Polarization of K-shell x-ray transitions in highly charged ions of Ar

Dipti[1], S. W. Buechele[1,2], A. C. Gall[1,2], S. Sanders[1,2], C. I. Szabo[1], R. Silwal[1,2], A. S. Naing[1,3], J. N. Tan[1], E. Takacs[1,2], and Yu. Ralchenko[1]

[1]National Institute of Standards and Technology, Gaithersburg, MD 20899
[2]Department of Physics and Astronomy, Clemson University, Clemson, SC 296342
[3]University of Delaware, Department of Physics and Astronomy, 217 Sharp Lab, Newark, DE 19716

We report x-ray polarization measurements performed at the NIST electron beam ion trap [1], using two Johann-type curved crystal spectrometers equipped with Si(111) crystals, their dispersion planes oriented parallel and perpendicular to the beam direction. The photon emission in the energy range of about 3.06 keV to 3.18 keV covering the resonance line of He-like argon and its dielectronic satellite lines in Li-like and Be-like ions was recorded using both spectrometers. Polarization of x-ray transition $1s^2 - 1s2l$ lines in He-like Ar were measured at 4 keV and 8 keV while Li-like Ar ($1s^22l - 1s2l2l'$) and Be-like Ar ($1s^22l2l' - 1s2l^22l'$) satellite lines were observed at electron beam energies between 2.25 keV and 2.38 keV in 10 eV intervals.

The analysis of the measured spectra was based on the collisional-radiative (CR) modelling using NOMAD code [2] with magnetic-sublevel atomic kinetics. The CR model included configurations with single electron excitations up to $n = 5$, and autoionizing states with single K-shell electron excitations to $n = 3$ for H-like to Be-like ions. The model considered the basic atomic processes for magnetic sublevels such as radiative decay rates, excitation (de-excitation) and ionization (3-body recombination), and autoionization and dielectronic capture. The corresponding cross sections and probabilities were determined using the Flexible Atomic Code (FAC) [3]. The polarizations calculated with the magnetic-sublevel CR model were also compared with the results obtained within the density matrix formalism [4]. Comparison of the two theoretical methods points out the importance of radiative cascades for the $1s^2 - 1s2l$ lines in He-like Ar. The details of the theoretical approach and the comparison with experimental results will be presented and discussed.

References

[1] J. D. Gillaspy, Phys. Scr. T71 (1997) 99-103.
[2] Yu. Ralchenko and Y. Maron, J. Quant. Spectr. Rad. Transf. 71 (2001) 609-621.
[3] M. F. Gu, Can. J. Phys. 86 (2008) 675-689.
[4] V. V. Balashov, A. N. Grum-Grzhimailo and N. M. Kabachnik, Polarization and correlation phenomena in atomic collisions: A practical theory course, (Kluwer Academic/Plenum, New York) (2000).