

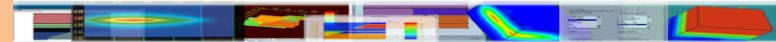
8x8 k.p model of type II superlattice photodetectors

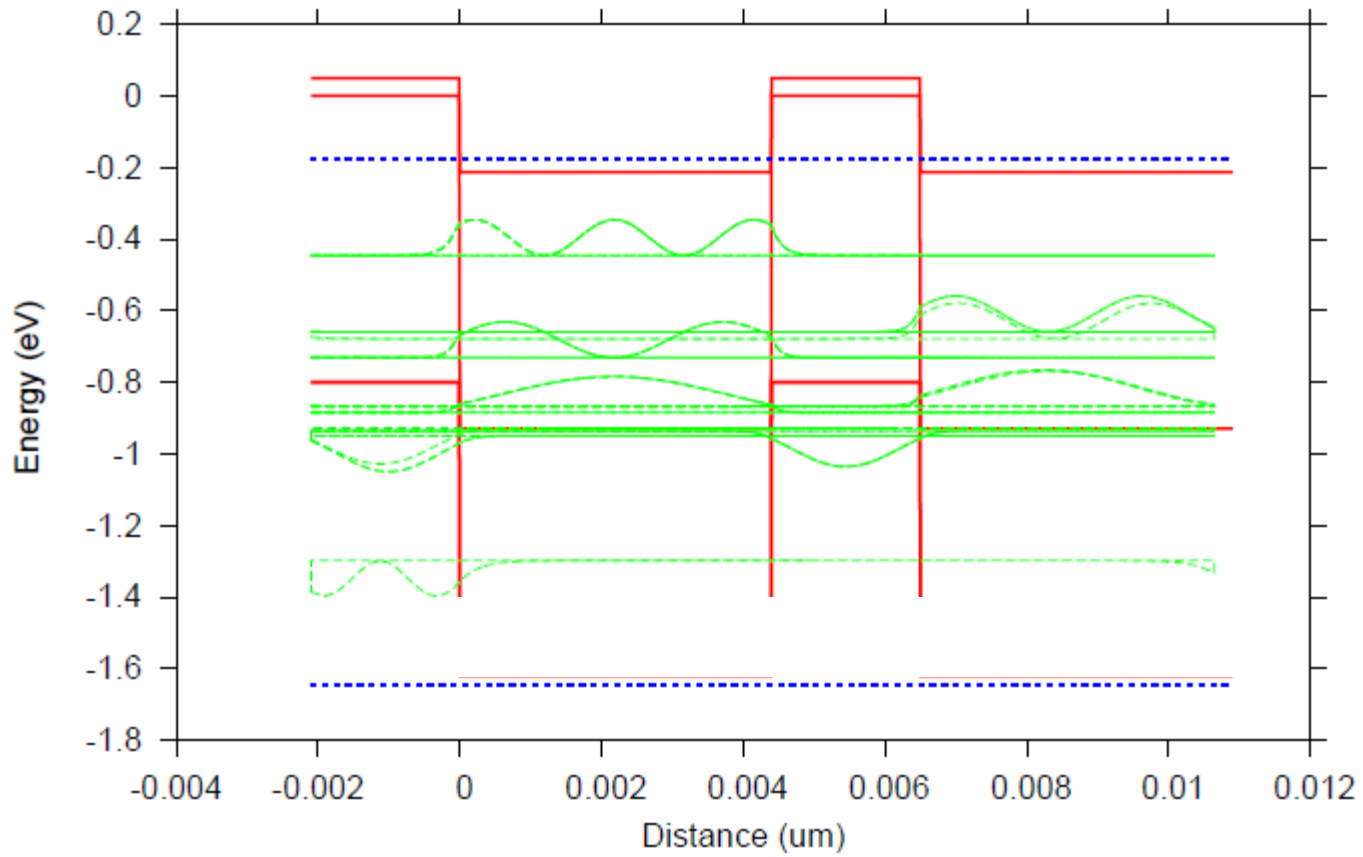
$$H_{8 \times 8}^{LK} = \begin{bmatrix} H_{4 \times 4}^U(k_t) & 0 \\ 0 & H_{4 \times 4}^L(k_t) \end{bmatrix}$$

$$H_{4 \times 4}^U = \begin{bmatrix} E_c + A & -\sqrt{3}V_\rho & -V_\rho + i\sqrt{2}U & -\sqrt{2}V_\rho - iU \\ -\sqrt{3}V_\rho & E_v - P - Q & R_\rho + iS_\rho & \sqrt{2}R_\rho - i\frac{1}{\sqrt{2}}S_\rho \\ -V_\rho - i\sqrt{2}U & R_\rho - iS_\rho & E_v - P + Q & -\sqrt{2}Q - i\sqrt{\frac{3}{2}}S_\rho \\ -\sqrt{2}V_\rho + iU & \sqrt{2}R_\rho + i\frac{1}{\sqrt{2}}S_\rho & \sqrt{2}Q + i\sqrt{\frac{3}{2}}S_\rho & E_v - P - \Delta \end{bmatrix}$$

