Magnetism of Single Atoms

Single-Atom Spin-Flip

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As we all know the ongoing miniaturization of magnetic data storage as we know it (and inherently, the increase of the capacity) is soon coming to an end. That is because by reducing the size of the magnetic domains on the disk, we inadvertently also decrease the magnetic stability of these domains. Just how abrupt this ending will be is illustrated very well by the following example.Take a magnetic domain that is just large enough to be stable, meaning that it can maintain its magnetization direction (i.e., the data) for, say, 10,000 years at room temperature. Now reduce the volume of this domain by only a factor of two: as a result of this seemingly small change, themagnetic decay time will suddenly drop by more than ten orders of magnitude to mere seconds! This merciless property of nature is known as the superparamagnetic limit.
What is the superparamagnetic limit and how can we find a way to beat it? What happens at the scale of single atoms and what is necessary befor we can store bits on atoms?
In my talk I will try to give an exciting insight into ongoing studies on magnetism of single atoms. We will see which elements provide promising properties and how we can flip a spin state. Further I will talk about spin orientation in absence of a magnetic field in anisotropic environments. In order to understand the magnetic properties of small engeneered structures of less than 10 atoms we will learn about antiferromagnetic coupling. Hopefully this talk will help to understand challenges and prospects for a future using single atoms in high storage density magnetic memories and in classical and quantum computing.