Abstract Submitted
for the DAMOP12 Meeting of
The American Physical Society

All-Optical Production of a Lithium Quantum Gas Using Narrow-Line Laser Cooling[1] TSUNG-LIN YANG, PEDRO M. DUARTE, RUSSELL A. HART, RANDALL G. HULET, Rice University — We have used the narrow $2S_{1/2} \rightarrow 3P_{3/2}$ transition in the ultraviolet (UV) to laser cool and magneto-optically trap (MOT) ^{6}Li atoms.[2] Laser cooling of lithium is usually performed on the $2S_{1/2} \rightarrow 3P_{3/2}$ (D2) transition, and temperatures of $\sim$300 μK are typically achieved. The linewidth of the UV transition is seven times narrower than the D2 line, resulting in lower laser cooling temperatures. We demonstrate that a MOT operating on the UV transition reaches temperatures as low as 59 μK. Furthermore, we find that the light shift of the UV transition in an optical dipole trap at 1070 nm is small and blue-shifted[3], facilitating efficient loading from the UV MOT. After loading from the UV MOT, 6×10^6 atoms with peak density $n_0 = 2.7 \times 10^{13}\, cm^{-3}$ remain at $T = 60\,\mu K$, which corresponds to $T/T_F \approx 2.7$. Evaporative cooling of a two spin-state mixture of ^{6}Li in the optical trap produces a quantum degenerate Fermi gas with 3×10^6 atoms in only 5 s.

[1]Supported by NSF, ONR, DARPA, and the Welch Foundation.
[2]P. M. Duarte et al., Phys. Rev. A **84**, 061406 (2011).
[3]M. Safronova, Personal Communication.

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Date submitted: 30 Jan 2012 Electronic form version 1.4