How anisotropic electrons influence the density diagnostic of hot plasma?

Zeyneb BEDRANE épouse TABET

Laboratoire de Physique Théorique

Département de Physique - Faculté des Sciences - Université Abou-Bakr Belkaïd de Tlemcen

Joint ICTP-IAEA Workshop on Fusion Plasma Modelling using Atomic and Molecular Data

Introduction

- X-ray line emission of highly charged He-like ions useful for diagnostic purposes.

Introduction

- X-ray line emission of highly charged He-like ions useful for diagnostic purposes.
- The ratio $R = I_z/(I_x + I_y)$

Forbidden line z $1\mathrm{s}2\mathrm{s}\,{}^3\mathrm{S}_1 \rightarrow 1\mathrm{s}^2\,{}^1\mathrm{S}_0$

Intercombination lines x, y $1\mathrm{s}2\mathrm{p}\,{}^3\mathrm{P}_{2,1} \rightarrow 1\mathrm{s}^2\,{}^1\mathrm{S}_0$

- this intensity ratio R is strongly sensitive to the density $n_{\rm e}$ above a certain critical value that increases from $\sim 10^8$ to $\sim 10^{12}$ cm^{-3} as Z is enlarged.

- this intensity ratio R is strongly sensitive to the density n_{e} above a certain critical value that increases from $\sim 10^8$ to $\sim 10^{12}$ cm^{-3} as Z is enlarged.

- Almost all of the previous works on using the intensity ratio R for plasma diagnostics were carried out under the assumption that the free electrons follow an isotropic Maxwellian velocity distribution.

- this intensity ratio R is strongly sensitive to the density n_{e} above a certain critical value that increases from $\sim 10^8$ to $\sim 10^{12}$ cm^{-3} as Z is enlarged.

- Almost all of the previous works on using the intensity ratio R for plasma diagnostics were carried out under the assumption that the free electrons follow an isotropic Maxwellian velocity distribution.

Aim of our work

investigate theoretically how a small fraction of monoenergetic electrons with a directed, beam-like distribution affects the intensity ratio R in hot plasmas and, hence, may modify the density diagnostic of plasmas with regard to a purely Maxwellian plasma.

Aim of our work

investigate theoretically how a small fraction of monoenergetic electrons with a directed, beam-like distribution affects the intensity ratio R in hot plasmas and, hence, may modify the density diagnostic of plasmas with regard to a purely Maxwellian plasma.

- Detailed calculations of the intensity ratio R for helium-like Ne^{8+} ions
- Electron densities n_e from 10^9 to 10^{13} cm^{-3}.
- steady-state collisional-radiative model based on an electron velocity distribution which includes both Maxwellian isotropic and monoenergetic beam components.

Aim of our work

investigate theoretically how a small fraction of monoenergetic electrons with a directed, beam-like distribution affects the intensity ratio R in hot plasmas and, hence, may modify the density diagnostic of plasmas with regard to a purely Maxwellian plasma.

- Detailed calculations of the intensity ratio R for helium-like Ne^{8+} ions
- Electron densities n_e from 10^9 to 10^{13} cm^{-3}.
- steady-state collisional-radiative model based on an electron velocity distribution which includes both Maxwellian isotropic and monoenergetic beam components.

- In these computations, the polarization and anisotropic angular distribution of the emitted lines are taken into account.

- In these computations, the polarization and anisotropic angular distribution of the emitted lines are taken into account.

Why Ne^{+8} ? ? ? ?

- In these computations, the polarization and anisotropic angular distribution of the emitted lines are taken into account.

Why Ne^{+8} ? ? ? ?

- Its large cosmic abundance

- In these computations, the polarization and anisotropic angular distribution of the emitted lines are taken into account.

Why Ne^{+8} ? ? ? ?

- Its large cosmic abundance
- The density range of sensitivity of the corresponding R ratio is characteristic of solar flare plasmas

Effect of directional energetic electrons on the density diagnostic of hot plasmas Z.Bedrane, M.K. Inal and S. Fritzsche, *J. Phys. B : At. Mol. Opt. Phys.*, **42**, 055701, (2009)