INSTITUTE SEMINAR

Friday, 7 August 2015 4:00 p.m. Fermion

Speaker:

Dr. Ayanjeet Ghosh
Post Doctoral Fellow, Department of Chemistry
University of Wisconsin-Madison

Title:

Structures and dynamics in peptides and proteins using two-dimensional infrared and sum frequency generation spectroscopy

Abstract:

The time course of a vibrational probe is ultra-sensitive to the motions of nearby atoms, particularly those with net charges like water, which cause instantaneous fluctuations of the vibrational frequency. Two dimensional infrared spectroscopy (2D IR) leads to direct quantitative inferences on these motions. Over the past decade, 2D IR spectroscopy has developed into a promising method for probing site-specific structure and dynamics of peptides, proteins and other biological assemblies. 2D IR methodologies were employed to investigate the pH induced ebb and flow of water in the M2 proton channel in influenza viruses through the spectral dynamics of the backbone amide modes. The 2D IR spectroscopy of pore lining amides in the M2 channel reveal that the conformational equilibrium in M2 entails a change in the mobility of the channel water similar to what might be expected for phase transition from frozen to liquid water. This approach was

extended to address drug binding modes in the channel. 2D IR experiments with drug-free and drug-bound channels expose the water mobility in the channel under different drug binding conditions, which is reflected in the spectral dynamics of the Ala30 and Gly34 amides, thus revealing a functional model of drug binding in the channel that is in qualitative consistency with the model proposed from MD simulations. The capabilities of 2D spectroscopy can be extended to surfaces through two-dimensional sum frequency generation (2D SFG) spectroscopy, which is a novel technique capable of measuring spectra analogous to 2D IR but with monolayer sensitivity and SFG selection rules. Applications of 2D SFG to exploring structures of a peptide segment FGAIL, a conserved sequence found in the islet amyloid polypeptide, will be presented. The 2D SFG spectra of FGAIL on model membranes reveal how hydrogen bonding interactions can play a vital role in the formation of aggregates on membranes, which is at the heart of understanding amyloid diseases such as type II diabetes.