MAR11-2010-000552

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

Femtosecond magnetism and spin manipulation on a time-scale of the exchange interaction

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The dynamics of phase transformations on the time-scale pertinent to atomic, orbital and spin motion is a rather unexplored field in physics. This is also a particularly interesting problem of modern magnetism, a study of which may have tremendous consequences for future development of magnetic recording technology. However, generation of magnetic field pulses much shorter than 100 ps and strong enough to reverse magnetization (more than 1T) is an extremely challenging technical problem.As a result the dynamics of the magnetic phase transitions at the sub-100 ps time-scale remains to be one of the most intriguing areas of modern magnetism [1,2]. Recently it has been observed that a 40 fs laser pulse influences spins in a magnet as an equally short pulse of effective magnetic field with a strength up to 20 T [3,4]. In my talk I will discuss how these opto-magnetic pulses can be used to excite a magnet on a time-scale of the exchange interaction between the spins [5-7]. Novel insights into the physics of non-equilibrium magnetism will be provided, showing that two exchange-coupled magnetic sublattices of a ferrimagnet may have totally different spin dynamics [8]. As a result, ultrafast spin reversal of two antiferromagnetically coupled magnetic sub-lattices appears to proceed via a novel ferromagnet-like transient state.

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