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CAMPUS UAB. BELLATERRA. BARCELONA

# SEMINAR

## Using Scanning Probe Microscopy for Studying Magnetism on the Nanoscale: Experiments, Models, and Outlook.

**Dr. Markus Ternes,** *Max-Planck Institute for Solid State Research*, *Stuttgart, Germany*

Scanning probe microscopes and, in particular, the scanning tunneling microscope have been shown to be very powerful tools for the investigation of magnetism at the atomic and molecular scale and bear the possibility to detect even nuclear spins.
In my talk I will discuss recent results on the high spin (S=10) prototypical molecular magnet manganese-12-acetate-16 [1] and an all organic radical with S=1/2 [2]. In these molecules we were able to detect the quantum magnetism by inelastic spin-flip excitations [3]. Furthermore, we detect many particle effects which we address to a Kondo screening of the localized spin by the substrate electrons. I will show that the results can be well understood by employing third-order scattering theory using a Kondo Hamiltonian [4] which also allow to get a deeper insight into spectroscopic features measured on single atoms.
In the second part of my talk I will present a new approach using a nitrogen-vacancy (NV) color center in diamond as a spin sensor. By attaching a nanodiamond containing this "probe spin" to the tip of a non-contact atomic force microscope the controlled coupling between the NV and nearby spins on the sample can be achieved, allowing an indirect observation of these spins via the fluorescence signal from the NV [5, 6]. This approach provides an unprecedented sensitivity by exploiting the quantum nature of the NV spin, enabling the coherent manipulation by pulsed detection schemes well known from EPR- and NMR- spectroscopy. In this case the sensitivity is limited by the coherence time of the NV, which exceeds 1ms in pure diamond. This corresponds to an energy resolution on the order of peV.

[1] S. Kahle et al., Nano Lett. 12, 518 (2012).
[2] Y. Zhang et al., accepted for Nature Comm.
[3] A. Heinrich et al., Science 306, 466 (2004).
[4] J. Kondo, Prog. Theor. Phys. 32, 37 (1964).
[5] C. Degen, Appl. Phys. Lett. 92, 243111 (2008).
[6] J.M. Taylor et al., Nature Physics 4, 810 (2008

**REMEMBER**

**Dr. Markus Ternes**

**Microscopy for Studying Magnetism on the Nanoscale: Experiments, Models, and Outlook.**

May 3, 2013 - 12:00 h.
Place: CIN2 Seminar Hall, CIN2 Bldg, UAB
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