Pumping Iron: Revealing Counterintuitive Mechanisms of Magnetization Dynamics

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Thin-film magnetic metals are workhorses in nanomagnetic devices, including sensors, memory, and oscillators. Yet, even for the most widely used ferromagnets, we still do not fully understand the mechanisms of key phenomena — such as magnetic damping and spin-orbit torques — for critical device applications. This lecture will highlight progress in revealing rather counterintuitive mechanisms of magnetization dynamics in thin films, especially those based on iron. Depending on the audience, I will delve into one or both of the following recent findings: (1) a fundamental damping mechanism from "procrastinating" electrons in clean iron films; (2) spin-orbit torque from subtle symmetry breaking in iron-nickel alloy films. I aim to convey that even seemingly mundane magnetic metals can exhibit intriguing foundational science, offering fresh perspectives on materials for nanomagnetic devices.

Bio

Satoru Emori received the B.S. in Materials Science and Engineering at the University of California Irvine in 2008 and the Ph.D. in Materials Science and Engineering at the Massachusetts Institute of Technology in 2013. Following his postdoctoral work at Northeastern University and Stanford University, he joined the faculty of Virginia Tech in fall 2017, where he is currently Associate Professor in the Department of Physics. His research aims to understand and control the physics of magnetization and flowing spins in magnetic thin films, which have the potential to enable energy-efficient memory and computers. He received a National Science Foundation CAREER Award in 2022. In the Nanoscience Program of the Academy of Integrated Science at Virginia Tech, he has developed interdisciplinary courses that connect basic science with technological applications in accessible ways. His service to the magnetics community includes serving as Member-at-Large of the American Physical Society's Topical Group on Magnetism and Its Applications (GMAG) and an organizer for the Magnetism and Magnetic Materials Conference and March Meetings of the APS.