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Spin transfer due to zero-point magnetization fluctuations[1] ANDREI ZHOLUD, RYAN FREEMAN, RONGXING CAO, AJIT SRIVASTAVA, SERGEI URAZHDIN, Emory University — Spin transfer torque (STT) enables efficient control of the magnetization state and generation of spin waves in nanomagnetic systems by spin-polarized electrical current, which is valuable for applications in spintronic devices. So far, STT has been interpreted exclusively in terms of the classical states of the magnetization interacting with spin current. We present theoretical analysis and experimental results demonstrating the significance of quantum magnetization fluctuations in STT. We will discuss a simple model describing the scattering between an electron spin and a quantum macrospin representing the magnetization. Our quantum scattering model predicts that the quantum fluctuations result in a non-analytical piecewise-linear dependence of spin wave intensity on the electrical current, with a singularity at zero current, and spin-wave generation by quantum STT for both directions of the spin-polarized current. Experimental measurements of the standard giant magnetoresistive nanopillars, based on Permalloy/Cu/Permalloy spin valves, confirm that the predicted quantum effects are dominant at modest cryogenic temperatures. Our results demonstrate that the entire spin-wave spectrum is involved in STT, with an average frequency of the excited spin waves in the THz range.

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Andrei Zholud
Emory Univ

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