HIGH-SENSITIVE SUB-MILLIMETER WAVE SPECTROSCOPY OF IONS AND FREE RADICALS

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Sub-millimeter wave spectroscopy in the frequency range of over 500 GHz has not been a territory of easy access. A number of space sub-millimeter wave telescopes are launched or planned, and in view of imminent collaboration between astronomy and laboratory spectroscopy, a sub-millimeter wave spectrometer system has been constructed with Russian made BWOs as radiation sources. Frequency ranges of 570-700 GHz and 770-840 GHz are covered with two BWOs. The sub-millimeter wave frequency is phase-locked to harmonics of a millimeter wave radiation generated by a Gunn oscillator. The sub-millimeter wave harmonic mixer was fabricated in Köln, a similar one used in G. Winnewisser's group.[a]

Unstable molecular species are generated either in an extended negative glow discharge cell or a hollow cathode discharge cell which can be cooled down to -80 °C. Several stable and unstable molecules such as $^{12}C^{18}O$, $O_2(^1\Delta_g)$, HN_2^+ and their isotopes are used for assessing the sensitivity of the system. The sensitivity of our system is found to be about 2×10^{-7} with 1 sec time constant and with 1.5 m path length. It corresponds to minimum detectable absorption coefficient of 1.3×10^{-9}cm^{-1}.

[a] See, for example, S. P. Belov, F. Lewen, Th. Klaus, and G. Winnewisser, J. Mol. Spectrosc. 174, 606(1995)