Reconstruction of Hydrogenic Ion Temperature Profiles on TCV

Ch. Schlatter, B. P. Duval, A. N. Karpushov

Ecole Polytechnique Fédérale de Lausanne (EPFL),

Centre de Recherches en Physique des Plasmas, CH-1015 Lausanne, Switzerland

Knowledge of plasma fuel neutral profiles is indispensable for particle transport studies in tokamaks. On TCV, a combination of experiment and simulation is used to recover the profiles. For this purpose, the absolute Charge-eXchange (CX) particle emission energy spectrum for hydrogen (H) and deuterium (D) of the Compact Neutral Particle Analyser (CNPA) in ohmic plasma discharges in limiter configuration has been calculated based on simulations using the kinetic transport code KN1D [1], [2]. The CNPA is installed at the midplane of TCV, with a horizontal line of sight perpendicular to the magnetic axis. Mass separation permits synchronous measurements of H and D over a wide range of energies (500 .. $50 \cdot 10^3$ eV) [3].

KN1D requires accurate input profiles for electron density, electron temperature and ion temperature together with the neutral particle pressure at the wall chamber. $T_e(r)$ and $n_e(r)$ are obtained from Thomson scattering measurements with the density profile normalised using a Far InfraRed interferometer. The ion (carbon) temperature profile is obtained from Charge eXchange Recombination Spectroscopy (CXRS). The fitted profiles are mapped to the chord of the CNPA. From the simulated hydrogenic neutral profiles, the radial neutral birth and reabsorption rate is determined and the remaining contribution to the escaping flux towards the NPA is calculated. The neutral edge pressure is iterated in the code to achieve agreement with the experimental CNPA CX-spectrum. Agreement is better than 10% for CNPA channels with satisfactory statistics.

Pseudo chord measurements of identical plasma configurations, displaced along the vertical coordinate, were used to probe different regions of the plasma cross section. The knowledge of the birth region of the detected neutrals was used to build a hydrogen temperature profile based on the inferred CNPA effective temperature T_{CNPA}. The resulting profile is in agreement with the CXRS carbon ion temperature for ρ = 0.3 .. 0.9 assuming an accuracy of 10% of T_{CNPA}.

References

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[2] A. N. Karpushov et al., 30^{th} EPS Conf. PCCF, London, P-2.152, ECA **28G** (2004)

[3] F. V. Chernyshev et al., Inst. Exp. Tech., **47** (2004) 214.