CONTINUUM ABSORPTION IN THE SOLAR EUV SPECTRA*

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It has been shown from ground-based and space observations that the lower corona of the Sun contains a significant amount of cool chromospheric material in highly inhomogeneous structures, such as spicules, dark mottles, and fibrils. Therefore, some interactions between the cool and the hot material have been found in optical and ultraviolet observations. One of such phenomena is the weakening of solar EUV line emission originating from the chromosphere-corona transition region (H I weakening) in the cool chromospheric material above the EUV emitting region, as suggested by Kanno (1979) and Schmahl and Orrall (1979). The remarkable nature of the weakening is that it is found even at the disc center of the quiet Sun.

Here we calculated the weakening of 11 ions by solving the rate equations (Dufton, 1977) in order to examine the wavelength-dependence of the weakening, because some authors did not find it (e.g., Doschek and Feldman, 1982).

Four points of this work are superior to other works up to now.

1. The steady-state rate equations of multilevel atoms were solved. Then we calculated the predicted intensities of a number of lines of 11 ions by using Dufton’s (1977) code. This code includes the spontaneous transitions, the collisional excitations by electron and proton impact, and the collisional de-excidations.

2. New atomic data were used.

3. In calculating the weakening we used only lines belonging to the common ion, which exclude the systematic errors due to an abundance, an ionization calculation, and various atomic data as well as due to the adopted values of the pressure and the temperature gradient of the model.

4. We convolved the intensities predicted from multilevel calculations over an instrumental profile of the observation, because all members of a multiplet were not always contained in the bandpass (1.6 Å) of the Harvard spectrometer on Skylab.

The equivalent optical thickness $\tau_H$ was used as the parameter representing the degree of the weakening. $\tau_H$ is defined by

$$I_{\text{obs}}/I_{\text{pr}} = k \exp \left[-(\lambda/\lambda_H)^2 \tau_H\right],$$

where $I_{\text{obs}}$ and $I_{\text{pr}}$ are the observed and predicted intensities, respectively, $\lambda$ is the


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Fig. 1. The normalized weakening $\ln(J_{\text{obs}}/J_{\text{pr}})$ vs $(\lambda/\lambda_H)^3$ for the quiet Sun. $\times$: CII, $\Delta$: NII, $\triangle$: NIII, $\triangle$: NIV, $\bullet$: OIII, $\bigcirc$: OIV, $\bigcirc$: OV, and $\square$: SIV. The points with arrows are the upper limit estimations due to blends.

Fig. 2. The equivalent optical thicknesses $\tau_H$ and $\tau_{\text{He}}$ as a function of temperature. The error bars show the standard deviations for each ion.

wavelength of the line, and $\lambda_H = 912$ Å. $\tau_H$ is the optical thickness at the Lyman continuum head, when the absorbing cool chromospheric material is assumed to be located above the EUV emitting region, and $k$ is a normalization factor showing the systematic errors mentioned above.