Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Probing spin wave excitations using magnetic tunnel junction structures[1] XIN FAN, CHONG BI, JOHN XIAO, Department of Physics, University of Delaware, CENTER FOR SPINTRONICS AND BIODETECTION TEAM — We propose a quantitative method based on the use of high tunneling magnetoresistance and small lateral dimension of magnetic tunnel junction (MTJ) to detect spin excitations in magnetic films with promising high spatial resolution and sensitivity. One ferromagnetic (FM) layer of the MTJ is pinned by an antiferromagnetic layer and the other one is free to rotate in response to an external magnetic field. In the presence of microwave magnetic fields, the free layer will precess, leading to the average resistance of MTJ change. By applying a constant dc current bias to the MTJ, a time dependent voltage can be introduced and measured which is related is the time dependent magnetization along the external static field direction. We have demonstrated the usefulness of this method by studying the spin wave excitations in a single elliptical Permalloy thin film (50 μm $\times$30 μm $\times$40 nm). At low microwave power, a uniform linear ferromagnetic resonance behavior has been observed. Surprisingly, above the spin wave instability threshold, the experimental results show a linear response of to the microwave field over a large range, which is followed by a phase limiting behavior. The linear behavior can be described by the theoretical model describing subsidiary resonance.

[1]The work is supported by NSF under grant number DMR-0827249 for measurement setup development, DOE under grant number DE-FG02-07ER46374 for measurements and analyses, and NSFC under Grant No. 60721001 and 60425102.

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Date submitted: 11 Nov 2011 Electronic form version 1.4