APCTP SEMINAR

Feb. 20 (Thu) 16:00 | #512, Hogil Kim Memorial Bldg.

TITLE

Multi-electron 2-D quantum dots in magnetic field via analytical integrals of Multipole Expansion of Coulomb interaction: Nonrelativistic approach

SPEAKER

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ABSTRACT

Two-dimensional superlattices, TMDCs and graphenes exhibit strong coulomb correlations among e-e, e-h, electron-phonon and etc. As the number of electron N increases, confining gate voltage and transverse magnetic field are superseded by increasing coulomb interactions (N(N- 1)/2 factors) that composes non-trivial Schrodinger equations. Each interaction term of two dimensional (2-D) systems calls logarithmic form of Green's function. Antilogarithm of the same can be proved by law of mathematical induction to obey multi-pole expansion followed by Legendre polynomial alike Green's function for three dimensional (3-D) systems. Surface integrals of both Dirichlet and Newman forms of Coulomb interaction exhibit sharp falls of the values and reach multipole expansion of generic coordinates. Representing such equations in Whittaker-M functions yields a modest alternate formalism, that accommodates integrals of Coulomb (exchange) correlations in single-summed, finite and exact Lauricella functions via Chu-Vandermonde identity. For higher carrier density (N=3,4,5,6,..), the multipole expansion is incurred as exact and finite summed Coulomb, Coulomb-type and dipole-type integrals.

Signature of interplay among gate voltage, magnetic field, dielectric constant, mass and density of carriers is examined in electronic spectra, magnetization, chemical potential for the systems spanning over wide range of materials (atom-like, BN, GaAs and etc.). Interestingly, chemical potential and addition energy as a function of magnetic field and number of carriers monitor the statistics between strongly degenerate to weakly degenerate composite fermions, Coulomb blockade and shell structure of 2-D superlattices. At the most, quadrapole and octapole suffice the convergence.

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