

**ThuPS26**

## **A 45 GHz Superconducting ECR Ion Source FECRAL and Its Technical Challenges**

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A next generation heavy ion accelerator complex HIAF (High Intensity heavy ion Accelerator Facility) was proposed by IMP and officially approved for nuclear physics and high energy density physics research. HIAF requests ion source capable of delivering 50  $\mu\text{A}$  of  $^{238}\text{U}^{34+}$  pulsed beam and 25  $\mu\text{A}$  of  $^{238}\text{U}^{34+}$  CW beam for injector of a superconducting heavy ion linac. A 45 GHz superconducting ECR ion source FECRAL (a Fourth generation ECR ion source with Advanced design in Lanzhou) was proposed and got financial support as a key technology R&D for HIAF facility. This paper will present preliminary technical-design of FECRAL ECR ion source such as magnetic field distribution produced by  $\text{Nb}_3\text{Sn}$  superconducting magnet with 6.5 Tesla axial mirror field and 3.4 Tesla sextupole field on the chamber wall, 20 kW@45 GHz microwave coupling system and ion beam transport line. Obviously to build a 45 GHz FECRAL ECR ion source, there will be many technical challenges to be taken, such as engineering and fabrication of the  $\text{Nb}_3\text{Sn}$  superconducting magnet with 12 Tesla maximum magnetic field on the conductor, cryogenic system of the magnet, efficient coupling of 45 GHz microwave power, effective mitigation of the bremsstrahlung thermal radiation to the 4.2 K cryogenics system, intense beam extraction and transmission with good beam quality, integration of the FECRAL ion source system and analyzing beam line onto a high voltage platform.