Interaction of GAM and broadband turbulence in plasma of t-10 tokamak[[1]](#endnote-1)\*)

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Geodesic acoustic modes – high frequency counterpart of zonal flows – are considered to be a possible mechanism of the plasma turbulence self-regulation in toroidal plasmas [1]. Study of structure of GUM and its interaction with broadband turbulence is impotant to understand physical mechanism of abnormal energy and particles transport [2]. Recent studies have shown that GAM consists of three frequency peaks: main peak an two satellites: low-frequensy and high frequensy [3]. The present research is focused on studying interaction of GAM and broadband turbulence using bicoherent analysis of data, received from heavy ion beam probe. Statistically significant value of cross-bicoherence quadric coefficient

Figure 1 – Cross-bicoherence $b\_{\left(φ, I\_{tot}, I\_{tot}\right)}^{2}(f\_{1}, f\_{2})$

 $b\_{x,y,z}^{2}\left(f\_{1}, f\_{2}\right)= \frac{|\left〈Φ\_{x}\left(f\_{1}\right)Φ\_{y}\left(f\_{2}\right)Φ\_{z}^{\*}\left(f\_{1}+f\_{2}\right)\right〉|^{2}}{\left〈|Φ\_{x}\left(f\_{1}\right)Φ\_{y}\left(f\_{2}\right)|^{2}\right〉\left〈|Φ\_{z}\left(f\_{1}+f\_{2}\right)|^{2}\right〉}$ (1)

is a mark of three-wave interaction between oscillations on frequencies *f*1*,* *f*2and *f*1*+* *f*2. In the formula (1) $Φ\_{x}\left(f\right)$ means the Fourier transform of the signal x at the frequency f, $Φ\_{x}^{\*}\left(f\right)$ – its complex-conjugated quantity. Figure 1 shows cross-bicoherence quadric coefficient calculated for signals of plasma potential  and density (total current of the ion beam *I*tot) in the shot with low electron concentration (ne ≈ 0.7 m-3).

Current study states that each of three peaks of GAM interacts with broadband turbulence with three-wave mechanism. Interaction has fine structure: each of three peaks corresponds to individual diapason of frequencies *f*2. Main peak of GAM intereacts with wide frequency diapason of turbulence, LF-satellite interacts with high frequency part of it, HF-satellite – with low-frequensy part.

References

1. Fujisawa A. et al, Experimental progress on zonal flow physics in toroidal plasmas, Nuclear Fusion 2007 **47** (10) S718-S726
2. Melnikov A.V. et al. Study of interactions between GAMs and broadband turbulence in the T‑10 tokamak // Nuclear Fusion 2017, **57** (6) 115001.
3. Krokhalev O.D., Melnikov A.V., GAM in plasma of T-10 tokamak: frequency structure and interaction with broadband turbulence. To be published in «JETP Letters»
4. Melnikov A.V. et al. Heavy ion beam probing – diagnostics to study potential and turbulence in toroidal plasmas // Nuclear Fusion 2017 **57** (6) 072004.
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/Mu/ru/BL-Krohalev.docx) [↑](#endnote-ref-1)