3 - 6 A Novel Method by Employment of RF-buncher to Study Electron-ion Recombination at Ultra-low Collision Energy at CSRe*

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Heavy-ion storage rings equipped with electron coolers have been extensively used for electron-ion recombination studies. For dielectronic recombination (DR) experiments at the CSR, electron cooler is used for cooling of the ion beams as well as for electron target, where electron ion collision energy is detuned by changing the cooler cathode voltage. However, the absolute collision energy close to the cooling point could not be determined precisely in the recent $^{40}Ar^{14+}$ DR experiment at the CSRm. Therefore, a novel method by utilizing a RF-buncher instead of the electron cooler to detune collision energy for electron-ion recombination measurement is proposed in this work.

The schematic view of the RF-buncher is shown in Fig. 1[1]. When applying the RF-buncher, a hitherto coasting ion beam will experience a longitudinal ponderomotive force, called the bucket force. As a result, the ion beam will be bunched. By sweeping the frequency of the RF-buncher, the velocity of the ions inside the bucket can be slightly detuned, resulting in non-zero collision energy. An estimation is given under the parameters of the recent test experiment performed with $^{12}C^{3+}$ ion beams on the CSRe[2]. The Schottky spectrum of electron-cooled and bunched ion beams of C^{3+} and O^{4+} is shown in Fig. 2. It can be found that the relative longitudinal momentum spread of the ions inside the bucket is less than 2×10^{-5}, and the detuning effect of the RF-buncher for the C^{3+} ion beams energy is more than 200 kHz revealed on the Schottky spectrum. This scanning leads to a 0.1 eV center-of-mass collision energy between electrons and ions. Therefore, a consecutive measurement of electron-ion recombination can be performed by scanning of the RF-buncher to detune the collision energy close to cooling point. This method will provide an opportunity to study the recombination process in ultra-low energy region such as the near-threshold DR spectrum as well as the RR enhancement effect, which may be caused by transient field-induced recombination[3].

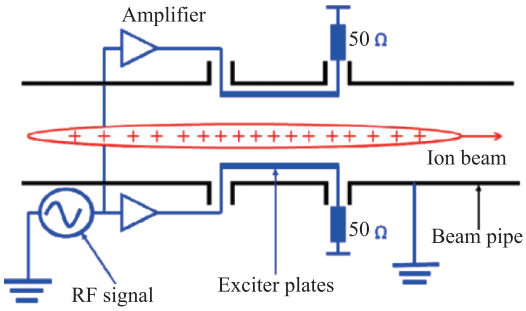

Fig. 1 (color online) Schematic of the RF buncher on the CSRe.

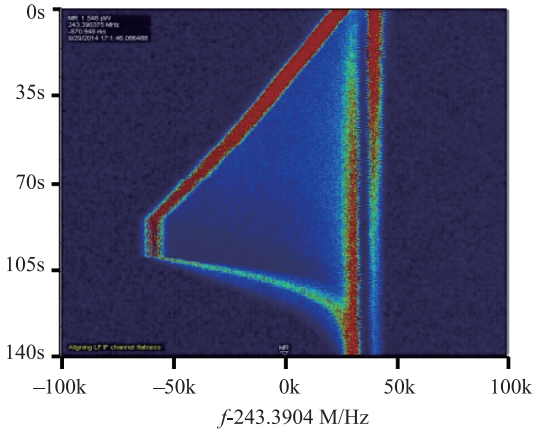

Fig. 2 (color online) Schottky spectrum under RF-buncher sweeping.

References

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