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Keynote speaker:

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Title of the Presentation:
Spin-Orbitronics: Principles, Materials and Devices

Short CV

Mihai Sebastian Gabor, PhD, Dr. Habil., is an Associate Professor at the Technical University of Cluj-Napoca (TUCN), where he leads the spintronics and spin-orbitronics research direction of the Center for Superconductivity, Spintronics and Surface Science (C4S). He received a joint PhD in Physics and Materials Engineering from Université Henri Poincaré, Nancy (France) and TUCN in 2011, and was awarded the habilitation in Materials Engineering in 2025 (thesis: Materials for Spin-Orbitronics). His research covers the growth of ultrathin magnetic heterostructures, spin-orbit torques, perpendicular magnetic anisotropy, the interfacial Dzyaloshinskii–Moriya interaction, and chiral domain-wall and skyrmion devices for memory, logic and neuromorphic computing. He has led five national research projects and has co-authored nearly 100 journal articles (Google Scholar h-index 27). He has been an invited researcher at SPINTEC-CEA Grenoble and an invited professor at Université Paris 13.

Abstract

Spin-orbitronics uses spin-orbit coupling in heavy metals and at interfaces to switch or move magnetization electrically with pure spin currents, making it a strong candidate for fast, non-volatile and energy-efficient memory, logic and neuromorphic hardware. This talk reviews the spin Hall effect, spin-orbit torques and the interfacial Dzyaloshinskii–Moriya interaction, and the materials requirements they set for heavy-metal/ferromagnet/oxide heterostructures: strong perpendicular magnetic anisotropy, efficient charge-to-spin conversion and controlled magnetic chirality. Using examples from ultrathin Pt/Co/MgO and Heusler-alloy films grown at C4S/TUCN, it illustrates how atomic-scale interface engineering tunes these properties and the current-driven dynamics of chiral domain walls and skyrmions. It then presents device functionalities built on these effects, including magnetic domain-wall diodes and routers and field-free spin-orbit torque elements for artificial synapses and neurons. The talk concludes with perspectives on voltage-gated control of spin-orbit effects and on integrating spin-orbitronic devices with conventional electronics.