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Spin wave spectrum of ferromagnetic nanotubes

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We investigate the spin wave spectra associated to a vortex domain wall confined within a ferromagnetic nanotube. With basis in simple models we obtain the spin wave dispersion relation. Also we add the Gilbert dissipation term. Our aim is to capture the basics spin wave physics behind the geometrical confinement of nobel magnetic textures.

The dynamical properties of magnetic nanostructures have been the focus of a variety of studies, especially because the potential applications in ultrahigh-density memory devices and sensors [1, 2], amongst other possible striking capabilities of this type of magnetic systems.

In this work we present our results on the study of the spin wave spectrum of ferromagnetic nanotubes. In particular we are interested on the potential capabilities that a spin wave structure characterization might have to render information concerning the magnetic reversion modes also we address the issue of domain wall motion on an magnetic nanotube. We are specially referred to the spin-wave excitations by the presence this domain wall. Comparing the case with the wall and without it. Also we include in the model, the Gilbert damping term because it’s relevance for experimental measurements.

These types of systems have been the target of extensive studies since they were synthesized for the first time some years ago [3, 4]. Among the most relevant results concerning the properties of nanotubes we remark those that either by energetic arguments, micro-magnetic and MonteCarlo simulations have provided a basic picture of the reversion process. There is basic agreement with the picture argued by Landeros et al. [5], following closely the phenomenology of magnetic nanowires, that the reversion process on magnetic nanotubes is driven by the nucleation and later displacement of transverse or vortex domain walls.

The results obtained are of high interest of a theoretical point of view but also from the experimental because the structure of spin wave excitations could be measured using Brillouin light scattering techniques and ferromagnetic resonance.

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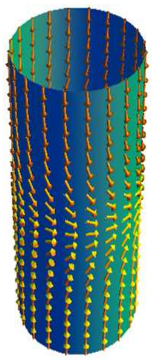

Figure 1: Schematic representation of a ferromagnetic nanotube with a vortex-type domain wall

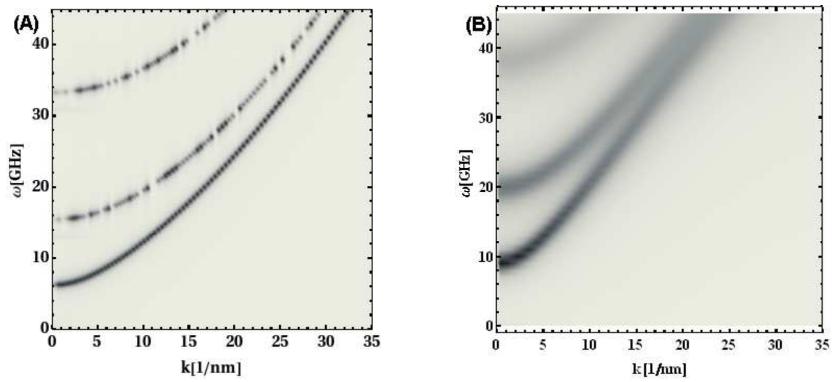

Figure 2: Numerical results of the dispersion relation of an infinite ferromagnetic nanotube with a vortex-type domain wall.**(A)** without dissipation **(B)** with dissipation.

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