Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter

Thursday, May 23rd, 2019 – 10:00 am
CFEL Seminar room IV (Bldg. 99)

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Fractional Excitonic Insulator

We argue that a correlated fluid of electrons and holes can exhibit a fractional quantum Hall effect at zero magnetic field analogous to the Laughlin state at filling 1/m. We introduce a variant of the Laughlin wavefunction for electrons and holes and show that for m=1 it describes a Chern insulator that is the exact ground state of a free fermion model with p_x + i p_y excitonic pairing. For m>1 we develop a composite fermion mean field theory, and we will give several pieces of evidence that our wavefunction correctly describes this phase. We will present physical arguments that the m=3 state can be realized in a system with C_6 rotational symmetry in which energy bands with angular momentum that differ by 3 cross at the Fermi energy. This leads to a gapless state with $(p_x + i p_y)^{\wedge 3}$ excitonic pairing, which we argue is conducive to forming the fractional excitonic insulator in the presence of interactions. Prospects for numerics on model systems and band structure engineering to realize this phase in real materials will be discussed.

Host: Angel Rubio

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