Massachusetts Institute of Technology
Department of Physics

Condensed Matter Theory Seminar

"Photo-induced spin current in magnetic insulators by shift current mechanism"

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Abstract: Photovoltaic effect is one of the most intensively studied nonlinear response phenomena in solids both in basic science and in industries (solar cells). An example of such is shift current in non-centrosymmetric semiconductors/insulators, where a macroscopic electric current is generated by a non-trivial shift of electron position during its optical transition. On the other hand, in correlated materials, lower-energy excitations often emerge due to the correlation effect: A typical example is magnetic excitations in Mott insulators. The optical transition of these emergent particles may result in unconventional transport phenomena. However, such possibilities are hardly studied so far.

In this work, we explore the current of chargeless low-energy excitations in correlated electron systems produced by the optical transition of low-energy excitations. As an example, we consider a quasi-one-dimensional magnetic insulators where the low-energy excitations are spinons. Using a nonlinear response theory, we study the way of generating the spinon current. We show that the three types of spin-light couplings induce a dc spinon current in a spin chain with a spin-liquid ground state: inverse Dzyaloshinskii-Moriya, Zeeman, and magneto-striction couplings [1]. We also show that a dc magnon current is produced by light in ordered antiferro- and ferri-magnets, even at the zero temperature where no thermal excitations [2]. In these cases, the zero-point fluctuation of spins plays a crucial role in producing the spin current.

[1] H. Ishizuka and M. Sato, Phys. Rev. Lett. **122**, 197702 (2019).
[2] H. Ishizuka and M. Sato, arXiv:1907.02734 (2019).

12:00pm noon
Tuesday, October 8, 2019
Duboc Room (4-331)

Host: Leonid Levitov