Microwave, Millimeter, Submillimeter, and Far Infrared Spectroscopy at the Jet Propulsion Laboratory

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The rotational spectroscopy program here at JPL has a variety of source and detector technology available covering the range of ground-based mm-wave telescopes up through the far-infrared capabilities of the Herschel Space Observatory (HSO). Commercial source and detector technology (<120 GHz, <4 cm^{-1}) have been shown to provide valuable full-band scanning capability with excellent resolution and sensitivity. Using JPL-built amplifiers and multipliers broad scanning capability (10 GHz) can be extended into the sub-millimeter range (500+ GHz, 16.7+ cm^{-1}) where detection is done with an InSb helium-cooled bolometer. Multiplier technology is expected to provide similar coverage in the THz range for which a ^{3}He-cooled detector is available for extra-sensitivity. Down-conversion of diode lasers with photo-mixer technology is also available for the THz range. Moderate resolution (45 MHz, 0.0015 cm^{-1}) coverage of the Far-Infrared (0.75–12 THz, 25-400 cm^{-1}) is available with a Bruker HR-120 FT-FIR equipped with a multi-pass white cell for up to 32 meters of path length.

The needs of astronomers are leaning towards heavier molecules with complex and often unpredictable spectra. Example survey scans of some typical interstellar molecules such as methanol and ethanol will be shown to exemplify the utility and need for further laboratory research. Other potential interstellar species, primarily alcohols, amides and cyanides have been scanned using the W-band source and detector, extending the base of microwave data into the millimeter range. The increase in sensitivity has revealed multiple states (excited vibrations and isomers) for most of these species. For full coverage of ground-based telescopes these studies must be extended into the submillimeter and coverage into the HSO bands is imperative for most known interstellar species.