DPP05-2005-000840

Abstract for an Invited Paper
for the DPP05 Meeting of
the American Physical Society

Current Drive by Electron Bernstein Waves[1]

ABHAY K. RAM[2], Plasma Science and Fusion Center, M.I.T.

In many conventional tokamaks, waves in the electron cyclotron range of frequencies (ECRF), the X mode or the O mode, have been successfully used for generating plasma current and for modifying the current profile. In the same range of frequencies the electron Bernstein waves (EBW) offer an intriguing alternative for generating plasma currents. EBWs are particularly suited for the high-β plasmas encountered in spherical tori (ST) like NSTX. Unlike the X and O modes, EBWs have no density limits and are strongly absorbed by electrons in the Doppler-shifted vicinity of harmonics of the electron cyclotron resonance. We have been studying two different means of driving plasma currents by EBWs – the Ohkawa scheme [1] and the Fisch-Boozer scheme [2]. The two schemes together provide enough flexibility to generate supplemental current for steady state operation and for modifying the current profile. We discuss the basic physics of the two schemes as applied to high-β operations in NSTX. More detailed insight is obtained from computations using the code DKE which solves the drift kinetic equation with Fokker-Planck collision operator and quasilinear RF diffusion operator. We find that EBWs damp on the tail of the electron distribution function. Consequently, the EBW current drive efficiency is higher than for the X or O modes. Additionally, the core plasma is better suited for the Fisch-Boozer scheme while the Ohkawa scheme works best on the outboard plasma side. In NSTX, current can be driven in the core and in the outboard plasma region using a single source frequency corresponding to the fundamental electron cyclotron resonance in the center. These studies extend to traditional ECRF current drive and could have applications in conventional tokamaks including ITER. [1] T. Ohkawa, General Atomic Technical Report GA-A13847 (1976); and J. Decker, in *AIP Conf. Proc. 694*, New York (2003), p. 447. [2] N. J. Fisch and A. H. Boozer, *Phys. Rev. Lett.* **45**, 720 (1980).

[1]Supported by DoE grants DE-FG02-91ER-54109 and DE-FG02-99ER-54521.

[2]In collaboration with Joan Decker and Yves Peysson (Cadarache).