Status of the proton injector for FAIR

R. Berezov[1], N. Chauvin[2], J. Fils[1], R. Hollinger[1], V. Ivanova[1], C. Ullmann[3]
[1]GSI, Darmstadt, Germany; [2]CEA, Saclay, France; [3]IAP, Frankfurt am Main, Germany

The FAIR proton LINAC, the synchrotrons for heavy ions SIS18 and SIS100 have to provide the primary proton beam for the production of antiprotons [1]. The injector for the proton LINAC has to deliver 100 mA proton beam with an energy of 95 keV and an emittance of 0.3π mm mrad (normalized, rms) at the entrance of the RFQ.

The injector for the p-linac consists of the microwave ion source with "five electrode" extraction system and a low energy beam transport (LEBT) for matching the beam to the RFQ. The Microwave ion source developed and made in CEA/Saclay, will be able to run in pulsed mode by pulsing the RF generator. The ion source operates with a microwave frequency equal to 2.45 GHz based on ECR plasma production with two coils each with 87.5 mT magnetic field [2]. The five electrodes extraction system consists of a plasma electrode (plasma chamber potential), a puller electrode (50 kV), screening electrode (5 kV) and two ground electrodes [3].

The LEBT composes two short solenoids with two H/V integrated magnetic steerers and a diagnostic chamber, which is shown in the Figure 1. The diagnostic chamber is equipped with an iris, as beam diaphragm for transverse beam limitation, an Alison scanner for emittance measurement, a secondary emission grid (SEM) for direct determination of position and angle distribution, a Wien filter for detection of different ion species as a check of beam composition and a beam stopper. It is also planned to install a 4-grid analyser temporally to measure the space charge compensation during the commissioning of the proton injector.

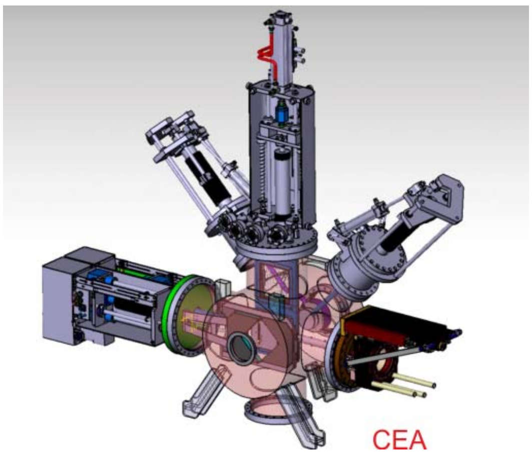

Figure 1. Diagnostic chamber with iris, Alison scanner, Wien filter, SEM grid and beam stopper.

For measuring ion beam intensity two current transformer (ACCT) will be installed behind the pentode extraction system and at the end of the LEBT beam line. The electrostatic chopper will be mounted between the LEBT and the RFQ to cut the beam pulse current to 36 μs. The total length of the compact LEBT is 2.3 m. The length reduced to minimize expected emittance growth along the beam line.

The assembly of the test bench for the commissioning at CEA/Saclay is rather finished. On Figure 2 the 3D model of the test bench is presented. The ion source is located on the platform with a potential of 100 kV inside the Faraday cage. The LEBT is installed outside of the Faraday cage and has ground potential.

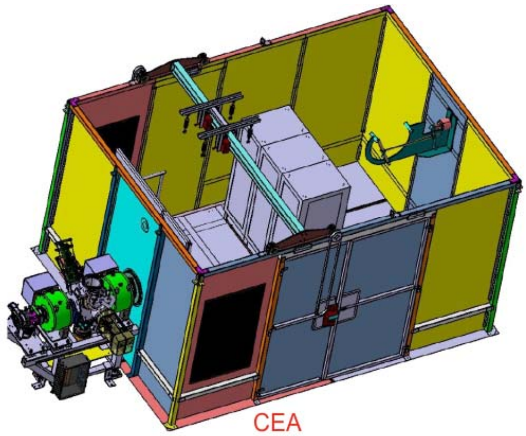

Figure 2: 3D model of the test bench for the commissioning at CEA/Saclay.

The first primary emittance measurement with the Alison scanner directly behind the extraction system is planned in Q2 (2015). After completing the LEBT installation with mini control system and power supplies, planned to start the commissioning in Q4 of 2015. For emittance measurement the mobile slit-grid emittance unit (from GSI) will be installed at the position of the entrance of the RFQ. It is also planned to perform measurements of beam current, stability of the source, space charge compensation and determination of the beam fraction.

References

[1] R. Hollinger, W. Barth et al., "High current proton beam investigations at the SILHI-LEBT at CEA/Saclay", Linac06 (2006) 232.

[2] C. Ullmann, R. Berezov et. al., "The proton injector for the accelerator facility of antiproton and ion research (FAIR)", Rev. Sci. Instrum. 85, 02A952 (2014).

[3] C. Ullmann, R. Berezov et.al., "Status and computer simulations for the front end of the proton injector for FAIR", proceedings of IPAC2014, Dresden, Germany.

DOI:10.15120/GR-2015-1-FG-GENERAL-21