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First Measurments of Electron Density Profile on HSX

C. Deng, D.L. Brower, W.X. Ding

Electrical Engineering Department
University of California, Los Angeles

A.F. Almagri, D.T. Anderson, F.S.B. Anderson, S.P. Gerhardt,
P. Probert, J. Radder, J.N. Talmadge

HSX Plasma Laboratory
University of Wisconsin, Madison

A multichannel millimeter-wave interferometer system is installed and operating on the quasi-helical stellarator HSX. The interferometer views the plasma cross section along 5 adjacent chords with 3 cm spacing. With this arrangement, coverage spans from the low-field side plasma scrape-off layer to well past the magnetic axis. A solid-state source operating at 288 GHz is utilized and works well for the plasma densities seen on HSX. At this frequency refraction is manageable but requires correction when doing inversions. The interferometer has sensitivity $n_e dl = 8 \times 10^{11}$ cm^{-2}. This system will be upgraded to include 9 channels with 1.5 cm spacing during summer, 2001. Currently, the phase information is being evaluated using analog electronics with bandwidth <10 kHz providing real-time line-integrated output. A digital phase comparator scheme has also been implemented whereby the measured waveforms are directly digitized and the phase evaluated using a software-based algorithm. This approach increases the time response up to the modulation frequency of 750 kHz. Improved time response permits measurement of high-frequency density fluctuations.

First results from the HSX stellarator with 2nd harmonic ECH at 28 GHz, using the 5 chord interferometer, indicate that the density profile is quite peaked for both quasi-helically symmetric (QHS) plasmas and those where the quasisymmetry is broken (mirror mode). However, for densities $n_e = 3 \times 10^{11}$ cm^{-3}, the profile for the QHS plasma (high stored energy) is narrower when compared to the mirror mode (low stored energy). For plasmas with a deeper mirror mode, the density profile broadens significantly. Profile changes with resonant heating location are not significant. Density profile variation with plasma configuration and resonant heating location using the 9 channel interferometer will be reported on at the meeting. For high density HSX plasmas, $n_e \geq 3 \times 10^{12}$ cm^{-3}, coherent oscillations are observed in the line-integrated density traces which are out of phase across the magnetic axis. These oscillations are observed at frequencies of 1-2 kHz and result in a periodic displacement of the density profile. The characteristics of these oscillations will be explored and reported. **Supported by USDOE under grant DE-FG03-01ER-54615, Task III.*

Transport/Diagnostics

Poster Presentation