V O R T R A G S E I N L A D U N G

im Rahmen des gemeinsamen Berufungsverfahrens
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W1-Professur „Theoretical Physics for Matter under Non-Equilibrium Conditions (BerNEM)"

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„From the discovery to the control of THz spin currents: towards ultrafast spintronics"

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The origin of the ultrafast demagnetization has been a mystery for long time. Recently we have proposed an approach based on spin dependent electron diffusion [1-2].

It was predicted [1-2] that spin bunches with velocities higher than the Fermi velocity can be launched from a ferromagnetic material and can be used to strongly manipulate the magnetization of distant layers. Several independent experimental results have confirmed the presence of strong THz spin currents. Our newest experimental findings have showed that 1) spin unpolarised electrons superdiffusing into a ferromagnetic layer can trigger ultrafast demagnetisation [3], 2) spin transport can be used to create an ultrafast increase of magnetisation [4] and 3) superdiffusive spin currents can be tailored by appropriate choice of materials and used to produce broadband THz emission via the inverse spin Hall effect [5].

The impact of these new discoveries goes beyond the field of ultrafast magnetisation dynamics. It shows how spin information can be, not only manipulated but also most importantly transported at unprecedented speeds. This new discovery lays the basis for THz spintronics.

[1] M. Battiato, K. Carva, P.M. Oppeneer, Phys Rev. Lett. **105**, 027203 (2010).

[2] M. Battiato, K. Carva, P.M. Oppeneer, Phys Rev. B **86**, 024404 (2012).

[3] A. Eschenlohr, *et al.*, Nature Mater. **12**, 332 (2013).

[4] D. Rudolf, *et al.*, Nature Comm. **3**, 1037 (2012).

[5] T. Kampfrath, *et al.*, Nature Nanotechnol. **8**, 256 (2013).