SPIN TORQUE DRIVEN MAGNETODYNAMICAL SOLITONS

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Magnetodynamical solitons are highly non-linear particle-like textures that derive their stability from an intrinsically dynamical state of their constituent spins. Although magnetodynamical solitons such as spin wave (SW) bullets can be sustained in ultra-low insulating magnetic films, such as YIG, using parametric pumping by external microwave fields [1], the advent of spin transfer torque vastly expanded on both the types of solitons and the types of systems than can harbour them. SW bullets have now been demonstrated in both spin torque nano-oscillators (STNOs) [2] and spin Hall nano-oscillators (SHNOs) [3], and the even more non-linear magnetic droplets have been demonstrated in STNOs with perpendicular anisotropy free layers [4,5].

While originally predicted in all-perpendicular STNOs [6,7], all experimental demonstrations of magnetic droplets have so far relied on orthogonal devices with an in-plane polarizing layer that requires a strong magnetic field for droplet nucleation [8]. In the first part of my talk I will present our recent demonstration of nucleation and sustained operation of magnetic droplets in all-perpendicular STNOs in modest perpendicular fields and over a wide range of nano-contact size [9]. The droplet is observed electrically as an intermediate resistance state, accompanied by broadband low-frequency microwave noise. Using canted fields, which introduce a non-zero relative angle between the free and fixed layer, the actual droplet precession frequency can also be determined.

In the second part of my talk I will describe the first demonstration of SW bullets in STNOs based on magnetic tunnel junctions [10]. The much higher magnetoresistance of these STNOs allows us to study the SW bullet properties in detail and the original SW bullet theory [11] can now be tested with much higher accuracy.

References

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