QUANTUM CASCADE LASER PUMPING FOR MOLECULAR LASING AND SPECTROSCOPY

PAUL CHEVALIER, ARMAN AMIRZHAN, FEDERICO CAPASSO, *Harvard John A Paulson School of Engineering and Applied Sciences, Harvard University, Cambridge, MA, USA*; HENRY O. EVERITT, *Physics, Duke University, Durham, NC, USA*.

The lack of powerful and tunable sources in the terahertz frequency (100 GHz to 10 THz) can limit the accuracy and resolution of rotational molecular spectroscopy. While the ground state rotational spectrum of molecules is easily measured, thanks to the large thermal population of lower rotational levels at room temperature, measuring the rotational spectra in sparsely populated excited vibrational states can be much harder. Unlike molecular infrared lasers, quantum cascade lasers offer continuous tunabilty across the ro-vibrational transitions of most molecules. Here, we exploit this tunability to demonstrate a new type of laser and a new type of spectroscopy. Pumping molecules using a quantum cascade laser dramatically enhances the population of sparsely populated vibrational states, and the resulting enhancement of their rotational absorption or emission lines enables the direct measurement of their otherwise weak spectra. In some molecules, this pumping even exceeds the lasing threshold, and every line in the rotational spectrum may be made to lase.