Contribution ID: **110** Type: **Contributed Oral**

Prospects and challenges of the next generation highly-charged ECR ion source

Tuesday, 9 September 2025 12:30 (20 minutes)

High performance highly-charged ECR ion sources have been operated for more than 40 years to deliver highly-charged heavy ion beams for worldwide cyclotron and linac heavy ion accelerators. Successful operations of the 3rd generation highly-charged ECR ion sources operating at 24-35 GHz microwave frequency such as LBNL 28GHz VENUS, IMP 24-28 GHz SECRAL&SECRAL-II, RIKEN 28 GHz SCECRIS and FRIB 28GHz SCECRIS, have demonstrated amazing performance in terms of beam intensity and charge state typically 5-10 pμA 238U35+ - 238U40+, which have boosted dramatically the performances of cyclotrons and linacs from the point of view of beam intensity and energy. Demands for higher intensity and higher charge state of heavy ion beams keep increasing particularly for high intensity heavy ion superconducting linacs. The 4th generation ECR ion source operating at 45-56 GHz microwave frequency is being developed worldwide to produce higher charge state heavy ion beams with higher intensity targeting 5-10 pμA 238U45+ - 238U50+. This paper will present an overview of developments and technical challenges of the 4th generation ECR ion source focusing on high power microwave coupling and high field minimum-B superconducting magnet. Concept of the 5th generation highly-charged ECR source will be proposed operating at 65-84 GHz microwave frequency targeting 5-10 pμA 238U60+ - 238U65+. Innovative structure of minimum-B superconducting magnet and performance prospects for the 5th generation ECR source will be presented and discussed in this paper.

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Session Classification: Oral Session

Track Classification: Production of highly charged ion beams