HIGH PRECISION ROVIBRATIONAL SPECTROSCOPY OF THE C_{60} FULLERENE

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Buckminsterfullerene, C_{60}, is the largest molecule for which quantum state resolved spectra have been observed, marking an important step towards quantum control of complex polyatomic systems. The first high resolution experiments, made possible by a combination of cavity-enhanced direct frequency comb spectroscopy and buffer-gas cooling[a], revealed detailed insights into the rovibrational structure of C_{60}, while also posing several outstanding spectroscopic questions. To address these, we have constructed a new spectrometer targeting the 8.5 μm vibrational band based on a continuous-wave quantum cascade laser (QCL). Linewidth narrowing via optical feedback stabilization is used to efficiently couple QCL light into a high-finesse optical cavity, providing high absorption detection sensitivity and a 100-fold improvement over the previous comb measurements. This talk will focus on new observations of low-J transitions, rovibrational perturbations, and saturated absorption effects. We will also discuss progress towards high resolution measurements of electronically excited C_{60}. The extraordinarily precise spectroscopic information revealed by such experiments presents new challenges for modern quantum chemistry and high accuracy *ab initio* spectroscopy of truly many-electron systems.

[a]P. B. Changala, M. L. Weichman, K. F. Lee, M. E. Fermann, and J. Ye, *Science* **363**, 49 (2019).