$$H_{4 \times 4}^L = \begin{bmatrix} E_c + A & -\sqrt{3}V_\rho & -V_\rho - i\sqrt{2}U & -\sqrt{2}V_\rho + iU \\ -\sqrt{3}V_\rho & E_v - P - Q & R_\rho - iS_\rho & \sqrt{2}R_\rho + i\frac{1}{\sqrt{2}}S_\rho \\ -V_\rho + i\sqrt{2}U & R_\rho + iS_\rho & E_v - P + Q & -\sqrt{2}Q + i\sqrt{\frac{3}{2}}S_\rho \\ -\sqrt{2}V_\rho - iU & \sqrt{2}R_\rho + i\frac{1}{\sqrt{2}}S_\rho & \sqrt{2}Q - i\sqrt{\frac{3}{2}}S_\rho & E_v - P - \Delta \end{bmatrix}$$

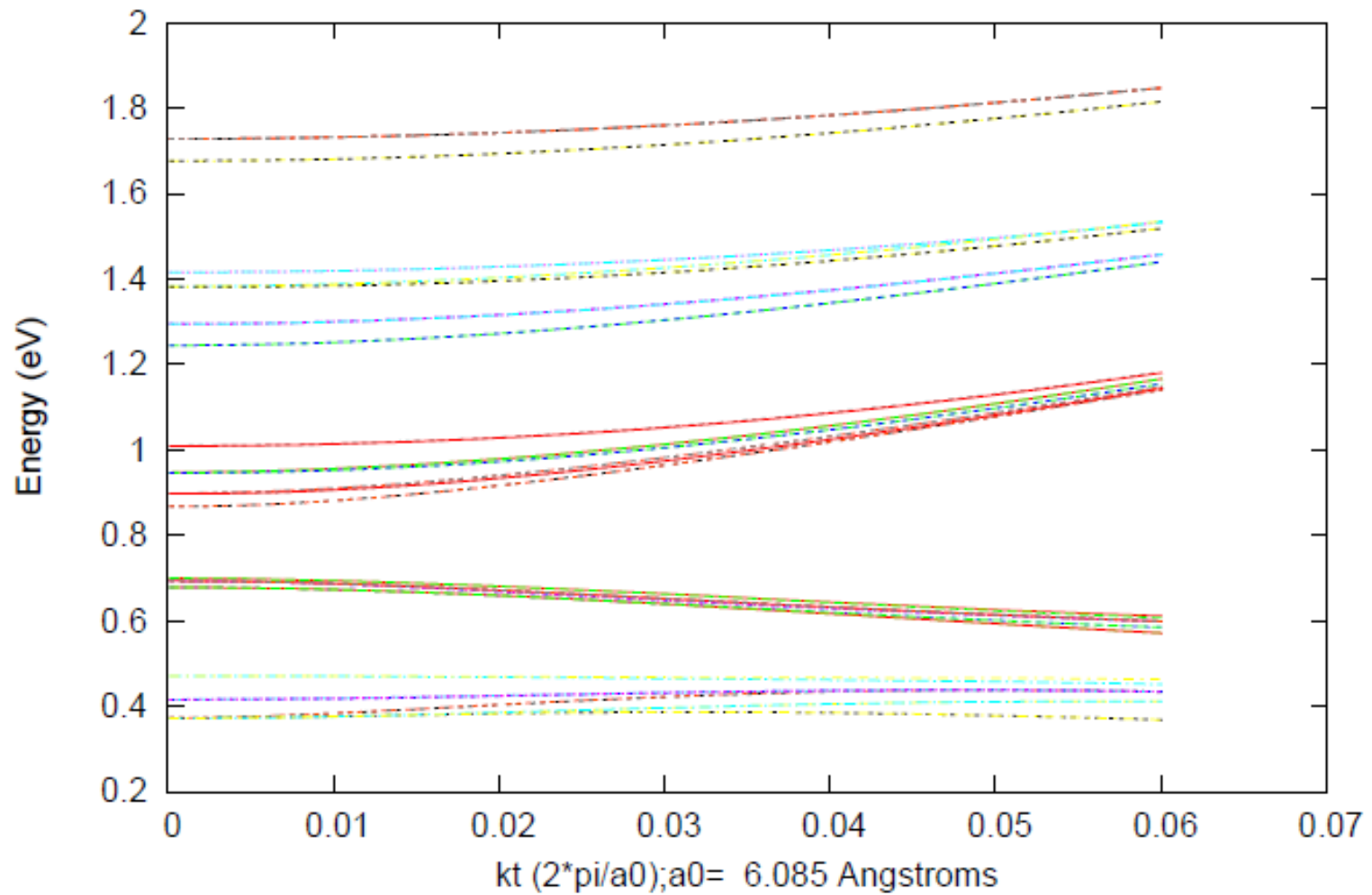
Ref: "Electronic band structures and optical properties of type-II superlattice photodetectors with interfacial effect," Peng-Fei Qiao, Shin Mou, and Shun Lien Chuang, 16 January 2012 / Vol. 20, No. 2 / OPTICS EXPRESS 2319



