INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
2A & 2B, Raja S.C. Mullick Road, Jadavpur, Kolkata-700032, India

Seminar Notice

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School of Physical Sciences

Title:	**On the origin of relativistic and ultrafast optomagnetic processes**
Speaker:	**Ritwik Mondal,Universität Konstanz,Germany**
Date:	**January 3, 2020 (Friday)**
Time:	**16:00 Hours**
Venue:	**Physics Seminar Room (C406), 3rd Floor, Centenary Building, IACS**
Abstract:	Fast and ultrafast dynamical processes in magnetic systems have become the subject of intense research for last the two decades. The phenomenological Landau-Lifshitz-Gilbert (LLG) spin dynamics has been employed to explain spin dynamics at fast to ultrafast timescales. However, at the ultrafast timescales, the exact form of traditional LLG equation has to be questioned because at these timescales several ultrarelativistic effects can become prominent (e.g., magnetic inertia). In this presentation, first, I will describe the relativistic quantum derivation of phenomenological LLG equation, however, with the additional magnetic inertia term. In the beginning, I will start with the relativistic Dirac-Kohn-Sham framework and establish a relativistic spin-photon coupling Hamiltonian [1]. Our results confirms that Zeeman-like coupling causes spin precession [2], spin-orbit coupling causes spin damping of Gilbert type [2] and higher-order spin-orbit coupling causes magnetic inertial dynamics (nutation) [3]. Within our approach, we could derive several relativistic and nonrelativistic spin torques, e.g., spin-transfer and spin-orbit torques [4]. I will show how the derived LLG spin dynamics could explain the ultrafast demagnetization and switching processes. Moreover, our derivation suggests that due to relativity, additional effects are expected within LLG equation; one of those is fieldderivative torque (FDT) [2, 4]. FDT originates from the fact that not only the field couples to the spins, but also, the time-derivative of the field couples to spins. In the second part, I will discuss the effect of FDT terms for resonant THz excitation in antiferromagnetic NiO and CoO [5]. [1] R. Mondal, M. Berritta, K. Carva, and P. M. Oppeneer, Phys. Rev. B 91, 174415 (2015). [2] R. Mondal, M. Berritta, and P. M. Oppeneer, Phys. Rev. B 94, 144419 (2016). [3] R. Mondal, M. Berritta, A. K. Nandy, and P. M. Oppeneer, Phys. Rev. B 96, 024425 (2017). [4] R. Mondal, M. Berritta, and P. M. Oppeneer, Phys. Rev. B 98, 214429 (2018). [5] R. Mondal, A. Donges, U. Ritzmann, P. M. Oppeneer, and U. Nowak, Phys. Rev. B 100, 060409 (2019).

All are cordially invited to attend the seminar