Monte Carlo Simulation of Superfluid Helium-4 in Mesoporous Silica

When quantum fluids are placed into low-dimensional environments, they exhibit novel behaviors differing from that of a bulk quantum fluid. Helium-4 absorbed into mesoporous silica provides a physical example of such a low-dimensional system that is realizable in the laboratory. Analysis of these systems can provide valuable insight into the nature of quantum fluids, and may have applications to quantum interferometer devices. Using an *ab initio* model [15] of helium, I intend to simulate the behavior of superfluid helium-4 inside two specific forms of mesoporous silica, MCM-41 and FSM-16. By deriving realistic helium-helium and helium-silica interactions based upon the Aziz and Lennard-Jones potential respectively and employing exact high performance Path Integral Quantum Monte Carlo (PIMC) computation techniques that utilize my derivations, I will simulate the behavior of Helium-4 inside these cavities in hopes of establishing a better theoretical understanding of this intriguing low dimensional system.