

Ion orbits and ion confinement studies on ECRH plasmas in TJ-II stellarator

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It has been observed that the ion temperature profile of several ECR heated stellarator plasmas is almost flat and it is even possible to find energetic ions well outside last close magnetic surface. For instance, this feature has been observed in TJ-II Flexible Helic [1] and LHD Heliotron [2]. Of course, the heat diffusivity obtained for such ion temperature profiles is very high and one should consider the possibility that transport cannot be described by Fick's law. In a previous work, the neutral fluxes and corresponding energies were measured for ECR heated plasmas in TJ-II. The measurements were carried out by means of two charge-exchange neutral particle analysers for radial positions $r/a > 0,6$ and showed that the absolute fluxes of hot neutrals go down as the minor radius increases, but their mean energies remain roughly constant even outside the last closed magnetic surface [3].

The explanation that was given in [3] for such flat mean energy profile was that the ion orbits are wide enough to communicate distant parts of the plasma radius, therefore giving an effective flat ion temperature profile, for the low density plasmas considered in that experiment. Some recent calculations show that ion orbits are pretty wide in tokamaks [4], which makes feasible the former explanation. The size of the orbits is determined by the energy of the ions and they are heated mainly in the plasma core by collisions with hot **electrons**.

Ion trajectories with different energies, pitches and starting points have been estimated and compared with the experimental data presented in [3], paying attention to the ion velocity distribution. The dependence of ion orbits and, hence, of ion confinement on the energy is studied with the results of the calculations. In particular, it is possible to check the validity of the previous explanation for the detected energy spectra of the CX-neutrals escaping from the plasma and, especially, for those hot CX-neutrals detected well outside last plasma surface.

References

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