Non linear effects of dipolar contributions in magnetic quantum dots

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Recently polar vortices were observed in magnetic dots, they are due to the competition between local exchange and long-ranged dipole-dipole interactions. Some authors also observed a frequency doubling of spin waves in such nanostructures [1] as well as other non-linear properties such as slow gyrotropic motion of vortices. These highly non-linear effects are quite localized at domain walls, i.e. at sites where magnetization direction is changing. Such a localization of non-linear effects is explained here from a Taylor expansion of dipolar interactions which results in an effective local non-linear interaction. And non linear terms occur only at the places where static magnetization is not uniform. Thus the present step proposes to observe the occurrence of non-linear effects in magnetic dots where vortices are formed. This brings new geometrical constraints for induced high frequency magnons. The effective energy picture for vortex localization is discussed in this framework and shown to be non harmonic in agreement with recent simulations on vortex gyrotropic motion.

9.7 cm

[1] S. J. Hermsdoerfer *et al.*, Appl. Phys. Lett. **94**, 223510 (2009).

13.4 cm

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