I.10 – Invited, VCTP-49

Regulated perturbation theory for two-dimensional atomic systems

Le Van Hoang

HCMC University of Education

We have developed a novel approach called regulated perturbation theory for solving the Schrodinger equation of a two-dimensional hydrogen atom in an external field by combining the conventional perturbation method with several elements of the Feranchuk-Komarov method. This includes the Levi-Civita transformation, the algebraic calculation technique using the annihilation and creation operators, and the introduction of a free parameter to optimize the convergence rate of the perturbation series. The application is demonstrated for excitons in monolayer transition-metal dichalcogenides in a magnetic field.

Presenter: Le Van Hoang

I.11 – Invited, VCTP-49

Dielectric environment and Rydberg excitons in atomically thin semiconductors

Hoang Ngoc Cam

Institute of Physics, Vietnam Academy of Science and Technology, Dao Tan Str. 10, 11154 Hanoi, Vietnam, Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research, 141980 Dubna, Moscow Region, Russia

The dielectric environment contributes to electrostatic interaction in atomically thin (2D) semiconductors, rendering their excitons environmentally sensitive. Extended Rydberg excitons, compatible with modern semiconductor technologies and thus offering prospects for quantum simulation, quantum optics and quantum sensing, have been observed in a 2D semiconductor up to n=11. How the environment affects 2D Rydberg excitons is still poorly understood. Here we exploit a variational approach for modeling 2D Rydberg excitons within an effective mass approximation. We formulate Rydberg exciton binding energies and wave functions in their systematic relation to the dielectric contrast of the 2D semiconductor and its immediate surroundings. The model demonstrates the environmental role in determining both the overall picture of the Rydberg exciton spectrum and individual features of each. Furthermore, it provides a scaling rule for Rydberg excitons in moderate and high screening media that resembles the behavior of their conventional 2D counterparts, but is governed by a function of dielectric contrast. Available experimental observations support our model, which clarifies fundamental Rydberg exciton physics in 2D semiconductors and can be used for dielectric control of Rydberg exciton features through dielectric engineering.

Presenter: Hoàng Ngọc Cầm

I.12 – Invited, VCTP-49

Quantum corrections to cosmological potentials and the origin of the cosmological constant

D. I. Kazakov

Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna, Russia

We demonstrate how one can calculate the leading quantum corrections to arbitrary scalar