

TEMPORAL SEPARATION OF TURBULENT TIME SERIES: MEASUREMENTS AND SIMULATIONS

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Density fluctuations were measured with the CO₂ laser based LOCALISED TURBULENCE SCATTERING (LOTUS) diagnostic [1] in the Wendelstein 7-AS (W7-AS) stellarator. The discharge analysed in this paper exhibited three confinement states: First L-mode, thereafter dithering H-mode and finally ELM-free H-mode (H*). We measured density fluctuations for a perpendicular wavenumber k_{\perp} of 14 cm⁻¹ in two toroidally displaced vertical measurement volumes passing through the plasma center. The purpose of the work presented is three-fold:

1. Verify that the basic procedure [2] can be applied to W7-AS plasmas
2. Use simulations to establish criteria for the applicability of the technique
3. Investigate the differences in the signals between L- and H-modes

Basically, we detect a complex signal S from each volume and can construct the phase derivative with respect to time

$$S = X + iY = A \times e^{i\Phi} \quad \partial_t \Phi = [X\partial_t Y - Y\partial_t X]/A^2, \quad (1)$$

whose sign determines the direction of the poloidal propagation of the fluctuations. To illustrate point 3 above, figure 1 shows the amplitude of the measured density fluctuation signal (top) and the corresponding phase derivative (bottom) for three 100 μ s time windows.

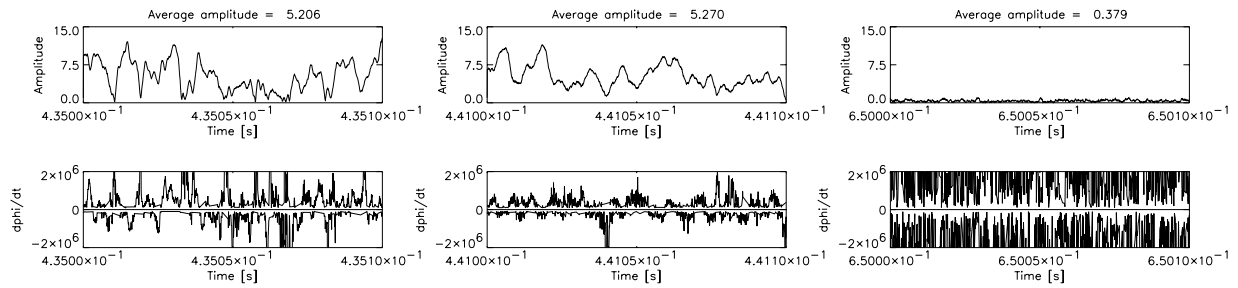


Figure 1: Amplitude (top) and phase derivative (bottom) of the signal from volume 1. Left: L-mode, center: H-mode and right: Background. Data shown was bandpass filtered [1 kHz, 1 MHz].

References

- [1] Saffman M et al., Rev. Sci. Instrum. **72** (2001) 2579
- [2] Antar G et al., Plasma Phys. Control. Fusion **41** (1999) 733