

Announcing the Final Examination of Priyanka Vaidya for the degree of Doctor of Philosophy in Physics

Date: October 28, 2019

Time: 11:00 am

Room: CSB 221

Dissertation title: Sub-Terahertz Spin Pumping from an Insulating Antiferromagnet

Abstract:

The combination of the spin transfer torque and spin Hall effects, or their reciprocal dynamical spin pumping and inverse spin Hall effects, respectively, enable reading and controlling the magnetization state in spintronics devices which are at the verge of mass commercialization as the next generation of energy-efficient and fast magnetic random-access memory applications with the use of ferromagnetic elements, e.g., the spin valve. However, these effects have remained elusive in antiferromagnetic-based devices up to date, despite the fascinating advantages offered by the absence of stray fields (zero net magnetization), Terahertz spin dynamics, and the widespread availability of metallic, insulating and semiconducting antiferromagnetic materials. In this thesis I report the first demonstration of sub-Terahertz dynamical spin pumping at the interface between an antiferromagnet and a non-magnetic material; more specifically a uniaxial insulating antiferromagnet MnF_2 and heavy metal Pt. The measured ISHE signal generated by the corresponding spin-charge current interconversion in the platinum layer is modulated by the handedness of the circularly polarized sub-THz irradiation. This effect results directly from the opposite chirality of each of the fundamental dynamical modes of the antiferromagnet. Contrary to the case of ferromagnets, this observation in an antiferromagnetic system allows unambiguously differentiating coherent spin pumping from incoherent spin Seebeck effect, by which electric signals result from thermal activation. A complete study of the generated electric signals at the antiferromagnetic resonances, the spin-flop mode and the transition between the two regimes as the microwave polarization is continuously varied from circular to linear polarizations enabled an understanding of the different phenomena governing interconversion of spin dynamics and charge currents at the MnF_2/Pt interface.

Outline of Studies:

Major: Physics

Educational Career:

M.S. University of Central Florida, US, 2016

M.Sc. Tribhuvan University, Nepal, 2012

B.Sc. Tribhuvan University, Nepal, 2008

Committee in Charge:

Dr. Enrique del Barco (Chair)

Dr. Madhab Neupane

Dr. Yasuyuki Nakajima

Dr. Florencio Eloy Hernandez (External Committee Member)

Approved for distribution by Dr. Enrique del Barco, Committee Chair, on October 14, 2019.

The public is welcome to attend.