A Numerical Solution of the Schrödinger Equation for Three-Charged Particle Bound Systems Utilizing the Faddeev Technique: A Detailed Analysis of Trions in a MoS_2 Layer

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Abstract

This presentation provides a comprehensive examination of the Faddeev technique's efficacy in numerically solving the Schrödinger equation for the bound state of three charged particles in two dimensions. We establish three coupled Faddeev integral equations in momentum space that are then utilized to outline the most generic bound state of three distinct charged particles interacting by different pair interactions. As a practical application and validation of this approach, we study the structure of trions, a three-body system composed of electrons and holes interacting with Rytova-Keldysh interaction on the MoS2 layer. We discuss details of the computational framework and the associated challenges in handling repulsive electron-electron interaction on implementing the coupled Faddeev integral equations to calculate the trion's binding energy and wave function [1].

[1] K. Mohseni, M. R. Hadizadeh, T. Frederico, D. R. da Costa, and A. J. Chaves, Phys. Rev. B 107, 165427 (2023)

Biography of Presenter

Dr. Mohammadreza Hadizadeh, an Associate Professor of Physics at Central State University (CSU), is a theoretical and computational physicist with a primary research focus on the quantum mechanics of few-body systems; he recently has an interest in implementing few-body techniques for 2D semiconductor materials. Leading the prestigious CSU's Intel Semiconductor Education Program, he has been honored with significant awards, including the 2021 SOCHE Faculty Excellence Award and the 2023 CSU President's Faculty Excellence in Research Award. He also serves on the editorial boards of esteemed journals, Scientific Reports and PLOS ONE.