Excited eigenmodes in soft magnetic half- and part-spheres with three-dimensional magnetic vortex

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1. Introduction

Recently, nontrivial spin textures such as the magnetic skyrmion [1] have been intensively and extensively studied. Novel dynamic features, such as excited eigenmodes of complex magnetic configurations in three-dimensional (3D) geometrical confinements, have been identified. However, the understanding of those features has been based mostly on 2D magnetic simulations, which approach is unsuitable for the study of complicated 3D nanostructures having a rich variety of shapes. Thus, it is necessary to utilize 3D calculations to reveal additional detailed features or new underlying physics of their static and dynamic properties. In this manuscript, we report findings on novel 3D dynamic features of excited eigenmodes in special geometrical confinements, namely half- and part-spheres,[2] which could not be obtained using 2D approaches.

2. Results and Conclusion

We studied the ultrafast magnetization dynamics of the characteristic excited eigenmodes in special geometrical confinements (i.e., soft magnetic half- and part-spheres with a three-dimensional (3D) magnetic vortex [3]) using 3D micromagnetic numerical calculations.[4] We found additional fine features of the zeroth- and first-order gyrotropic modes and asymmetric $m = +1$ and $m = -1$ azimuthal spin-wave modes, which detailed information is unobtainable from 2D numerical calculations. Moreover, we examined the perpendicular bias field dependence of those eigenmodes, which data provides for an efficient means of control over the excited modes. Such 3D numerical calculations offer additional details or new underlying physics on the dynamic features of the 3D vortex structure in arbitrary-shape magnetic nano-elements such as half- and part-spheres.

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3. References

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