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Characterization of Argon Plasma in a Multi line Cusp Magnetic Field: Towards a Favorable Source for NBI System

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The positive or negative ion sources which form the primary component of neutral beam injection (NBI) in controlled nuclear fusion using magnetic confinement have to meet simultaneously several demanding requirement like to produce high current, high energy and low-emmitance stable H- ion sources and to confine them etc [1]. It is very well known that multi cusp magnetic fields can confine high dense plasmas [2] and thus the application of multi cusp magnetic field geometry has received a great attention in a wide range of systems viz. ion sources, plasma facing material and diagnostic testing in fusion reactors [3-4]. Apart from the fusion studies cusp magnetic fields are rigorously used in plasma etching reactors, ion thrusters, Magnetrons and also in plasma wave study experiments [2, 6-7].
A versatile Multi line cusp plasma device of axial length 1.2m and diameter 40cm has been developed in house, by using six electromagnets placed over the periphery of a cylindrical chamber. The magnetic field lines are profiled by using a core material Vacoflux-50. In this paper, by performing simulations in FEMM (Field Element Method Magnetic) [8] tools, we first show how to profile the magnetic field lines as per the requirements. Then we characterize the filamentary Argon plasma in this variable Multi line cusp magnetic field and illustrate the effect of variable magnetic field on mean plasma density, particle confinement time, leak width and size of field free region by changing the magnet current.

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Author: Mr PATEL, amitkumar (institute for plasma research)

Co-authors: Ms SHARMA, Meenakshee (Institute for Plasma Research); Dr GANESH, Rajaraman (Institute for Plasma Researh, Bhat Village, Gandhinagar 382428, Gujarat, INDIA); Dr NARAYANAN, Ramasubramanian (Institute for Plasma Research, Gandhinagar); Prof. CHATTOPADHYAY, prabal (institute for plasma research)

Presenter: Mr PATEL, amitkumar (institute for plasma research)

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