

## Spatio-temporal Measurement of Spin Wave Transmission through Air Gap Using Light Pulses

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Information transport via spin wave is considered to produce less heat and consume less energy. Spin wave generation by light pulses[1] is a promising method to control amplitude, phase, or spatial shape of spin waves easily with power or polarization of the light pulses, and spatial shape of the light spots. Using our optical imaging method[2], spin wave propagation in non-uniform system, as reflection at an edge of a magnetic crystal[3], was observed. Recently, spin wave transmission through an air gap was reported[4] though spatio-temporal waveform was not measured. In this research, transmission of spin wave packet through an air gap was measured spatio-temporally using light pulses.

In the experiment, two  $\text{Gd}_{4/3}\text{Yb}_{2/3}\text{BiFe}_5\text{O}_{12}$  crystals (120  $\mu\text{m}$  thick) were aligned in a plane, with an air gap. edges of the crystals were aligned parallel to each other. Circularly polarized light pulses with central wavelength of 1300 nm were focused on one sample in a line-shaped spot with 70  $\mu\text{m}$  width to generate spin waves. The light spot was parallel to the edge and 200  $\mu\text{m}$  apart from the air gap. Spin wave was measured by optical pump-probe imaging method[2]. Spatial waveform of spin wave at 1000 ps after spin wave generation is shown on Fig. 1. Width of the air gap was 40  $\mu\text{m}$ .

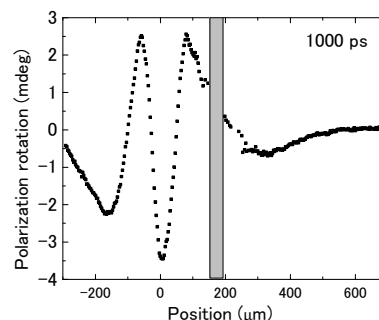
Propagation of spin wave was calculated assuming dipole interaction among the spins in the two samples. Gap width dependence of amplitude or phase of spin waves was also compared with the experiment.

[1] T. Satoh *et al.*, Nat. Photon. **6**, 662 (2012).

[2] I.Yoshimine *et al.*, J. Appl. Phys. **116**, 043907 (2014).

[3] I.Yoshimine *et al.*, the 75<sup>th</sup> JSAP Autumn meeting (2014).

[4] T. Schneider *et al.*, EPL (Europhysics Letters) **90**, 27003 (2010).



**Fig. 1:** spatial waveform of spin wave transmitted through the air gap (width: 40 mm, delay: 1000 ps).