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Optical Spectroscopy and Lifetime Studies of Ytterbium Atoms Trapped in Noble Gas Solids[1] CHEN-YU XU, Argonne National Laboratory and University of Chicago, JAIDEEP SINGH, Argonne National Laboratory and Technische Universität München, JAKE ZAPPALA, Argonne National Laboratory and University of Chicago, KEVIN BAILEY, JOHN GREENE, Argonne National Laboratory, ZHENG-TIAN LU, Argonne National Laboratory and University of Chicago, PETER MUELLER, THOMAS O'CONNOR, STEPHEN PRATT, HONG XU, Argonne National Laboratory — As a point defect in a lattice, a neutral ytterbium (Yb) atom isolated in a solid noble gas matrix shares many similarities with the celebrated nitrogen-vacancy center in diamond, including optically accessible transitions, their spontaneous emission, and the inter-system crossing. Our studies are undertaken to determine the feasibility of optically polarizing the nuclear spins of the trapped atoms, which has potential applications in testing fundamental symmetries, studying nuclear moments of exotic isotopes, and perhaps quantum memory and quantum computing. The high resolution optical spectra show line splitting owing to the atomic structure of Yb and the symmetry of multiple trapping sites. The Yb transition $6s^2 \ \ ^1S_0$ – $6s6p \ ^3P_1$ experiences an enhanced spontaneous emission rate due to the index of refraction of the matrices. The decay of Yb's metastable $6s6p \ \ ^3P_0$ in both odd and even isotopes are directly observed for the first time and the vacuum hyperfine quenching rate of the odd isotope is extracted.

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