CLOSED-CYCLE HE-COOLED ABSORPTION CELLS DESIGNED FOR A BRUKER IFS-125HR: FIRST RESULTS BETWEEN 79 K AND 297K

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Gas absorption cells specifically designed to achieve stable temperatures down to ~70 K to fit inside the sample compartment of an evacuated Bruker (IFS-125HR) Fourier Transform spectrometer (FTS) have been developed at Connecticut College, and tested at the Jet Propulsion Laboratory (JPL). In operation, the temperature-controlled cooling by a closed-cycle helium refrigerator achieved a temperature stability of ± 0.01 K. The unwanted absorption features initially observed from cryo-deposits formed on the outside cell windows were eliminated by adding an internal vacuum shroud box around the coolable cell to isolate it from residual gases in the evacuated FTS chambers. The effects of vibrations arising from the closed-cycle helium refrigerator upon the FTS spectra were characterized. Using this set up, high resolution spectra of several methane isotopologues (such as $^{12}CH_4$, $^{13}CH_4$ and $^{12}CH_3D$) broadened by N_2, were recorded in the 1230 to 1850 cm^{-1} spectral region. Such data are needed to characterize the temperature dependence of line shapes at very low temperatures for remote sensing of outer planets and their moons. Results from the initial analysis of the R(2) manifold of the ν_4 fundamental band of $^{13}CH_4$ are discussed to examine whether the N_2-broadened half width coefficients follow a simple exponential temperature-dependence over the entire 80 - 296 K temperature range. This initial test was very successful, proving that a high precision Fourier transform spectrometer can be easily configured for spectroscopic studies at very low temperatures relevant to planetary atmospheres.[a]

[a]Research described in this paper was performed at Connecticut College, the College of William and Mary, NASA Langley Research Center and the Jet Propulsion Laboratory, California Institute of Technology, under contracts and cooperative agreements with the National Aeronautics and Space Administration.