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Interplay between magnetic topology, density fluctuations and confinement in high- β Wendelstein 7-AS plasmas

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Previous high- β experiments in the Wendelstein 7-AS (W7-AS) stellarator have shown that it was not possible to reach the stability β -limit; the discharges remained either power or radiation limited. To ameliorate this situation, the W7-AS neutral beam system has been reconfigured from balanced to unbalanced injection, totalling 4 MW of injected power. Experiments were performed at 1.25 T with full beam power to ascertain the effects of the increased β -value. The present paper contains an analysis of the behaviour of density fluctuations in these plasmas.

The density fluctuations were measured with the CO₂ laser based LOcalised TURbulence Scattering (LOTUS) diagnostic in two toroidally displaced vertical measurement volumes. The selected wavenumber k_{\perp} was 20 cm⁻¹. Figure 1 shows measurements from two plasmas (in separated columns) which were identical apart from the fact that a net current was driven by an ohmic transformer in one of the shots (to the right), thereby increasing the ι -value of the plasma and decreasing the stored energy. Positive/negative frequencies on the crosspower plots are due to fluctuations travelling outward/inward parallel to the major radius. Changes are observed for both frequency signs: Fluctuations having positive frequencies spin down and increase at low frequencies, while the negative frequency component reduces strongly. The possible explanations for this behaviour will be discussed.

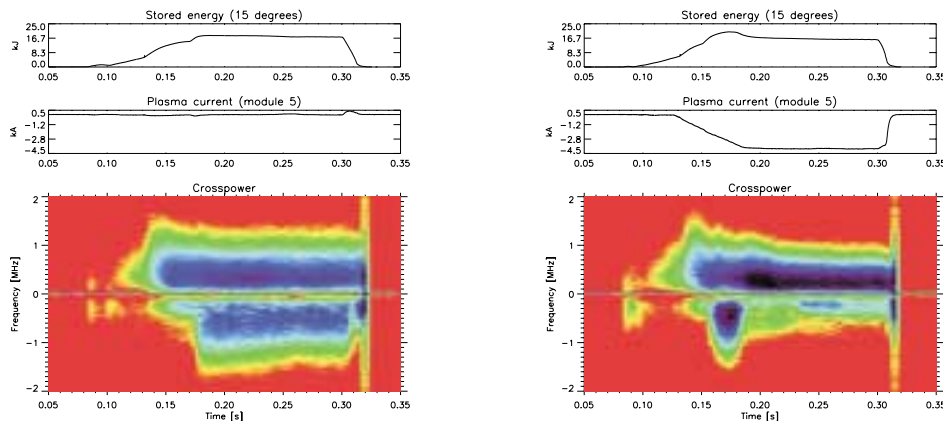


Figure 1: (Colour) From top to bottom: Plasma energy, plasma current and crosspower (identical logarithmic scale) of density fluctuations in the two volumes. Left: A plasma with zero net current (51262), right: A plasma with -4 kA net current (51266).