Physics Colloquium

Michigan Technological University

Thursday, February 3, 2011, 4:00 pm

Room 139, Fisher Hall

Towards *Single-atom-controlled* Device

Subhasish Mandal

Advisor: Dr. Ranjit Pati

Abstract: *Single-atom-controlled* device has been explored recently in the context of molecular junction. Here, by using a codoping model, where a cation and an anion are introduced simultaneously into the host to maintain charge neutrality, we have probed the electron transport characteristics in a strongly coupled single molecular junction. We have used 1, 12-dicarba-{\it closo}-dodecaborane inorganic molecule as a precursor and have replaced one of the vertex carbon atoms by a boron atom and simultaneously decorated it with an endohedrally doped alkali atom (Li/Na) to look into the role of dopant atoms on the conductivity. The commonly used thiolate anchoring groups are used to attach the molecule in between two gold electrodes, and a parameter free, first-principles, nonequilibrium Green's function approach is used to calculate the current-voltage characteristics. Charge transfer from the alkali atom to the host is found to have a profound effect on the electronic structure causing a dramatic change in the conductivity. Since the single alkali atom controls the behavior of electron flow in this circuit, we term this device as a *single-atom-controlled* device.

Nonreciprocal and Unidirectional Optical Bloch Oscillations in Magneto-Optic Waveguide Arrays

Pradeep Kumar

Advisor: Dr. Miguel Levy

Abstract: In the present study we explore nonreciprocal Bloch-like optical oscillations in transversely magnetized chirped waveguide arrays. Bloch oscillatory motion is a remarkable phenomenon first predicted by F. Bloch and C. Zener in the 1930's for electrons in crystals, consisting of oscillatory trajectories for particles subject to a constant unidirectional force in a periodic potential. In optical systems this constant force can be replicated by designing into the array a constant difference in waveguide mode index between adjacent waveguides. Photons are thus made to feel a "force" but can travel against this driving force. The presence of non-reciprocity in the system allows for normal-mode dephasing and the possibility of unidirectional Bloch oscillations. It is shown that one can violate the conditions for Bloch oscillatory motion in one propagation direction while maintaining a periodic oscillatory motion in the opposite direction.

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