ULTRAFAST COHERENT LASER-SPIN INTERACTIONS IN NANOSCALE OBJECTS

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The present project has the ambition of exploring theoretically and numerically the coherent dynamics of spins excited by intense and ultrashort laser pulses. The interaction of a femtosecond electromagnetic pulse with the electron spin in a ferromagnetic metal has been the object of intense investigations, both theoretical [1] and experimental [2], during the past fifteen years. The main effect that has been observed – though not yet fully elucidated – is the quick loss of magnetization following the excitation by a femtosecond laser pulse [3]. New experiments – carried out at IPCMS in the team led by Dr. Jean-Yves Bigot – have given a new twist to this problem, with promising future developments, both theoretical and experimental.

These experiments have shown the existence of a coherent coupling between a femtosecond laser pulse and the magnetization of a ferromagnetic thin film [4]. The underlying interactions and mechanisms are not yet understood.

A possible mechanism might be the modification by the laser field of the exchange interaction which is responsible for magnetism. This issue will be addressed during this thesis.

In order to tackle this problem, we propose to develop a model of light-matter interaction combining a non-perturbative theory based upon the Kramers-Henneberger translation transformation and a two level molecular model calculation.

Numerical simulations will be also performed in order to compare with available experimental results.

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