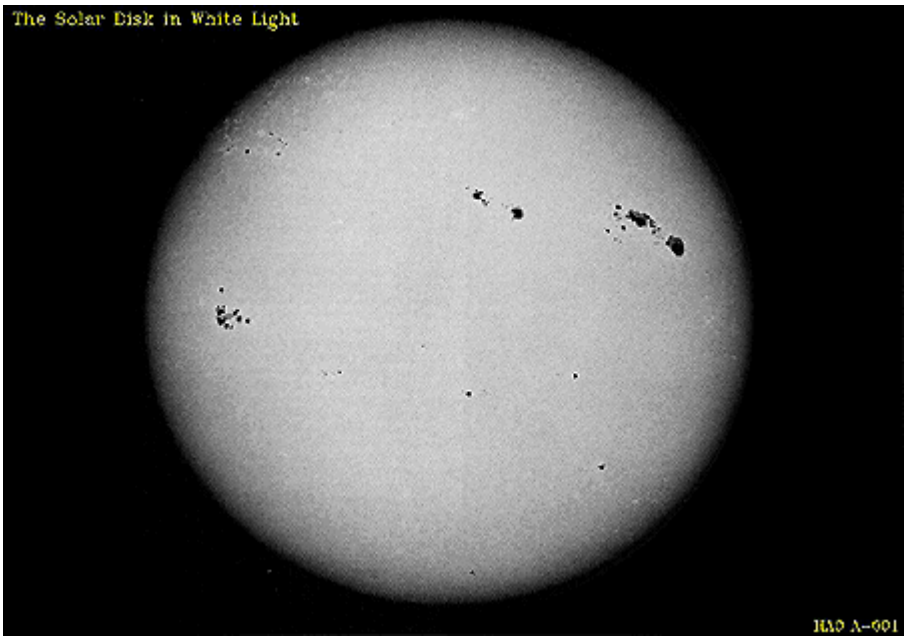
The Sun

By J. De Keyser and V. Pierrard

The Sun is a large ball of plasma. This means: a collection of moving electrically charged elements. It is difficult to speak of the "solar surface", because this giant ball is gaseous. But why is it then that we see a solar disc with a clear edge? Well, the gas inside the Sun is strongly compressed (by the weight of the mass on top). On the outside, the density gets smaller, up to the point where the gas becomes transparent to visible light. This region is called the photosphere. It corresponds to the visible solar disc. The radius of the Sun (actually the radius of the photosphere) measures 695.990 km; this is more that hundred times the radius of the Earth. The temperature of the photosphere is about 6400 K (and explains the white-yellow colour of the solar disc).

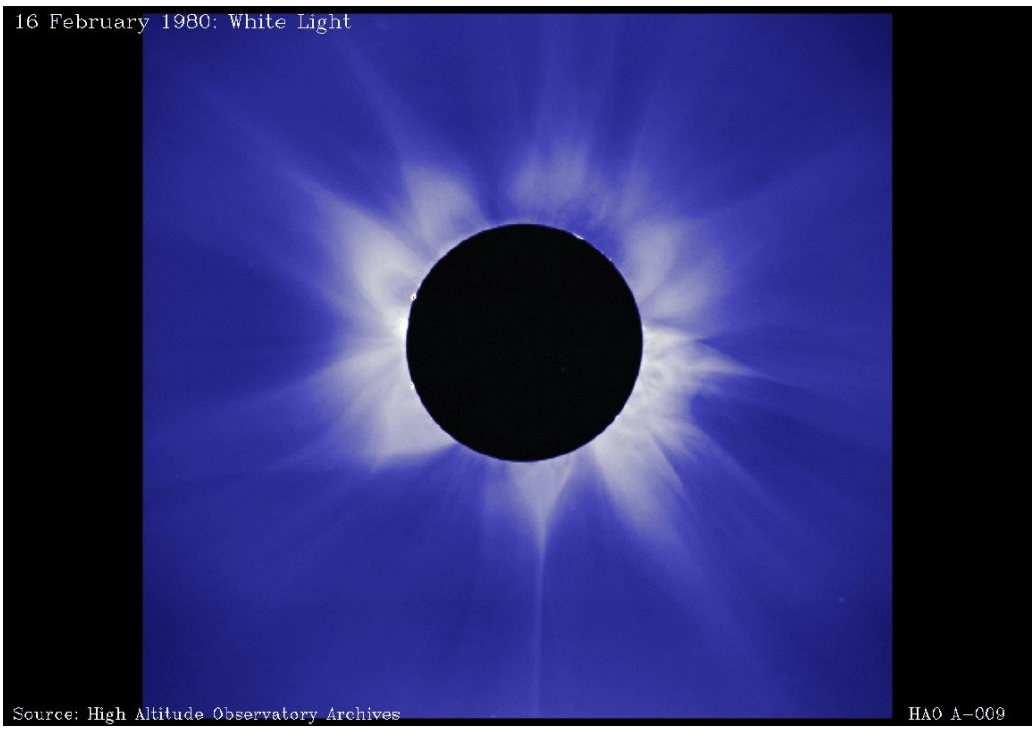
Within the Sun nuclear reactions produce heat and energy. The gas in the Sun's outer layers transports this heat by convection: Bubbles of hot gas rise to the photosphere and emit the absorbed heat in the form of radiation or pass the energy to the higher solar atmosphere, while cooled gas sinks down again. These gas bubbles give the photosphere its "granular" view.



Sometimes, we can see sunspots in the photosphere, like on the picture alongside. These are areas that are cooler than the surrounding photosphere (some 4500 degrees). Sunspots mostly appear in groups and come with local magnetic fields.

The lifetime of a sunspot group can be days to several weeks, sometimes even longer. One can also see the sunspots move over the Sun in the course of consecutive days. Because of that, Galileo Galilei was able to determine the rotation period of the Sun (25 days near the equator, 36 days near the Poles).

On top of the photosphere lies the chromosphere, and above that the corona. The temperature in the chromosphere - a thin transition layer - is 10000 degrees, while it reaches more than a million degrees in the corona. However, the gas gets more and more rarefied. Where the magnetic field lines are open (in the coronal holes), the solar wind escapes from the corona.



The corona is normally visible only during a total solar eclipse, when the Moon covers the solar disc exactly. The photo alongside shows the corona during an eclipse in 1980.

Nowadays one also uses a coronograph (this is a telescope in which one artificially holds a disc in front of the solar image, so as to imitate an eclipse).

The Sun is variable. One has observed that a number of phenomena keep on returning with a periodicity of about 11 years. These phenomena include sunspots and explosive events on the Sun, like solar flares and coronal mass ejections. One speaks of the "solar activity".

During periods of low solar activity no or very few sunspots appear. During sunspot maximum, several groups with in total even hundred sunspots may be present. The Sun then also emits more ultraviolet light and X rays. The cycle of solar activity corresponds to major changes in the magnetic field of the Sun. While during low solar activity the magnetic field of the Sun more or less looks like that of a bar magnet, the magnetic field becomes very unsteady for high activity. Actually, the polarity of the global magnetic field turns over: Two periods of 11 years are necessary to return to the initial situation. These changes in the large-scale magnetic field of the Sun are of course felt in the solar wind as well.

To conclude, a warning: never try looking at sunspots without the proper material. Never look straight in the Sun, certainly not with binoculars or a telescope: you risk of getting blind at once. Only with special filters or projection methods, you can safely look at the solar disc.