8.1.3 The Sun

Radio emission from the sun arises from several different phenomena and can be divided into three main components – 1) the quiet sun component, which is always present, 2) the slowly varying component and 3) the active sun component which is caused by sunspots and flare activity.

The quiet sun component of the radio emission is from thermal emission from the hot ionized gas. In order to understand from which part of the sun's atmosphere this emission arises, one needs to understand the main opacity source at radio wavelengths. (The opacity is a measure of how much a wave gets absorbed as it travels through a medium). The main source of opacity in the sun's atmosphere (the photosphere, chromosphere and corona) at radio wavelengths comes from electrons. The bulk of the emission arises from the region where the opacity, W , is near 1, since at higher optical depth regions cannot be penetrated and the low optical depth regions do not produce enough emission. At visible wavelengths this happens at the photosphere where the temperature is about 6000 K and hence the sun appears as a blackbody with that temperature. At a frequency of 100 GHz (wavelenth 0.3cm) the emission originates at the same height in the photosphere and the sun appears as a 6000 K blackbody. But at a frequency of 1.4 GHz (wavelength of 21 cm) the emission originated from the top of the chromosphere and is seen as a blackbody of temperature of about 100,000 K. And at longer wavelengths (300 cm or frequency of 0.1 GHz) the emission arises from the corona and is a 2 million K blackbody. All this also means that the size of the sun measured at the different wavelengths will vary.

The other two components are related to the sunspot activity on the sun. The slowly varying component is also thermal in origin and arises from the region above the sunspots where the electron density is higher. The blackbody temperature of these regions can be as high as 2 million K. Thus the regions above the sunspots can contribute more radio emission than the total area without sunspots and increase the total radio flux relative to the quiet sun. So the change in the total radio flux is dependent on the total number of sunspots. The radio flux density then follows the 11 year sunspot cycle.