Laser Cooling of Ytterbium-171 Ion by Polychromatic Light Without the Use of a Magnetic Field

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Standard methods of laser cooling of $^{171}Yb^{+}$ in a radiofrequency trap involve the use of coherent light fields resonant with the optical transitions of the $^2S_{1/2}-^2P_{3/2}$ line, as well as a magnetic field that destroys the a coherent population trapping (CPT) at the $^2S_{1/2}$ $(F = 1)$ level. Further precision measurements, made using clock transitions (quadrupole $^2S_{1/2}(F = 0) \rightarrow {}^2D_{3/2}(F = 2)$ and octupole $^2S_{1/2}(F = 0) \rightarrow {}^2F_{7/2}(F = 2)$), require significant suppression and control of residual magnetic fields. In this work, we propose an alternative method of laser cooling $^{171}Yb^{+}$ using polychromatic fields, which allows complete elimination of the magnetic field in ion cooling and thus suppresses any shifts related to the quadratic Zeeman effect from uncontrolled residual magnetic fields.

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