Control of skyrmion magnetic bubble gyration

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The skyrmion magnetic bubble in a ferromagnetic disk exhibits hypocycloidal gyrations contrary to the vortex gyration showing a simple circular trajectory [1]. To describe the hypocycloidal bubble gyration, a mass term is needed in Thiele's equation [2]. In this study, we analytically derived both mass and spring constant term, which are crucial parameters for describing the bubble gyration. Values obtained by these analytic expressions were consistent with those obtained by simulations. We could find the dependences of these two terms on several external parameters including the bubble radius. Especially, using the radius's dependence, we could obtain regular polygon-like trajectories such as a square and a triangle confirmed by the numerical simulations [3]. Based on this effective method to control the bubble gyration, the regular polygon-like trajectories of this skyrmion magnetic bubble make it possible to study the bubble gyration without time-resolved experiments.

Reference

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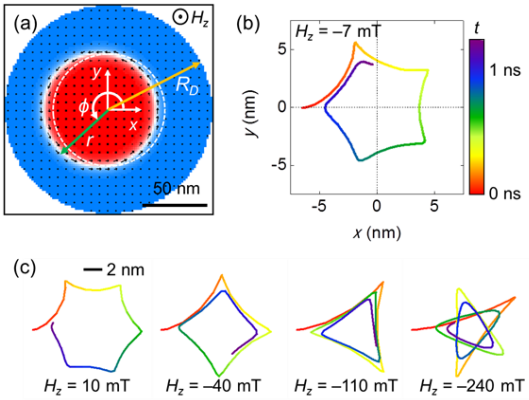

Fig. 1 (a) A magnetic bubble domain state in a perpendicular magnetic anisotropy disk. (b) A regular pentagon-like trajectory of the bubble domain gyration with the external field H_z = ‐7 mT. (c) Several examples of regular polygon-like trajectory with respect to the external field. The time scale is the same as in (b).