X RAY LINE POLARISATION: A TOOL TO DIAGNOSTIC THE ANGULAR DISTRIBUTION OF NON-THERMAL ELECTRONS GENERATED IN LASER-PRODUCED PLASMAS

Zeyneb Bedrane and Mokhtar K. Inal
Sciences Faculty, Physics Department,
B.P. 119, 13000 Tlemcen,
Algeria

In laser-produced plasmas non-thermal electrons could be generated with an anisotropic velocity distribution. The first PPS experiment on laser-produced plasma has been reported by Kieffer *el al*[1]. In the one hand they measured the polarization degree of the resonance line of Al11+ and found it equal to P= -0.25 ± 0.07. In the other hand they calculated the velocity distribution in a coronal model. The polarization degree of the w line was calculated to be -0.1 to -0.15. Fujimoto and Kazantsev[2] mentioned that Kieffer *et al* assume the population kinetics to be corona equilibrium however the electron density is of the order of 1021 cm-3, for such higher density plasma this assumption may not be valid and the collisional radiative model should be employed. For these reason the purpose of the present work is to study theoretically the polarization of the resonance line 1s2p 1P1 →1s2 1S0 taking into account both the excitation of the upper level from the ground 1s2 1S0 and the metasable 1s2s 1S0 levels. We consider the excitation of Al11+ ions with monoenergetic unidirectional electron beam. The required collision strengths for the transition between magnetic sublevels were computed using semi-relativistic distorted wave approximation. For partial waves with angular momenta up to 20 the collision strengths were calculated with the Coulomb-Bethe approximation. Our results shown clearly that the inclusion of the excitation from the metastable level in the 2 1P1 population has a strong depolarization effect. For an energy of 123Ry, the polarization degree decreases noticeably varying from 60% to 37%. The contribution of the metastable level gives rise to an important augmentation of the anisotropy degree of the velocity distribution function of the non-thermal electrons.

1. J. C. Kieffer, J.P. Matte, M. Cheker, Y. Beaudoin, C.Y. Chen, S. Coe, G. Morou, J. Dubau and M.K. Inal, Phys. Rev. E 48, 4648 (1993)

2. T. Fujimoto and S. Kazantsev, Plasma Phys. Control Fusion 39, 1267-1294 (1997).