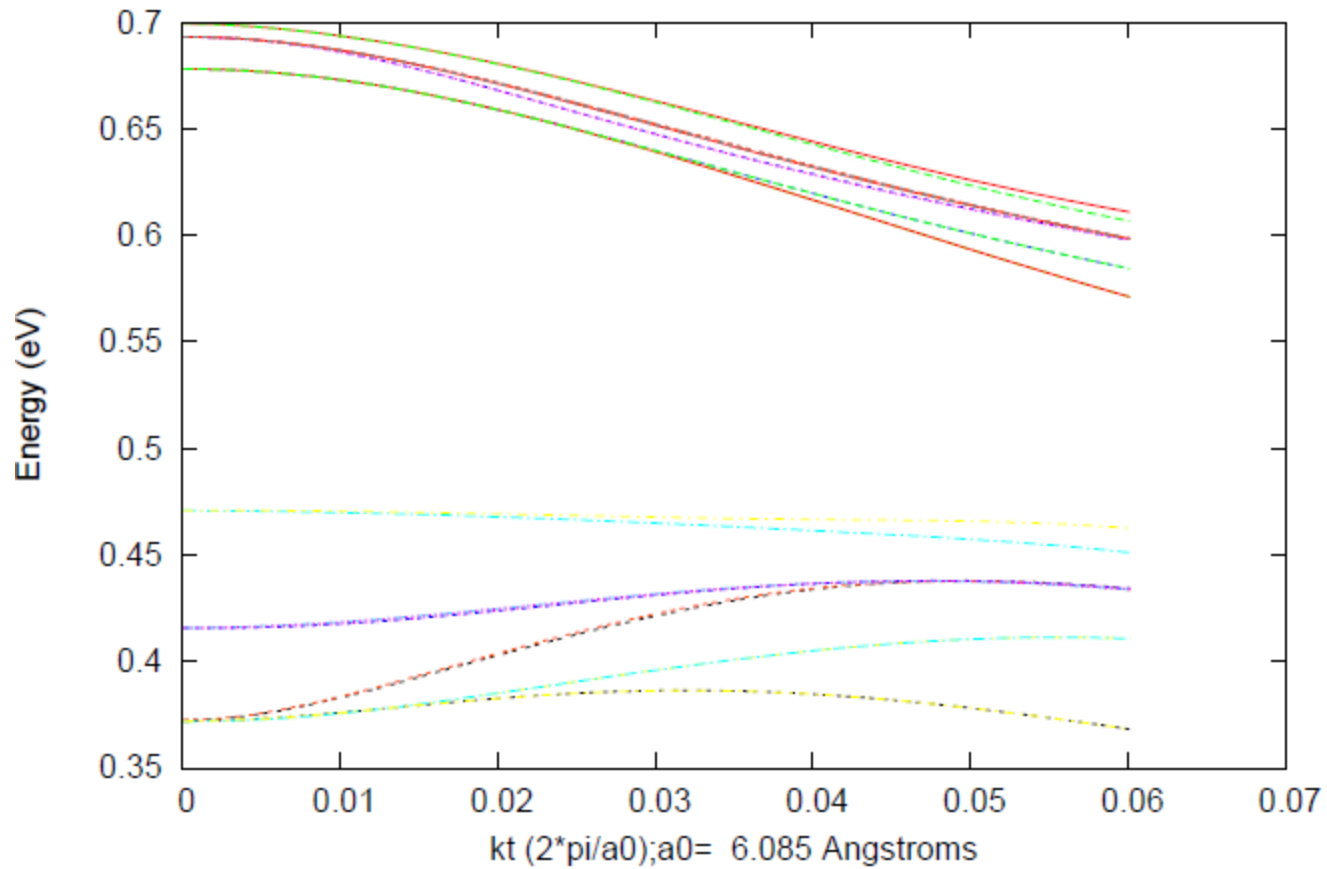


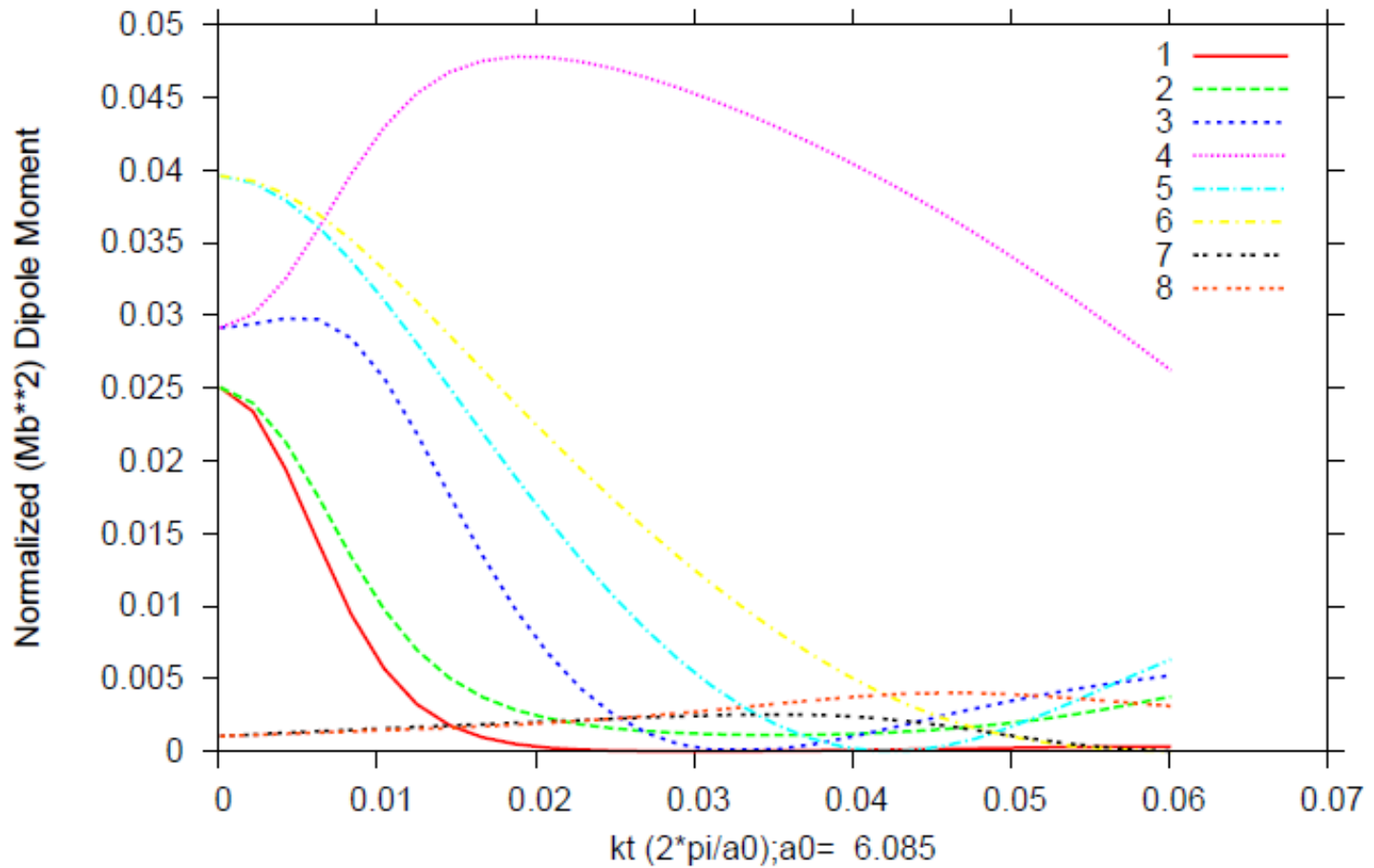
Wave function example of GaSb/InAs (21A/44A), with 6 periods

