Quantum Cascade Laser Simulation

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Motivation:

Realistic prediction and improvement of THz-QCLs performance

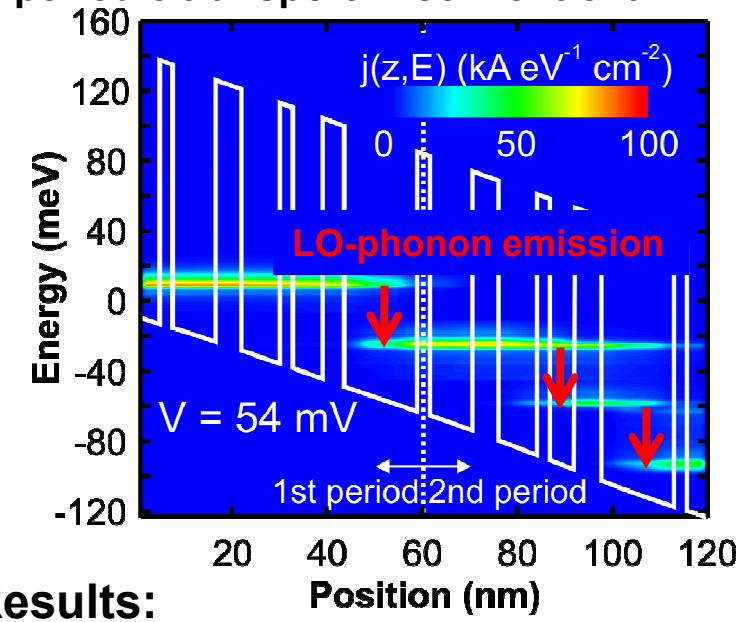
Approach:

- Nonequilibrium Green's functions formalism for electrons in nonparabolic effective mass representation
- Inclusion of incoherent scattering on phonons, impurities, alloy disorder and rough interfaces as well as electron-electron scattering
- Calculation of optical gain in linear response consistently including state lifetimes and occupation

Impact:

- Demonstrated quantitative agreement with experiment
- NEGF-Code used by research groups in Europe, USA and Asia
- Several proposed devices are currently under fabrication

Non-periodic transport in conventional THz-QCLs



Results:

- Determined critical failures of common approximations in the area of NEGF [J. Comput. Electron. **6**, 183 (2007); to be published in PRB]
- Identified several mechanisms that limit the performance of state of the art THz quantum cascade lasers (THz-QCLs) [PRB 79, 195323 (2009)]
- Proposed efficient THz-QCLs and novel design concepts [APL **94**, 151109 (2009); Laser Physics **19**, 762 (2009); phys. stat. sol. (c) **5**, 290 (2008)]