§13. Collisional Radiative Model for Xe^{10+} Ions and the Contribution of Satellite Lines on EUV Spectra

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In order to analyse the observed spectra of Xe ions from LHD and CHS, we have made collisional radiative models (CRM) for Xe ions and studied the spectra. EUV spectra from Xe ions have been studied mainly in high density plasma such as laser produced plasmas. Since the electron density in LHD is low ($n_e \sim 10^{12} - 10^{14}$ cm^{-3}) compared to those in laser - produced plasmas ($n_e > 10^{20}$ cm^{-3}), we need to construct a collisional radiative model which can be applied in low density plasmas. In low density plasmas the most important process for emission is excitation by electron impact. In the low temperature region, we have to take into account the contribution of recombination. We estimated the contribution by dielectronic recombination.

We used the Hullac code [1] for all the necessary atomic data, energy levels, radiative transition rates, excitation rate coefficients, autoionization rates in our models. We have included n = 4 and 5 levels; e.g. 752 levels for Xe^{10+} ions. In our CRM only singly excited states are included. In Fig.1 we show a calculated spectrum by CRM for Xe^{10+} ions at 50 eV and $n_e = 10^{13}$ cm^{-3} by solid line. In this wavelength region 4d – 5p transition is dominant. We also compare a spectrum made from the value of gAr for 4d – 5p transition where g is a statistical weight and Ar is a transition probability. The spectrum made by gAr can be considered to be the 4d – 5p spectra at high density because a population density is proportional to the statistical weight in high density. The emission lines in longer wavelength region near 140A are stronger in CRM than gAr.

We have estimated the contribution of dielectronic satellite lines produced by dielectric recombination and found that the satellite lines can be significant at low temperature lower than 20 eV. In Fig.2 we show the intensity coefficient by excitation process and by dielectronic recombination process for a line as a function of temperature.

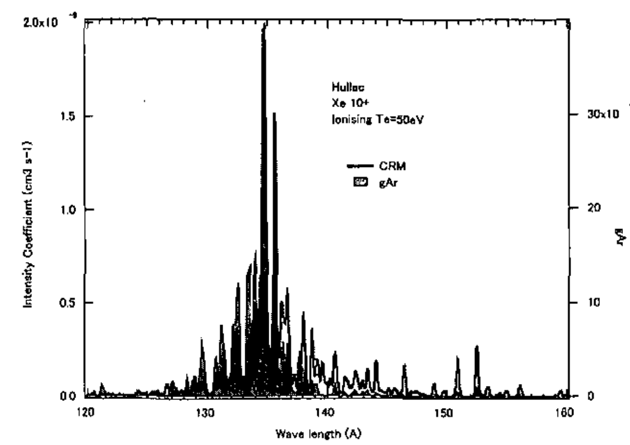

Fig.1 Comparison of the theoretical spectra by CRM (solid line) and gAr values (painted).

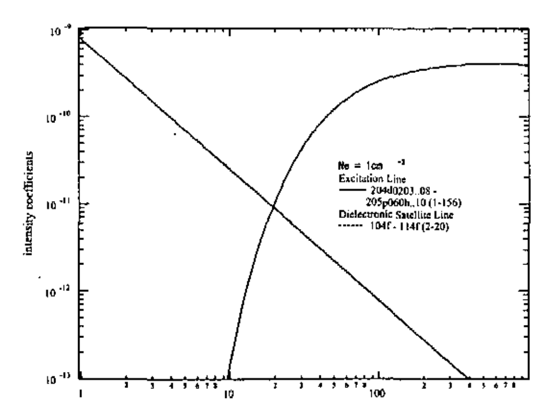

Fig.2. Intensity coefficient for an excitation line (solid line) and a dielectronic satellite line (dashed line).

We have also estimated the contribution of other ions such as Xe^{26+} which can emit the lines near 135 A. Emission coefficients for such high charge ions are smaller by one order of magnitude than those of Xe^{10+}. We have to know the ion abundances of different ions in plasmas to know the contribution of these high charge ions.

[1] A. Bar-Shalom, M. Klapisch and J. Org, Phys. Rev. A38, 1773 (1988)