Institute for Research in Fundamental Sciences

School of Physics

Ph.D Defense Session

Title:

Linear and non-linear optical properties and many-body effects studies of two dimensional structures

Candidate:

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Link:

https://www.skyroom.online/ch/schoolofphysics/defense

Time:

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Abstract:

In this thesis, we investigate the optical properties of several two-dimensional systems using different theoretical and numerical methods. Monolayer two-dimensional crystalline systems with broken inversion symmetry have shown unique optical response properties. So, First We calculate the non-reciprocal photo-current in the nonlinear response of two dimensional models involving the Berry connection in the presence of impurity scattering processes. Our results are based on quantum kinetic theory, where we calculate the non-equilibrium distribution function of the valence and conduction bands. We find the significant current peak emerges at the interband absorption threshold in the electron-doped system and the peak is remarkably sensitive to the electron density as well as the effective band masses. The current originates from trigonal warping, and increases when the warping hoping parameter increases as well the band masses. Then we study the photoresponse of monolayer graphene embedded between two polar hBN slabs for mid-infrared light. We investigate the leading role of phonons on frequency dependence on the photoresponse when the light excites the system by analyzing the reflection and transmission coefficients of the system. We have shown that, the adsorption changes drastically for s and p polarization when the system is a metal gate and the maximum absorption in graphene can be achieved when hBN is considered as a hyperbolic material with TM light polarization. The role of phonons in photocurrent paves the way to the possibility of tailoring the graphene photoresponse.

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