First simultaneous observation of co- and counter-current fast ion losses in the ASDEX Upgrade tokamak

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Understanding the mechanisms responsible for fast ion losses is critical for the success of future magnetically confined fusion power plants. Towards this goal, a double pinhole collimator has been developed for a fast ion loss detector (FILD) [1] in the ASDEX Upgrade tokamak. This collimator features a mirrored design of the FILD geometry. FILDSIM [2] simulations were applied to optimize the geometry of the collimator diagnostic [3]. This new FILD open its operational window to simultaneous measurements of co- and counter- current fast ions generated by NBI and ICRH, enabling improving our understanding of their interplay with the objective of ensuring their confinement.

The commissioning of this new probe is carried out in H-mode plasmas with an on-axis magnetic field of B_0 = -2.5 T, and a plasma current of I_p = 0.7 MA. With 4 MW of ICRH in H minority heating, co- and counter- current fast ion losses are observed with the same energy and trapped pitch angles ($|v_{II}/v| < 0.2$). Once a single NBI source of 2.5 MW is applied, both ICRH and NBI losses are identified simultaneously on the FILD signals. The highest fast ion fluxes are measured at pitch ($v_{II}/v = 0.5$) and 93 keV, corresponding to the main injection energy of a radial NBI source. Once the two NBI sources (5 MW) are applied, the losses induced by ICRH disappear, due to the change in the ion distribution function.

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