

Laser cooling and precision laser spectroscopy of highly charged ions: from the CSRe to HIAF

Monday, 19 September 2016 18:00 (2 hours)

The combination of advanced lasers and heavy ion storage rings provides a novel research platform for atomic physics and nuclear physics of highly charged ions (HCI). Laser cooling of highly charged heavy ion beams could reach a much lower momentum spread and much faster cooling speed as compared to electron-cooling and stochastic-cooling. Laser cooling is also considered as one of the most promising techniques to reach high phase-space densities for relativistic heavy ion beams at storage rings. Meanwhile, laser spectroscopy of HCI has already been demonstrated as a precision spectroscopy tool at many storage rings, especially for hyperfine-splitting measurements of H-like and Li-like Bi at the ESR in Darmstadt, Germany. Based on the success of laser cooling of C³⁺ at the ESR, and the experience of test laser cooling experiments at the CSRe, an experiment of laser cooling of Li-like O⁵⁺ ion beams is currently preparing at the CSRe by using a 220 nm cw laser. These experiments can hopefully be performed at the beginning of next year. Laser cooling and precision laser spectroscopy of HCI and even radioactive ion beams, are also being prepared for the High Intensity Accelerator Facility (HIAF), in China and for FAIR in Germany. We will present the preparation of laser cooling of O⁵⁺ at the CSRe, and also present the design of the laser cooling and laser spectroscopy of HCI at HIAF.

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Session Classification: Poster Session and Coffee