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# Circular stripe domains imprinted into the out-of-plane magnetised material

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Engineered magnetic textures are prominent for numerous sensors, data storage and processing applications. Magnetic films with perpendicular anisotropy are well-known to exhibit transverse instability resulting in nucleation of stripe domains [1]. The key role in the stripe domain formation plays the nonlocal magnetostatics interaction. Typically, such instability is realized by applying an in-plain magnetic field. An alternative way to create magnetic texture can be realized by stacking two magnetic layers with in-plane and out-of-plane magnetization, providing an efficient way to create a variety of magnetic states even with different topological properties [2].

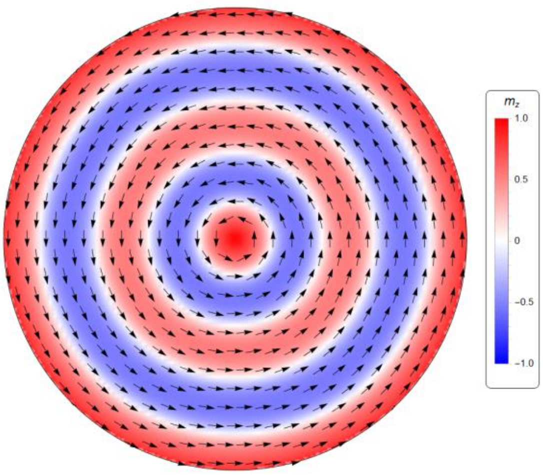


Fig. 1. Magnetization structure of circular stripe domains induced by interlayer exchange coupling between the Cobalt nanodisk and Permalloy nanodisk (interlayer exchange (RKKY) coupling constant σ = 0.38 mJ/m$^2$). The following parameters of the Co disk were used in OOMMF simulations: disk radius R=500nm, thickness L = 8 nm, exchange constant A = 2·10$^{-11}$ J/m, saturation magnetization $M_s$ = 5·10$^5$ A/m, easy-normal anisotropy K = 2·10$^5$ J/m$^3$. Arrows show the in-plane magnetization distribution and colours correspond to the $m_z$ component.

Here we consider a vertically stacked magnetic heterostructures Py/Pd/Co of cylindrical geometry. Due to the interlayer exchange coupling between the thick vortex-state Py nanodisk and thin Co layer a vortex structure is induced in the Co nanodisk. A new circular stripe domain state over the vortex background is realized due to the competition between local and nonlocal interactions. Consecutive phase transitions between the vortex state, the circular stipe domain and the vortex cone phase take place by tuning the interlayer exchange coupling parameter and Co disk thickness. Circular stipe domains magnetic structure on the top of Co disk is represented in Fig.1. The detailed analysis of remanent states is performed by means of micromagnetic simulations. The existence of circular stripe domains corresponds to experimentally detected donut state [2].

## References

[1] A. Hubert and R. Schäfer, Magnetic domains: the analysis of magnetic microstructures, Springer (2009)

[2] R. Streubel et al, Scientific Reports 5, 8227 (2015)