Production and Storage of Hyperpolarized Noble Gases

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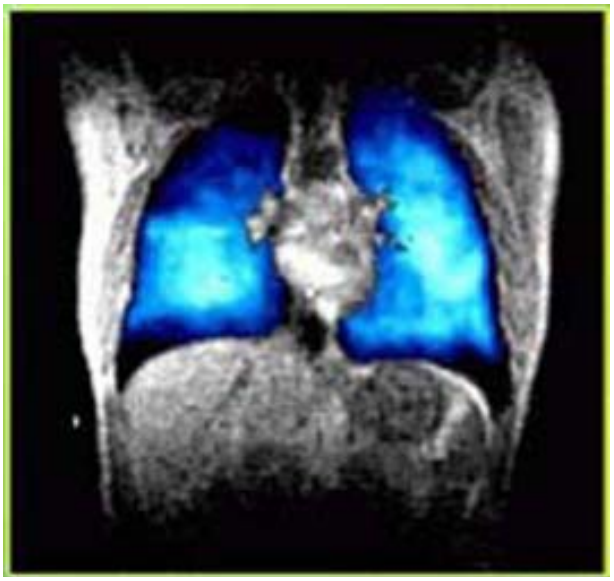

Medical imaging application of hyperpolarized gases.

Large non-equilibrium nuclear polarization in the spin-1/2 isotopes ^{3}He and ^{129}Xe can be achieved through spin-exchange optical pumping (SEOP) techniques. These hyperpolarized (HP) gases have many applications, including medical imaging, biochemistry and studies of the interface of chaos and quantum mechanics. Understanding the physics governing both the production and relaxation of HP noble gases is critical for efficient experimentation. This seminar will address methods used to create HP ^{3}He and important relaxation mechanisms in HP ^{129}Xe as well as provide a brief introduction to nuclear magnetic resonance and SEOP.

Spin-exchange optical pumping is used to create HP gases by transferring angular momentum from circularly polarized photons to noble gas nuclei via an alkali metal intermediary, typically Rb. A recent development called hybrid SEOP utilizes a mixture of K and Rb to greatly increase the efficiency of production of HP ^{3}He.

At low densities, the formation of bound ^{129}Xe-Xe molecules has recently been identified as the primary intrinsic spin relaxation mechanism, with T_1 limits as short as 4 hours for samples of pure Xe. This indicates that wall relaxation rates have been overestimated due to this overlooked molecular mechanism. We measured ^{129}Xe relaxation rates at fields of 2.8 mT-14.1 T and observed that the molecular relaxation mechanism can be suppressed at high magnetic fields. We also observed a significant decrease in the relaxation rate as the temperature was increased from 20°C to 100°C. These experiments have led to a deeper understanding of intrinsic ^{129}Xe relaxation mechanisms and have important implications for studies of wall relaxation mechanisms as well as storage of hyperpolarized ^{129}Xe.

WSU PHYSICS SEMINAR

Tuesday,

March 25, 2008

1:00 PM

LL 121

LIGHT REFRESHMENTS WILL BE SERVED.