N u c l e a r S e m i n a r

Optically Probing Nuclei Trapped in Cryogenic Solids: Opportunities for Nuclear Physics

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Monday

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4 P.M.

Rm 124 NSH

Inert gases frozen at cryogenic temperatures have been used to trap and study atoms and molecules for over 60 years. In particular, thin films of noble gas solids (NGS) are a promising medium for the capture, detection, and manipulation of atoms and nuclear spins. They provide stable, chemically inert, and efficient confinement for a wide variety of guest species. Because NGS are transparent at optical wavelengths, the guest species can be probed using lasers. Longitudinal and transverse nuclear spin relaxation times of a guest species can be made very long under well-understood and feasible conditions.
Potential applications include measurements of rare nuclear reactions, long-term memory for quantum information processing, and tests of fundamental symmetries.

In this talk, I will summarize the results of our optical spectroscopic study of ytterbium atoms embedded in a frozen neon matrix, which was performed at Argonne National Lab. Furthermore, I will describe the planned activities of my new group at the NSCL at MSU, which includes the demonstration of optical single atom detection in-medium and the measurement of spin relaxation times of trapped nuclei. Our eventual goals are (1) to use single atom detection to measure the $^{22}Ne(a,n)^{25}Mg$ & $^{22}Ne(a,g)^{26}Mg$ nuclear reactions, which are important for the *s*-process in stellar nucleosynthesis, and (2) to search for the permanent electric dipole moments of pear-shaped nuclei such as ^{225}Ra and ^{229}Pa, which have an enhanced sensitivity to time-reversal & parity violating interactions originating within nuclei.

Refreshments served prior to the seminar in Rm 124.

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