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Observation of fractional synchronization of spin torque nano-oscillators to a symmetry-breaking microwave signal VASYL TYBERKEVYCH, ANDREI SLAVIN, Department of Physics, Oakland University, Rochester, MI, PHIL TABOR, SERGEI URAZHDIN, Department of Physics, West Virginia University, Morgantown, WV — Spin torque nano-oscillators (STNO) are novel microwave oscillators. Strong non-linearity and non-isochronity facilitate synchronization of STNOs to external driving signals. Using novel experimental setup, in which external signal is supplied in form of both microwave magnetic field and microwave current, we studied STNO synchronization in a wide range of driving signal frequencies. We observed multiple synchronization regimes corresponding to different relations $r = f_e/f$ between external frequency f_e and the locked oscillation frequency f. Both integer (r = 1, 2, 3, 4) and fractional (r = 3/2, 7/3, 5/2, 7/2) synchronization regimes were clearly resolved. Theoretical analysis and numerical simulations show that pronounced fractional synchronization becomes possible only when the driving signal destroys symmetry of STNO magnetization trajectory with respect to half-period rotation, which is possible only when both microwave components (magnetic field and current) act simultaneously on STNO.

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