

P-A Colloquium, 4:10 pm, 05 March 2015

Speaker: Jaideep Taggart Singh, MSU Physics & Astronomy and NSCL

Title: Searching for Lung Disease and The Origin of Matter Using Magnetized Noble Gases

Abstract:

Over the last thirty years, nuclear spin-polarized noble gases have been used as polarized nuclear targets for electron scattering experiments, sources for signal in magnetic resonance imaging (MRI), systems to search for violations of fundamental symmetries & exotic short range forces, and spin filters for neutron scattering experiments. This broad range of applications is due to the many favorable properties of noble gases. They are chemically inert which makes them harmless in biological contexts. Because He-3 and Xe-129 both have a nuclear spin of $1/2$, hours long spin precession times are attainable in suitably uniform magnetic fields. Large volumes of highly polarized gas are readily produced using two different but closely related techniques: metastability exchange optical pumping and spin-exchange optical pumping (SEOP). In this talk, I will discuss the physics behind SEOP, show some examples of hyperpolarized gas MRI, and describe a new search for the permanent electric dipole moment (EDM) of Xe-129. Significant advances in the efficiency of SEOP are due to improvements in laser technology and the increased understanding of the underlying physics. Hyperpolarized gas MRI provides detailed images of, among other things, the void space in lungs, which is used to study diseases such as asthma. Finally, our new search for the EDM of Xe-129 benefits from ultrasensitive magnetometry using superconducting quantum interference devices (SQUIDs) and the world's most quiet magnetic environment which is located in Munich, Germany.