ICFO

COLLOQUIUM: Atomically thin semiconductors : probing strongly correlated electrons using excitons

ATAC IMAMOGLU

December 04, 2020
12:00 to 13:00
Online (Zoom)

If the Coulomb repulsion between the electrons becomes significantly stronger than their kinetic energy, the itinerant electrons in the two-dimensional systems are expected to form a spatially-ordered state, termed a Wigner crystal [1]. According to former Quantum Mont
 Carlo calculations [2], the ratio rs of the two energy scales must exceed 30 for such
 crystallization to occur in the absence of the magnetic field (B = 0). Owing to seve
e difficulties in satisfying this condition for conventional semiconductors (e.g., GaAs), pri
r experimental studies of the crystalline electronic states have mainly focused on the electro
s confined to single Landau level under strong external magnetic field, which almo
t completely quenches the kinetic energ
. In this talk, I will describe recent experiments in atomically-thin transition met

l dichalcogenides (TMDs) where it is possible to reach rs > 40. Our measurements provide
a direct evidence that the electrons at densities < 3 · 1011 cm-2 in a pristine MoSe2 monola
er spontaneously break the continuous translation symmetry and form a Wigner crystal even
at B = 0 [3]. This is revealed by our low-temperature (T = 80 mK) magneto-optical spectrosc
py experiments that utilize a newly developed technique allowing to unequivocally det
ct charge order in an electronic Mott-insulator state [4]. This method relies on the modifica
ion of excitonic band structure arising due to the periodic potential experienced by the exci
ons interacting with a crystalline electronic lattice. Under such conditions, optically-inac
ive exciton states with finite momentum matching the reciprocal Wigner lattice vector k
k-W get Bragg scattered back to the light cone, where they hybridize with the zero-m
mentum bright exciton states. This leads to emergence of a new, umklapp peak in the
ptical spectrum heralding the presence of periodically-ordered electronic lattice.

ZOOM LINK TO JOIN IN: http://s.ic.fo/AtacImamoglu041220

All interested may join this session. Participants will be asked to register upon entry.

Host: Darrick Chang

Hosted by: Darrick Chang