Relativistic effects on EBW heating and current drive in TJ-II Stellarator

F. Castejón, A. Cappa, M. Terechshenko, A. Fernández-Curto, J. M. García-Regaña and L. Barrera.
Laboratorio Nacional de Fusión. Asociación Euratom/CIEMAT para Fusión.
28040, Madrid (Spain)

TJ-II is a middle sized Flexible Heliac in operation in Madrid whose plasmas are created and heated by two 53,2 GHz gyrotrons (second harmonic) delivering 300 kW each. One NB injector is used for second phase heating and a second one is being conditioned presently. The cut off density for the 2nd harmonic X mode, nc=1.7 x 10 19 m-3, is reached as soon as NBI is switched on and no more ECRH is got. Electron Bernstein Waves (EBW) are considerd both for having additional heating after NBI switch on and to perform kinetic studies at high density plasmas.

Previous works have shown that the most suitable scheme for EBW in TJ-II is the O-X-B1 that has acceptable efficiency heating for central densities above 1.2 x 10^{19} m^{-3} [1], and frequency heating of 28 GHz. A hardware system based on an evacuated corrugated waveguide with a steerable final mirror has been designed allowing us to accomplish central EBW heating [2].

Non relativistic ray tracing calculations were performed using the code TRUBA to estimate the EBW heating properties of such a scheme [3]. In this work, relativistic effects are included both in ray trajectory and absorption and compared with the non-relativistic ones. Preliminary results show that those effects are not negligible.

Current drive is calculated using the response function estimated using Langevin Equations [4]. The previous method, that was valid for $|N_{||}|<1$ and for the 1st Larmor radius order, has been modified to be adapted to EBWs. Any value of $N_{||}$ is now allowed and the estimates are valid for any value of the parameter $k_{\perp}\rho$, which is basic since $N_{\perp}$ can be very large in the EBW propagation and absorption.

---

[1] F. Castejón et al. Fusion Science and Technology 46 (2004) 327.
[2] A. Fernández. Fusion Science and Technology 46 (2004) 335
[3] M. Tereshchenko et al. EPS
[4] F. Castejón, C. Alejaldre and J. A. Coarasa. Physics of Plasmas 1 (1992)