MAR16-2015-020255
Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Magnetic domain walls as reconfigurable spin-wave nano-channels[1]

KAI WAGNER, 1. Helmholtz-Zentrum Dresden - Rossendorf, Institute of Ion Beam Physics and Materials Research, Dresden, Germany. ;2. TU Dresden, Dresden, Germany

Research efforts to utilize spin waves as information carriers for wave based logic in micro- and nano-structured ferromagnetic materials have increased tremendously over the recent years [1,2]. However, finding efficient means of tailoring and downscaling guided spin-wave propagation in two dimensions, while maintaining energy efficiency and reconfigurability, still remains a delicate challenge.
Here we target these challenges by spin-wave transport inside nanometer-scaled potential wells formed along magnetic domain walls. For this, we investigate the magnetization dynamics of a rectangular-like element in a Landau state exhibiting a so called 180 Nel wall along its center. By microwave antennae the rf-excitation is constricted to one end of the domain wall and the spin-wave intensities are recorded by means of Brillouin-Light Scattering microscopy revealing channeled transport. Additional micromagnetic simulations [3] with pulsed as well as cw-excitation are performed to yield further insight into this class of modes.
We find several spin-wave modes quantized along the width of the domain wall yet with well defined wave vectors along the wall, exhibiting positive dispersion. In a final step, we demonstrate the flexibility of these spin-wave nano-channels based on domain walls. In contrast to wave guides realised by fixed geometries, domain walls can be easily manipulated. Here we utilize small external fields to control its position with nanometer precision over a micrometer range, while still enabling transport. Domain walls thus, open the perspective for reprogrammable and yet non-volatile spin-wave waveguides of nanometer width.

[1]: A. V. Chumak, V. I. Vasyuchka, and B. Hillebrands, Nat. Phys. 11, 453-461 (2015).
[2]: D. Grundler, Nat. Phys. 11, 438-441 (2015).
[3]: A. Vansteenkiste, J. Leliaert, M. Dvornik, M. Helsen, F. Garcia-Sanchez and B. van Waeyenberge, AIP Advances 4, 107133 (2014).
[4]: K. Vogt, F. Y. Fradin, J. E. Pearson, T. Sebastian, S. D. Bader, B. Hillebrands, A. Hoffmann and H. Schultheiss H. , Nat. Comm. 5, 3727 (2014).

[1]Financial support by the Deutsche Forschungsgemeinschaft within project SCHU2922/1- 1 is gratefully acknowledged.