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Analytic Solution to a Three-Level Optical Pumping System with Constant Coefficients WILLIAM DULANEY, TYLER DULA, JULIA HINDS, Appalachian State Univ — In the process of developing a new senior-level laboratory experience in atomic phosphorescence, a lack of consistency has been noted in the literature for the room-temperature radiative lifetime associated with the emission of the R-lines of Cr^{3+} in ruby. Much of the existing work on the metastable ^2E term that gives rise to the R-lines focuses on the fluorescence decay of these lines. Here the excitation of the metastable population as a function of time is investigated to supplement an understanding of these radiative transitions. In an attempt to identify an appropriate parent population for the metastable terms during the excitation phase, the dynamical system is approximated as three-energy levels in Cr^{3+} in ruby: a ground state, a "pump" excited state, and a metastable state. Assuming a constant optical pumping rate and natural decay rates for the pump and metastable energy levels, three coupled first-order, linear, differential equations have been deduced for the observed population dynamics for the three states in response to optical excitation. The analytical and numerical solutions of these equations are presented here with preliminary comparisons to experimental data for the radiative excitation and de-excitation of the metastable levels in Cr^{3+} in Ruby.

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