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Progress toward an Ytterbium Optical Clock ZEB BARBER, CHAD HOYT, CHRIS OATES, LEO HOLLBERG, NIST-Boulder — We report progress toward an optical frequency standard based on the narrow $^1S_0 \leftrightarrow {}^3P_0$ transition of odd ytterbium isotopes at 578 nm. Recoil-free spectroscopy of neutral atoms tightly confined to an optical lattice could support fractional frequency instabilities of 10^{-18}in one second. Loading the lattice from cold atomic clouds will provide large numbers of atoms and good signal-to-noise. We present initial results of two stage cooling and trapping experiments. The first stage consists of collecting and cooling atoms from an atomic beam using the broad 399 nm line and InGaN diode lasers. Second stage cooling to ~50 mK is performed on the 556 nm intercombination line using frequency-doubled light from a narrow linewidth infrared fiber laser. A single pass of 1 W fundamental power through a periodically-poled lithium niobate crystal produces ~30 mW of 556 nm light. With a fast linewidth of ~60 kHz, locking the laser frequency to the atomic beam fluorescence is sufficient for cooling on this ~180 kHz transition. This all-solid-state laser architecture enables simple and robust production of large numbers of atoms at ultracold temperatures for precision spectroscopy in a lattice.

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