

LABORATORY MICROWAVE SPECTROSCOPY OF INTERSTELLAR MOLECULES

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One of the main difficulties to identify molecular species in space has been raised by the lack of reliable spectroscopic data for various molecules, especially for chemically active free radicals and molecular ions. Some of the free radicals and molecular ions have been fundamental to the study of chemistry in space but they are too active under terrestrial conditions and are hardly produced in concentrations enough for laboratory observations. We have developed a millimeter-wave spectrometer of high sensitivity suitable for observations of transient molecules. It covers the frequency region of 30 to 410 GHz and has the sensitivity enabling us to detect molecules in a concentration of 10^7 molecules/cm³ (about 30 ppb). This high sensitivity is achieved by a combination of low noise and high power microwave source, low noise detector, and low loss cell in the high frequency region, assisted by a mini-computer. We have studied various diatomic and polyatomic transient species, some of which may have likely astronomical significance. They are H₂D⁺, PO, PO₂, HPO, CCO, HCCN, SiN, FeO, and CH₃O.

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