Investigation of GAM zonal flows in the TEXTOR tokamak

I. Shesterikov[1], Y. Xu[1], M. Vergote[1], M. Van Schoor[1], G. Van Oost[2] and the TEXTOR team

[1] *Laboratory for Plasma Physics, Ecole Royale Militaire/Koninklijke Militaire School, Brussels, Belgium*

[2] *Department of Applied Physics, Ghent University, B-9000 Gent, Belgium*

The floating potential and density fluctuations have been measured by two sets of Langmuir probe arrays installed at two toroidally opposite positions at the edge of TEXTOR.

From the frequency spectra of floating potential fluctuations a noticeable peak around 10 kHz is identified as geodesic acoustic mode (GAM) zonal flows. Several properties of this mode have been confirmed: (i) toroidal and poloidal symmetry (m=n=0) and radially finite wavelength; (ii) GAM frequency consistent with dispersion relation, i. e., $f_{GAM} \sim C_S / R$, where C_S and R are the ion sound speed and major radius, respectively; (iii) GAM is nonlinearly coupled with background turbulence .

The bicoherence analysis is a main indicator of the three-wave interactions of background turbulence and GAMs. Auto-bicoherence analysis of the floating potential fluctuations shows a significant level of nonlinear interaction concentrated at the GAM frequency of ~ 10 kHz. The noticeable peak of GAM oscillations appears also in summed bicoherence. Cross-bicoherence between potential and density fluctuations has also been observed around the GAM frequency. The next tool to analyse the nonlinear interaction between the GAM and background turbulence is the envelope analysis technique, which is defined by the Hilbert transform of ambient turbulence. The results indicate that the envelope of high-frequency fluctuations is modulated by frequencies close to that of the GAM.

The probability density function (PDF) of the temporal interval of intermittent events in the turbulence-driven particle flux has been calculated. The PDF shows clear peaks of the intermittent flux bursts around the GAM frequency, revealing that the turbulent flux is modulated by GAM zonal flows.

In addition, the influence of the Dynamic Ergodic Divertor (DED) on the GAM zonal flows has also been studied at TEXTOR. With DED, it is found that both the GAM zonal flow amplitudes and the nonlinear coupling of GAM with ambient turbulence are substantially reduced, suggesting a significant impact of magnetic perturbations on zonal flow structures.