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EX/P3-06: Suprathermal Ion Studies in ECRH and NBI Phases of the TJ-II Stellarator

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In TJ-II we have been able to detect suprathermal ions by passive spectroscopy in the plasma interior and by means of a luminescent probe for those escaping from the confinement region. We have measured their temporal evolution in both cases and with several vision cords in the first system. The luminescent probe has very high sensitivity and it was operated in a height pulse analysis regime. Its data was processed by an ad hoc digital pulse algorithm which has made possible to determine its ion energy distribution function in ECRH and NBI regimes. We have been studying, not only with protons but also in some selected impurity ions, temperatures and population of these suprathermal ions as well as its flow and rotation velocity when the available photon statistics permit it. We have attained several conclusions: a) the typical temperatures of the suprathermal ions is a factor 4 higher than the thermal one in the case of protons; b) in many cases the ion energy content of this suprathermal component is comparable to the energy content of the thermal one with relevant implications for the TJ-II energy balance; c) the suprathermal rotation measured in a poloidal plane can be a factor between 2.5 and 5 higher than the rotation of the thermal component.
All these results represent a true challenge for theories capable of explaining its generation, like in the case of ECRH phase, and its rotation: suprathermal particles constitute an excellent probe of physical mechanisms inside a high temperature plasma complementary of thermal ones. Its time behavior in transient situations has made possible to realize that the confinement time is lower as the energy of the selected population is higher, and this fact suggests that the deconfinement mechanisms of suprathermal ions cannot be explained solely by Coulomb collisions, but rather well intrinsic properties of the TJ-II magnetic configuration, like magnetic ripple, magnetic configuration, etc., must be invoked even to understand qualitatively this behavior within the stellarator field.

Country or International Organization of Primary Author

SPAIN

Author: Mr ZURRO, Bernardo (Spain)

Co-authors: Dr BACIERO, Alfonso (Laboratorio Nacional de Fusion, Asociacion EURATOM-CIEMAT); Dr CAPPA, Alvaro (Laboratorio Nacional de Fusion, Asociacion EURATOM-CIEMAT); Dr LINIERS, Macarena (Laboratorio Nacional de Fusion, Asociacion EURATOM-CIEMAT)

Presenter: Mr ZURRO, Bernardo (Spain)

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