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## **Experimental investigation on ECR ion source plasma towards more intense highly charged ion beam production**

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ECR ion source development is generally following the scaling laws and now is stepping into the 4th generation era. Nevertheless, the fundamental issues that determine the performance of a high performance ECR ion source remain the same, i.e. the magnetic field, microwave heating and ion confinement and extraction. Unfortunately, as most of the high performance ECR ion sources are busy with routine operation, there are not many new studies on the issues as aforementioned. With the high performance 18-28 GHz ECR ion sources at IMP, we have made numerous interesting investigations towards better understanding of ECR ion source plasma of high power high frequency so as to make more intense beam extraction of highly charged ions. We devised a novel movable Vlasov launcher and gave the first experimental demonstration of this technique to improve the microwave heating efficiency in superconducting ECR ion sources. With new microwave operating scheme and plasma manipulation techniques, the capability to produce intense pulsed beams of highly charged ions with a long peak duration of 5~10 ms in afterglow mode has been demonstrated, which provides a viable option of high intensity pulsed beam injection for the next generation heavy ion synchrotrons such as HIAF. This paper will summarize the recent progresses of experimental research with high performance ECR ion sources at IMP. The new recorded high intensity ion beam production as well as our interpretation on the experimental studies will be given.

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