Contribution ID: **166** Type: **Poster**

Characterization of Hydrogen Plasma in an ECR Based Large Volume Plasma Chamber

Hydrogen plasma characterization was carried out in a large volume (dia˜ 1.0 m, h˜ 1.0 m) plasma chamber to evaluate efficacy of production of uniform, large-area H- beam for fusion applications. Up to seven Compact ECR Plasma Sources (CEPS; Indian Patent #301583, Patentee: IIT Delhi) can be mounted on the top dome of the chamber (one in center and six on a ˜60 cm dia circle). Axially poled permanent ring magnets provide the magnetic field for each CEPS and the total field in the chamber is the combined field of all CEPS. Separate experiments were conducted with: (i) a single CEPS at the center, (ii) seven CEPS with identical polarity on all the magnets and (iii) six CEPS with opposite polarity on adjacent magnets. In case (ii) the field lines repel while for (iii) a cusp field is formed between adjacent sources. For case (i), one obtains a uniform plasma density over 40 cm radius (ne ˜ 4 × 10ˆ10 cm-3, Te ˜1–2 eV), ˜ 70 cm downstream (from central source mouth) with 400W power at ˜ 1-3 mTorr pressure, yielding ideal conditions for volume mode H- production over a large area. For case (ii), however, plasma from each source flows along its individual field lines, without forming uniform plasma downstream. Whereas for case (iii), because of cross-talk between adjacent sources, the system became unstable, giving oscillations in plasma formation and microwave reflected power. Hence, it appears that the single CEPS configuration is the most efficacious for large area H- generation.

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Funding Information

Partially Funded by Institute for Plasma Research, Gandhinagar (IITD-IRD Project Ref : RP-03115)

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Session Classification: Poster Session 2

Track Classification: Ion sources for fusion