Yale Institute for Nanoscience and Quantum Engineering

Friday- March 4, 2016

12:00 to 1:00 p.m.

BECTON SEMINAR ROOM

Light lunch will be served at 11:45 a.m.

Haitan Xu

Department of Physics, Yale University

"Topological Energy Transfer in an Optomechanical System with Exceptional Points"

Exceptional points are topological singularities in the spectrum of an open system where complex eigenvalues of the underlying non-Hermitian Hamiltonian coalesce. We show the existence of an exceptional point in an optomechanical system composed of a suspended SiN membrane and a Fabry-Perot cavity in a cryostat. We realize topological energy transfer between two mechanical modes of the membrane by encircling the exceptional point. We also demonstrate the nonreciprocal behavior of the energy transfer.

Professor Eric Altman

Department of Chemical & Environmental Engineering, Yale University

"Two Dimensional Silica: From Model Catalysts to Atomic Membranes"

Two dimensional SiO_2 van der Waals layers are constructed from mirror image planes of corner-sharing SiO_4 tetrahedra arranged in crystalline or amorphous structures. Similar to the surfaces of zeolite catalysts, the layers expose no dangling bonds and can be made chemically reactive by substituting Al for Si. Thus these new materials offer the opportunity to study the catalytic surfaces of nanoporous zeolites using scanning probe microscopy (SPM). To elucidate this potential we have been using SPM in conjunction with theory. Experimentally we find that despite the weak van der Waals interaction with the supporting metal substrate, epitaxial strain can be used to tailor the structure. Specifically, uniaxial strain introduces rows of elongated eight-membered rings into the crystalline arrangement of six-membered rings. Building on this result, calculations indicate that by tuning biaxial strain it can be possible to replace the favored six-membered rings with combinations of eight- and four-membered rings. We have also theoretically explored controlling the structure via doping and found that replacing Si with Al does not intrinsically change the structural energy landscape; however, the strong preference for large charge balancing cations to occupy larger rings also favors introducing eight-membered rings into the structure. This suggests that a templating method analogous to that used to create a plethora of zeolite structures may also be applicable in two dimensions. Finally, I will describe our nascent effort to fabricate atomically thin size selective membranes for separating small molecules.

Host: Professor Eric Altman