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Precision calculations of atomic properties of Ga and Ga-like ions[1]

U.I. SAFRONOVA, University of Nevada, Reno, M.S. SAFRONOVA, University of Delaware, T.E. COWAN, University of Nevada, Reno — Energies of the $4s^2np_j$ (n = 4-8), $4s^2ns_{1/2}$ (n=5- 8), $4s^2nd_j$ (n= 4-7), $4s^2nf_j$ (n= 4-5), and $4s^25g_j$ states in neutral gallium are obtained using relativistic all-order method. Reduced matrix elements, oscillator strengths, and transition rates are determined for the 130 possible $4s^2nl_j - 4s^2n'l'_{j'}$ electric-dipole transitions. Electric-quadrupole and magnetic-dipole matrix elements are evaluated to calculate the lifetime of the $4s^24p\ ^2P_{3/2}$ state in Ga-like ions with Z = 30–100. The hyperfine constants A are determined for 28 $4s^2nl_j$ states in ^{69}Ga I and ^{71}Ga I isotopes. All above mentioned properties are obtained in the relativistic single-double (SD) approximation, where single and double excitations of Dirac-Fock wave functions are included to all orders of perturbation theory. Using SD wave functions, accurate values are obtained for various matrix elements. The resulting data are used to determine transition rates, oscillator strengths, and lifetimes. These calculations provide a theoretical benchmark for comparison with experiment and theory.

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