SEMINAR ANNOUNCEMENT

Title of Talk: **Electrostatics of water at the nanoscale**  
By:  
Professor Gerard Wong  
*University of Illinois, Department of Materials Science and Engineering, Department of Physics*

**Date:** 12th December 2008 (Friday)  
**Time:** 1.30pm – 2.30pm  
**Venue:** Hilbert Space (PAP-02-02)  
Division of Physics and Applied Physics  
School of Physical and Mathematical Sciences

**Abstract:**  
Current understanding of electrostatics in water is based on mean-field theories like the Poisson-Boltzmann formalism and its approximations, which are routinely employed in colloid science and computational biology. This approach, however, breaks down for highly charged systems, which exhibit counterintuitive phenomena such as overcharging and like-charge attraction. We examine the collective spatial and temporal correlations of multivalent ions that mediate like-charge attraction between strongly-charged polyelectrolytes using inelastic x-ray scattering. We find a new acoustic phonon mode associated with correlated counterions. The excitation spectra at high wave-vector $Q$ reveal unexpected liquid-like dynamics due to ions interacting with their ‘cages’ of nearest neighbors. The measured speed of sound and collective relaxation rates in this liquid agree surprisingly well with simple model calculations until the nanoscopic regime, where the granularity of water is important. It is well-known that the role of water in ‘wet’ electrostatics is difficult to access theoretically and experimentally at molecular time-scales and length-scales. Using 3rd generation synchrotron sources, it is possible to combine spectroscopy and diffraction in an inelastic x-ray scattering experiment. We show that it is possible to do experiments in the frequency and momentum domains and directly measure the Greens function for water. Using this, we will show that it is possible to reconstruct water dynamics at sub-Angstrom spatial and 50 femtosecond temporal resolution.

The dynamic hydration structure of a negatively charged ion moving at 250m/s and 1000m/s. Red and blue shifts represents increases and decreases in average induced oxygen density respectively. The hydration structure evolves from an isotropic shell at rest to a hydration cap at 250m/s, and finally to a hydration ring at 1000m/s, which is near typical thermal speeds.

Host: Dr SUM Tze Chien  
Assistant Professor  
Division of Physics and Applied Physics  
School of Physical and Mathematical Sciences

**COLLEGE OF SCIENCE**  
NANYANG TECHNOLOGICAL UNIVERSITY  
SPMS-04-01, 21 NANYANG LINK, SINGAPORE 637371  
FAX: +65 6515 8229   TEL: +65 6513 8459