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Technical Approach towards the 4th ECR Ion Source FEER and the Latest Progress

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Aiming to the production of 1 e mA U³⁺ intense highly charged ion beam, the 4th generation ECR ion source 45 GHz FEER (First 4th generation ECR ion source) is under development at IMP. Fundamental progresses have been made towards this challenging machine. The first superconducting ECR ion source magnet based on Nb₃Sn technology is going to be in place to provide sufficient magnetic confinement to the 45 GHz microwave heated plasma. A new microwave coupling method called the Vlasov launcher has been proposed and successfully tested that can enhance the peak performance by 20% or higher. High power plasma chamber incorporated with the micro-channel cooling concept has been successfully developed and put in operation to handle the very challenging localized over-heating with the power dump density of ~10 MW/m² or beyond, which enables the long-term stable operation of an ECR ion source at 10 kW power level. Careful tuning of a 24 GHz ECR ion source operating at afterglow mode has made very intense pulsed highly charged ion beams. Typical ion beams such as 503 e μA Xe³⁰⁺, 266 e μA Xe³⁴⁺, 169 e μA Xe³⁸⁺ and 50 e μA Xe⁴²⁺ at the FWHM pulse length of ~10 ms have been produced. Intense ion beams have been already used for routine operation at IMP, such as the continuous operation of Kr²⁶⁺ or Xe³²⁺ at the intensities of 200~300 e μA. This paper will present the status of the FEER and the key technologies to make it work at high microwave power and high intensity ion beam production.

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Yes

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