of size than the planets



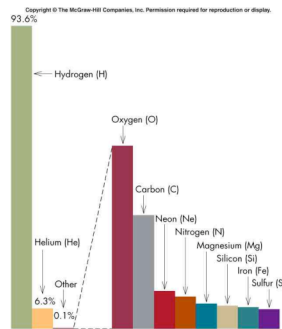
Further properties of the Sun

- The chemical composition of the Sun: *cosmic composition*
- The *luminosity* of the Sun = $3.85E+26$ Watts
- The age of the Sun (*how could we know this?*)
- Comparison with other objects (Vega, Arcturus, stars in M13, etc)

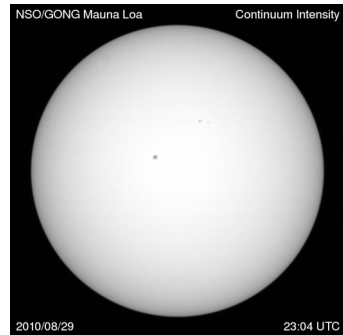
What is the Sun made of?

The stuff of the universe

The recipe of Jupiter and Saturn

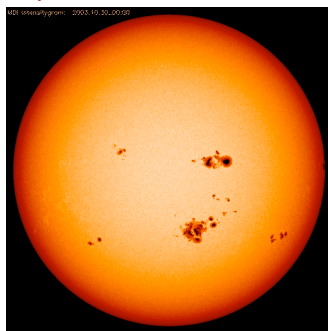


The changing face of the Sun

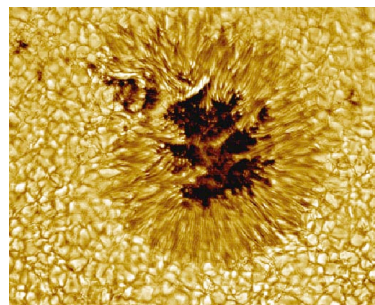


In contrast to today, there can be many sunspots on the Sun

Sun of October 30, 2003



Structure of a Sunspot

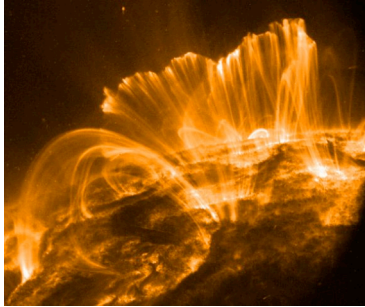


Sunspots are regions of very strong magnetic field (2000 Gauss)



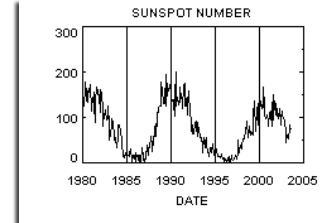
Demo

Solar magnetic fields reach far out into space

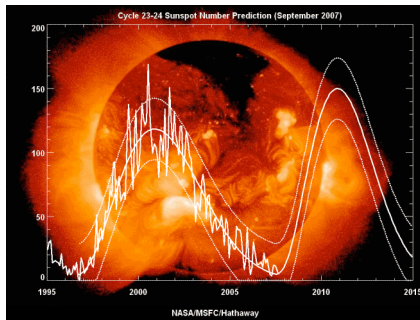


The 11 Year Solar Cycle

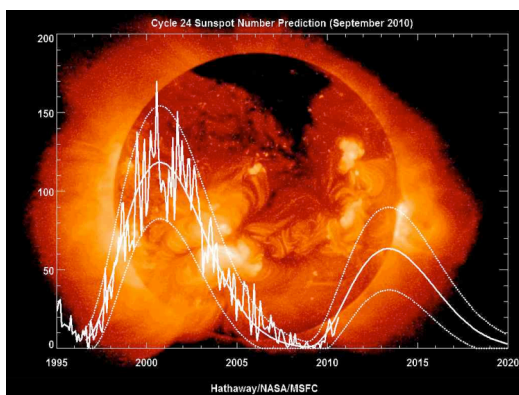
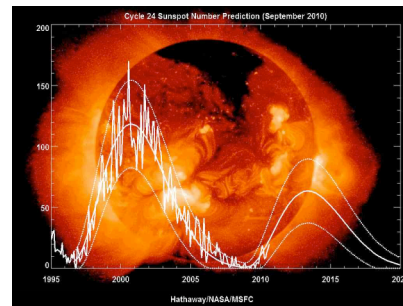
The Sun has a "heartbeat"; its properties change on a period of 11 years



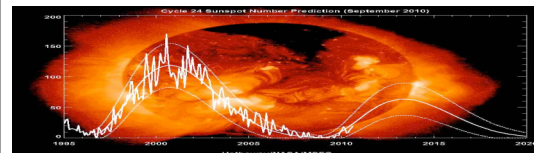
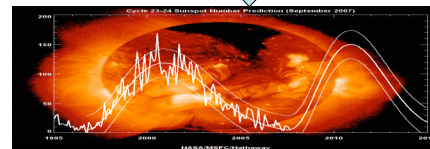
Latest data on this sunspot cycle



An indication that our knowledge of the solar cycle is far from perfect

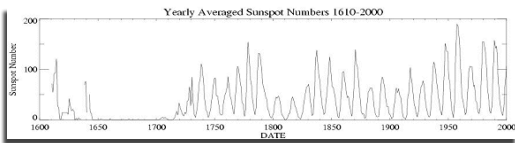


Predictions in 2007



Observations and predictions as of today

The Sunspot Cycle has been going on for a long time



Observations show cycle persisting, but “turning off” from 1650 to 1730 (Maunder Minimum)

The Structure of the Solar Atmosphere

- Photosphere
- Chromosphere
- Corona
- Temperature increases as you go up
- Outermost layer flows out into space to form the *Solar Wind*



The Solar Wind

- A wind past the Earth at 400 km/sec
- The Sun is “melting away”
- Density 19 orders of magnitude less than atmosphere
- A medium for solar events
- May have “sandblasted” the early atmosphere of Mars



The Lesson for Other Stars

- Do they also have sunspots, sunspot cycles, etc?
- How does all this (magnetic fields, solar wind, rotation) relate to the age of a star?