4-band k.p Model, Conduction and Valence Subbands versus kt

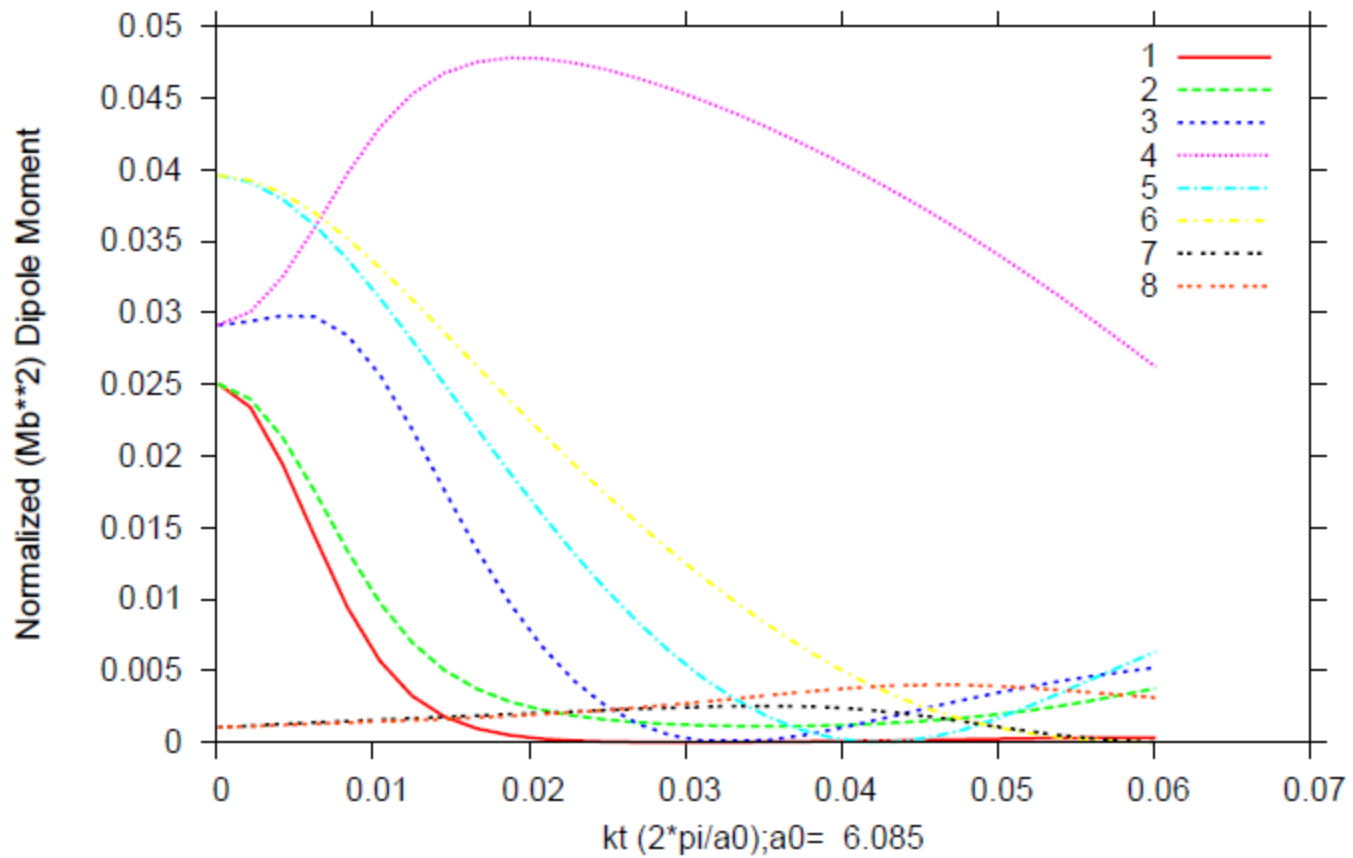


4-band k.p Model, Valence