SPIN-WAVE SELF-GENERATION IN FERRITE-FILM ACTIVE RING OSCILLATOR

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At present an increased research interest to study microwave stationary and chaotic signal generation in magnetic film active ring oscillators is evident [1,2]. It is well known that a transition from regular dynamical behavior of auto-oscillators to chaotic one takes place through a series of bifurcations [3].

This work reports for the first time a detailed experimental investigation of a transition from the quasi-periodic regime to chaotic regime of the spin-wave self-generation in ferrite-film active-ring oscillator. An unusual peculiarity of this transition was that it was caused not by a chain of modulation instabilities of the initially generated harmonics (like in [4,5]), but due to entering into oscillation the new amplified harmonics of the oscillator. A special attention was given to obtain and study the stationary regimes of self-generation appearing after the third bifurcation. In the experiments, we used a set-up similar to that reported in [5]. The experimental ring system consisted of a spin-wave delay line, a broadband microwave amplifier, and an adjustable attenuator for gain control. The ring signals were measured through a directional coupler, a fast oscilloscope, and a spectrum analyzer.

The experimental investigation was carried out with a gradual increase in the relative ring gain G. We observed three bifurcations in which new sidebands having incommensurate frequencies appeared. The nature of the new sidebands was a four-wave mixing of the initial sidebands with the new single harmonic entering into oscillation. Phase portraits of the observed waveforms were reconstructed on the basis of the measured oscilloscope traces by a method of time delay. Then the values of the fractal dimension D and minimal embedding dimension were calculated using the standard Grassberger-Procaccia method. The results show that D was equaled 1.00 after the first bifurcation that corresponded to the limit cycle in the phase space. After the second and the third bifurcations the values of D were 2.12 and 3.52, respectively. These values allow concluding that the corresponding attractors of the system have a fractal structure in the phase space. The work was supported by Ministry of Education and Science of Russian Federation (Project "Goszadanie").

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