PENNING IONIZATION PROCESSES INVOLVING COLD RYDBERG ALKALI-METAL ATOMS

ALAA ABO ZALAM[1], M. S. DIMITRIJEVIĆ[2], V. A. SREĆKOVIĆ[3], N. N. BEZUGLOV[1,4,5], K. MICULIS[4], A. N. KLYUCHAREV[1] and A. EKERS[5]

[1]*Saint Petersburg State University, St. Petersburg 199034, Russia*

[2]*Astronomical Observatory, Volgina 7, 11060 Belgrade 38, Serbia*
E-mail mdimitrijevic@aob.rs

[3]*Institute of physics, University of Belgrade, P.O. Box 57, 11001, Belgrade, Serbia*

[4]*University of Latvia, Institute of Atomic Physics and Spectroscopy, Riga, Latvia*

[5]*King Abdullah University of Science and Technology, Thuwal, Saudi Arabia*

Abstract. The Penning ionization (PI) processes in cold gas media of alkali atoms are investigated in this contribution. The corresponding autoionization widths show a drastic dependence (by orders of magnitude) on the orbital quantum numbers of Rydberg atoms involved in a long-range dipole-dipole interaction. Nontrivial dependence of PI efficiency on the size of colliding particles was considered, with a particular accent to the applications for the research of cold matter created in experiments with magneto-optical traps. We described analytically optimal, highly asymmetric configurations of atomic Rydberg pairs, which lead to explosive intensification (by several orders of magnitude) of free electron escaping due to PI. This property may be favorable for the generation of primary (seeding) charged particles when a cold Rydberg medium evolves into a cold plasma. Under the frame of the semiclassical approach, we obtained universal analytical formulas containing two fitting parameters which allow one to evaluate PI rate constants. The results of the corresponding calculations are presented in the tabulated form convenient for further use for diverse pairs of alkali-metal atoms.

References

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