Magnetic Field Assisted sub-THz Quantum Cascade Lasers

A. WADE, Y. KIM, D. SMIRNOV, National High Magnetic Field Laboratory, S. KUMAR, Q. HU, Massachusetts Institute of Technology, B.S. WILLIAMS, University of California, Los Angeles, J. RENO, Sandia National Labs — In THz QCLs radiative transitions take place between closely-spaced 2D electronic subbands (1THz \sim 4meV) of a multi-QW semiconductor system. THz quantum cascade lasers now cover the frequency range from 1.2 THz to 5 THz, though cryogenic cooling is still required. Further progress towards the realization of devices emitting at longer wavelengths (sub-THz QCLs) and higher temperatures may be realized in a system with additional lateral confinement. Here we use strong magnetic fields to achieve quasi-0D confinement in THz QCL based on the resonance phonon design. We studied two designs: (a) 2-well injector/2 well active region, emitting at 3 THz at B=0; and (b) 1-well injector/3-well active region, emitting at 2 THz at B=0 T. By applying the appropriate electrical bias and strong magnetic fields, we achieved laser emission at 0.8-0.9 THz at B>16 T [1], and 0.6 THz at B\sim 17 T, from devices a and b respectively. The ability to achieve sub-THz lasing is due to magnetic field enhanced population inversion in a quasi-0D QCL. [1] Wade, A et. al., Magnetic field assisted Terahertz quantum cascade laser operating up to 225K, Accepted for publication Nature Photonics (2009)