Public Abstract
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The electron transport properties can be affected by the configuration of magnetization orientation in a metallic ferromagnetic system. One example is the giant magnetoresistance (GMR) effect which is exploited commercially in hard disk industry. The 2007 Nobel Prize in physics was awarded to Albert Fert and Peter Grunberg for the discovery of GMR.

Spin angular momentum transfer is the reverse effect of GMR. Spin polarized current passing through a nanoscale magnet transfers some of its spin angular momentum to the magnet, generating a so called spin transfer torque to the magnetization. This provides a new means to manipulate magnetizations instead of using magnetic field.

The spin transfer torque may pump energy to the nanomagnet, inducing the magnetization to switch its orientation or to oscillate persistently. Such spin transfer induced magnetization reversal is a relatively new phenomenon that is currently being researched as a method of writing in Magnetic Random Access Memories (MRAM). On the other hand, the recently discovered current-driven magnetization oscillators with tunable microwave frequencies in spin valves (a nanometer sized sandwich structure consisting of ferromagnetic/nonmagnetic/ferromagnetic layers) are very desirable for magnetic storage devices and for telecommunications.

We studied the magnetization dynamics of spin transfer induced magnetization oscillations (STO). We applied a universal method, Melnikov Integral, to determine different dynamical phases. Our investigation revealed when the dynamics of STO becomes unstable. We analyzed the route to this instability, the embedded universality and its possible experimental observations. We compared the intrinsic instability to the temperature induced thermal noise.