Main ion temperature and rotation measurements at the plasma edge of ASDEX Upgrade and comparison to neoclassical theory

P. Cano-Megias[1,2], E. Viezzer[2,3], A. Jansen van Vuuren[2,3], R. McDermott[4], D. Cruz-Zabala[2,3], M. Cavedon[4], R. Dux[4], U. Plank[4], R. Chacartegui-Ramirez[1] and the ASDEX Upgrade team[4*]

[1] Dpt. of Energy Engineering, University of Seville, Camino de los Descubrimientos, s/n. 41092, Seville, Spain
[2] Centro Nacional de Aceleradores, C/ Tomás Alva Edison, 7, 41092, Seville, Spain
[3] Dpt. of Atomic, Molecular and Nuclear Physics, University of Seville, Avda. Reina Mercedes, 41012 Seville, Spain
[4] Max Planck Institute for Plasma Physics, Boltzmannstrasse. 2, 85748 Garching, Germany
[*]See the author list of H. Meyer et al., Nuclear Fusion, 59, 112014, (2019)

The diagnosis of plasma properties is fundamental for understanding the particle, energy and momentum transport in magnetic confinement devices, which would ultimately allow its optimization. Typically, ion impurity properties are measured using the Charge Exchange Recombination Spectroscopy (CXRS) technique [1]. The direct measurement of the main ion (here, deuterium) temperature, density and rotation profiles is in comparison more challenging, and has been rarely assessed for many years. Advances in the diagnostic and analysis techniques have made these measurements available in the pedestal region [2–4], which is a critical region for the overall plasma performance and confinement.

A new optical head with 30 lines of sight (LOS) has been installed at the ASDEX Upgrade tokamak, which allows for simultaneous measurements of main ion and impurity properties in the edge transport barrier. A subset of these LOS is connected to the edge FIDA spectrometer, providing the main ion measurements with a temporal resolution of 1.5 ms [5]. A forward model, based on FIDASIM [6], has been developed for the interpretation of the main ion spectra [4]. The corrections due to the Zeeman effect are also considered for the evaluation of impurity and main ion spectra.

In this work, main ion and impurity measurements at different collisionalities and levels of torque input are presented. The experimental study is completed with a comparison of the main ion profiles to neoclassical predictions using the NEOART code [7].

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