**First measurements of an imaging heavy ion beam probe at the ASDEX Upgrade tokamak**

J.Galdon-Quiroga1, G.Birkenmeier2,3, P.Oyola1, H.Lindl2, A.Rodriguez-Gonzalez1, G.Anda4, M.Garcia-Munoz1, A.Herrmann2, J.Kalis2, K.Kaunert2, T.Lunt2, D.Refy4, V.Rohde2, M.Sochor2, B.Tal2, M.Teschke2, E.Viezzer1, E.Wolfrum2, S.Zoletnik4 and the ASDEX Upgrade Team

*1 Department of Atomic, Molecular and Nuclear Physics, University of Seville, Seville, Spain*

*2 Max Planck Institute for Plasma Physics, Garching, Germany*

*3 Physics Department E28, Technical University of Munich, Garching, Germany*

*4Centre for Energy Research, Budapest, Hungary*

The imaging heavy ion beam probe (i-HIBP) diagnostic [1-3] has been successfully commissioned at ASDEX Upgrade. The i-HIBP injects a primary neutral beam into the plasma, where it is ionized leading to a fan of secondary (charged) beams. These are deflected by the magnetic field of the tokamak and collected by a scintillator detector, generating a strike-line light pattern which encodes information on the density, electrostatic potential and magnetic field of the plasma edge. The first measurements have been made, demonstrating the proof-of-principle of this diagnostic technique. A primary beam of Rb has been used, opposed to the 133Cs beam used in the prior campaign, with energies ranging between 35-70 keV and extracted currents up to 1.2 mA. The neutralization efficiency is up to 80% and the typical beam diameter is of the order of 5 mm, without using any additional collimator. The first signals have been obtained in experiments covering a wide range of parameter space, with plasma currents (Ip) between 0.2-0.8 MA and on-axis toroidal magnetic field (Bt) between 1.9-2.7 T. Low densities appear to be critical for the performance of the diagnostic, as signals are typically observed only when the line integrated density is below in the central interferometer chord, depending on the plasma shape. The toroidal orientation () of the beam is found to be critical. Signals have been obtained only in the range of . It is observed that stray light from the plasma, as that provoked by edge localized modes, can mask the beam signal in the scintillator detector. To alleviate this problem, a filter centered at the scintillator wavelength emission (500-580 nm) is included in the optical setup. The signal-to-noise ratio is observed to degrade during the campaign due to the impact of neutron fluence on the transmissivity of the image guide. This is partially healed by exposing the image guide to heating cycles up to 220 ºC. The typical pattern observed in the scintillator detector consists of a strike-line of 30 mm width. The strike-line moves as expected when either Bt or Ip are ramped, as well as when the beam is deflected. Additionally, clear dynamics in the intensity of the strike-line are often observed, which might be linked to filamentary activity in the plasma edge. Finally, simulations have been carried out to investigate the sensitivity of the expected signals to plasma density and temperature. The results are in qualitative agreement with the experimental observations, suggesting that the diagnostic is almost insensitive to fluctuations in the temperature profile, while the signal level is highly determined by the density profile due to the beam attenuation.

*[1] J.Galdon-Quiroga et al., JINST* ***12*** *C08023 (2017)*

*[2] G.Birkenmeier et al., JINST* ***14*** *C10030 (2019)*

*[3] G.Birkenmeier et al., FED* ***168*** *112644 (2021)*