

# Absorption Spectrum

With the optics features of **nextnano++**, the optical absorption spectrum can be calculated for various polarization directions.

## Physics Model

The absorption rate in a semiconductor can be written as

$$R_{ba} = \frac{2}{V} \sum_{k_a} \sum_{k_b} \frac{2\pi}{\hbar} |H_{ba}|^2 \delta(E_b - E_a - \hbar\omega)(1-f_a) \cdot f_b,$$

where the matrix element  $|H_{ba}|$  depends on the polarization of light and the  $\mathbf{k}$  vector.

## Input File

## Results

### Transition Matrix Element

The transition matrix element  $H_{ab}(\mathbf{k})$  is plotted as a function of  $\mathbf{k}=(k_x, k_y)$  for a 1D structure in figure 1

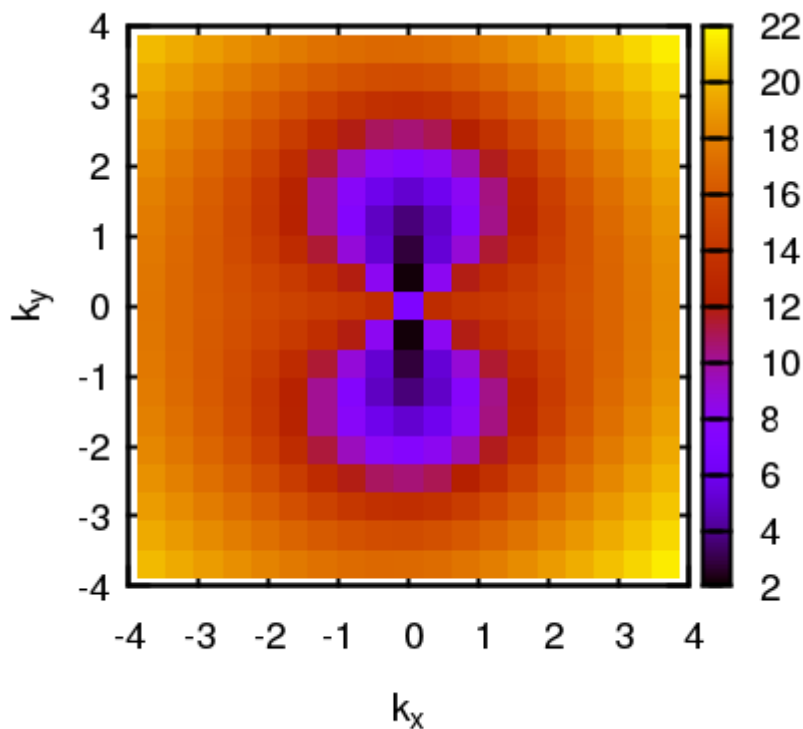


Figure 1: Transition matrix element in  $\vec{k}$  space

## Eigenvalues

The first eigenfunction's energy in the  $k$ -space is plotted in figure 2 for electrons, and in figure 3 for holes.

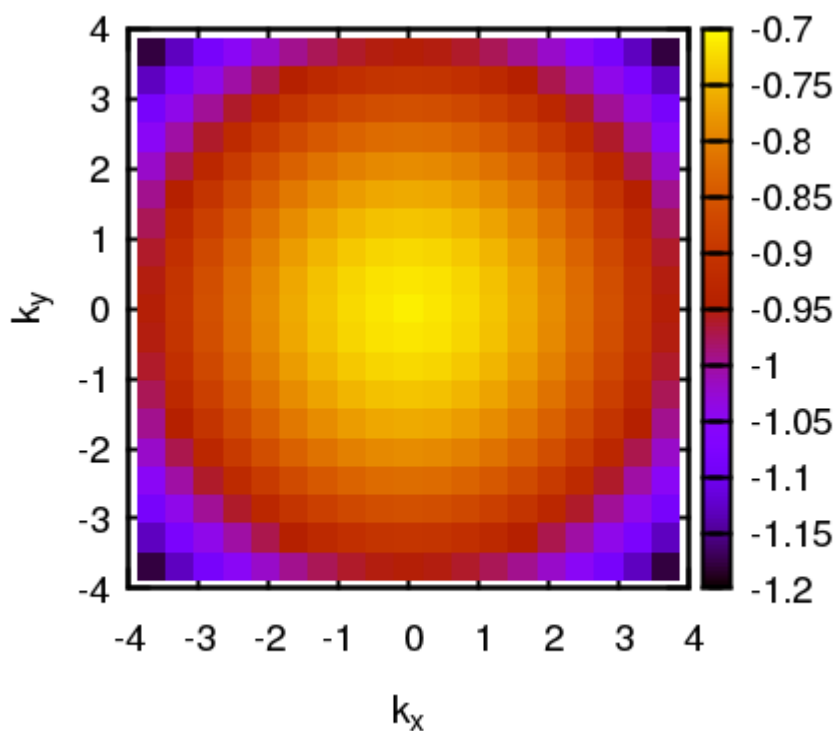


Figure 2: Energy dispersion relation in the  $\vec{k}$  space for electrons

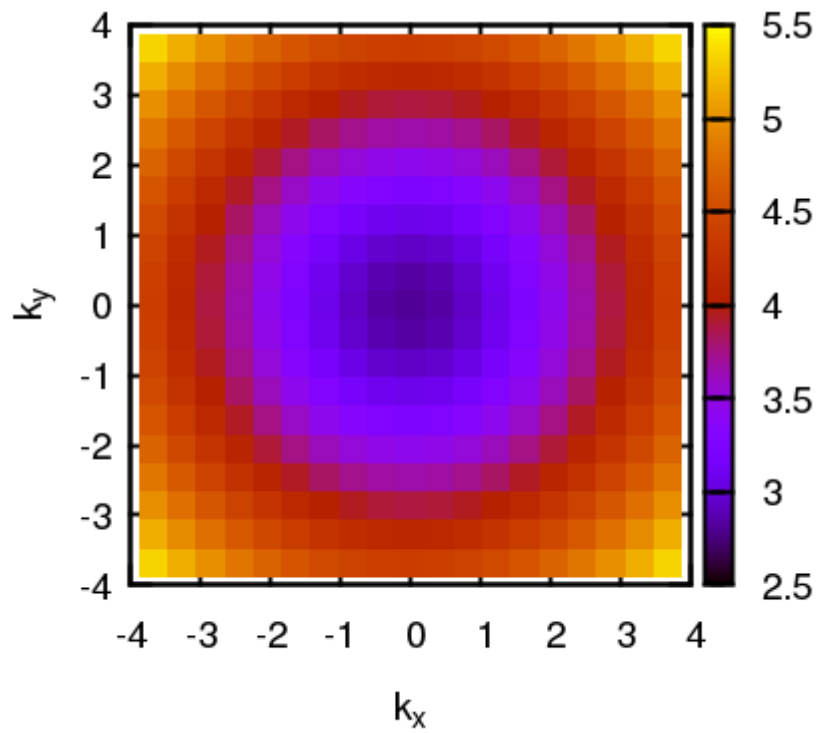


Figure 3: Energy dispersion relation in the  $\vec{k}$  space for holes

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