Contribution ID: **66**   Type: **Invited Talk**

Non-degenerate Parametric Pumping of Spin Waves by Acoustic Waves

Friday, 24 February 2017 18:06 (36 minutes)

We demonstrate the parametric pumping of spin waves by longitudinal acoustic waves in YIG. Backward volume magnetostatic spin waves in the frequency range of 1.2 GHz –1.3 GHz travelling in a YIG film have been amplified using an acoustic wave resonator driven at frequencies near twice the spin wave frequency. The existence of a distinct pump threshold that increases quadratically with frequency offset and the observation of a counter-propagating idler wave provide convincing evidence of the nonlinear parametric pumping process.

Parametric pumping involves the nonlinear interaction between three waves, the signal spin wave at frequency f_s, the idler spin wave at frequency f_i, and the pump at frequency f_p. Energy conservation dictates that the three frequencies satisfy the relation $f_p = f_s + f_i$.

In the present experiments, the pump is a standing acoustic wave which couples to the spin waves via magnetoelastic coupling in the YIG. To conserve momentum, the idler wave propagates counter to the signal wave.

In previous work \1 we studied only the degenerate case, $f_p = 2f_s$. Under this condition the signal and idler waves occur at the same frequency, making it difficult to distinguish the idler wave from the inevitable electromagnetic feedthrough of the signal wave excitation. In the present experiments, we extend the work to the non-degenerate case, where the counter-propagating idler as well as a distinct threshold for its appearance are clearly observed.

The experimentally determined threshold for pumping, at an acoustic amplitude of 40 pm, is similar in magnitude to the threshold predicted by a recent theoretical treatment by Keshtgar et al. \[2]. The quadratic increase in threshold with frequency offset from the degenerate case indicates a spin wave damping linewidth of \delta H=1 Oe, which is typical for the films used.
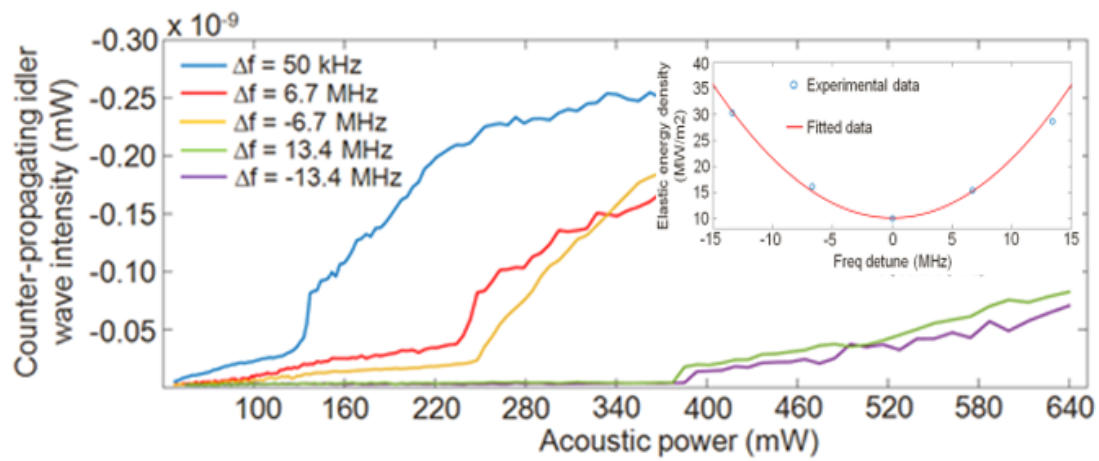
Fig. 1 Parametrically generated idler wave intensity as a function of acoustic pump power for several different pump frequencies. The inset shows the threshold acoustic intensity versus frequency offset.

Figure 1: Plot of idler power versus pump power

1. P. Chowdhury, P, Dhagat and A. Jander, IEEE Transactions on Magnetics 51, 1 (2015).
2. H. Keshtgar, M. Zareyan and G. E. W. Bauer, Solid State Communications 198, 30 (2014).

Primary author: JANDER, Albrecht (Oregon State Unirsity)

Presenter: JANDER, Albrecht (Oregon State Unirsity)