Negative Hydrogen Ion Production in HELEN-1 (HELicon Experiment for Negative ion source)

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Helicon wave heated plasmas sources are very efficient in terms of ionization per unit power consumed. Owing to the production of high plasma density in helicon plasma sources, these sources could be used for an efficient negative ion source in terms of RF power budgeting is concerned. In the HELEN[1] device at IPR, helicon plasma using hydrogen gas is produced by applying RF Power of 13.56 MHz at 900-1000W using a Nagoya-III antenna for exciting m = ±1 azimuthal mode in the plasma. The characteristic density jump from inductively coupled mode to Helicon mode is observed at Prf ~ 800W. This density jump depends on the neutral pressure as well as the axial magnetic field. Two diagnostic methods are used to measure negative hydrogen ion density. Cavity Ring Down Spectroscopy (CRDS) technique and laser photo-detachment (LPD) technique using a 1064 nm Nd:YAG laser and an RF compensated Langmuir probe. Typical plasma density in the present experimental configuration is ~ $10^{12}cm^{-3}$ and typical negative ion density is ~ $10^{9}cm^{-3}$ measured by Cavity Ring Down Spectroscopy (CRDS) technique. The negative ion density is correlated with the particle balance model.

1. Arun Pandey et al., Performance evaluation of a permanent ring magnet based helicon plasma source for negative ion source research, Rev. Sci. Instrum. **88**, 103509 (2017).