Ion and electron temperature and electron density profiles comparisons in the TJ-II stellarator with Li coated wall.

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The flexible heliac TJ-II is a medium size stellarator (R=1.5 m a≤0.2 m B< 1T) which can vary its rotational transform profile over a wide range. In TJ-II, the principal ion temperature is routinely measured along a discharge using two Acord-12 neutral particle analyzers (CX-NPA) whose viewing line-of-sights are symmetric about the plasma centre ($\rho \cong \pm 0.1$) with 1 ms of temporal resolution. In addition, a charge exchange recombination spectroscopy (CXRS) system is used to obtain fully-striped impurity ion temperature profiles covering ρ = 0.2 to 0.9. Finally, a Thomson Scattering system provides electron temperature and density radial profiles once per plasma discharge.

The recent coming on line of two neutral beam injectors (NBI) heating systems in TJ-II (H^o, ≤33 keV, ≤1 MW) with direct heating of the plasma ions has made the ion channel more important than in previous electron cyclotron resonance (ECR) heated plasmas. Now, since ion temperature profiles are an important element when performing transport studies, and given the restrictions of the CX-NPA diagnostic (two radial measurements per discharge), such data has been attained by changing the position of the CX-NPA diagnostic in a series of reproducible discharges.

In this work we compare electron temperature and density profiles obtained by the Thomson Scattering diagnostic to those ion and impurity temperature profiles obtained by the CX-NPA and CXRS in order to deduce a general rule for estimating ion temperature profiles when the central value is known. In ECR heated plasmas the ion profile shape will follow that of the electron density as the source of heating ions is collisions with electrons. In NBI heated plasmas a fraction of the injected power (~30%) heats directly the ions, thereby making the ion temperature profile less dependent on the electron density profile and more similar to that of the electron temperature as both species are heated at the same radial position.