Unlocking the secret of the Kondo Effect

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(PhysOrg.com) -- A team of scientists including researchers from the London Centre for Nanotechnology at UCL (University College London) and the IBM Almaden Research Center has forged a breakthrough in understanding an intriguing phenomenon in fundamental physics: the Kondo effect. The findings are reported online today in the scientific journal *Nature Physics*.

The Kondo effect, one of the few examples in physics where many particles collectively behave as one object (a single quantum-mechanical body), has intrigued scientists around the world for decades. When a single magnetic atom is located inside a metal, the free electrons of the metal 'screen' the atom. That way, a cloud of many electrons around the atom becomes magnetized.

Sometimes, if the metal is cooled down to very low temperatures, the atomic spin enters a so-called 'quantum superposition' state. In this state its north-pole points in two opposite directions at the same time. As a result, the entire electron cloud around the spin will also be simultaneously magnetized in two directions.

Now, using a technique that was developed by the same team in 2007, the researchers have shown that it is possible to predict when the Kondo effect will occur – and to understand why. The key turns out to be in the geometry of a magnetic atom's immediate surroundings. By carefully studying how this geometry influences the magnetic moment (or "spin") of the atom, the emergence of the Kondo effect can now be predicted and understood.

Dr. Cyrus Hirjibehedin, a member of the IBM team who is now a Lecturer at UCL (University College London) and a part of the academic staff of the LCN, said: “This result represents a major advance in our understanding of this fundamental physical phenomenon and could have important consequences for future nanoscale magnetic devices.”

Citation: 'The role of magnetic anisotropy in the Kondo effect', by A. F. Otte, M. Ternes, K. von Bergmann, S. Loth, H. Brune, C.P. Lutz, C.F. Hirjibehedin and A.J. Heinrich, is published in the journal *Nature Physics.*

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