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Swap cooling of trapped ions by resonant charge exchange with ultracold atoms SOURAV DUTTA, Tata Institute of Fundamental Research, Homi Bhabha Road, Colaba, Mumbai 400005., S. A. RANGWALA, Raman Research Institute, C. V. Raman Avenue, Sadashivanagar, Bangalore 560080. — We demonstrate, for the first time, a novel ion cooling method based on resonant charge exchange collisions between trapped ions and their parent neutral atoms [1]. The experiments are performed in a hybrid atom-ion trap consisting of a Paul trap for ions and a magneto-optical trap for atoms. Specifically, we observe that cooling of trapped $^{133}Cs^{+}$ ions by ^{133}Cs atoms is more efficient than cooling of $^{133}Cs^{+}$ ions by ^{85}Rb atoms. This observation cannot be explained by considering elastic collisions alone, signaling the presence of an additional mechanism in the parent-daughter Cs-Cs^{+} case, which is cooling by resonant charge exchange (RCE). We additionally find that, on an average, cooling by RCE can be more efficient than elastic collisions despite that fact that the RCE cross section is much lower than the elastic collision cross section. This happens because a single RCE collision is two orders of magnitude more efficient at cooling than a single elastic collision, in our energy regime. The results have implications for future studies on charge transport by electron hopping in ultracold atom-ion system. [1] Phys. Rev. A 97, 041401(R) (2018)

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