Contribution ID: **25** Contribution code: **MOP06** Type: **Poster Presentation**

Performance of the hybrid ECR ion source development at IMP

Monday, September 16, 2024 5:00 PM (1h 30m)

Highly charged ion beams have wide applications in fundamental sciences such as nuclear physics and atomic and molecular physics, as well as in applied industries including heavy ion cancer therapy and semiconductor processing. The Electron Cyclotron Resonance (ECR) ion source is one of the most effective devices for producing highly charged ion beams. Based on the requirement for a relatively simple structure and high performance ECR ion source, a Hybrid superconducting Electron Cyclotron Resonance ion source Advanced in Lanzhou (HECRAL) has been designed and constructed at the Institute of Modern Physics (IMP). The magnetic confinement of the ion source is realized by the axial mirror field provided by four superconducting solenoids while the radial hexapole magnetic field supplied by non-Halbach hexapole permanent magnet. The axial injection and extraction magnetic fields reach 3.4 T and 1.7 T, respectively. The radial field at the plasma chamber wall of a 100 mm inner diameter is above 1.4 T. This paper will present a detailed magnet design. The ion source was commissioned and operated at a frequency of 18 GHz with 3 kW power, approaching the performance of the Superconducting Electron Cyclotron Resonance ion source with Advanced design in Lanzhou (SECRAL) operating at the same frequency. Several high intensity high charge state ion beams have been produced, such as 723 eμA O^{7+}, 70 eμA Ar^{16+}, 95 eμA Kr^{26+}, 21 eμA Xe^{35+}, 120 eμA Bi^{33+}, and 88 eμA U^{37+}, and so on.

Footnotes

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Session Classification: MOP: Monday Poster Session

Track Classification: MC1: New Development and Status Reports