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Low-temperature, high-density magneto-optical trapping of potassium using the open 4S → 5P transition at 405 nm
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— We report the laser cooling and trapping of neutral potassium on an open transition. Fermionic ^{40}K is captured using a magneto-optical trap (MOT) on the closed $4S_{1/2} \rightarrow 4P_{3/2}$ transition at 767 nm and then transferred, with unit efficiency, to a MOT on the open $4S_{1/2} \rightarrow 5P_{3/2}$ transition at 405 nm. Because the $5P_{3/2}$ state has a smaller line width than the $4P_{3/2}$ state, the Doppler limit is reduced. We observe temperatures as low as 63(6) μK, the coldest potassium MOT reported to date. The density of trapped atoms also increases, due to reduced temperature and reduced expulsive light forces. We measure a two-body loss coefficient of $\beta = 2 \times 10^{-10}\,\mathrm{cm^3\,s^{-1}}$, and estimate an upper bound of $8 \times 10^{-18}\,\mathrm{cm^2}$ for the ionization cross section of the 5P state at 405 nm. The combined temperature and density improvement in the 405 nm MOT is a twenty-fold increase in phase space density over our 767 nm MOT, showing enhanced pre-cooling for quantum gas experiments. A qualitatively similar enhancement is observed in a 405 nm MOT of bosonic ^{41}K.

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