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Hot-electron interactions with non-collinear surface spins revealed via image-potential states

Understanding the interactions of hot electrons with localized spins is an important prerequisite for the development of spintronic applications. A model system to investigate these interactions are image-potential states (IPS) forming a Rydberg-like series of unoccupied states in front of surfaces [1]. Using a spin-polarized scanning tunneling microscope (SP-STM) in the field emission mode, we locally investigate IPS above magnets with non-collinear spin textures. Our studies on the double layer (DL) Fe/W(110) spin spiral [2], the DL Fe/Ir(111) spin spiral [3] and the monolayer Fe/Ir(111) nano-skyrmion lattice [4] reveal the IPS local spin quantization axis rotating on the lateral atomic scale. Even high-order IPS located 10 nm away from the surface reflect the non-collinear spin texture, thereby allowing for atomic-scale magnetic imaging at unprecedented large tip-sample distances. Since IPS properties are determined by the unoccupied surface band structure [1,5], our experiments indicate that the exchange-correlations between hot electrons of up to 20 eV and bulk electrons in non-collinear thin-film magnets are governed by all the electron interactions at the Fermi level.

- [1] P. M. Echenique and J. B. Pendry, *J. Phys. C: Solid State Phys.* **11**, 2065 (1978).
- [2] S. Meckler *et al.*, *Phys. Rev. Lett.* **103**, 157201 (2009).
- [3] P. J. Hsu *et al.*, *Phys. Rev. Lett.* **116**, 017201 (2016).
- [4] S. Heinze *et al.*, *Nature Phys.* **7**, 713 (2011).
- [5] M. Nekovee *et al.*, *Phys. Rev. Lett.* **70**, 3099 (1993).

All interested colleagues are welcome to this seminar lecture (45 min. presentation followed by discussion)

Friedrich Aumayr
(LVA-Leiter)

W. Werner
(Seminar Chair)