Physics Seminar – 2014/03/18 **Created on 2014/03/13**

Honours Presentations

DATE: Tuesday, March 18, 2014
TIME: 1:00 PM
PLACE: C3024

Format: There will be 3 presentations, each 15 minutes with time after each for questions from the audience.
Speakers: Stephen Spencer, Mike Grudich, Collin Knight
Other attractions: Donuts and coffee!

Speaker: Stephen Spencer
Title: Brillouin Light Scattering Studies of Porous Silicon-Based Heterostructures
Abstract: Brillouin light scattering experiments were performed on multilayered porous silicon films (ideal, defective, and stacked superlattices) using a 180◦ backscattering geometry. Spectra were collected at various angles and peaks in the spectra were classified as either due to surface or bulk acoustic phonons, the velocities of which were determined from the corresponding Brillouin peak frequency shifts. Phonon velocities for ideal and defective superlattices with the same constituent layer porosities were nearly identical. Different behaviour was observed between superlattices with diffferent constituent layer porosities. Bulk mode velocities found in the stacked superlattice were found to be similar to those in ideal and defective superlattices with the same layer porosities, but the Rayleigh surface velocity was found to be different. There was an additional peak seen in the spectra of the stacked superlattice that was not seen in spectra collected on ideal and defective superlattices with the same constituent layer porosities.

Speaker: Mike Grudich
Title: Classical gravitational scattering in the relativistic two-body problem
Abstract: Black holes are an ubiquitous end state of stellar evolution and successfully explain some of the most extreme physics encountered in astronomical observations. The Kerr geometry is the known exact solution to Einstein's equations for a static, eternal black hole within the framework of general relativity, and hence is of great importance in relativistic astrophysics. An understanding of the orbital dynamics of test bodies and light rays in the Kerr spacetime is therefore fundamental to the physics of a black hole. In this work, the scattering and capturing properties of unbound, ``hyperbolic'' orbits in the spacetime are studied. In particular, the differential scattering cross section and capture cross section are derived over the parameter space of specific energies, impact parameters and black hole spin orientation and magnitude. The problem is then generalized to the motion of two massive objects on a hyperbolic encounter, and the added effects of gravitational radiation and finite mass ratio studied within the post-Newtonian formalism.

Speaker: Collin Knight
Title: High Pressure Morphology of Bicellar Mixtures Containing Anionic Lipids
Abstract: Long and short chain phospholipids, when mixed together in an aqueous solution, segregate into planar bilayer and curved edge regions respectively. These soft matter structures are known as bicellar dispersions, they display a range of different morphologies depending on condtions and their compositions. Replacing some of the zwitterionic phosphatidylcholine headgroup lipids with anionic phosphatidylglycerol headgroup lipids in a bilayer is known to induce interdigitation at a lower pressure. Variable-pressure deuterium nuclear magnetic resonance (2H-NMR) spectroscopy experiments were done on bicellar mixtures composed of deuterated 1,2-dimyristoyl-sn-glygero-3-phosphocholine (DMPC-d54), anionic 1,2-dymyristoyl-sn-glycero-3-phosphoglycerol (DMPG); and the short chain lipid 1,2-dihexanoyl-sn-3-phosphocholine at a molar ratio of 3:1:1. Spectra were obtained at temperatures up to 60◦ C and pressures up to 140 MPa. Interdigitation was found to occur in these mixtures in two ways. At 40 - 50◦ C and 83 MPa, an interdigitated phase was only found after cooling, suggesting it may be metastable. The pesistence of interdigitation, induced under these conditions, to lower temperatures may reflect kinetic trapping of a non-equilibrium mixing of the long- and short-chain components. Increasing pressure of another sample at ambient pressure to 140 MPa at 52◦ C, followed by an increase in temperature to 60◦ C, showed inter-digitation as well. At 56◦ C and 134 MPa, spectral features characteristic of interdigitation were found to increase over time in a constant environment. This suggest that the interdigitated phase found within this region of phase space is stable. This study provides some insight into how the organization of lamellar phases is determined by the balance between the interactions in the phospholipid headgroups and the interior regions of a bilayer. It may contribute to new approaches in the preparation of lipid assemblies with a greater range of properties and morphologies.

ALL ARE WELCOME!!!