# Magnetic remanence in single atoms

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Stabilizing the magnetization of a single surface-adsorbed atom is the key to store and process information in the smallest unit of matter. To achieve this goal, it is required to stabilize the spin of the magnetic atom against thermal and quantum fluctuations. For a decade, the research in the field focused on 3*d* atoms [1]. However, they all show a paramagnetic behavior down to 0.3 K [2]. Recently, the focus of the research shifted to rare earth atoms, whose 4*f* electrons provide large magnetic moments and anisotropies, as well as an efficient decoupling from the environment.

In this talk, I will show that rare earth atoms exhibit magnetic stability on the timescale of hours when adsorbed on ultra-thin decoupling layers grown on a metal substrate. First, we used X-ray magnetic circular dichroism (XMCD) to prove that Ho atoms on MgO/Ag(100) exhibit magnetic stability, with a spin lifetime of 1500 s at 10 K and hysteretic loops up to 40 K [3]. These features qualify them as the first single atom magnets. Second, combining XMCD with scanning tunneling microscopy, we realized a model bit patterned media made of single Dy atoms. When deposited on graphene/Ir(111), these atoms exhibit magnetic stability at 2.5 K. In addition, the moiré pattern originating from the graphene/Ir lattice mismatch drives a self-assembly mechanism, which allows organizing the Dy atoms into ordered arrays [4]. Our results pave the road to magnetic information storage at the single atom level.

## References

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[4] R. Baltic et al., Nano Lett. 16, 7610 (2016).