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Abstract of Invited lecture

SPECTROSCOPIC INVESTIGATIONS DURING SOLAR ECLIPSES

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Total solar eclipse occurs when the Moon passes in between the Sun and the observer on the Earth and the angular diameter of the Moon is slightly larger than that of the Sun, so the solar disc (the photosphere) can be covered by it. This enables us to separate out the bright photosphere, so the total solar eclipses provide unique opportunities for study of the much less bright outer atmospheric layers of the Sun, the chromosphere and corona.

The chromosphere appears just after the beginning (the second contact) and before the end (the third contact) of totality for a few seconds. During these several seconds the bright spectral lines flash out through the whole spectrum. According to Young this sudden appearance of emission spectrum is called the flash spectrum. It consists of a large number of emission lines and a continuum. By taking successive spectra of the chromosphere, as the Moon moves across it, we can observe the changes of spectral line profiles with high spatial resolution. From these observations extensive studies of the vertical structure of chromosphere can be made. There are two methods of observation of flash spectrum at the total solar eclipse. One is the slitless and the other one is the slit spectrograph method. The type of spectrography depends on the problem that has to be solved. For instance if we intend to measure the whole energy of the chromospheric line we have to use the slitless method. This method allows us to make observations with very high height resolution (about 100 km). On the other hand, this method is not suitable for the spectral line profile measurements, because the line profile will be affected by the extension of the chromosphere and by the atmospheric turbulence. Because of that the slit method has to be introduced for line profile observations. The disadvantage of slit method is the difficulty of determining the position of the slit in the chromosphere. Unfortunately, both methods have a disadvantage that observations integrate the radiation over a long path which includes various parts with different properties that are very difficult to disentangle. Although the chromospheric spectrum has been observed at many eclipses from 1870. large gaps still exist in our knowledge of the spectrum. For instance, the transition of the photospheric into chromospheric spectra and the behaviour of line profiles are still of importance in attempts to find the energy sources that produce the temperature rise not only in the chromosphere but in the corona, too. Spectra of active regions observed at the limb at an eclipse are also of great interest.

The solar corona is a very hot, low dense and optically thin gas. The radiation of the solar corona consists of three components: the K, F and E corona. The K corona is the photospheric light scattered by electrons, but due to high velocity and the Doppler broadening the spectral lines of the photosphere are washing out. The F corona, which is created by scattering of photospheric light on dust particles between the Earth and Sun, shows the photospheric absorption spectral lines. As these particles are slow moving, the photospheric lines are not washed out. The E corona is combined light of different emission lines. Some of these lines have the intensity which exceeds their background continuum many times (often by a factor 100). Their widths are usually about 0.1 nm. These emission lines in the visible spectrum derive from forbidden transitions of highly ionized atoms like FeX, FeXIII or FeXIV and they are very useful for study of the temperature and velocity structure of the corona that is of crucial importance for understanding the coronal heating mechanism.