ROTATIONAL CLOSURE IN LASER-COOLING NONLINEAR MOLECULES

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Laser-cooling molecules relies on rapid and continuous photon scattering events that provide the "momentum kicks" that slow down molecules. Experimental implementation of laser cooling with enough photons scattered per molecule (about 10^4 or 10^5) requires not only a highly diagonal Franck-Condon matrix but also rotational closure. Achieving rotationally closed photon cycling in laser cooling asymmetric-top molecules is nontrivial[a] due to the lowered symmetry and complex intramolecular interactions, including the spin-orbit interaction and vibronic interactions. In this talk, we will discuss transition intensities between rotational energy levels of electronic states involved in laser-cooling asymmetric-top molecules, rotational branching ratios, and selection rules. Using alkaline-earth monoalkoxide radicals as examples, we will predict the rotational branching ratios using a "coupled-state model" [b] and discuss possible pumping and re-pumping schemes.

[a] B. L. Augenbraun, J. M. Doyle, T. Zelevinsky, and I. Kozyryev, Phys. Rev. X 10, 031022 (2020).
[b] J. Liu, J. Chem. Phys. 148, 124112 (2018).