

Special Seminar

2 pm, Monday, October 5, 2026

Physics, 3rd floor, Reading Room

Branislav K. Nikolić (U Delaware)

Ultrafast Optical Excitation of Antiferromagnetic or Inertial Magnons in 2D Magnets

Abstract: For applications in magnonics, there is a considerable experimental effort to excite coherent magnons by ultrafast light, whose frequencies are as high as possible and wavelengths as short as possible. In particular, the advent of two-dimensional (2D) magnetic materials—such as 2D antiferromagnetic semiconductors CrSBr, NiPS₃, MnPS₃, CrI₃ and their van der Waals heterostructures—has made possible recent experiments observing how femtosecond laser pulse excites magnons via exciton mediation. Our theory explains [1] such excitation as the consequence of a novel spin-transfer torque mechanism mediated by excitons, which is also supported by very recent experiments on CrSBr [2]. We additionally predict novel charge pumping [1,3] signatures of exciting magnons. For metallic 2D magnets, we explain [4] how the bath of light-driven electrons can dramatically modify Landau-Lifshitz dynamics to introduce in it either a non-Markovian kernel (with fractal properties in double time plane) or magnetic inertia, depending on the intensity of light. Our extended Landau-Lifshitz equation [4], microscopically derived from Schwinger-Keldysh field theory [5], predicts the possibility of excitation of coherent inertial magnons at frequencies above the standard band of thermal magnons. Thus, both examples offer realizations of high-frequency and all-electrical control of magnetic order in quantum materials where initially electrons interact with the fast-changing electric field of light, which then leads to their photocurrent driving the dynamics of local magnetization.

Biosketch: Branislav K. Nikolić is a Full Professor of Physics at the University of Delaware and a Senior Visiting Scientist at RIKEN in Japan. He received his Ph.D. in theoretical condensed matter physics from Stony Brook University, and a B.Sc. degree from the University of Belgrade, Serbia. He was visiting Professor at the University of Regensburg, National Taiwan University, Centre de Physique Théorique de Grenoble-Alpes and Beijing Normal University. His research focuses on nonequilibrium quantum many-body and field theory, computational quantum transport, multiscale quantum-classical approaches, and high-performance scientific computing, including applications to technologically relevant problems in spintronics, magnonics, quantum information, nanoelectronics and nano-bio interface.

References: [1] J. Varela-Manjarres et al., Phys. Rev. B 113, 134403 (2026). [2] N. J. Brennan et al., Nat. Mater. (2026). [3] A. Suresh et al., Phys. Rev. B 101, 214412 (2020). [4] F. Reyes-Osorio et al., Phys. Rev. Lett. 135, 246701 (2025). [5] F. Reyes-Osorio et al., Phys. Rev. B 109, 024413 (2024).

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