Subbands versus kt

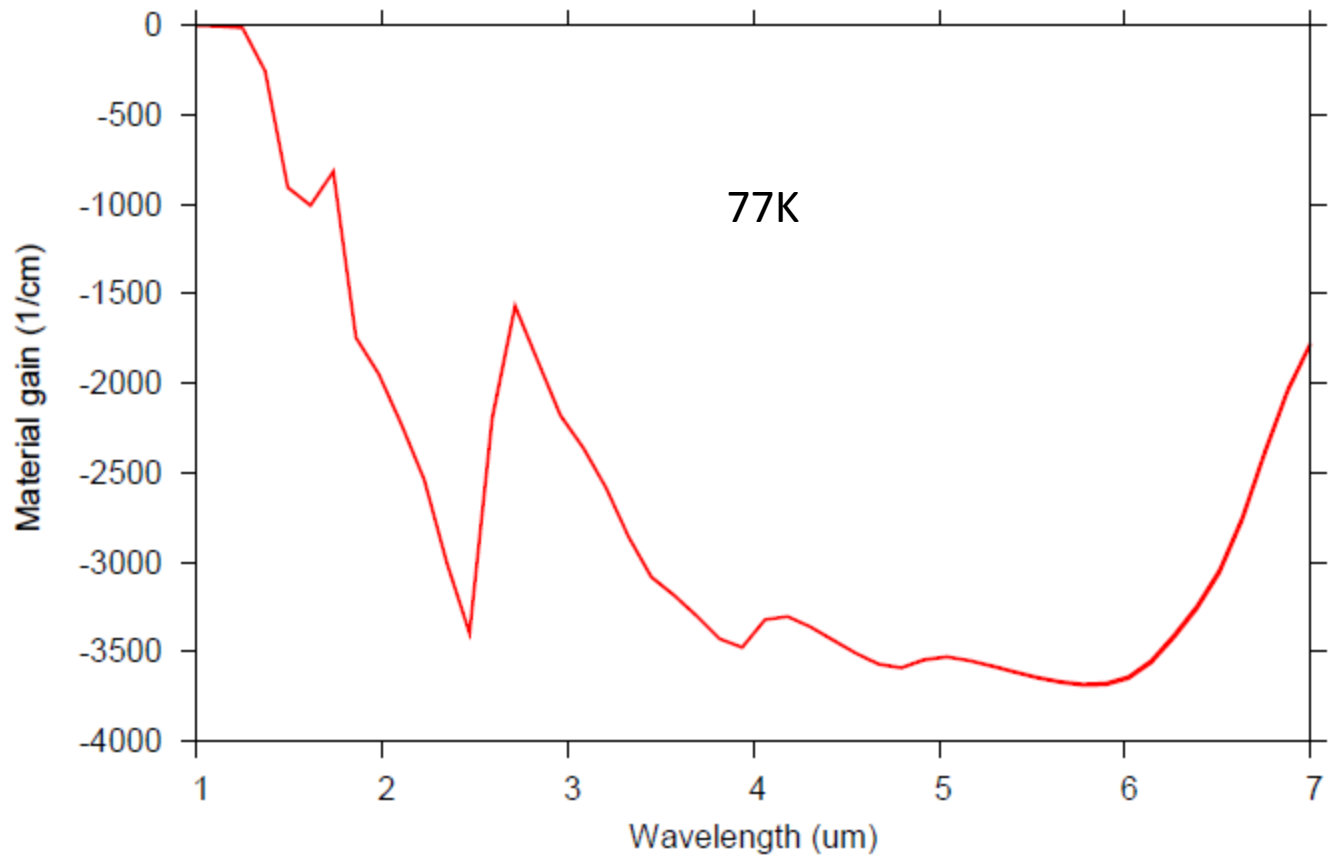




Dipole moment of TE polarization, from Gamma-1 state

