Alignment-transfer rate coefficients for collisional excitation of O V ion in an anisotropic two-temperature plasma

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Rate coefficients for the transfer of alignment in the electron-impact excitation of ions are required for collisional-radiative modeling of polarized line emissions from non-thermal plasmas with cylindrically symmetric electron velocity distributions [1]. These coefficients, denoted $C_0^{KK'}$ with K, K'=2,4,…, are obtained from the multipole cross sections $\sigma_Q^{KK'}$ with $|Q| = 0,1,2,\ldots,\min(K,K')$ [2]. Unlike $\sigma_{Q=0}^{KK'}$, the $\sigma_{Q\neq 0}^{KK'}$ cannot be deduced from the usual cross sections for transitions between magnetic sublevels. Their calculations are much more difficult since they must include coherences between different magnetic sublevels within the initial and final ion levels. Until now, there have been no published calculations of $C_0^{KK'}$ taking into account $\sigma_{Q\neq 0}^{KK'}$.

In an attempt to fill this gap, we report here calculations of the alignment-transfer rate coefficients C_0^{22} and C_0^{44} for excitations of the Be-like ion O V from its metastable levels 2s2p $^3P_1$ and $^3P_2$, using an anisotropic Maxwellian electron distribution. The calculations are made in terms of the ratio $T_\perp / T_{//}$ characterizing the anisotropy degree of the electron distribution, for different values of the mean electron energy $\langle \varepsilon \rangle = k\left(T_\perp + T_{//}/2\right)$ in the range 30−450 eV, $T_{//}$ and $T_\perp$ being respectively the longitudinal and transverse temperatures with respect to the quantization axis *z*. The multipole cross sections $\sigma_{Q=0-2}^{22}$ and $\sigma_{Q=0-4}^{44}$ are computed in the factorized method of the relativistic distorted-wave approximation from an extended version of the Flexible Atomic Code [3].

In order to illustrate the effects of coherences, we give in figure 1 typical results of C_0^{22} versus $T_\perp / T_{//}$ for two selected excitations. Clearly, as the electron distribution deviates from the perfect beam along the *z* axis ($T_\perp / T_{//} \to 0$), the coherences lead to an important increase of C_0^{22} besides a reversal trend of the curves.

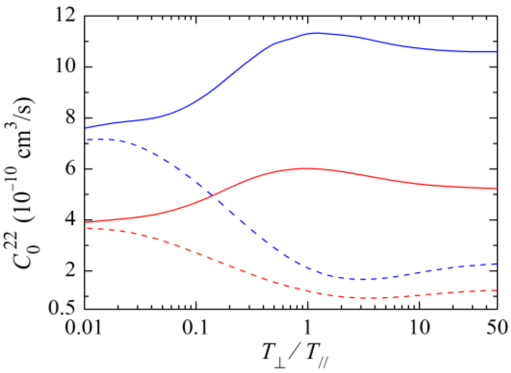

Figure 1. C_0^{22} versus $T_\perp / T_{//}$ with $\langle \varepsilon \rangle = 120$ eV for 2s2p $^3P_2$ →2s3p $^3P_2$ (lower curves in red) and 2s2p $^3P_2$→2s3d $^3D_3$ (upper curves in blue). Solid curves include coherences via $\sigma_{1,2}^{22}$, dashed curves do not.

References

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[2] G. Csanak, C. J. Fontes, P. Hakel and D. P. Kilcrease, J. Phys. B **44**, 215701 (2011).

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