# View Abstract

**FINAL ID:** None

**TITLE:** Heusler-compound nanocontact vortex oscillators

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**ABSTRACT BODY:**
**Digest Body:** Spin-torque nano-oscillators (STNO) are nanoscale spintronic devices in which applied currents drive self-sustained magnetization oscillations. Heusler compounds are promising materials for spintronics as they exhibit low Gilbert damping for magnetization dynamics and large spin polarizations due to their (almost) half-metallic nature [1,2]. As such, they are ideal for devices such as spin-torque nano-oscillators, where critical currents can be reduced by the lower damping values and output signals enhanced by stronger magnetoresistances. This idea has been explored in vortex-based systems involving $Co_2Fe_xMn_{1-x}Si$ where large output powers and large quality factors have been reported [3].

A unique feature of nanocontact vortex oscillators is the onset of periodic core reversal above a critical current [4-6]. This reversal occurs concurrently with the steady-state gyration around the nanocontact, giving rise to various behaviors we have previously studied: chaotic core reversal [4,5], phase-locking or modulation phenomena [6] in permalloy-based spin valves. These dynamics are driven primarily by currents flowing in the film plane (CIP), resulting in spin-transfer torques of the Zhang-Li form, rather than the Slonczewski torques associated with currents perpendicular to the film plane in nanopillar geometries. Here, we will discuss how the dynamics changes when all Heusler spin valves are used instead. We fabricated 20-nm nanocontacts on $Co_2MnGe/Au/Co_2MnGe$ films grown by molecular beam epitaxy, with a nano-indentation technique [7].

We investigated the vortex dynamics in the time and frequency domain at room temperature. An example of the measured current-dependence of the power spectral density is given in Fig. 1. We observe a rich harmonic content with oscillations that persist down to 4.5 mA, which is lower than previous cases [4-6]. Moreover, the power spectra comprise broad bands that are reminiscent of a chirped signal. Other frequency domains measurements show single frequency signal, broad spectral lines or extinction of the signal over current intervals.

Time domain measurements enable us to observe other behavior, such as mode hopping, which can be seen on Fig. 2 for different currents. Other measurements have exhibit other behaviors, such as mode coexistence, intermittent signal or signal fluctuations. We attribute the rich dynamics to the coupled motion of vortices in the free and reference layers. This hypothesis is supported by some simulations.

**References:** [1] T. Graf *et al*., IEEE Trans. on Magn., 47, 367-373 (2011)
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[3] T. Yamamoto *et al*., Phys. Rev. B 94, 094419 (2016)

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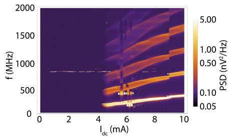
[5] T. Devolder *et al*., Phys. Rev. Lett. 123, 147701 (2019)
[6] J. Létang *et al*., Phys. Rev. B 100, 144414 (2019)
[7] J. Létang *et al*., arXiv:1906.08492 (2019)

**KEYWORDS:** Magnetic vortex, Heusler, Spin Torque Oscillator.

**IMAGE CAPTION:**
Figure 1: Power spectral density of vortex oscillations with applied dc current. The frequency bands are suggestive of a chirped signal.

Figure 2: (a) Power spectral density computed from time-domain measurements. (b-d) Time-domain measurements for different dc current. Mode hopping between two frequencies is visible.



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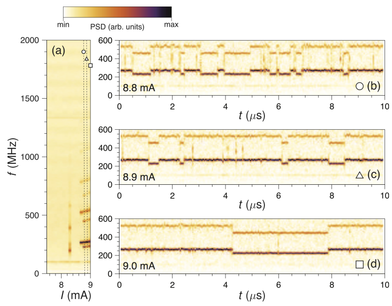

Figure 2: (a) Power spectral density computed from time-domain measurements. (b-d) Time-domain measurements for different dc current. Mode hopping between two frequencies is visible.

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**Previous Presentation:** No – I didn't present a paper at MMM 2020

**Online Archive:** No

**AWARDS:**