6 - 21 Development of LECR4 ECR Ion Source at IMP

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A new room temperature ECR (Electron Cyclotron Resonance) ion source, LECR4 (formerly called DRAGON), is under construction at IMP. LECR4 is designed to operate at microwaves frequencies of 14.5 to 18 GHz. Its axial solenoid coils cooled with evaporative medium provide amirror field of 2.5 T at the injection and 1.4 T at the extraction, respectively. Its radial magnetic field is about 1.0 T at the inner wall of plasma chamber (Inner diameter is 76 mm). The sextupole magnet is made up of 36-segmented Halbach structure permanent magnets. Table I lists the axial magnetic parameters of LECR4 which are very close to those of SECRAL operating at 18GHz and the GTS.

Table 1 Main Parameters of LECR4, GTS and SECRAL operating at 18 GHz.

	LECR4	GTS	SECRAL
Operating frequency (GHz)	14～18	14 ～ 18	18
Resonance length (mm)	14 GHz：80 18 GHz：110	14 GHz：95 18 GHz：145	105
Plasma chamber (mm)	L：480 ϕ：126	L：300 ϕ：80	L：420 ϕ：126
Max. axial injection field (T)	2.7	2.5	2.5

In general, axial mirror field of a room temperature ECR ion source is provided by a set of water-cooled resistive axial solenoids. The solenoid coils are typically made of hollow-conductor cooled by de-ionized pressurized-water. One of the new features of LECR4 is that all the axial solenoid coils are immersed in and cooled by a 47.7 ℃ evaporative medium. Although there are various schemes for cooling the magnetic system with evaporative medium, immersion would be the most effective cooling for the magnetic system of ECR ion source. The whole system consists of condenser, liquid-down tube, immersion tank, vapor-flow tube, etc. the schematic drawing of the evaporative cooling system and the outlook of the magnet is shown in Fig. 1.

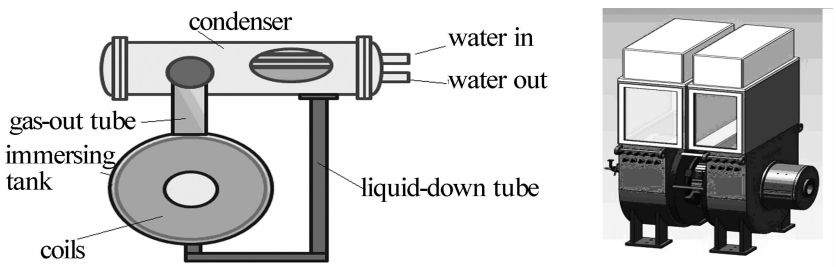

Fig. 1 Schematic layout of evaporative cooling system for LECR4.

A prototype of the axial solenoid coils and coolant condenser has been built to test evaporative cooling effectiveness. The achieved current for the injection solenoid coils is 300 A that is equivalent to an average current density of about 13 A/mm^2, slightly higher than that achieved with normal hollow copper conductor with strong water cooling.

The beam transport line of LECR4 is designed to be able to transport intense heavy ion beams with high efficiency and high resolution. The beam line consists of a solenoid lens and a 90-degree analyzing magnet. The turbo molecular pump is directly attached on the extraction flange of the source body in order to enhance the pumping speed for the plasma chamber. LECR4 is insulated with at least 3 mm thick material so as to achieve maximum 30 kV beam extraction high voltage.

Up to now, all the solenoid coils and the hexapole magnet are already, and the whole assembling of LECR4 is to start in July 2013. Once the source and the transport line are completed, the commissioning will start. The first plasma is expected in December 2013.