

## ON THE ASSIGNMENT OF OPTICALLY PUMPED FAR-INFRARED LASER EMISSION FROM CH<sub>3</sub>OH

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Since 1970, observations of optically pumped FIR laser lines have provided windows into the complexities of the torsion-rotation structure of excited vibrational states of methanol, principally for the CO-stretching mode but also for the CH<sub>3</sub>-rocking, OH-bending and CH<sub>3</sub>-deformation modes. However, the richness and variety of the FIR laser emission presented a significant spectroscopic challenge to identify the IR-pump/FIR-laser energy level and transition schemes. With the advent of tunable diode lasers and high-resolution Fourier transform instruments capable of full rotational resolution of the infrared bands, this task became more feasible, and a valuable synergy has developed between IR spectroscopy and FIR laser studies in initially pointing towards and then confirming possible assignments.

In this talk, recent progress in the assignment and confirmation of FIR laser transition systems for CH<sub>3</sub>OH will be presented. Earlier proposals by Henningsen of pumping from  $\nu_t=2$  torsionally excited ground state levels up to the CH<sub>3</sub>-deformation mode are now supported by spectroscopic evidence, and in turn have provided important signposts to spectral assignments involving a variety of torsional states of the CH<sub>3</sub>-deformation, OH-bending, CH<sub>3</sub>-rocking and CO-stretching modes. The FIR laser system pumped by the 9P(22) CO<sub>2</sub> laser line is particularly interesting both torsionally and vibrationally. The IR pump transition has been reassigned as arising from a K=0 A,  $\nu_t=2$  ground-state level, but the identity of the upper state is not clear. Two of the FIR laser lines go to K=1 A,  $\nu_t=0$  OH-bending levels, while another pair is deduced to connect, following the logic of Sherlock Holmes, to the elusive out-of-plane CH<sub>3</sub>-rocking mode.

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