On passive mode locking in THz quantum cascade lasers

Quantum cascade lasers (QCLs) are unipolar semiconductor devices emitting in the mid- and far-infrared spectral ranges. Due to their relatively narrow linewidths and short gain recovery times, these lasers have been deemed difficult, if not impossible, to passively mode lock (PML) [1, 2]. However, the successful mode locking of QCLs is of utmost importance as it could allow generation of ultrashort pulses and also formation of broadband frequency combs. As a consequence, the research community invested substantial effort and funds in devising methods for active mode locking of QCLs with some limited success achieved [1, 2]. In this submission, we revise the prospect of passively mode locking a THz QCL via a fast saturable absorber (FSA). Our results, based on the numerical solution of the Maxwell-Bloch equations, show that it could be possible to implement a “text-book” FSA-PML mechanism, robust over large variations of the experimental parameters.