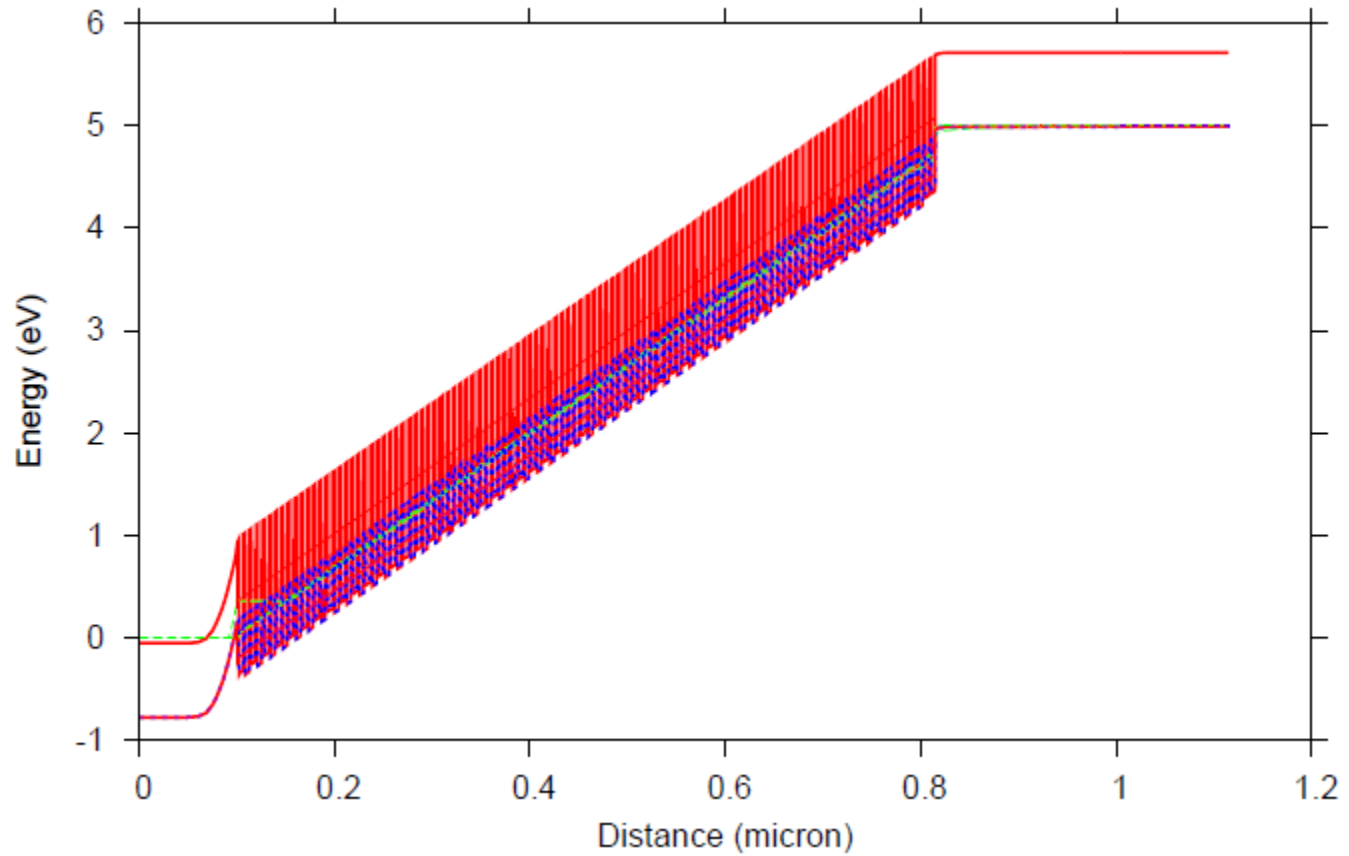


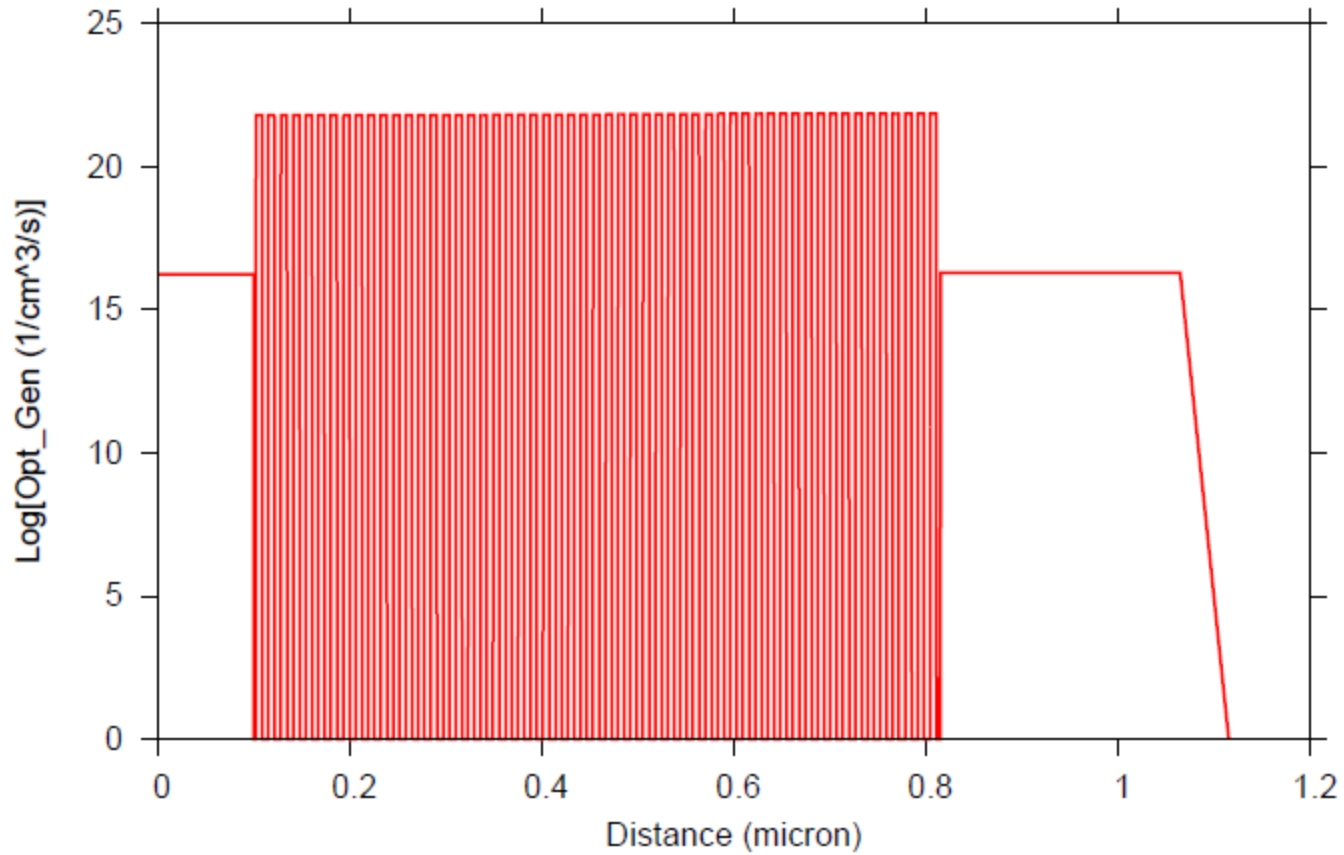
Dipole moment of TM polarization, from Gamma-1 state



