

Some Thing About Me

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Background

Name: Phuong
Family name: Vo Chau
University: University of Science, VNU-HCM
Major: Physics
Department: Theoretical Physics
Graduation: Honour class, top 1st
Location: Ho Chi Minh city, Vietnam

Internship: Institute of Physics, HCM city.

Supervisor: Dr. Huynh Thanh Duc.

- Study and doing project on solid state physics - semiconductor.
- Project: "Calculation of Shift Tensor in Transition Metal Dichalcogenide".
- Undergrad thesis: "Calculation of The Linear-Absorption Spectrum of An Ideal Two-dimensional System of MoS_2 ".

Skills: Theory and numerical (FORTRAN, Python).

Project:

Name of project:

“Calculation of Shift Tensor in Transition Metal Dichalcogenide”.

Approach:

- Second order perturbation in light-matter interaction
- Tight-binding model
- semiconductor Bloch equations

Methods:

- Theoretical (in second quantization)
- Numerical (FORTRAN, PYTHON)

Result:

- From 3-band TB + SBEs \rightarrow shift current tensor for TMD monolayers.

Reported in: EIER 2024.

Calculation of Shift Tensor in Transition Metal Dichalcogenide

Why?

- Bulk photovoltaic (BPV) effect occurs in non-centrosymmetric materials, without the need of heterostructures or interfaces
- BPV effect has the potential to overcome the Shockley–Queisser limit of photon–electricity conversion in a conventional p–n junction
- TMD monolayers are semiconductors with a direct band gap, no center of inversion, Strong spin-orbit coupling leads to a spin splitting of hundreds meV.

Based on the second perturbation of light-matter interaction:

$$\mathbf{A}(t) = \sum_p A_{\omega_p} e^{-i\omega_p t} + c.c$$

Second-order current response:

$$\mathbf{J}_{shift}^i(\omega) = \sum_{j,k} \sigma_{shift}^{i,j,k}(\omega) A_{\omega}^{j*} A_{\omega}^k + c.c$$

Shift current tensor:

$$\begin{aligned} \sigma_{shift}^{ijk}(\omega) = & \frac{e^3}{L^2 \hbar^2 m^3} \sum_{c,v,\mathbf{k}} \frac{p_{cv}^k(\mathbf{k})}{(\varepsilon_c(\mathbf{k}) - \varepsilon_v(\mathbf{k}))/\hbar - \omega - i\gamma} \\ & \times \left[\sum_{\lambda \neq c} \frac{p_{v\lambda}^j(\mathbf{k}) p_{\lambda c}^i(\mathbf{k})}{(\varepsilon_c(\mathbf{k}) - \varepsilon_{\lambda}(\mathbf{k}))/\hbar - \omega - i\gamma} \right. \\ & \left. - \sum_{\lambda \neq v} \frac{p_{v\lambda}^i(\mathbf{k}) p_{\lambda c}^j(\mathbf{k})}{(\varepsilon_{\lambda}(\mathbf{k}) - \varepsilon_v(\mathbf{k}))/\hbar - \omega - i\gamma} \right] \end{aligned} \quad (1)$$

Project also is my thesis:

"Calculation of The Linear-Absorption Spectrum of An Ideal Two-dimensional System of MoS_2 "

Approach:

- semiconductor Bloch Equations
- Hatree-Fock Approximation to include the Coulomb interaction

Methods:

- Theoretical (in second quantization)
- Numerical (FORTRAN run in parallel)

Result:

- Confirm the exciton binding energy in agree with experiment results.

Reported in front of:

Department of Theoretical physics (HCMUS-VNU)

Current Status

Diploma student in ICTP:

- First semester: All E (Excellent) grades.
- Second semester (currently): studying DFT, Superconductivity, Advantage Numerical Method,...
- Third semester (incoming): Doing thesis with prof. Natasha Stojic and available for other projects.

Research Interest:

- Quantum Hall Effect (Especially in Integer Quantum Hall effect, self-taught).
- Solid state physics, semiconductor physics (have experience).
- Second phase-transition (Applying Landau-Ginzburg theory) in condensed matter (studying).

Thank You For Your Interest.