

“Spintronics Preeminent Team Faculty Seminar”

April 14, 2016 @ 10:30am

WANG, ROOM 1004

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Title: Thermally-induced spin transport in metals and across metal/magnetic insulator interfaces

Bio: Johannes Kimling received his Diploma degree from the University of Konstanz in 2008 and his Doctoral degree in Physics from the University of Hamburg in 2013. In 2014 he joined the Department of Materials Science and Engineering at UIUC, where he is currently a postdoctoral research associate with Prof. David G. Cahill.

Abstract: A thermal bias imposed to a magnetic material can drive a pure spin current. Due to the absence of charge currents that dissipate electric energy into Joule heat, pure spin currents are relevant for energy-efficient information technologies. Further, pure spin currents are central to spin caloritronic strategies for conversion of heat into electric energy.

Recently, a novel measurement approach has been developed that is based on optical pump-probe techniques and allows for studying thermally-induced spin transport at the picosecond time-scale.[1] This time-scale is highly relevant for understanding the non-equilibrium physics of spin caloritronic effects, since it matches the time-scale of thermalization between electrons, phonons, and magnons, the time-scale of spin-relaxation in normal metals, and the time-scale of ultrafast magnetization dynamics.

In this seminar, I will discuss the basic sources of spin currents relevant in our recent experiments: ultrafast demagnetization, spin-dependent Seebeck effect, and spin Seebeck effect. I will show how magnetic heat capacity determines the demagnetization rate of ferromagnetic metals [2] and present a thermal spin transfer torque experiment on slowly-demagnetizing TbFe, which is dominated by the spin-dependent Seebeck effect. In this context, I will address the problem of spin heat accumulation,[3] which could complicate quantitative analysis of spin-dependent Seebeck experiments. Furthermore, I will present novel measurements of the longitudinal spin Seebeck effect that indicate sub-picosecond fast angular momentum transfer between normal metals and ferrimagnetic insulators. Finally, I will discuss possible future research projects that address local spin-dependent energy transfer in ferromagnetic metals, superdiffusive spin transport, and spin transport through antiferromagnetic insulators.

[1] G.-M. Choi, C.-H. Moon, B.-C. Min, K.-J. Lee, and D. G. Cahill, *Nature Physics* **11**, 576 (2015).

[2] J. Kimling, J. Kimling, R. B. Wilson, B. Hebler, M. Albrecht and D. G. Cahill, *Phys. Rev. B* **90**, 224408 (2014).

[3] J. Kimling, R. B. Wilson, K. Rott, J. Kimling, G. Reiss and D. G. Cahill, *Phys. Rev. B* **91**, 144405 (2015).