Researchers light up 'dark' spins in diamond

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Discovery could lead to room temperature quantum computing

Researchers at UC Santa Barbara have potentially opened up a new avenue toward room temperature quantum information processing. By demonstrating the ability to image and control single isolated electron spins in diamond, they unexpectedly discovered a new channel for transferring information to other surrounding spins -- an initial step towards spin-based information processing.

Quantum information processing uses the remarkable aspects of quantum mechanics as the basis for a new generation of computing and secure communication. The spin of a particle is quantum mechanical in nature, and is considered a viable candidate to implement such technologies.

A team of researchers including graduate students Ryan Epstein and Felix Mendoza, and their advisor, David Awschalom, a professor of physics, were intrigued by the long-lived electronic spins of so-called nitrogen-vacancy impurities in the diamond crystal – defects that only consist of two atomic sites. So, about two years ago, they embarked on developing a sensitive room temperature microscope that would allow them to study individual defects through their light emission.

This microscope, with its unique precision in the control of the magnetic field alignment, has allowed them to not only detect individual nitrogen-vacancy defects, but also small numbers of previously invisible 'dark' spins from nitrogen defects in their vicinity. These spins are called 'dark' because they cannot be directly detected by light emission and yet, it appears that they may prove extremely useful.

"We have found a channel for moving information between single electron spins at room temperature," said Awschalom. "This bodes well for making networks of spins, using the dark spins as wires, in order to process information at the atomic level."

The paper, "Anisotropic interactions of a single spin and dark-spin spectroscopy in diamond," is being published by *Nature Physics* in November 2005, and is available through advance online publication at: www.nature.com/nphys/journal/v … /ncurrent/index.html

Source: University of California - Santa Barbara

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