University of Crete
Department of Physics

Physics Colloquium

Tuesday, 6 June 2023 | 13:30 – 14:30, Seminar Room 3rd floor

Spin and charge current dynamics in spintronic THz emitters

Prof. Evangelos Papaioannou

Institute of Physics, Martin-Luther University Halle-Wittenberg, Germany

Department of Physics, Aristotle University of Thessaloniki, Greece

ABSTRACT

Ultrafast spin-to-charge conversion in heterostructures composed of ferromagnetic (FM)/non- magnetic (NM) thin films can give rise to the emission of THz electromagnetic waves [1]. The experimental scheme involves the use of femtosecond (fs) laser pulses to trigger ultrafast spin and charge dynamics in FM/NM bilayers, where the NM layer features a strong spin-orbit coupling. Via the inverse spin Hall effect (ISHE), the spin current generated in the FM layer by the fs-laser pulse is converted to an ultrashort charge current burst that gives rise to the THz radiation [1].

In this presentation, I will show the potential of spintronic THz emitters (STE) for stronger THz radiation and adjustable bandwidth by studying the spin and the subsequent charge current dynamics after the laser illumination.

I will initially focus on the FM/NM interface engineering and its correlation to the strength of the excited spin current which is the source of the THz radiation [2]. Next, I will discuss that not only the spin current dynamics but also the charge redistribution is important for the properties of the THz signal [3]. The charge relaxation leads to a current backflow with a delay and a time constant that mainly depends on the conductivity and the dielectric properties of the emitter.

References

[1] E. Th. Papaioannou, René Beigang, Nanophotonics **10(4),** 1243-1257, (2021).
[2] L. Scheuer, M. Ruhwedel, D. Karfaridis, I. Vasileiadis, D. Sokoluk, G. Torosyan, G. Vourlias, G. Dimitrakopoulos, M. Rahm, B. Hillebrands, T. Kehagias, R. Beigang, E.Th. Papaioannou, iScience **25**, 104319, (2022).
[3] G. Schmidt, B. Das-Mohapatra, E. Th. Papaioannou, Phys. Rev. Applied **19**, L041001 (2023).