Contribution ID: **131** Type: **Talk**

Three-body systems in novel two-dimensional materials

Monday 2 September 2019 14:00 (25 minutes)

Studies related to the formation and calculations of the properties of positively (ehh) and negatively (eeh) charged trions in two-dimensional (2D) materials, which includes transition metal dichalcogenides (TMDC) [1], silicene, germanene, and stanene (Xenes) [2], and phosphorene are presented. We provide the current status of the theoretical and experimental research and recent calculations. It is demonstrated that the reduction of dimensionality itself necessitates a change to the formalism, and requires the modification of the bare Coulomb potential to account for non-local screening effects. The screening effects, resulting from the host lattice, make the Coulomb force between charge carriers much weaker than in atomic systems. Results of calculations of the binding energy of trions in these materials by using the Rytova-Keldysh (RK) potential [3] are presented.

We study the binding energies of trions in suspended two dimensional monolayers of TMDC in the framework of the effective-mass model by employing the method of hyperspherical harmonics in configuration space [1,4]. The trion fine structure, based on formation of intravalley trions in spin singlet and intervalley trions in triplet states and their stability is addressed. We study the binding energies of trions in Xenes by solving the Schr\"{o}dinger equation with the RK potential and field-dependent charge carrier masses and demonstrate that an external electric field can be used to tune the eigenenergies of trions by changing the effective mass of charge carriers. To understand the importance of dielectric screening on the formation of trions, we perform calculations of the binding energy for trions in 2D materials placed in three different dielectric environments: suspended in vacuum, supported on different substrates, and encapsulated by dielectric. The analysis and comparison of our results for the binding energies of trions with experimental data and those calculated via different theoretical methods are presented.

This work is supported by US Department of Defense under Grant No.
W911NF1810433 and PSC CUNY under Grant Award \# 62261-00 50.

[1] R. Ya. Kezerashvili, Sh. M. Tsiklauri, Few Body Syst.
58, 18 (2017).
[2] I. Filikhin, R. Ya. Kezerashvili, Sh. M. Tsiklauri, B.
Vlahovic, Nanotechnology 29, 124002 (2018).
[3] L. V. Keldysh, Sov. Phys. JETP 29, 658 (1979). \noindent
[4] I. Filikhin, R. Ya. Kezerashvili, Sh. M. Tsiklauri, B.
Vlahovic, Nanotechnology 29, 124002 (2018).

Author: KEZERASHVILI, Roman (City University of New York)

Presenter: KEZERASHVILI, Roman (City University of New York)

Session Classification: Parallel Session Monday: Atoms and Molecules

Track Classification: Invited