6 - 2 Recent Progress of the SSC-Linac*

Yin Xuejun, Yuan Youjin, Zhang Xiaohu, Lu Wang, Du Heng, Li Xiaoni, Jiang Peiyong, Li Zhongcan, Wang Haonin, Yang Yaqing, Ma Lizhen, Xu Zhe, Zhang Xuezhen, Sun Liangting, Yao Qinggao, Meng Jun, Cai Guozhu, He Yuan, Zhao Hongwei, Xia Jiawen, Liu Ge[1], Lu Yuanrong[1], Zhu Kun[1], Gao Shuli[1], Yan Xueqing[1], and Chen Jiaer[1]

([1]State Key Lab of Nuclear Physics and Technology, Peking University, Beijing, 100871, China)

SSC-Linac[1] as the injector for the Separated Sector Cyclotron (SSC), is being constructed at national laboratory Heavy Ion Research Facility at Lanzhou (HIRFL). The injection and extraction energy are 3.7 keV/u and 1.025 MeV/u, respectively. Fig. 1 shows the front end section of the SSC-Linac. The high charges state continus wave (CW) 4-rod RFQ has been designed and fabricated for some years. From the end of 2013, the commissioning of the RFQ was performed and the beam test was carried out in April 2014. In this paper the experiment result will be presented.

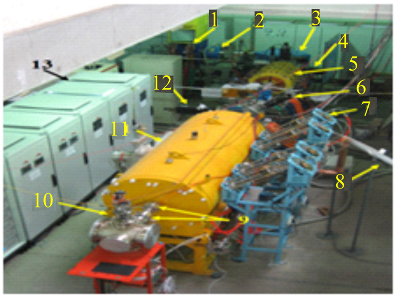

Fig. 1 (color online) General view of the SSC-Linac. 1-ECR ion source; 2-focusing solenoid; 3-90° dipole magnet; 4-emittance scanner; 5quadrupoles;6-movable wire scanner; 7-movable tuner; 83-1/8” coaxial tubes; 9-two FCTs; 10,12-Faraday cup;11-RFQ; 13-power supplies.

The CW RFQ has been developed under the collaboration between IMP and Peking University supported by National Natural Science Foundation of China. This RFQ can accelerate ion from 3.7 to 143 keV/u with the ratio of charge-to-mass 1/7~1/3.

Low level RF measurement of RFQ has been completed in October 2013. The operating frequency 53.667 MHz was obtained by using four tuners. On the critical coupling state, the Q_0 value of the cavity was 6 440, which was 97% of the simulation result. In January 2014, the high power conditioning of RFQ was implemented. Fig. 2 is the RF power conditioning experiment setup. The conditioning experiment was begun in the pulse mode from low power with 10% duty factor. Fig. 3 shows the power signals which were measured by the pickups. The average power increased gradually by raising the length and amplitude of the pulse.

The test is very stable with little sparking. After about 30 h conditioning, 35 kW with 30% duty factor was fed into the cavity almost no feedback. After then, the power conditioning of 35 kW in CW mode has been successfully carried out.

Fig. 2 (color online) RFQ power conditioning setup.

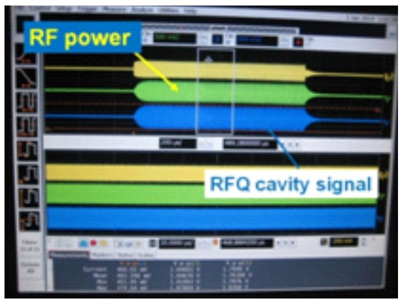

Fig. 3 (color online) RFQ power conditioning measurement.

Beam tests were performed from April after the LEBT had been installed and aligned successfully[2]. The particle energy was measured using the Time of Flight (TOF) method with two FCTs (Fast Current Transformers) installed after the RFQ exit as shown in Fig. 4.

The distance of two FCTs is ~ 240.7 mm and the corresponding time of flight is ~ 8.6 ns. Beam current and transmission were measured by three Faraday cups which were equipped in various positions.

* Foundation item: National Natural Science Foundation of China (10635090, 11375243)

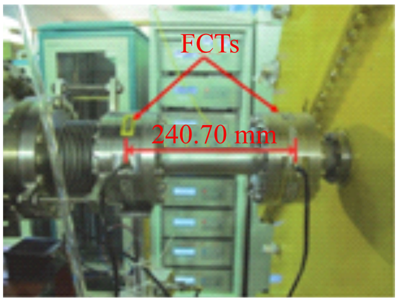

Fig. 4 (color online) Two FCTs for beam energy measurement.

