Scientists take another step towards quantum computing using flawed diamonds

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(PhysOrg.com) -- David D. Awschalom, of the Center for Spintronics and Quantum Computation, University of California, Santa Barbara, in a paper published recently in the *Bulletin of the American Physical Society*, describes a way to connect the laser-induced spinning of an electron in a free (defect) space in a diamond, with a nearby nitrogen atom in its natural state, thus, providing a means for creating a quantum data bit (qubit).

Awschalom's discovery takes advantage of the fact that some diamonds have a flaw in them, which at the atomic level means holes are left in the lattice that make up the diamond structure. It is well known that these extra electrons can be made to spin by lasers or even microwaves; what Awschalom did was figure out a way to measure the slight magnetic pull between the free electron and the nucleus of a nearby nitrogen's atom, all based on the spin of the free electron, and then to use that data to ascertain characteristics of the nitrogen atom. And that's all you need to create a qubit.

It's been noted that the spin generated by the laser only lasts about a 100 nano-seconds, which granted isn't very long, but certainly long enough for a high speed computer to perform many calculations. The exceptional thing though is that because the time frame is so short, it would be virtually impossible for anyone to slip in and manipulate the system, thus making a future computer, almost impossible to hack.

To look at the system another way, imagine an array of tops, all spinning

for just one second; if you could ascertain the state of something else, say the string that was pulled to cause each top to spin, based purely on the data contained in the spinning top, then you'd have the equivalent of a qubit; and in quantum computing, that's all you really need; well, that and a method for creating an array of just tops, or with the diamond, all defects.

Scientists have for years been intrigued by the idea of a quantum computer; a machine that relies on natural atomic structures and phenomena; such a machine would be able to perform calculations based on existing materials, such as the flaw in a diamond, rather than have to build them from scratch from comparatively bulky materials. Such a machine would dwarf the capabilities of modern computers due to such physical things as the close proximity of atoms relative to one another as compared to the distance data must now travel through micro-processors, much less data I/O channels.

With his paper Awschalom shows an actual example of a real world way to create an environment where cubits can be created, observed, and maybe even used to someday create an actual quantum computer; yet another step in a very long process.

More information: meetings.aps.org/Meeting/MAR11/Event/138902

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