Resonant nonlinear frequency multiplication in microscopic magnetic elements

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9.7 cm

Here we report on the experimental study of nonlinear frequency multiplication in Permalloy–film ellipses subjected to intense microwave magnetic field. The ellipses had lateral dimensions of 1 by 0.5 μm and the thickness of 10 nm and were prepared by e–beam lithography on top of 1–μm–wide microwave transmission line used for the excitation of magnetization dynamics. The experiments were performed by micro–focus Brillouin light scattering spectroscopy with the spatial resolution of about 250 nm and the frequency resolution of 100 MHz.

We show that the resonant modes of the magnetic elements can be excited by applying a microwave signal at a frequency which is by a factor of two or even three smaller compared to the resonant frequency. We study the spatial characteristics of the nonlinearly excited modes and show that the double–frequency excitation is efficient for modes with anti–symmetric spatial profiles, whereas the triple–frequency excitation is efficient for modes with symmetric profiles. The latter process shows an especially high efficiency, which makes it promising for technical applications.

13.4 cm

Subject category :

3. Magnetic Structure and Dynamics

Presentation mode :
poster

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