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Parametric scaling studies of the energy confinement time for ECR heated TJ-II plasmas

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TJ-II stellarator (R = 1.5 m, a < 0.22 m, $B_0 \leq 1.2$ T) is a well suited device for experimental studies on rotational transform dependencies due to its wide range of available iota ($0.96 \leq$ iota $(0) \leq 2.5$). This flexibility is achieved by changing the currents of the two central coils, circular and helical [1]

So far, ECRH plasmas have been produced (53.2 GHz, $P \leq 0.6$ MW), with scans in magnetic configuration (È (a) from 1.3 to 2.2) and plasma volume (0.6 to 1.1 m^3). Experimental values of the plasma energy confinement time, τ_E, (up to 4 ms) have been obtained, so far, from the measured plasma energy content given by diamagnetic loops in quasi-steady state. A systematic survey of the kinetic τ_E values (obtained from radial density and temperature profiles) has also just started.

The diamagnetic global energy confinement time is well fitted by the LHD scaling but is lower than the ISS95 value [2]. Multi-machine scaling laws like these, aim to reproduce average trends, rather than discuss in detail physics aspects. In particular, both scaling laws predict a strong dependence on the minor plasma radius, a, and a weaker negative dependence on absorbed power, P. TJ-II edge diagnostics indicate that density and temperature are low in a zone that extends well inwards from the calculated last closed flux surface [3, 4]. This fact suggests the important role that the fast particles trapped in the complex TJ-II magnetic ripple structure might play [5]. They could constitute a direct energy losses channel. Obviously, the nominal a and P values used in the comparison of TJ-II τ_E do not take into account this relevant issue.

The iota dependence of τ_E seems to be stronger than that indicated by the ISS95 scaling. However, due to the strong coupling of volume and iota in TJ-II plasmas, further careful analysis must be performed before a conclusive statement can be made.

Very recently, a new confinement regime has been found in TJ-II with the induction of toroidal plasma current by means of the OH transformer [6]. It looks promising: with a few kA of negative plasma current, plasma stored energy can be increased up to a factor 2 for several configurations.

[1] A. López-Fraguas et al "Magnetic surface mapping in TJ-II heliac", in this workshop.
[2] U. Stroth et al., Nuclear Fusion, **36**, 1063 (1996)
[3] F. Tabarés et al., Plasma Phys. Control. Fusion (2001)
[4] T. Estrada et al., Density Profile Measurements by AM Reflectometry in TJ-II, Plasma Phys. Control. Fusion (2001)
[5] V. Tribaldos, Phys. Plasmas, **8** 1229 (2001)
[6] J. Romero, "Confinement control with induced toroidal current in the flexible Heliac TJ-II", in this workshop

Topic 4, Poster preferred

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