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Towards quantum sensing with noble-gas-trapped thulium atoms
VINOD GAIRE, CHANDRA RAMAN, COLIN PARKER, Georgia Institute of Technology — Motivated by the prospect of atomic-scale sensing, we investigate the properties of thulium atoms trapped in solid helium and argon matrices. Neutral thulium (Tm) is a lanthanide atom whose single-hole f-shell electronic structure is equivalent to that in the Yb3+ ion frequently used in solid-state optical applications. Existing spectroscopy in solid helium [1] suggests that Tm metastable lifetimes can remain long, and that the linewidth can become quite narrow on inner-shell f-f transitions. Potential placement of noble gas films on material or device surfaces would allow sensing of the local environment, and the relatively unperturbed nature of the transitions suggests a high degree of quantum control may be possible. If these attributes carry over to neon and argon hosts this would be desirable because solid helium exists only under pressure at very low temperatures. As a first step towards understanding them we will present lifetime and coarse lineshape measurements of the 1140 nm line in both neon and argon hosts. In both cases lifetimes are tens of milliseconds. Spectroscopy shows most of the fluorescence signal within a narrow band, with a splitting of unknown origin in both cases. [1] Ishikawa et al, PRB 56 780 (1997)

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