ON METHODS FOR ENHANCING THE PERFORMANCES OF ECR ION SOURCES

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The *ECR* ion source is clearly the best choice of existing sources for the generation of *cw* beams of highly charged ions and, therefore, sources with enhanced charge-state distributions and intensities within a particular charge-state are at a premium for high-energy accelerator-based applications. The technology of the source has slowly but steadily advanced over the past several years principally by: improvement in plasma confinement; improvements in vacuum quality; supplementing their plasma-discharges with cold electrons; and use of the gas mixing effect. More recently, it has been suggested that their performances can be significantly further enhanced by increasing the physical sizes of their ECR zones in relation to the sizes of their plasma volumes (*spatial*- and *frequency*-domain methods). Further improvements are expected by choosing RHCP (TE_{11}-mode) microwave radiation that efficiently over-laps a large, uniformly distributed ECR zone, launched from a properly designed injection system at a shallow angle with respect to the direction of the magnetic field containing a resonance. This article reviews principles of ECR ion sources, examines the underlying elementary theoretical basis for launching microwave radiation into the source, examines the reasons why enlarged ECR zones are desirable and provides experimental evidence of the viability of these concepts for enhancing the performances of sources equipped with these provisions.

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