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Laser Cooling of Erbium Atoms J.J. MCCLELLAND, H.Y. BAN[1], M. JACKA[2], J.L. HANSSEN, J. READER, NIST, Gaithersburg, MD USA — We have identified five closed, or nearly-closed, $J \rightarrow J+1$ transitions in atomic erbium at wavelengths of 401 nm, 583 nm, 631 nm, 841 nm, and 1299 nm. These transitions can be reached by common tunable single-frequency laser systems, and are thus in principle suitable for laser cooling. The 401 nm and 583 nm lines have known natural lifetimes of 5.8 ns and 0.96 μs, respectively, but the lifetimes of the 631 nm, the 841 nm and the 1299 nm lines have not been investigated to date. We have performed measurements of the 631 nm and 841 nm lines and have determined their lifetimes to be (5.6 $\pm$ 1.4) μs and (20 $\pm$ 4) μs, respectively. Calculations of the 1299 nm line lifetime will also be presented. Knowing these lifetimes, we can predict that precooling on the 401 nm line together with narrowband cooling on the 841 nm line should produce temperatures approaching a recoil limit of 80 nK. Such cold temperatures, in combination with erbium's large magnetic moment and atomic mass, will allow studies of magnetic trapping deep in the quantum regime and of cold collisions with strong dipole-dipole interactions. Applications include atomic frequency standards, quantum information processing, and deterministic atom-by-atom doping of optically active materials.

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