

Laser cooling of relativistic O^{5+} ion beams at storage ring CSRe

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The combination of advanced lasers and heavy ion storage rings provides a novel research platform for atomic physics of highly charged ions (HCI) [1]. Laser cooling and precision laser spectroscopy of HCI are considered as frontiers of atomic physics research at heavy ion storage rings. Based on the success of laser cooling of C^{3+} at the ESR, and the experience of test laser cooling experiments at the CSRe, laser cooling of lithium-like $^{16}O^{5+}$ ion beams with a relativistic energy of 275.7 MeV/u was achieved for the first time at the heavy-ion storage ring CSRe in Lanzhou, China [2]. A CW laser system with a wavelength of 220 nm was employed to cool the RF-bunched ion beams. After laser cooling, the relative longitudinal momentum spread of O^{5+} ion beams reached to $\delta p/p < 1 \times 10^{-6}$ at ion number of 10^6 . To our knowledge, the O^{5+} ions are of the highest charge state and at the highest energy that have been ever cooled by laser cooling. We will present the first results of laser cooling of relativistic O^{5+} ion beams at the CSRe as well as the plans of the laser cooling and laser spectroscopy of HCI at the High Intensity Accelerator Facility (HIAF) [3], in China.

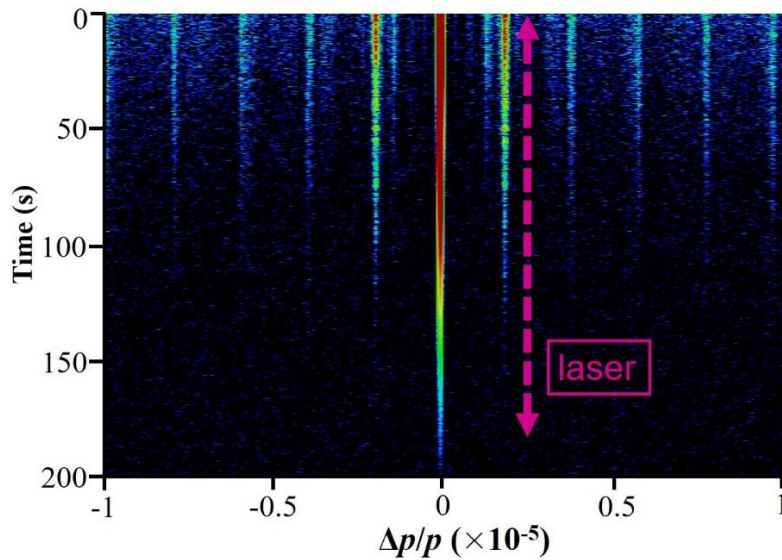


Figure 1: Schottky spectrum of laser-cooled $^{16}O^{5+}$ ion beam at an energy of 275.7 MeV/u.

[1] M. Bussmann, 2014 *ICFA Newsletter*; D. Winters, *et al.*, 2017 *Phys. Scr.*, **T166** 014048.

[2] W. Wen, *et al.*, 2019 *Hyperfine Interacts* in press; H. Wang, *et al.*, 2019 in preparation.

[3] X. Ma, *et al.*, 2017 *NIMB*, **408** 169; J.C. Yang *et al.*, 2013 *NIMB*, **317** 263.

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