# Shrinking of resonant manifold under flow shear at the stellarator TJ-K

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Since in magnetically confined fusion plasmas the evolution of transport barriers at the transition from the low to high confinement regime is accompanied by $E \times B$ shear flows, their interrelation with transport producing drift-wave (DW) turbulence has attracted much interest. In the Hasegawa-Mima model the redistribution of energy in DW turbulence is described by quadratically non-linear three-wave interactions [1], which are limited by resonance conditions in wavenumber and frequency domain according to the DW dispersion relation. The set of coupling modes can be understood as resonant manifold [2]. Gürcan et al. showed theoretically that in a sheared flow field the resonant manifold, among which potential structures associated with zonal flows, are persistent coupling partners, shrinks in time [3]. In the present work, the phenomenon of manifold shrinking is addressed experimentally at the stellarator TJ-K.

To this end, the DW dominated turbulence in TJ-K plasmas is measured simultaneously by an array consisting of 128 Langmuir probes, with 32 tips aligned to each of four neighboring fluxsurfaces within a poloidal cross-section. Frequency-wavenumber bispectral analysis of potential fluctuations is carried out, temporally triggered to the occurrence of large amplitude zonal (poloidally averaged) potential events. This way, the analysis is constricted to coupling drift modes being subject to the DW dispersion relation. The time dependence of the frequency decomposition for conditional analyses is maintained by using a wavelet decomposition. This allows to temporally correlate the change in the behavior of poloidal mode coupling with naturally occurring zonal flows.

The bispectrum essentially represents the coupling manifolds, where an effective mode number is defined to measure the extent. When a shear flow persists, i.e. during the occurrence of the ZF, the effective mode number decreases. This is considered as the shrinking of the manifold. A shrinking of the manifold forces the DWs to couple into lower wavenumber modes an thus favoring large scale structures as described by the straining out process of turbulent vortices.

## References

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