Role of MHD activity triggered by fast ions in tungsten transport in JET hybrid discharges

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MHD activity is known to be acting on impurity transport and in particular the sawtooth crash is found to flush out the tungsten accumulated inside the q=1 surface. On JET, when ICRH power is added to a NBI-heated H-mode discharge, the resulting increase of fast ion pressure gradient inside the q=1 surface may trigger the fishbone instability. When a regime with large amplitude and frequency span of the fishbones is achieved, the tungsten profile peaking decreases strongly and flat profiles can be observed before the sawtooth crash.

In the hybrid scenario (B_t=2.8-3.2T, I_p=2.0-2.4MA, $P_{NBI+ICRH}$=25-32MW) with on-axis ICRH power exceeding 3MW, fishbones are also triggered in 40% of the 39 analysed pulses. The fishbone structure (amplitude, frequency span, cycling time) varies during the high power phase and the mode may alternate with the continuous (1,1) internal kink mode. In that latter case, the tungsten peaking increases strongly with the continuous mode. On average for this data base, it is found that the tungsten peaking of the pulses with fishbone activity is lower than those with no fishbones and is compatible with operation at high normalized beta (β_N>2) for more than 4 s. In fishbone-free discharges, the tungsten transport is found to be dominated by neo-classical transport unless tearing modes, mainly with toroidal number n=2 or n=3, are triggered and strong tungsten peaking occurs in the plasma core.

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