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Improved confinement regime in TJ-II Stellarator

I. García-Cortés, F. L. Tabarés, E. de la Luna, V. Tribaldos, E. Ascasíbar, R. Balbín, B. Brañas, T. Estrada, J. Herranz, F. Medina, M. Ochando, I. Pastor, J. Romero, D. Tafalla and TJ-II Team

Laboratorio Nacional de Fusión, Euratom-Ciemat, 28040 Madrid, Spain

Spontaneous transition to an enhanced particle and energy confinement regime has been recently observed in TJ-II Stellarator plasmas in some magnetic configurations. The energy content of the plasma shows an enhancement up to a factor 1.5 in the improved phase. The transition is achieved with 300 kW electron cyclotron resonance heating (ECRH) at low line averaged density ($0.7-0.8 \cdot 10^{19} \text{ m}^{-3}$) plasmas. The TJ-II plasmas are limited by the vacuum chamber which acts as a helical limiter. The gas puffing control, and hence the fuelling rate, seems to be a critical parameter in the achievement of the transition.

TJ-II typical plasmas are characterized by peaked electron temperature and flat density profiles (measured with Thomson Scattering and reflectometry). After the transition, the electron temperature profile becomes broader, showing the maximum increase in temperature about mid-radius and the density rises in the whole plasma volume. Meanwhile, the density near the limiter decreases. The H α signal also falls after the transition. The charge-exchange flux increases and its spectra indicate a rise in the mean ion (particle) energy after the transition. The Soft X-Rays shows a significant increase, especially in the larger pressure gradient region. The magnetic fluctuations, present before the transition and attributed to ELM-like phenomena, disappear in the enhanced confinement phase. The electrostatic turbulence, measured with Langmuir probes at the limiter position, is also reduced.

The improved state in TJ-II resembles those of the H-mode in tokamaks and W7-AS stellarator. The low density and the dependence with the fuelling rate points to atomic physic processes as the key parameter governing the transition in TJ-II stellarator. More work is being done in order to clarify this point.

Topic 2

Poster YES

E-mail address: Isabel.GarciaCortes@ciemat.es