

An orbitally driven single atom magnetic memory on black phosphorus

Alexander A. Khajetoorians¹

¹*Scanning Probe Microscopy Department, Institute of Molecules and Materials, Radboud University, Nijmegen, the Netherlands*

a.khajetoorians@science.ru.nl

Single-atom memory represents the ultimate limit in high-density storage and a route toward quantum coherent manipulation. Of particular interest are single magnetic atoms on surfaces, which can represent a bit employing the bi-stability of the magnetic moment, as they offer tunable interatomic coupling and bottom-up design. While atomic spins can have long-lived lifetimes, the key challenge has been to decrease fluctuations induced by spin-sensitive readout or scattering mechanisms utilizing robust magnetic anisotropy. We demonstrate a single-atom magnetic memory derived from bi-stability in the orbital configuration of a single Co atom on semiconducting black phosphorus, yielding two stable and distinct total magnetic moments. Utilizing scanning tunneling microscopy and *ab initio* calculations, we detail the effect of the local tip-induced gate potential and spatially anisotropic wavefunctions on the switching behavior. I will also detail the electronic properties of black phosphorus and intrinsic defects as seen with tunneling spectroscopy. This opens up the possibility of utilizing the orbital degree of freedom for robust single-atom magnetic information storage without requiring spin-sensitive detection, as well as understanding the effect of gating a single atomic bit with an anisotropic charge distribution.