6 - 27 Progress of PLIA in Lanzhou

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The electric field has been measured and analyzed by the optical electric integrated electric field measurement system[1]. The measurement result of the electric field provides an important reference for subsequent beam acceleration experiment. The acceleration experiment was performed with existing equipment to achieve the proof-of-principle of pulse line ion accelerator (PLIA).

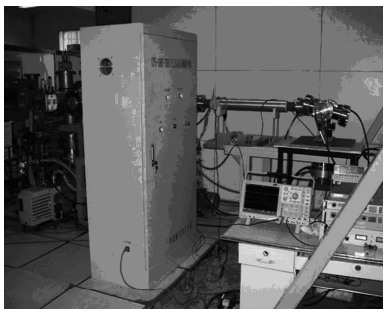

Fig. 1 The measurement site figure.

The measurement site is shown in Fig. 1. It consists of ECR ion source, PLIA accelerating structure, and beam measurement system etc. 20 keV He^+ is chosen as the injected ion in the preliminary experiment. The beam measurement with electrostatic energy analyzer and electron multiplier is done by varying the DC voltage of the electrostatic dipole, and collecting the beam current at the exit of electrostatic energy analyzer with the electron multiplier. Fig. 2 is the measurement signal of electrostatic energy analyzer with electrostatic dipole voltage of 3.7 kV, which correspond to the ion energy of 28 keV. This illustrates that part of 20 keV He^+ is accelerated to 28 keV, which is less than the theoretical calculation value 87 keV. The reason is that the actual axial electric field is small than the theoretical calculation, so the accelerated ions will enter into the deceleration zone before leaving the helix. To solve this problem, we increase the injected energy of ions to avoid it entered into the deceleration zone before leaving the helix. By calculation, we increase the injected ion energy to 24 keV. Based on the improved parameters, the experiment was repeated. Fig. 3 is the measurement signal of electrostatic energy analyzer with electrostatic dipole voltage of 7.7 kV, which correspond to the ion energy of 55 keV. The experiment result is larger than the theoretical calculation value 46 keV. This is due to the presence of fringe field at the front and rear ends of helix, which will affect the accelerating process.

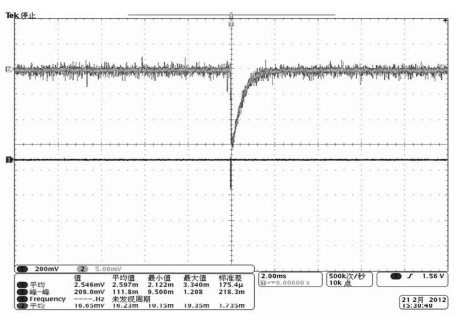

Fig. 2 The measurement signal of electrostatic energy analyzer with electrostatic dipole voltage of 3.7 kV.

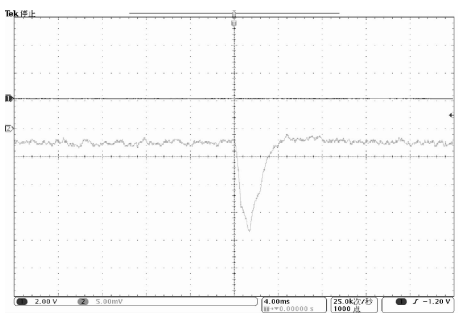

Fig. 3 The measurement signal of electrostatic energy analyzer with electrostatic dipole voltage of 7.7 kV.

Reference

[1] Shen Xiaokang, Zhang Zimin, Cao Shuchun, et al., Chinese Physics, C36, 7(2012)661.