



Methods for Designing Quantum Cascade Lasers

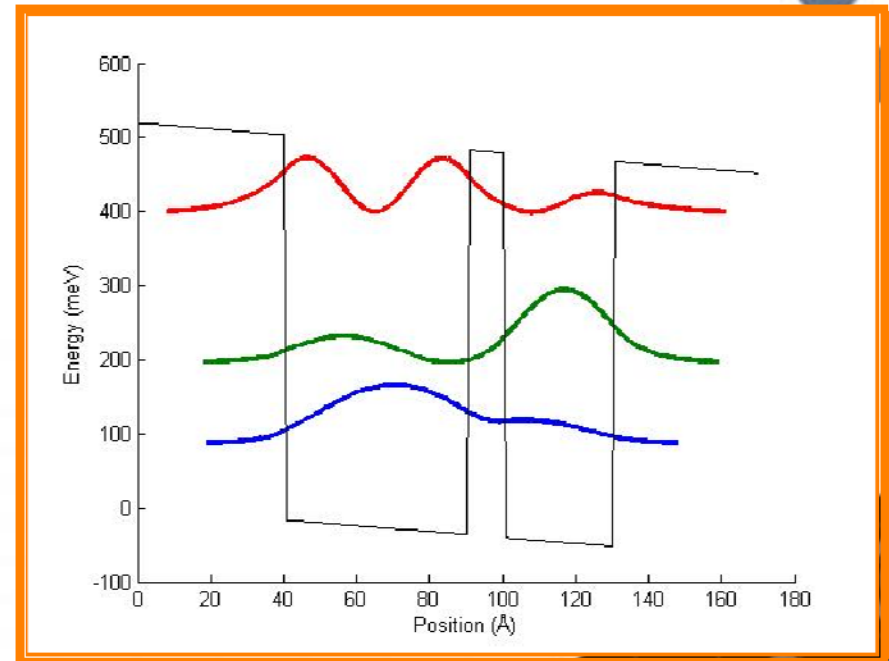
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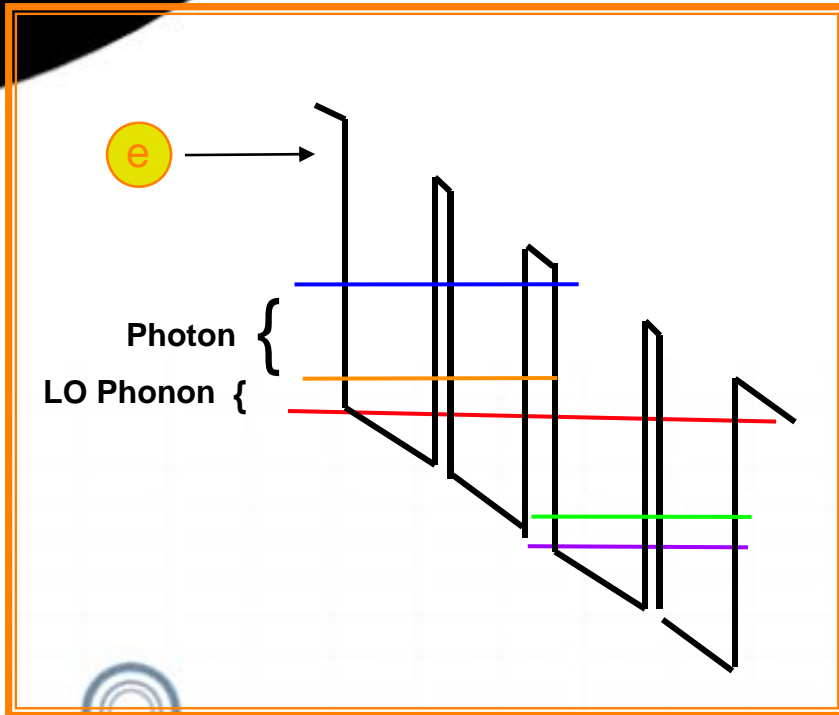


QCL Physics

- Layered structure of laser's wafer creates potential wells
- When voltage is applied across the laser, electrons will relax from higher to lower energy levels emitting either light or LO phonon
- Widths of wells determine spacing between energy levels and therefore the frequency of light emitted



Laser Model



- I Considered various methods of finding desired difference between energy levels (ΔE)
 - I took a simple model to test: a double square well with no injector region

Attempted Methods

- Methods:
 - Computer Program ErwinJr: numerically solves for Energy levels and wave functions when widths of wells and barriers are given
 - Analytically: determine an equation for the Energy as a function of the widths of a set of wells. Subsequently solve for the widths using the known desired energy differences
 - Additional Program: automatically change the size of the wells and barrier by $\pm \Delta\varepsilon$ and determine the corresponding energy for each variation. Select the set of $\Delta\varepsilon$ that provides the ΔE closest to the desired energy level and iterate till convergence.