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The quest for logic functionalization of magnetic nanoclusters

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Abstract

In this talk our quest for functional magnetic logic elements will be revised. Ever since the laser-induced ultrafast demagnetization of ferromagnetic materials was discovered [1], spintronics has become a main research field in the area of magnetism and optical control.

Starting from one-magnetic-center over to two- and three-magnetic-center molecules, the necessary elementary mechanisms (spin flip and spin transfer) will be discussed to finally arrive at more complex functionalities such as actually constructing and preparing magnetic logic gates.

With the help of high-level *ab initio* quantum chemistry the possible spin manipulation scenarios will be elucidated [2], followed by a discussion pertinent to the design of magnetic structures whose purpose is the coherent magneto-optical control. Emphasis will be given on the structural aspects of the most successful nanostructures as well as their electronic-level scheme [3]. Along the way some derived rules-of-thumb and important physical aspects, like the conservation of total angular momentum, the spin and charge dynamics decoupling as well as the role of phonons and symmetry breaking will also be addressed [4].

[1] E. Beaurepaire, J.-C. Merle, A. Daunois, and J.-Y. Bigot, Phys. Rev. Lett. **76**, 4250 (1996)

[2] G. Lefkidis, G. P. Zhang, and W. Hübner, Phys. Rev. Lett. **103**, 217401 (2009)

[3] W. Jin, F. Rupp, K. Chevalier, M. M. N. Wolf, M. Colindres Rojas, G. Lefkidis, H.-J. Krüger, R. Diller, and W. Hübner, Phys. Rev. Lett. **109**, 267209 (2012)

[4] G. P. Zhang, W. Hübner, G. Lefkidis, Y. Bai, and T. F. George, Nature Physics **5**, 499 (2009)

Biography

Georg Lefkidis studied Chemistry at the Aristotle University of Thessaloniki, Greece, where he also got his Ph.D. in the Laboratory of Applied Quantum Chemistry in 2002. 2003 he joined the Physics Department of the University of Kaiserslautern, Germany, first as a postdoctoral fellow and, since 2007, as a tenured Senior Researcher/Lecturer. He has published more than 35 peer reviewed articles and serves as referee for several journals. His main research interests include second harmonic generation, ultrafast (magneto-) optics, laser induced dynamics and spintronics of nanoclusters, as well as the various degrees of freedom involved in the processes.