Imaging Spins in Motion

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Today's electronic devices still rely primarily on electrical charges to transmit signals. As device sizes continue to shrink further into the nanoscale, we are approaching the limits of what can be done using conventional approaches. The spin of an electron offers a means to overcome this scientific and design barrier. Spin can be exploited simply by using it as an additional degree of freedom in a flowing electrical current. However, even greater breakthroughs are possible if we leverage waves in a magnetic material, known as spin waves or magnons, to transmit information. Spin waves can travel through metals and insulators, and because there are many different ways to manipulate spin waves – local magnetic fields, spin orbit torques, anisotropies, spin textures, exchange bias, heat, and more – new paradigms for information transmission and processing are possible. In this talk I will discuss how we use light to image spins in motion with the goal of developing a deeper understanding of how we can manipulate and control spin waves. I will talk about some of our recent work on spin wave/acoustic wave coupling done using Brillouin light scattering. Understanding the coupling between these waves is important both because magnetoelastic waves can travel considerably farther than spin waves, and because magnetoelastic coupling potentially offers an energy-efficient route to spin manipulation. I will also talk about a new project that we are working on that will take tabletop magnetic imaging into the realm of the nanoscale with picosecond time resolution.

Biographical Sketch

Kristen Buchanan is an Associate Professor at CSU. She joined the Department of Physics in 2008. Prior to coming to CSU, she earned a PhD in Physics at the University of Alberta in 2004, for which she received the Governor General's Gold Medal, an award that recognizes the doctoral graduate who achieves the highest academic standing/cumulative scholarly achievement at the University of Alberta, and she worked at Argonne National Laboratory first as a National Science and Engineering Research Council (NSERC) postdoctoral fellow in the Materials Science Division and then as a scientist with the Center for Nanoscale Materials. She is the recipient of a DOE Early Career Award and has also received funding from the National Science Foundation and from the W.M. Keck Foundation. Her research focuses on magnetic materials, particularly magnetic spin textures and spin dynamics in thin films and patterned structures.