PHYSIKALISCHES KOLLOQUIUM

Sommersemester 2024

Das Kolloquium findet (soweit unten nicht anders angegeben) jeweils montags **jeweils montags um 16:15 Uhr online via Zoom** statt.
(Der jeweilige Link wird noch zur Verfügung gestellt.).

03.06.2024

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From single atom magnets to single atom qubits

Abstract

In his talk There's Plenty of Room at the Bottom, given at the APS meeting in 1959, Richard Feynman expressed the vision to ultimately store information in single atoms. The feasibility of magnetic information storage in single atoms has indeed been demonstrated in 2016, where two adsorbate/substrate systems with stable magnetic quantum states were identified [1,2]. These systems were labelled single atom magnets since each of these surface adsorbed single atoms behaves as a classical permanent magnet. The atoms can be magnetized up or down and remain in that state for hours. These results were confirmed by individually addressing these atom [3,4] and several further systems discovered that exhibit these fascinating proper¬ties [5,6]. The temperature at which the magnetization spontaneously relaxes is referred to as energy relaxation time T1 (for the best systems it is infinite at 4 K and a few minutes at 45 K).

The next goal is to explore whether single atom quantum bits are feasible. This requires long-lived magnetic superposition states that can be manipulated by external stimuli. One figure of merit of a qubit is its coherence time T2 with respect to the Rabi period that quantifies how many operations can be performed until the state decays. Encouraged by lanthanide atoms in bulk insulators having long T2 [7], we performed electron spin resonance measurements on single lanthanide atoms adsorbed at surfaces, which is the first step to understand nuclear and electron spin coherence in such systems [8].

[1] R. Baltic et al. Nanolett. 16, 7610-7615 (2016).

[2] F. Donati et al. Science 352, 318-321 (2016).

[3] F. D. Natterer et al. Nature 543, 226 (2017).

[4] F. D. Natterer et al. Phys. Rev. Lett. 121, 027201 (2018).

[5] A. Singha et al. Nat. Communic. 12, 4179 (2021).

[6] B. V. Sorokin et al. Adv. Funct. Mater. 2023, 2213951 (2023).

[7] M. Zhong et al. Nature 517, 177 (2015).

[8] G. Czap, J. Valesco Jr., R. M. Macfarlane, C. Lutz, and H. Brune, to be published.

Für die Dozentinnen bzw. Dozenten der Fakultät

Prof. Dr. Hinkov, Prof. Dr. Hinrichsen, Prof. Dr. Porod, Dr. Ünzelmann und Hr. Kuhr