Interaction of matter with optical vortices: The role of light-field topology

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ABSTRACT

Over recent years remarkable advances were made in the fabrication and control of optical vortices, i.e. light beams carrying orbital angular momentum. Nowadays such beams are routinely produced in a wide range of frequencies, intensities, and duration [1]. When interacting with matter, optical vortices may transfer a definite and controllable amount of orbital angular momentum [1] and offer so a new way for light-assisted, ultrafast spintronics, particularly in spin-orbit coupled systems [2]. This contribution presents how optical vortices interact with magnetic materials or trigger an orbital charge current in Carbon-based materials such as endohedral molecular magnets [3,4,5], graphene, or graphene nanostructures, as well as semiconductor nanostructures [6] with a strong Rashba spin orbit coupling. We evaluate the associated magnetic field pulses and envisage the possibility of controlling these pulses by tuning the light parameters. These internal magnetic field pulses serve then for steering the local spin dynamics or generating spin polarized currents bursts on a femtosecond time scale.

References

[1] D. L. Andrews, *Structured light and its applications: An introduction to phase-structured beams and nanoscale optical forces* (Academic Press, 2011).
[2] G. F. Quinteiro, P. I. Tamborenea, and J. Berakdar, Opt. Expr. **19**, 26733 (2011).
[3] J. Crose et al. Nat. Mater. **7**, 884 (2008)
[4] R. Westerström et al., J. Am. Chem. Soc. **134**, 9840 (2012)
[4] J. Wätzel, Y. Pavlyukh, A. Schäffer and J. Berakdar, Carbon **99**, 439-443 (2016)
[6] J. Wätzel, and J. Berakdar, Scientific Reports **6**, 21475 (2016)