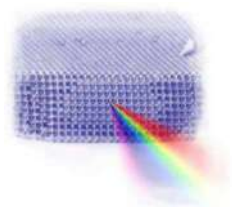


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Modelling of THz quantum cascade laser dynamics

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Abstract. We report on our recent progress in modelling THz frequency quantum cascade laser [1] (QCL) dynamics, where we have considered regimes of passive mode locking using distributed saturable absorber [2] and configuration for laser feedback interferometry [3]. Carrier transport simulations are used for the extraction of parameters for the dynamical simulations. Localized wavefunctions are calculated by solving the Schrödinger-Poisson equation system using the first neighbour and tight binding approximations, together with the infinite period QCL consideration. The transport of electrons through the quantum well heterostructure is modelled by a density matrix approach [4] where all the relevant scattering mechanisms are described as perturbations with the Fermi-golden rule, using the wavefunctions and material parameters as inputs. In order to model passive mode locking we then solve Maxwell-Bloch equations using two approaches: (i) a full wave model and (ii) a model which has reduced numerical complexity by employing rotating wave approximation (RWA) and slowly varying envelope approximation (SVEA). Graphene saturable absorber interacts with the optical field via an intensity-dependent loss. For modelling laser dynamics under optical feedback we use effective semiconductor Maxwell-Bloch equations.

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