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Subkelvin spin polarized STM: measuring magnetization curves of individual adatoms

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Magnetic nanostructures consisting of a few atoms on non-magnetic substrates are explored as model systems for miniaturized data storage devices and for the implementation of novel spin-based computation techniques. Since these nanostructures are well defined and controllable on the atomic scale, they are ideally suited to study the fundamentals of magnetic interactions. We used spin polarized scanning tunneling spectroscopy at subkelvin temperatures to image the magnetization of individual adatoms as a function of an external magnetic field. This allows to directly measure their magnetic interactions at very low energy scale. We will present the design of the 300mK STM [1] and then focus on the results. Interestingly, Co atoms on Pt(111) behave paramagnetic even at very low temperatures, 300 times smaller than the previously reported giant barrier between up and down spin [2]. A peculiar variation in the saturation flux density, which is measured for each atom, is found. This is attributed to their mutual indirect exchange via the substrate electrons. Indeed, we observe an interaction between the adatom and a Co monolayer stripe oscillating with distance between ferromagnetic and antiferromagnetic coupling on the scale of the Fermi wavelength.

[1] J. Wiebe et al., Rev. Sci. Instrum. 75, 4871 (2004).
[2] P. Gambardella et al., Science 300, 1130 (2003).