Magnetostatic coupling between the a ferromagnetic stripe and a nanodot

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One of the main research directions in magnonics focuses on the excitation of short wavelengthSWs (SWs). Recently, a few approaches have been proposed, but with some limitations like the lack of anefficient source of SWs, which further limits the development of magnonic applications.

One promising upcoming solution is to use an inscribed skyrmion in a nanodot but such a system can have a lot of variables, especially with a time-resolved analysis.

In this prospect, we will narrow the scope and focus on the static system composed of a nanodot with varying magnetic states on top of an in-plane magnetized stripe.

The waveguide ismagnetically saturated along its length and is separated from the nanodot by a spacer of 1.5 nm. It is 384 nmwide and 4.5 nm thick, and a few micrometers long with absorbing boundary conditions at its edge bothextremities to avoid any kind of back-propagating SWs.

The nanodot must have a specific geometry and size, as it requires a strong enough interfacial Dzyaloshinskii-Moriya Interaction to allow for the formation of a skyrmion. For this reason, the nanodot is made of Pt/Co/Ir circular layers with a diameter of 300 nm to create a strong shape anisotropy which allows the presence of a metastable state such as a skyrmion in its core.

When relaxing this system, a *spin-dot-shadow* is created in the waveguide, meaning the magnetization below the nanodot will deviate from their saturated magnetization along the x axis because of the dipolar coupling with the skyrmion. In the same way, the waveguide will influence the magnetization inside the nanodotand affect the shape of the skyrmion. In our example, the skyrmion's core expends and becomes egg shaped under the influence of the waveguide.

In the case of the out-of-plane magnetized nanodot (without an inscribed skyrmion), the induced magnetostatic field can be approximated to the field distribution of the magnetic dipole.

This analysis is repeated for many values of the DMI as it is the principal factor in the resulting texture in the nanodot, which allows us to compare very similar systems with different skyrmions shapes.

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