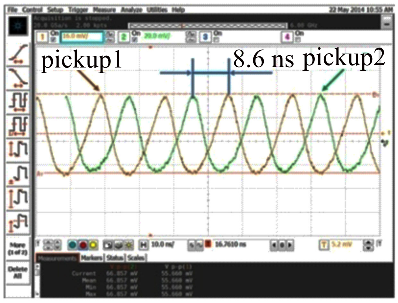

Fig. 5 (color online) Beam signals detected by two FCTs.

The $^{16}O^{5+}$ ion beam was transported through the RFQ and accelerated to 141.9 keV/u on 4th April . The measured current was 149.5 eμA. After carefully conditioning in higher power status, $^{40}Ar^{8+}$ ion beam was successfully accelerated in May 23rd, the measured energy and current were 142.8 keV/u and 198 eμA, respectively. The beam transmission was up to 94%. The beam signals detected by FCTs were shown in Fig. 5.

References

[1] Chen Xiao, Yuan He, Youjin Yuan, et al., Chinese Physics C (HEP &NP), 36(2012)84.

[2] X. Yin, Y. Yuan, X.H. Zhang, et al., "THE R&D STATUS OF SSC-LINAC", Proceedings of IPAC2014, Dresden, Germany.

6 - 3 Closed Orbit Correction in Electron Cooler Section at CSRe

Tang Meitang, Yang Xiaodong, Mao Lijun, Li Jie, Ma Xiaoming, Yan Tailai, Zhao He, Li Peng, Chai Weiping, Zheng Wenheng, Zhang Xiaohu, Yang Jiancheng, Yuan Youjin and Xia Jiawen

The injecting section and the cooler section are apart from each other at CSRm, while the electron cooler system is installed at the injecting section of CSRe[1]. So for the CSRe we not only need to satisfy the beam injecting condition but also need to satisfy the beam cooling condition. At present, we use the ramping bump and the kicker to inject beam, and after injection the bump disappear quickly and the beam goes to the cooling orbit and begin cooling. This method has a disadvantage that the beam cooling condition cannot be satisfied until the bump is down. In the past year, we try to find a new method to correct the orbit of cooler section. Instead of using ramping bump we use the fixed bump to satisfy the injecting and the cooling condition at the same time.

We use Winagile for design. Fig. 1 shows the calculated result. From this figure, we can find that there is no closed orbit distortion at the cooler section for the revolution beam, so it will ensure the ion beam and electron beam overlap coaxially on the condition that the ion beam can be injected. Table 1 shows the parameters of the correctors, the currents of the dipoles outside the cooler (D_coll, D_gun) are larger than maximum output currents of the power supply at magnetic rigidity of 5.875 Tm (as shown in Table 1).

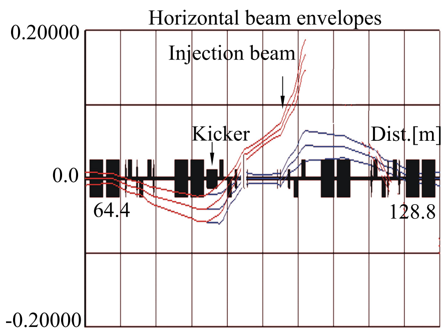

Fig. 1 (color online) The injecting orbit (red lines) and the revolution orbit (blue lines). (328 MeV/u $^{58}Ni^{28+}$, Brho=5.875 Tm).

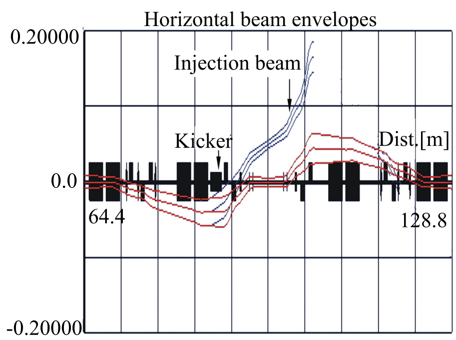

Fig. 2 (color online) The injecting orbit (blue lines) and the revolution orbit (red lines). (328 MeV/u $^{58}Ni^{28+}$, Brho=5.875 Tm, with the opposite magnet field direction).