A spectroscopic study of forbidden transitions of noble gases in tokamaks

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Argon and Krypton has been used for plasma diagnostics and as plasma coolant in many tokamaks around the world. Nevertheless, there is a great lack of information concerning these spectra, mainly when considering transitions in visible and ultraviolet for intermediate degrees of ionization, as that produced by forbidden transitions. Most of the information available for Ar III-VII and Kr II-VIII are in vacuum-ultraviolet, whose detection techniques are more complicated than that for visible. Visible lines occur in Ar or Kr spectra mainly due to electric dipole and also to electric quadrupole transitions, but only a few lines were observed up to now: considering all degrees of ionization, from 4967 observed lines of Argon, only 50 are due to forbidden transitions. For Krypton, only 35 of the 4426 observed lines are from forbidden transitions. Krypton has been proposed to be used in the ITER (International Thermonuclear Experimental Reactor) tokamak to produce radiating mantle that spreads the heat load, cooling the edge plasma region, which emphasizes the importance of that study for future applications in fusion plasma technology. Due to the low density of the tokamak plasmas, forbidden lines are possible to be observed. In present work, we will add small portions of krypton in the NOVA tokamak at University of Campinas, looking for intra-configuration magnetic dipole transitions for Kr V. We have special interest in the $^1S_0$-$^1D_2$ transition at 5133 Å, $^1D_2$-$^3P_1$ transition at 6258 Å, and $^1S_0$-$^3P_2$ transition at 3134 Å, observed before in astrophysical plasmas. We calculated the transition probabilities for Kr V transitions, using Hartree-Fock and Dirac-Fock methods in order to estimate line intensities during the laboratory experiments.

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