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THE INTERNAL DYNAMICS FOR ONE-DIMENSIONAL SOLITONS IN ANTIFERROMAGNETS WITH REAL DZYALOSHINSKY-MORIYA INTERACTION.

The nonlinear internal dynamics of one-dimensional topological magnetic solitons in antiferromagnets were studied theoretically, taking into consideration their real magnetic symmetry [1]. The presence of the Dzyaloshinskii–Moriya interaction (DMI) in the general form, which is not reduced to a purely antisymmetrical form, leads to appearance a gyroscopic term in the Lagrangian system. It was shown that the nature of the soliton internal dynamics is related to the presence of such terms, the form of which is determined by the magnetic symmetry of the antiferromagnet (AFM).
The internal dynamics of solitons, the research on which started as a purely fundamental problem in the physics of low-dimensional magnets defines new prospects for applications in nanoelectronics of magnetic materials. Most of the results obtained in this field are related to the solitons of the magnetization field of ferromagnets. Antiferromagnetic structures possess unique characteristics, although the internal dynamics of solitons in such structures have been studied to a much lesser extent. Resonance frequencies of the AFM reach several THz due to the exchange enhancement effects, exceeding by an order of magnitude the resonance frequencies in ferromagnets. Exchange enhancement also has a place for the spin-pumping effects, antiferromagnets can conduct and even amplify the spin current. These properties of antiferromagnets determine the great possibilities for their practical application in spintronics [2]. Recently, it has been proposed to use antiferromagnets to create self-oscillators, which are excited by spin pumping and working in the range of terahertz [3].
The presence of the DMI, even sufficiently weak, leads to qualitatively new effects in soliton dynamics. In the presence of this interaction, the rotational dynamics of the antiferromagnetic vector l for a number of antiferromagnets becomes connected with the translational dynamics of the soliton. For a sufficiently high precession frequency of the vector l in a soliton, Cherenkov radiation of magnons should appear.
The excitation and support of the above described dynamics is very interesting opportunity. Considering the general dissipative function, with "anti-damping" effect due to the spin pumping, shows the existence of a boundary cycle at which connected oscillations of the center of the domain wall with the oscillations of the vector l is possible. This effect can be used to develop new types of antiferromagnet spintronic devices with the use of breaking the dynamics of soliton by spin current. It is worth noting that the antiferromagnetic soliton is topological and stable even when the pumping is switched off, in contrast to non-one-dimensional solitons in ferromagnetic nanogenerators. Furthermore, it is easy to create an AFM soliton at a specific location in the device using a sufficiently weak magnetic field.
The existence of Cherenkov radiation of magnons at higher frequencies allows synchronize a soliton antiferromagnetic generator with the use of several solitons. The possibility of generating a short-wavelength magnons that is excited by the effect of spin pump can consider separately.

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