Abstract for ICAMDATA05, Meudon, France
October 15–19, 2006

Atomic data for Ar ions

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Domain : Astrophysics

Transition probabilities (Aij) and electron impact excitation cross sections (se) of singly and higher ionized species of Ar have been evaluated, in order to extend our Collisional - Radiative (C-R) code to Argon plasmas with up to six times ionized species [1]. All argon spectra from Ar I through Ar VI are now included in calculations of Ar plasmas with all outer shell 3p6 electrons taken into account, depending on the electron temperature of interest. Comparison of atomic structure and radiative properties from the following codes have been made: (a) our CbA Coulomb Approximation code, based in the approximation introduced in [2], (b) the code contained within the SUPERSTRUCTURE package developed at University College [3] and (c) the Los Alamos National Laboratory (LANL) codes [4] available through the Internet [5].

Data obtained from other theoretical calculations or measured experimentally, including data from existing databases, whenever available, have also been taken into account. Existing data are known to be very scarce, while a large number of transitions must be taken into account in modelling the spectra from each multiplet. Such modeling requires ab initio calculations for transitions involving levels for which the corresponding energies have not been measured. The available evaluated energy levels (and transition probabilities, whenever they exist) from the NIST site [6], although of very good quality, are not sufficiently complete for our task; therefore, we have carried out calculations to supplement the database for the C-R model.

Together with the spontaneous emission, electron impact excitation and de-excitation processes are required for modelling the plasma spectra. As is the case for radiative processes, the available tabulated data are not sufficiently complete for carrying out the C-R model. Therefore, calculations of se have also been carried out for transitions between the same multiplets considered for structure and transition probabilities. Due to the increased importance of the electron impact excitation in cases in which the lower level of the transition is significantly populated, the ground and metastable levels values are always included in the calculations. Once the excitation cross section is evaluated, the inverse process, collisional de-excitation, can be easily evaluated through detailed balance. We have made extensive use of the LANL codes [7] to obtain a consistent set of excitation cross sections for use in the C-R model. Some of the results obtained will be presented and discussed during the Conference.

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