CAVITY RING-DOWN SPECTROSCOPY OF JET-COOLED YO MOLECULES

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Yttrium (II) oxide (YO) is one of the first molecules that have been laser-cooled. Although the laser-cooling cycle in the reported experiment[a] involves the $\tilde{A}^2\Pi_{1/2} - \tilde{X}^2\Sigma^+$ (0, 0) transition, "dark" electronic states such as $\tilde{A}'^2\Delta_{3/2}$ also play important roles and directly affect the cooling efficiency. Moreover, the forbidden $\tilde{A}'^2\Delta_{3/2} - \tilde{X}^2\Sigma^+$ transition can be utilized for further cooling of YO molecules.[b] To better understand the ro-vibronic structure of YO, we have obtained and analyzed the cavity ring-down (CRD) spectrum of the $\tilde{A}^2\Pi_{3/2,1/2} - \tilde{X}^2\Sigma^+$ (0, 0) transition of jet-cooled YO molecules. Detection of the $\tilde{A}'^2\Delta - \tilde{X}^2\Sigma^+$ (0, 0) transition is in process. We will discuss experimental measures that will be taken to further improve the signal-to-noise ratio for the pursuit of "dark"-state spectra of YO and other candidate molecules for laser cooling.

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[a] M. T. Hummon, M. Yeo, B. K. Stuhl, A. L. Collopy, Y. Xia, and J. Ye, *Phys. Rev. Lett.* **110**, 143001 (2013)

[b] A. L Collopy, M. T Hummon, M. Yeo, B. Yan, and Jun Ye, *New J. Phys.* **17**, 055008 (2015)