The Sun, the closest star

Background for next week’s lab

What are the absolute magnitudes of some stars

<table>
<thead>
<tr>
<th>Star</th>
<th>M (abs. mag)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun</td>
<td>4.8</td>
</tr>
<tr>
<td>Tau Ceti</td>
<td>5.8</td>
</tr>
<tr>
<td>Altair</td>
<td>2.2</td>
</tr>
<tr>
<td>Vega</td>
<td>0.5</td>
</tr>
<tr>
<td>Deneb</td>
<td>-6.9</td>
</tr>
<tr>
<td>UV Ceti A</td>
<td>+15.3</td>
</tr>
</tbody>
</table>

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

Apparent magnitude of Jupiter right now: -2.9

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: 1.989E+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 = $3.85 \times 10^{26}$ 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 changing face of the Sun

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

Structure of a Sunspot

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

![Graph showing the solar cycle](image)

**Latest data on this sunspot cycle**

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

![Graph showing recent data](image)

**Predictions in 2007**

Observations and predictions as of today

![Predictions graph](image)
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?