Optical gain (negative absorption) of the type II SL

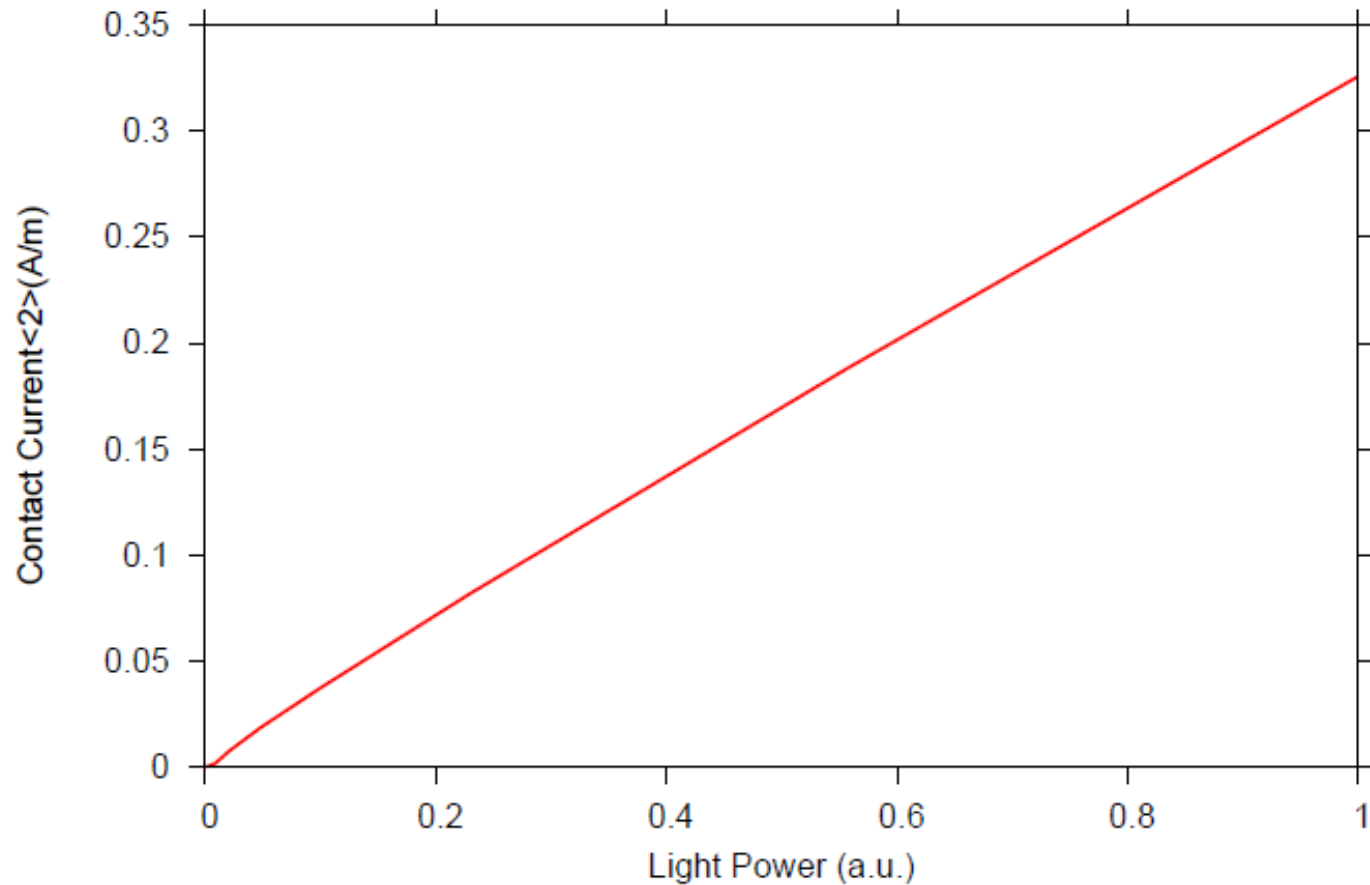
150K 100 periods GaSb/InAs (21/44A)





Optical generation rate distribution at 1000W/m²

PD response at 150K 1000W/m²



Summary

- Efficient solution of 8x8 k.p model considering periodic boundary conditions.
- Accurate calculation of optical absorption spectrum.
- Fast computation of photo response of typeII SL PD at long wavelengths.