

Sympathetic laser-cooling of a single heavy ion in a Penning trap

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Single-ion sympathetic laser cooling is typically performed with ions that are created directly inside an ion trap, most often a linear Paul trap. This technique has been widely applied in optical clock research through the implementation of quantum logic spectroscopy [1, 2]. In contrast, the cooling of ions produced outside the trap is less common; an example is the sympathetic cooling of thorium ions within a linear chain of $^{40}\text{Ca}^+$ ions [3]. Earlier studies using the Penning trap platform have been comparatively scarce, with only demonstrations involving clouds composed of two ion species [4]. At the University of Granada, we are investigating sympathetic laser cooling of individual ions in a 7 T Penning trap with the goal of forming a two-ion hybrid Coulomb crystal for pure photon-based mass spectroscopy [5, 6]. In this contribution, we present the status of sympathetic laser cooling in a 7 T Penning trap installed in a cryogen-free magnet, in combination with the photon-based identification techniques. Although the present target ion has a mass relatively close to that of the sensor ion, the production of thorium ions in the laboratory will soon enable the extension of these techniques to research opening prospects for experiments involving ions from heavy and superheavy elements.

References

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