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# Laser cooling and trapping of short-lived radium ions

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Radium-225 (nuclear spin 1/2) is a particularly appealing candidate for optical clocks and testing fundamental symmetries due to its accessible electronic structure and heavy, octupole deformed nucleus. We demonstrated the first laser cooling of short-lived $^{224}Ra^{+}$ (3.6 day half-life) and $^{225}Ra^{+}$ (15 day half-life) ions which are loaded into linear Paul traps by a two-step photoionization process. We observed the $7s\ ^2S_{1/2} \rightarrow 7d\ ^2D_{5/2}$ clock transition in $^{224}Ra^{+}$ and $^{225}Ra^{+}$. This work was done with an effusive oven source based on the decay of longer-lived thorium atoms, which is expected to provide a useful supply of radium atoms over several thorium half-lives. We will measure the absolute transition frequencies of the electronic transitions needed for laser cooling and operating an optical clock with both short-lived isotopes. In parallel efforts, we are measuring the hyperfine structure of $^{225}Ra^{+}$ and developing an orthotropic oven to produce a more efficient radium source. In following work we will produce and trap radium molecules which have enhanced sensitivity to tests of fundamental symmetries.

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