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DIAGNOSTIC STUDY OF PROMINENCE-CORONA INTERFACE

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Abstract

The Extreme Ultraviolet emission lines, observed as well as theoretical, have been used in an attempt to infer the physical parameters in the prominence-corona interface. The results are discussed in the context of attempts to understand the prominence-corona interface.

1. Introduction

In this study we have used the extreme ultraviolet (EUV) spectrum (300-630 Å) to infer electron densities within the interface separating a prominence and the solar corona. The basic approach is to consider emission lines whose intensity ratios are sensitive to electron density variations. The line intensities are from the EUV spectrum of an erupting prominence observed from Skylab (Widing et al.1986).

2. Density and Temperature diagnostics

We have considered some of the lines belonging to the ions Ne V, Ne VI, Mg VI, Mg VII, and Mg VIII. Ne V ion has lines at 416.23Å ($^1D_2 - {}^1D_2$) and 572.29Å ($^3D_3 - {}^3P_2$) with intensities 92 and 81 respectively. The observed intensity ratio I (416.23)/I(572.29) is 1.136. Mg VII ion has

lines at 319.00Å ($^1D^\circ_2 - {}^1D_2$) and 434.94Å ($^3D^\circ_3 - {}^3P_2$) with observe intensities 68 and 54 respectively. The observed intensity ratio I(319.0)/I(434.94) is 1.259. The variation of intensity ratios for Ne V and Mg VII lines as a function of electron density Ne are given in Figure 1. The open circles are from the calculations of Raju and Dwivedi (1979). The filled circles refer to the calculations mentioned in the paper by Widing et al.(1986, Figure 4). The crosses refer to the observed intensity ratios for the prominence. The squares refer to the theoretical intensity ratios obtained for a model atmosphere of the chromosphere-corona transition region (Raju and Dwivedi).

Mg VIII ion has two lines at 430.47Å ($^2D_{3/2} - {}^2P^\circ_{1/2}$) and 436.76Å ($^2D_{5/2} - {}^2P^\circ_{3/2}$) with observed intensities 36 and 96 respectively. The observed intensity ratio for these two lines is 0.64.

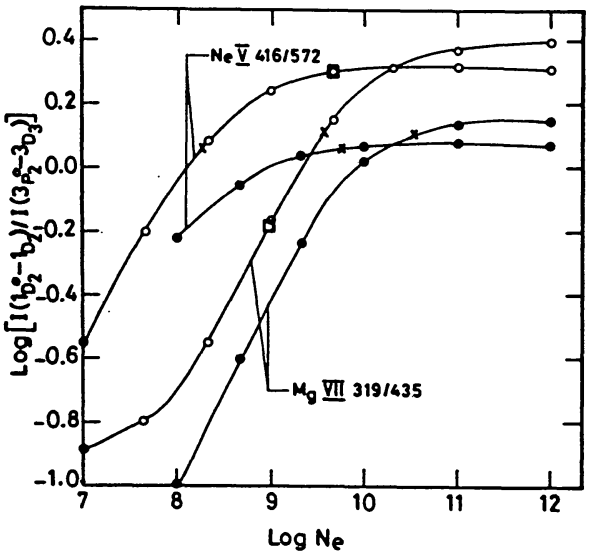

Figure 1: Theoretical line intensity curves for the ratio of $^1D^\circ_2 - {}^1D_2$ to $^3P^\circ_2 - {}^3D_3$ for Ne V and Mg VII. O: Raju and Dwivedi (1979). ● :Weiding et al. (1986). X: Observed intensity ratios for the prominence. □ : For a model atmosphere of chromosphere-Corona transition region, Raju and Dwivedi (1979).

In Table I we have listed electron densities for the line intensity ratios mentioned above. We have also tabulated the electron pressure parameter N_eT_e. Temperature values (T_e) are those for which the relative ion abundance of an element is maximum.

Table I. Physical parameters for a prominence-corona interface

Ion	A:	T_e	N_e	N_eT_e	B:	T_e	N_e	N_eT_e
Ne V	a	2.5+5*	1.85+8	4.63+13		2.5+5	4.63+9	1.16+15
	b	2.5+5	5.44+9	1.36+15				
Mg VI Ne VI		4.0+5	1.1+9	4.4 + 14		4.0+5	1.5+9	6.00+14
Mg VII	a	5+5	3.69+9	1.85+15		5.0+5	1.0+9	5.0+14
	b	5+5	3.41+10	1.71+16				
Mg VIII		8+5	5.8 +8	4.64+14		8.0+5	5.8+8	4.64+14

*2.5+5 means 2.5×10^5

In the set A the row 'a' values are from Raju and Dwivedi (1979). The row 'b' numbers and the values for Mg VI, Ne VI are from Widing et al. (1986). Mg VIII values are from Dwivedi (1988). The pressure parameter 'N_eT_e' in set A does not seem to show a systematic trend.

Systematic trend for the pressure parameter across the P-C interface can be obtained, illustratively, in the following way. For the Ne V ion we assume the electron density to be given by the theoretical ratio indicated by the square symbol in Figure 1. This leads to an electron density of 4.63×10^9 (cm^{-3}) and $N_eT_e = 1.16 \times 10^{15}$. Similarly for Mg VII the intensity ratio is 0.66 corresponding to an electron density of 10^9 (cm^{-3}) and $N_eT_e = 5 \times 10^{14}$. In the case of Mg VI we assume a value of $1.5 \times 10^9 (cm^{-3})$ for the electron density. This gives for the intensity ratio I(349.163)/I(403.307) a value of 0.794. The corresponding

electron density is 1.5 x 10^9 (cm^{-3}) (Raju and Dwivedi, 1989). In the case of Mg VIII ion we have retained the values given in set 'A'. The new values for the pressure parameter are given in set 'B' of the Table I.

Conclusion

We have used EUV line intensities of an erupting prominence observed from Skylab to infer physical parameters across the P-C interface. It would be necessary to obtain accurate line intensities for many more lines in order to model the P-C interface. For instance, none of the observed Mg VI lines could be used for intensity ratios. Si VIII has only one observed line. Future observations for prominence would have to be with extended spectral range. The nature of pressure across the P-C interface would give an idea of the magnetic field structure if no other forces are present for steady state conditions.

References

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DIJAGNOSTIČKO ISTRAŽIVANJE PROSTORA IZMEĐU PROMINENCIJA I KORONE

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izlaganje

Sažetak: Koriste se opažane emisione linije u ekstremnom ultraljubičastom području kao i teorijska razmatranja da bi se odredili fizikalni parametri u prostoru između prominencija i korone, te se diskutiraju rezultati.