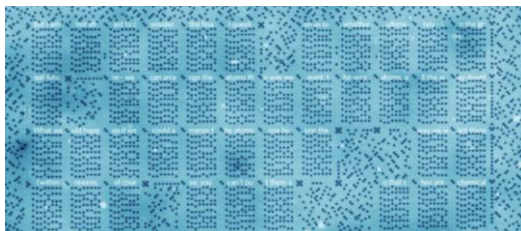


Miniaturization has now reached the limit where the functionality of laboratory prototypes depends on the physical state of a single atom [1]. Examples of these single dopant devices include quantum sensors based on NV point defects in diamond [2] and single dopant transistors [3]. In this talk I will provide a theoretical perspective of the exciting prospects in this research front, focusing on two aspects. First, the challenges and the potential to upscale single atom devices, illustrated with our recent demonstration [4] of a kilobyte where every bit is encoded in a single atomic vacancy on 2D square lattice of Chlorine atoms self assembled on the (100) surface of Cu (see Figure). Second, the electric manipulation of individual of both the electronic and nuclear spin of individual magnetic atoms and point defects on surfaces [5,6], and their potential as quantum bits.

[6] A graphene based nuclear spin quantum computer. N. García-Martínez, J. L. Lado, M. Melle-Franco, J. Fernández-Rossier, in preparation

#### Figures



#### References

- [1] Single atom devices: Quantum Engineering. J. Fernández-Rossier, *Nature Materials* 12, 480 (2013)
- [2] Nanoscale imaging magnetometry with diamond spins under ambient conditions. G. Balasubramanian, et al. *Nature* 455, 648 (2008)
- [3] A single-atom transistor. M. Fuechsle, et al. *Nature Nanotechnology* 7.4 (2012): 242 (2012)
- [4] A kilobyte rewritable atomic memory. F. E. Kalff, M. P. Rebergen, E. Fahrenfort, J. Girovsky, R. Toskovic, J. L. Lado, J. Fernández-Rossier, A. F. Otte, *Nature Nanotechnology* 11, 926 (2016)
- [5] Universal mechanism for electron paramagnetic resonance of individual adatoms. J. L. Lado, A. Ferrón, and J. Fernández-Rossier. arXiv:1611.01110 (2016).