(GGA) it equals 3.3 eV, while utilization of hybrid HSE functional with 0.4 mixing parameter gives 4.8 eV, which is in reasonable agreement with experiment [2].

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1. C. E. Dreyer et al, Annual Review of Materials Research 48, 1 (2018).
2. M. Mackoit-Sinkevičienė et al, Applied Physics Letters 115, 212101 (2019).
3. O. Parcollet et al, Computer Physics Communications 196, 398 (2015).

CAUSTIC OF MAGNETOELASTIC WAVES IN A THICK YIG FILM

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The caustic of magnetoelastic waves (MEW) propagating in a thick $Y_3Fe_5O_{12}$ film is investigated. The frequency range is obtained where the MEW caustic occurs. The caustics directions as a function of the wave frequency are calculated.

The caustic of magnetoelastic waves (MEW) propagating in a thick $Y_3Fe_5O_{12}$ (YIG) film is investigated.

The approach for studying the properties of MEWs is based on the research of surfaces of constant frequency and the calculation of the MEWs amplification factor A through the geometric characteristics of these surfaces [1,2].

This method allows to determine the specific propagation directions along which the wave intensity increases sharply. This phenomenon is called caustic [3].

It can be assumed that YIG crystal is the dielectric ferromagnet with a cubic crystal lattice, and it possesses an isotropic phonon spectrum.

In this study, the MEW with long wavelength are considered, and the theory of magnon-phonon interaction in the framework of macroscopic approximation can be applied therefore [4]. Total energy of the system consists of elastic, magnetic, and magnetoelastic parts. The magnetic part of the energy contains magnetic dipole interaction than can be expressed through the demagnetization factors. They produce significant effect on the properties of magnetoelastic waves in ferromagnetic films if the magnetic field has a typical value for experimental researches (H is about 1 - 10 kOe).

The MEW spectrum consists of four eigenmodes, but one of them (LmT-mode) has the greatest spectrum anisotropy and hence is most interesting for the search for caustics. This mode passes through two points of magnetoelastic resonance. The first of

them relates to the interaction of longitudinal phonons (L) with magnetic mode (m), and the second one relates to the interaction of transverse phonons (T) with m-mode.

It is shown, that if the wave frequency of LmT-mode belongs to the region $72 < \nu < 247$ MHz, then the constant frequency surface has two directions of zero Gaussian curvature K.

Since $A \sim 1/K$ [1], then A tends to infinity, the wave intensity increases significantly, and caustic of MEW occurs in these directions.

Two caustic directions differ from each other for the following reasons. In the first direction, the wavevector q and group velocity V become almost perpendicular, while in the second direction, these vectors are almost parallel to each other.

Therefore two caustic directions become close to each other in the space of wave vectors, but are separated from each other in the space of group velocities. Moreover, the value of A in the first caustic direction decreases due to the fact that q and V are almost perpendicular and A is proportional to the cosine of angle subtended by these vectors. Thus, in the MEW spectrum in YIG plate, one should expect the main and additional caustics. The group velocity directions of these caustics are well separated.

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1. Every A.G. , Phys.Rev.B, 34(4), 2852, (1986)
2. Bakharev S. M., Borich M.A., Savchenko S. P., Journal of Magnetism and Magnetic Materials. 487, 165294 (2019)
3. Arnold V.I., Catastrophe Theory, Springer, Berlin (1984)
4. Akhiezer A.I., Bar'yakhtar V.G., Peletminskii S.V., Spin waves, North-Holland Pub. Co., Amsterdam (1968)

PROCESSES OF EVOLUTION OF RADIATION DEFECTS IN SOLIDS BY THE USAGE OF CELLULAR AUTOMATA

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In work the results of computer modeling of radiation defects formation are presented. The usage of cellular automata showed that formation of defects has nonlinear character and depends on initial distribution of particles and order parameter of system.

It is known that the electronic excitations are formed in solids under the action of ionizing radiation, nonradiative decay of which can lead to the formation of Frenkel pairs of defects. The currently existing experimental research methods make it possible to register already structurally formed centers, but do not make it possible to gradually