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EUV diagnostics for boron-like ions from spectra obtained by SUMER/ SOHO

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The SUMER (Solar Ultraviolet Measurements of Emitted Radiation) spectrograph on the spacecraft SOHO (Solar and Heliospheric Observatory) is offering an unprecedented view of the solar spectrum in the wavelength range 465-1610 Å (Wilhelm et al., 1995, 1997; Lemaire et al., 1997). This wavelength region is dominated by the emission lines in the transition region and low corona. We revisit the density-dependence of boron-like ions : N III, O IV, Ne VI, Na VII, Mg VIII, Al IX and Si X; whose transitions fall within the SUMER bandpass. The logarithmic temperatures of formation of these ions are 4.9, 5.2, 5.6, 5.9, 6.0 and 6.1 K respectively. Many of the lines are measured for the first time : higher resolution and sensitivity of the SUMER spectrograph allow for the identification and measurement of weaker lines than was possible previously, and at positions higher off the solar limb.

In most cases we discuss, we compare an allowed line, where the decay of the upper level is almost radiative, to a forbidden line, where the electron collisional de-excitation competes with radiative processes in the decay of the upper level. These lines were not previously observed for two related reasons : (1) insufficient instrumental sensitivity, which led to (2) inability to observe sufficiently low density regions where these line ratios have their full diagnostic potential. A comprehensive identification and intensities of SUMER spectral lines are given by Curdt et al. (2001). There exists a vast literature on diagnostics of solar plasmas including the most recent one by Dwivedi et al. (2002).

Electron impact excitation rates for all ions come from Zhang et al. (1994), from extensive R-matrix calculations and hence include resonance contributions for all levels. Proton rates between the two levels of the ground configuration and among the three levels of the ^{4}P term have also been taken into account. Einstein decay rates come from diferent sources (Flower and Nussbaumer, 1975; Dankwort and Trefftz, 1978). For want of space we present here the MG VIII line ratio only in the SUMER spectral range. The Mg VIII λ 772/λ 782 line ratio shown in Figure 1 is a new potential density-diagnostic ratio. This ratio is temperature-insensitive, and yields a density of about 7×10^8 cm^{-3} in quiet solar regions, making use of SUMER observations. This line ratio is a good density diagnostic

for the quiet Sun and coronal hole plasmas. A detailed study on many other density-diagnostic line ratios from boron-like ions observed by SUMER in the solar regions off limb is under way (Mohan and Dwivedi, 2002).

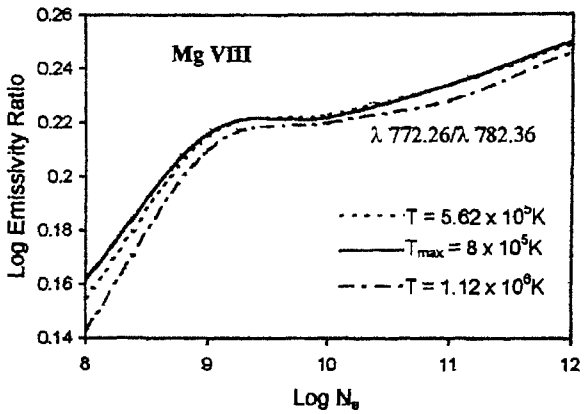

Figure 1. Mg VIII, λ772/λ782 line ratio in density-dependence at temperatures T_{max} and $\Delta T = \log T_{max} \pm 0.15$.

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