§28. Microwave Plasma Source for Negative Hydrogen Ion Production

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A microwave plasma source for the negative hydrogen ions production was constructed and tested. Principle structure of the source is shown on Fig. 1. Source consists of two chambers: production chamber (cylindrical, 6 cm in diameter and 20cm long) and confinement chamber, rectangular shape (26x26cmand 30cm deep). Microwaves are absorbed in the production chamber and produced plasma diffuses to the confinement chamber along the magnetic field lines, where it gets uniform. Walls of the confinement chamber are shielded by the cusp magnetic field which is 2kG at the wall and vanishes at the distance of 3cm from the wall. As a result we get 20x20cm in crossection uniform hydrogen plasma of density 3×10^{11}cm^{-3} and electron temperature 1-2eV. This plasma source is described in details elsewhere[1]. In present experiments microwave power is 5kW.

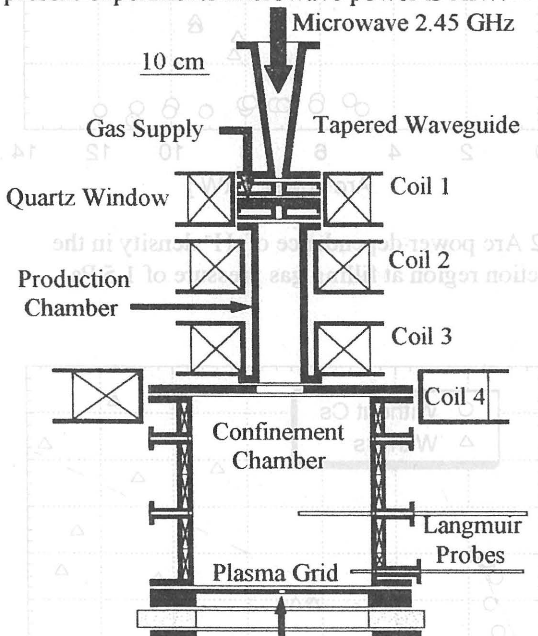

Fig. 1. Schematic diagram of the microwave plasma source.

Negative hydrogen beam was extracted through a single hole 1cm in diameter by applying extraction voltage of 5kV. Beam profile is measured using 9-channel faraday cup unit. Role of the conditioning coil 4 (which define the magnetic field in the extraction region near plasma grid) in the negative ions generation has been studied. Resulting data are shown on Fig. 2. We can see, that negative ion production curve resembles that of the plasma density, but is lower when the electron temperature is high. That means, H^- increases with decrease of the electron temperature up to 0.75 eV when H^- production is reported to be most efficient.

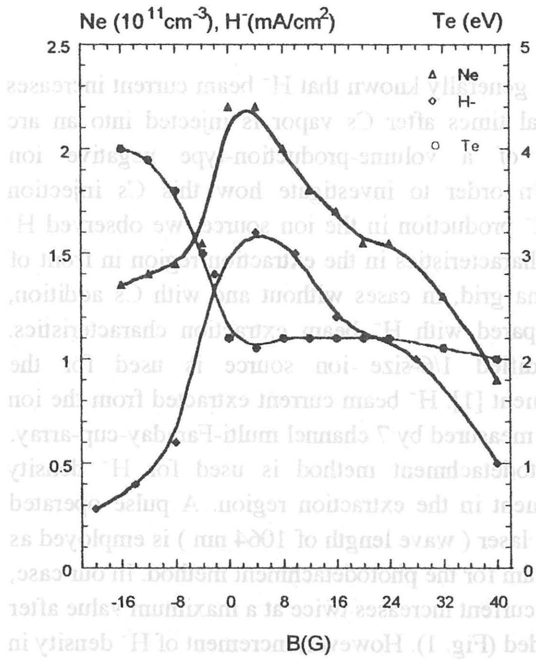

Fig. 2. Negative hydrogen ion production and plasma parameters dependence on theresidual magnetic field in the plasma grid area.

As a result of optimization, negative hydrogen ion beam of 1 mA has been extracted. That corresponds to 1.25mA/cm^2 of H^- current density at the Plasma grid region. That demonstrates high efficiency regarding plasma volume and inputed energy. This source may be considered as an alternative for the Neutral Beam Injection (NBI).

Reference:

[1] Mozjetchkov M. *et al.* Rev. Sci. Instrum. 69,2 (1998), p.971