Abstract Submitted
for the APR13 Meeting of
The American Physical Society

Prospects of Optical Single Atom Detection in Noble Gas Solids for Measurements of Rare Nuclear Reactions JAIDEEP SINGH, KEVIN G. BAILEY, Argonne National Lab, ZHENG-TIAN LU, Argonne National Lab and University of Chicago, PETER MUELLER, THOMAS P. O'CONNOR, Argonne National Lab, CHEN-YU XU, University of Chicago, XIAODONG TANG, Notre Dame — Optical detection of single atoms captured in solid noble gas matrices provides an alternative technique to study rare nuclear reactions relevant to nuclear astrophysics. I will describe the prospects of applying this approach for cross section measurements of the $^{22}\mathrm{Ne}\,(\alpha,\mathrm{n})\,^{25}\mathrm{Mg}$ reaction, which is the crucial neutron source for the weak s process inside of massive stars. Noble gas solids are a promising medium for the capture, detection, and manipulation of atoms and nuclear spins. They provide stable and chemically inert confinement for a wide variety of guest species. Because noble gas solids are transparent at optical wavelengths, the guest atoms can be probed using lasers. We have observed that ytterbium in solid neon exhibits intersystem crossing (ISC) which results in a strong green fluorescence (546 nm) under excitation with blue light (389 nm). Several groups have observed ISC in many other guest-host pairs, notably magnesium in krypton. Because of the large wavelength separation of the excitation light and fluorescence light, optical detection of individual embedded guest atoms is feasible. This work is supported by DOE, Office of Nuclear Physics, under contract DE-AC02-06CH11357.

Jaideep Singh
Argonne National Lab

Date submitted: 07 Jan 2013 Electronic form version 1.4