A SEARCH FOR THE 8.5 μm VIBRATIONAL SPECTRUM OF C_{60} IN THE LABORATORY AND SPACE

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Buckminsterfullerene (C_{60}) was discovered during experiments designed to simulate the conditions of carbon star outflows. C_{60} is stable against photodissociation, is expected to be present in the interstellar medium, and has been detected in craters on NASA's Long Duration Exposure Facility and in sediments related to meteorite impacts. C_{60} has four infrared active modes that should be observationally detectable, and we have conducted searches for the 8.5 μm mode toward three molecular cloud sources and the variable star R Coronae Borealis with the Texas Echelon Cross Echelle Spectrograph (TEXES) instrument at NASA's Infrared Telescope Facility (IRTF).

In the laboratory, gas phase emission spectra of C_{60} have been obtained at high temperatures[a], and infrared absorption studies in a parahydrogen matrix have also been conducted[b]. Yet a cold, rotationally resolved gas phase spectrum is required for direct comparison to observational spectra. To this end we are utilizing continuous-wave cavity ringdown spectroscopy (cw-CRDS) to investigate the rovibrational spectrum of C_{60} using an 8.5 μm continuous-wave quantum cascade laser (cw-QCL). Solid C_{60} is heated to > 600 °C and the resultant vapor is supersonically expanded with argon through a $0.030''$ pinhole. Using this supersonic expansion source, we have observed a rotational temperature of < 30 K (with N_2^+ in the near IR), and a residual Doppler linewidth of 60 MHz (with this QCL, using CH_2Br_2). The results of the cw-CRDS laboratory study and observational work on C_{60} will be presented.

[a] Frum et al. *Chem. Phys. Lett.* **176** (504), 1991.
[b] Sogoshi et al. *J. Phys. Chem.* **104** (3733), 2000.