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Autonomous and forced dynamics in a spin-transfer nano-oscillator: Quantitative magnetic-resonance force microscopy[1]

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In this talk, we will discuss how magnetic-resonance force microscopy, can provide quantitative measurement of the power emitted by a spin-transfer nano-oscillator, consisting of a normally magnetized Py—Cu—Py circular nanopillar, excited both in the autonomous and forced regimes.[2] From the power behavior in the subcritical region of the autonomous dynamics, one obtains a quantitative measurement of the threshold current and of the noise level. Their field dependence directly yields both the spin torque efficiency acting on the thin layer and the nature of the mode which first auto-oscillates: the lowest energy, spatially most uniform spin-wave mode. We will then demonstrate that the observed spin-wave spectrum in the forced regime critically depends on the method of excitation. While the spatially uniform radio-frequency (RF) magnetic field excites only the axially symmetric modes having azimuthal index $\ell = 0$, the RF current flowing through the nano-pillar, creating a circular RF Oersted field, excites only the modes having azimuthal index $\ell = +1$.[3] It is then demonstrated that in order to phase lock this auto-oscillating mode, the external source must have the same spatial symmetry as the mode profile, i.e., a uniform microwave field must be used rather than a microwave current flowing through the nanopillar.

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[2]A. Hamadeh, et al. PHYSICAL REVIEW B 85, 140408(R) (2012)
[3]V.V. Naletov et al. PHYSICAL REVIEW B 84, 224423 (2011)