Some Thing About Me

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The Abdus Salam International Center for Theoretical Physics

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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 1^{st}
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 → 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:

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

Shift current tensor:

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

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, seft-taught).
- Solid state physics, semiconductor physics (have experience).
- Second phase-transition (Applying Landau-Ginzburg theory) in condensed matter (studying).

Thank You For Your Interest.