Ablation loading for compact Ca^+ and Al^+ ion trapping setup

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Currently, for realizing an optical reference one can choose from a large diversity of earth elements such as $^{40}Ca^+$, $^{27}Al^+$, $^{171}Yb^+$, $^{88}Sr^+$, etc. Yet all of the components mentioned above have one thing in common: ion loading and trapping is a fundamental process when realizing any optical reference. The loading process should be effective and controlled as it is a daily routine. The generally utilized method to successfully load the ions into the trap is by using the resistively heated oven. This method is easily implemented but can only be applied for some elements as there are limitations associated with the high temperatures necessary to vaporize the material. For these materials, it is favorable to use a laser pulse ablation. In the work, we propose a simple design for an integrated loading setup for multi-ion species, i.e. $^{40}Ca^+$ and $^{27}Al^+$ using both a heated oven and the laser pulse ablation (Fig. 1).

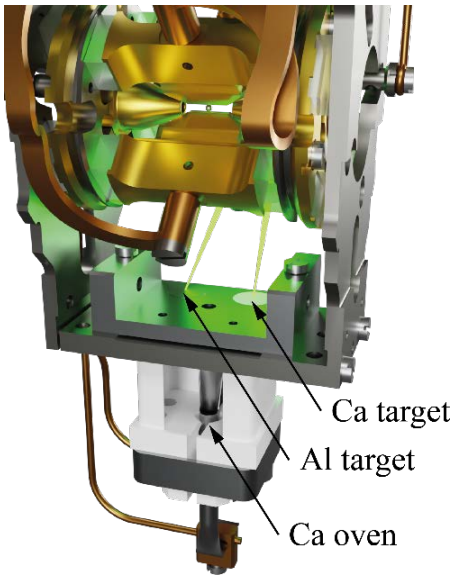

Fig. 1: Visualization of the ion trap with sources of calcium and aluminum atoms.

The design emphasizes on innovative features that come from valuable experience from our current assembly. This important insight into possible improvements allows us to make significant design changes from the ground up. The loading structure in our case allows loading two species with different evaporation temperatures (500 °C for Ca and 1300 °C for Al in vacuum). The design was successfully built, and the preliminary generation of both species was verified by measuring their absorption spectra. Fig. 2 shows the results of ion generation of $^{40}Ca^+$ using both methods.

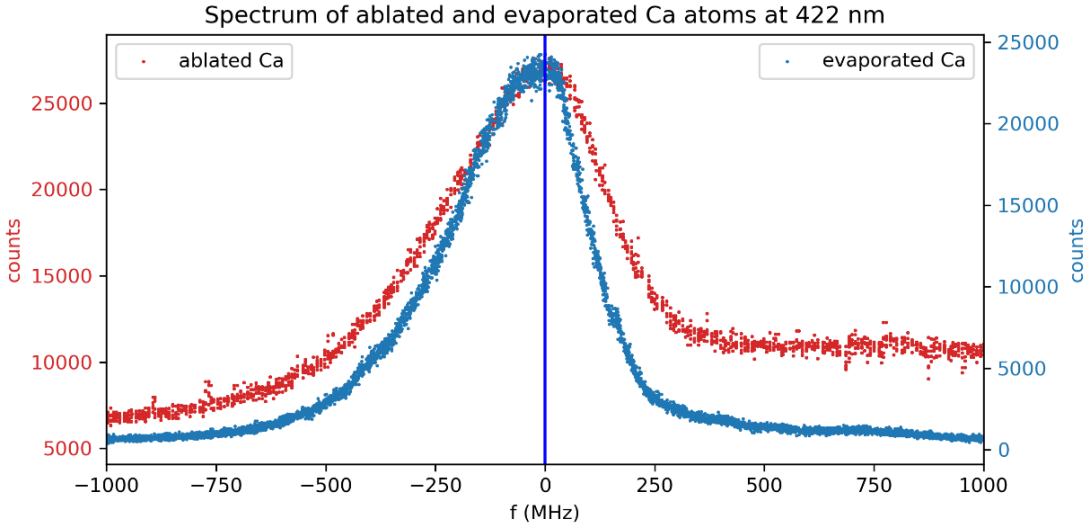

Fig. 2: Spectrum of ablated and evaporated calcium atoms at 422 nm.