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Hysteretic synchronization of a spin-torque nano-oscillator to a microwave signal SERGEI URAZHDIN, West Virginia University, VASIL TIBERKEVICH, ANDREI SLAVIN, Oakland University — We report measurements of phase-locking of oscillations in a current-driven spin-torque nano-oscillator (STNO) to a microwave magnetic field. Measurements were performed at T=5 K on magnetic point contacts on extended 3.5 nm thick Permalloy films, incorporated in a giant magnetoresistance structure. The locking is detected by a linear variation of the precession frequency f with the external signal frequency fext, and dramatic narrowing of the precession linewidth. When the amplitude of the locking signal hmw was sufficiently large and its frequency was close to unlocked oscillation frequency f0 we observed the predicted hysteretic phase-locking [1] but only when the microwave field hmw was perpendicular to the dc field H. In addition to locking at f=fext, we also observed locking at f=fext/n with other integer n. In case n=2, the locking also becomes hysteretic at sufficiently large hmw., but only when the microwave field is parallel to the dc field H. These results are consistent with the resonant linear excitation of magnetic precession for n=1, and parametric pumping for n=2.

[1] R. Bonin *et al.*, Eur. Phys. Journal B 68, 221 (2009).

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