CONDENSED MATTER SCIENCES SEMINAR

Sandeep Joy

Ohio State University

Host

Dr Cyprian Lewandowski

Title

The story of Wigner crystallization in Bernal bilayer graphene

Wednesday, August 28th, 2024

1st Floor – B101

15:00-16:00

Abstract

In Bernal bilayer graphene (BBG), a perpendicular displacement field flattens the bottom of the conduction band and thereby facilitates the formation of strongly-correlated electron states at low electron density. Here, we focus on the Wigner crystal (WC) state, which appears in a certain regime of sufficiently large displacement field, low electron density, and low temperature. We first consider a model of BBG without trigonal warping, and we show theoretically that Berry curvature leads to a new kind of WC state in which the electrons acquire a spontaneous orbital magnetization when the displacement field exceeds a critical value. We then consider the effects of trigonal warping in BBG, and we show that they lead to an unusual ``doubly re-entrant" behavior of the WC phase as a function of density. The rotational symmetry breaking associated with trigonal warping leads to a nontrivial ``minivalley order" in the WC state, which changes abruptly at a critical value of displacement field. In both cases, we estimate the phase boundary of the WC state in terms of density, displacement field, and temperature.

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Bio

Sandeep Joy is a Ph.D. candidate in Physics at The Ohio State University, where he studies Wigner crystal phases and phase coexistence in two-dimensional electron systems under the mentorship of Dr. Brian Skinner. He earned his integrated BS-MS degree in Physics from the Indian Institute of Science Education and Research (IISER), Pune.