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Plasma Flow, Turbulence and Magnetic Islands in TJ-II

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The effect of magnetic islands on plasma flow and turbulence is experimentally investigated in ohmically induced magnetic configuration scans at TJ-II. This operational mode allows sweeping the radial position of a low order rational surface in a controlled way, what reveals effects that are difficult to notice in scans performed on a shot to shot basis. The main diagnostic used in the present work is a Doppler Reflectometer (DR). A characteristic signature of the n/m = 3/2 magnetic island as it crosses the DR measurement position is clearly detected, showing a modulation in the perpendicular flow that changes twice its direction. This modulation allows the calculation of the radial propagation velocity of the magnetic island as well as an estimation of the island width, being close to 3 cm. As the magnetic island crosses the DR measurement position two peaks appear in the DR signals spectra. The double peak reflects the vortex around the magnetic island O-point. The consistency of the results is confirmed in five different magnetic configurations with slightly different rotational transform in combination with two different OH current intensities. TJ-II results resemble those found in LHD where the plasma flow is measured along the 1/1 magnetic island. Fluctuations of the perpendicular flow and density have been also measured along the 3/2 magnetic island. An increase in the low frequency flow oscillations is measured at the magnetic island boundaries together with a reduction in the density fluctuation level; the later being more pronounced at the inner island boundary. These observations could explain the link between magnetic islands and transport barriers observed in a number of fusion devices like TJ-II. Further studies have been performed to characterize the radial correlation properties of the density fluctuations in the presence of magnetic islands, both numerically and experimentally in TJ-II. The analysis of the density fluctuations simulated using a MHD code shows that in the presence of a magnetic island the coherence profile shows a characteristic asymmetry. This asymmetry is also detected by the Doppler reflectometer synthetic diagnostic. Experimentally, asymmetric coherence profiles have been eventually found which can be interpreted to be due to magnetic islands.

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