Department of Physics
Condensed Matter Physics
Clarendon Laboratory, Parks Road, Oxford OX1 3PU

UNIVERSITY OF OXFORD

CONDENSED MATTER SEMINAR

Thursday 30th of November at 2.15pm

"Magnetic Remanence in Single Rare Earth Atoms"

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Atomic-scale magnets with long magnetic lifetimes represent the smallest unit of matter that can be used to store information [1, 2]. Understanding their properties is the key to reach the ultimate downscaling of magnetic memories. To this end, the main requirement is to retain the magnetization in absence of magnetic field. The fingerprint of this feature is the remanence in magnetic hysteresis loops. Among the widely studied single-ion molecular magnets, the best examples show magnetic remanence up to 20 K [3]. A potential strategy to improve their magnetic stability against temperature is the use of individual atoms adsorbed on the surface, which can provide a reduced interaction with the environment and, consequently, a greater magnetic stability.

In this work, I will present an investigation of single rare-earth atoms supported on non-magnetic surfaces such as Dy on graphene/Ir(111) [4] and Ho on MgO/Ag(100) [5]. Using X-ray magnetic circular dichroism, we demonstrated that these atoms exhibit magnetic lifetimes on the timescale of thousands of seconds at 2.5 K and 0.01 T. These features qualify them as the first single atom magnets. Remarkably, Ho atoms on MgO/Ag(100) exhibit an unprecedented magnetic stability even at higher temperatures. At 0.01 T, we observe magnetic lifetimes of 1500 s up to 10 K. Further increase of the temperature triggers thermally activated relaxation processes and the magnetic lifetime decreases to about 100 s at 30 K. However, in a strong external field of 6.8 T, we observe the magnetic lifetime to remain constant at about 1200 s up to 30 K. Our results suggest that the interaction between magnetic atoms and the environment is frustrated due to the limited number of quantized vibrational modes, hence effectively suppressing spin reversal mechanisms.

Host: Prof Arzhang Ardavan

Audrey Wood Seminar Room, Clarendon Laboratory