Laser cooling of stored relativistic ion beams with large momentum spreads using a laser system with a wide scanning range

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Synopsis New results on laser cooling of stored, bunched, relativistic ion beams are presented. For the first time it has been possible to cool an ion beam with large momentum spread without initial electron cooling or scanning of the bunching frequency by using a single cw laser system.

We present results on a recent laser cooling experiment on bunched C^{3+} ion beams at relativistic energies at the Experimental Storage Ring, GSI Darmstadt, Germany. In order to directly cool all ions with an initial momentum spread of the RF-bunched beam, a scanning cw laser system has been applied during the experiment, the frequency of this laser system at the UV range (257.3 nm) can be scanned more than 12 GHz corresponding to the longitudinal momentum spread about ~10^{-5} of the ion beam. A schematic view of the laser cooling of a coasting ion beam and a bunched ion beam is shown in Figure 1(a) and Figure 1(b), respectively.

Our results prove that the initially large momentum spread of bunched ion beams can be efficiently cooled using a single cw laser by scanning the laser frequency over a broad frequency range. The cooling rate is mainly limited by the speed of the frequency scan. In comparison to previous laser cooling experiments at ESR [1, 2], this new cooling scheme does not require initial electron cooling of the ion beam or scanning of the bunching frequency. This very promising scheme can be directly adopted to future high-energy ion storage rings. In order to further improve the technique, follow up experiments at the CSRe in Lanzhou are planned for this year.

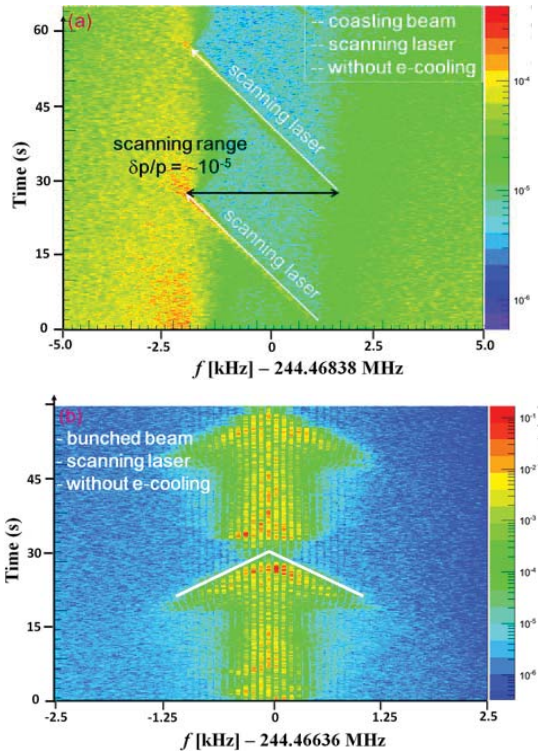

Figure 1. Schematic view of the cooling scheme for a coasting ion beam (a) and a bunched ion beam (b). The Schottky noise signal strength is plotted logarithically.

References

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