# HIGH-RESOLUTION TERAHERTZ GAIN SPECTRA OF MID-INFRARED PUMPED $NH_3$

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Inversion of population in the terahertz (THz) range can be obtained thanks to the optical pumping of polar molecules in the mid-infrared range. Generally it is done with $CO_2$ lasers but recently we have demonstrated the first molecular laser pumped by a quantum cascade laser (QCL). It is based on the optical pumping of the $NH_3$ molecule in the $\nu_2$=1 state. The gain is obtained by the stimulated emission on pure inversion transitions of $NH_3$ (large amplitude motions) around 1 THz that are not accessible to continuous-wave (CW) $CO_2$ lasers. We present here CW high-resolution gain measurements of two strong lines: the (3,3) around 1.073 THz and the (4,4) around 1.083 THz. The measurements are done with a THz multiplication chain and an InSb bolometer. The gain profiles are recorded at different pressure and different QCL frequencies as for an IR/THz double resonance experiment. The highest gain at the best conditions are obtained with the (3,3) line: 10 dB/m for a pump power of about 40 mW. To our knowledge this gain is highest measured in the THz range for a CW-pumped molecule. These measurements will help the understanding and the design of our $NH_3$ lasers. This kind of laser will find applications in THz molecular spectroscopy/astronomy as a source or as a local oscillator for heterodyne detection.