Static structures and dynamics of frustrated bimerons

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The magnetic spin textures with non-trivial topology has been an important topic in the fields of magnetism and spintronics for the last few years [1]. For example, the magnetic skyrmion is a promising topological spin texture, which exists in perpendicularly magnetized systems and can be used as a spintronic information carrier. Magnetic bimeron is a topological counterpart of skyrmions in in-plane magnets, which can also be used to carry information. In this work [2], we report the static properties of bimerons with different topological structures in a frustrated ferromagnetic monolayer, where the bimeron structure is characterized by the vorticity Q_v and helicity η. It is found that the bimeron energy increases with Q_v, and the energy of an isolated bimeron with $Q_v = \pm 1$ depends on η. We also report the dynamics of frustrated bimerons driven by the spin-orbit torques, which depend on the strength of the damping-like and field-like torques. We find that the isolated bimeron with $Q_v = \pm 1$ can be driven into linear or elliptical motion when the spin polarization is perpendicular to the easy axis. We numerically reveal the damping dependence of the bimeron Hall angle driven by the damping-like torque. Besides, the isolated bimeron with $Q_v = \pm 1$ can be driven into rotation by the damping-like torque when the spin polarization is parallel to the easy axis. The rotation frequency is proportional to the driving current density. In addition, we numerically demonstrate the possibility of creating a bimeron state with a higher or lower topological charge by the current-driven collision and merging of bimeron states with different Q_v. Our results could be useful for understanding the bimeron physics in frustrated magnetic systems.

References

1) Nat. Rev. Phys. **2**, 492 (2020); J. Phys. D: Appl. Phys. **53**, 363001 (2020); J. Phys.: Condens. Matter **32**, 143001 (2020); J. Appl. Phys. **124**, 240901 (2018); Nat. Rev. Mats. **2**, 17031 (2017); Adv. Mater. **29**, 1603227 (2017); Phys. Rep. **704**, 1 (2017); J. Phys. D: Appl. Phys. **49**, 423001 (2016); Proc. IEEE **104**, 2040 (2016); Nat. Rev. Mats. **1**, 16044 (2016); J. Phys.: Condens. Matter **27**, 503001 (2015); Nat. Nanotech. **8**, 899 (2013).
2) Phys. Rev. B **101**, 144435 (2020).

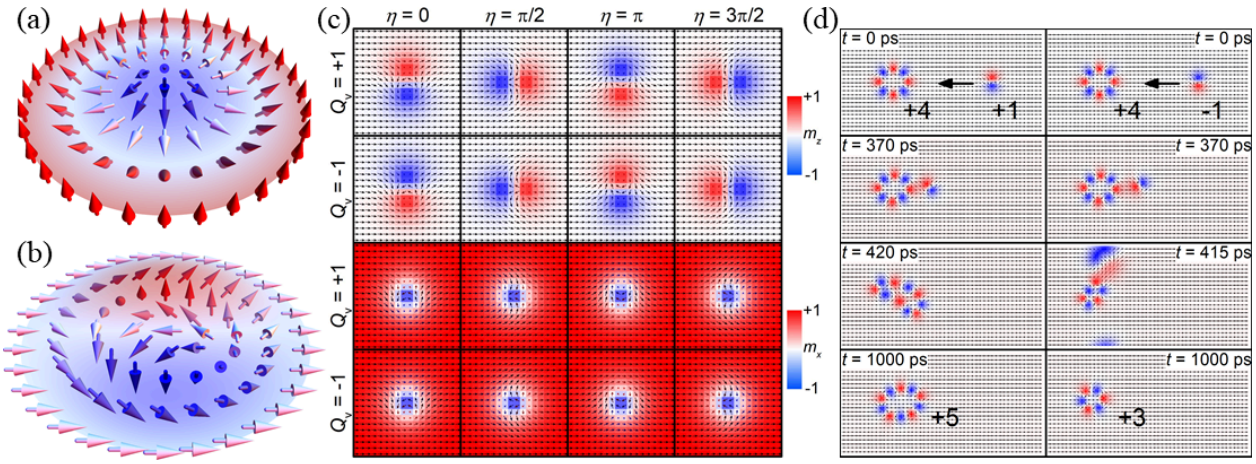

Figure 1. (a) Illustration of a skyrmion with $Q_v = 1$. (b) Illustration of a bimermon with $Q_v = 1$. (c) Top view of simulated static bimeron solutions with different Q_v and η. (d) Current-induced collision and merging of an isolated bimeron and a cluster-like bimeron state. More details can be found in [Phys. Rev. B **101**, 144435 (2020)].