Logic functionalization and angular momentum conservation in magnetic nanoclusters

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We present an *ab initio* theory of ultrafast nanologic elements based on optical Λ-processes [1-3]. Using high-level quantum chemistry we show that in 2- and 3-magnetic-center structures both spin flips and spin transfers are possible within a hundred femtoseconds. From 3-magnetic-center clusters we are able to construct OR, XOR (CNOT), and AND gates [2]. Thus multicenter magnetic clusters allow to exploit spin dynamics for full-fledged logic functionalization.

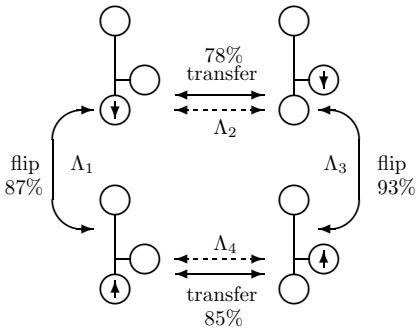

Figure 1: Possible spin-manipulation mechanisms in the Ni_3Na_2 cluster.

In order to explain the angular momentum conservation during the process we propagate in time the intragap levels of a NiO cluster under the influence of a laser pulse [3]. Using quantum optics analysis we show how the coherently induced material polarization leads to angular-momentum exchange between the light and the irradiated antiferromagnetic NiO (001) surface. We also predict a dynamic Kerr-effect, which provides a signature for monitoring spin-dynamics, by simply measuring the transient rotation and ellipticity of the reflected pump beam [1].

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

[2] W. Hübner, S. Kersten and G. Lefkidis, Phys. Rev. B **79**, 184431 (2009).

[3] G. Lefkidis and W. Hübner, Phys. Rev. B **76**, 014418 (2007).