Formation and collapse of guided spin-wave bullets in a medium with induced magnetic anisotropy

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Abstract:

The formation of quasi-2D nonlinear spin-wave eigenmodes in longitudinally magnetized stripes of a ferrimagnetic film, the so-called guided spin-wave bullets [1], was experimentally observed by using time and space-resolved Brillouin light scattering spectroscopy and confirmed by numerical simulation. These bullets represent stable spin-wave packets propagating along a waveguide structure, for which both transversal instability and interaction with the side edges of the waveguide are important. Our experimental and theoretical investigations show that formation of these stable nonlinear wave packets is strongly affected by the transverse confinement of the medium. The discovery of these modes demonstrates the existence of quasi-stable nonlinear solutions in the transition regime between one-dimensional and two-dimensional wave packet propagation.

It has been later found that further increasing of the spin-wave amplitude leads to the destabilization of the bullet which becomes apparent through a strong 2D compression of the spin-wave packet followed by a wave collapse. The spin-wave energy involved in the collapse process is emitted by the moving collapsing area in the form of four spin-wave caustic beams. The beams are pairwise symmetrically arranged relative to the bias magnetic field. The peculiarities of the observed directional radiation from a moving area are well described by the theoretical model.

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References:

1. A.A. Serga, M.P. Kostylev, and B. Hillebrands, Phys. Rev. Lett. 101, 137204 (2008).