Coupled modes of one-dimensional skyrmion lattices in nanostrips

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Magnetic skyrmions have been intensively studied because they are promising as a potential candidate for information-storage and -processing devices owing to their robust features including nano-scale size, topological stability, and ultra-low threshold current density necessary for their motions [1]. Also, the gyration and breathing dynamic modes of single skyrmions are found[2-4]. Therefore, collective excitations of those modes in one- or two-dimensional arrays of skyrmions are of increasing interest from both fundamental and technological aspects. Here, we report on a delicate study, using micromagnetic numerical simulations, of dynamic coupling between neighboring skyrmions in narrow-width nanostrips where two or more skyrmions are periodically arranged. We found that there exist strongly coupled modes of both the gyration and breathing excitations that exhibit their characteristic dispersions in nanostrips. Moreover, the application of perpendicular magnetic fields allows for the control/modification of the dispersions of their coupled modes, thereby providing a means of controlling the fast propagations of the gyration and breathing modes. This work might offer a new route towards developments of a new type of efficient, reliable, fast, and low-power-consumption information-storage and -processing devices.

References

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