Magnetic islands rotation in JET

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The propagation of magnetic islands is relevant for tearing mode stability and for diagnostic applications. Several studies [1-3] have found that the island frequency (ω) is proportional to the toroidal angular velocity of the plasma ions (Ωi) at the island location and to the toroidal periodicity number, ω = n Ωi. In order to check this observation, the frequency of islands associated with the q = 2 surface was systematically compared with local plasma rotation as inferred from Charge Exchange data and MSE-conditioned q-profiles (Fig. 1). The observation was confirmed for a wide range of island widths (w), spanning to low values w << ρs/Ls/Ln (ρs, Ls and Ln being the ion sound gyroradius, shear and density characteristic lengths respectively), for which propagation should follow the E×B velocity rather than the fluid one [4]. In order to resolve this apparent contradiction, the analytic theory in [4] was reconsidered using improved expressions of neoclassical flow damping as given in [5]. It turned out that poloidal flow damping imposes a link between island phase velocity and parallel ion flow inside the island, Vp = Vπ ε/q, which is equivalent ω = n Ωi. In other words, the latter is founded on a link between island frequency and toroidal plasma rotation that holds in a very wide range of parameters, and not on the equality between island phase velocity and perpendicular plasma velocity, which holds for very large islands only.

The paper will present the systematic comparison between island frequency and plasma rotation; the theoretical justification of the results and possible diagnostic applications will be discussed.


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