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Magneto-optical trapping of erbium atoms: trapping without repumping J.J. MCCLELLAND, J.L. HANSSEN, Electron Physics Group, NIST — We will discuss recent observations of a robust magneto-optical trap (MOT) for erbium atoms that operates without repumping, despite many "optical leaks" from the excited state. The surprisingly high trap population of over 10^6 atoms is explained by a novel recycling mechanism, in which (1) excited atoms decay to metastable states that are confined by the quadrupole magnetic field of the MOT because of their high spin, (2) a large fraction of these metastables eventually decay to the ground state, remaining in the magnetic trap, and (3) these cold ground state atoms are recaptured by the MOT. A simple rate equation model of this recycling mechanism shows excellent agreement with measurements of the time dependence of MOT fluorescence, indicating validity of the model. In addition to showing it is possible to trap atoms with optical leaks without repumping, this demonstration of an erbium MOT opens a wide range of new possibilities for practical applications and fundamental studies with cold atoms, impacting such diverse fields as quantum optics, quantum information processing, ultra-precise frequency standards, quantum degenerate gases, cold collisions, trace atom detection, nanostructure fabrication, and atom-by-atom doping of materials.

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