Zeeman torque dynamics induced by ultrashort terahertz radiation

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The development and improvement of terahertz emitters [1, 2] has caused a wave of interest in this radiation due to the potential wide range of applications [3]. In particular, usage of the ultrashort terahertz pulse is seen as a potential for ultrafast magnetization switching (by means of Zeeman torque). Moreover, the usage of such radiation requires the simultaneous development of compatible radiation detectors [4] and from this point of view magnetic dynamics can be used for terahertz pulse detection. Therefore, a convenient analytical description of an ultrashort terahertz pulse and an analysis of its influence of the incoming pulse on the magnetic dynamics is an important task.

In this work, we propose a general theoretical model for Zeeman torque dynamics induced by ultrashort terahertz radiation that very well correspond to simulations based on micromagnetic method. It provides the frequency spectrum of the magnetic component of the electromagnetic pulse and analyzes (on the basis of available experimental data for fcc Co [5] and bcc Fe [6, 7]) the possibility to recover information about the pulse magnetic field from the observed response dynamics of the magnetization components (or even one component).

The obtained theoretical dependences could be potentially used to design a new type terahertz detectors based on the sensitivity to the magnetic component of the electromagnetic radiation.

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