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IEEE Magnetics Society, San Diego Chapter

SEMINAR TALK BY

Igor Barsukov

Physics and Astronomy, University of California, Riverside

when:
TUESDAY, FEBRUARY 25, 2020
2:30 PM Refreshments
3:00 PM Seminar

where:
JKW AUDITORIUM
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Biography

Igor Barsukov graduated with Diploma in Physics from Ruhr-University Bochum (Germany). He commenced his graduate studies at the Academy of Sciences in Prague (Czechia) as a recipient of the Marie-Curie Fellowship and obtained his PhD degree from the University Duisburg-Essen (Germany). As a postdoctoral researcher, he moved to UC Irvine. In 2016, he joined the Department of Physics and Astronomy at UC Riverside as Assistant Professor. His lab works on experimental condensed matter physics with a focus on spintronics. The research interests include microwave and terahertz spectroscopy, spin transport, nonlinear spin dynamics, and thermodynamics of magnetic systems. Igor Barsukov is a recipient of UCR's Junior Faculty Excellence in Teaching Award.

Inversion of the spin-torque effect by resonant nonlinearity in nanomagnets

Nanoscale magnets are the building blocks of many existing and emergent spintronic applications, e.g. nonvolatile spin torque memory, spin torque oscillators, neuromorphic and probabilistic computing. Controlling magnetic damping in nano-magnets holds the key to improving the performance of future technologies. Here, we experimentally demonstrate and theoretically corroborate that a ferromagnetic nano-particle can exhibit spin dynamics qualitatively different from those predicted by the harmonic oscillator model. Nanolinear contributions to the damping can be unusually strong, and the effective damping parameter itself can exhibit resonant dependence on field/frequency.

We carry out spin torque ferromagnetic resonance on magnetic tunnel junction (MTJ) nanopillars with in-plane and out-of-plane magnetic anisotropy. We observe a discrete spin-wave spectrum in the geometrical confinement of the MTJ free layer. It's analysis uncovers a nonlinearity that has a strong impact on nanomagnet's response even at low excitation levels . The nonlinearity shows a distinct resonant enhancement at characteristic magnetic fields corresponding to the three-magnon scattering. We present evidence of processes in which two quanta of the lowest-energy mode merge into one quantum of higher-energy modes.

Our work demonstrates that nonlinear damping in nanomagnets is qualitatively different from that in extended systems. The observed resonant magnon scattering drastically alters the magnetization dynamics of a nanomagnet driven by spin torques. It reverses the effect of the spin torque on magnetic damping and turns an anti-damping torque into a dissipation-enhancing torque. The discovery of this counter-intuitive effect advances our understanding of spin dynamics in nanoscale magnetic systems and has far-reaching implications for spin torque oscillators, spin torque memory, and other emergent spintronic technologies.

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