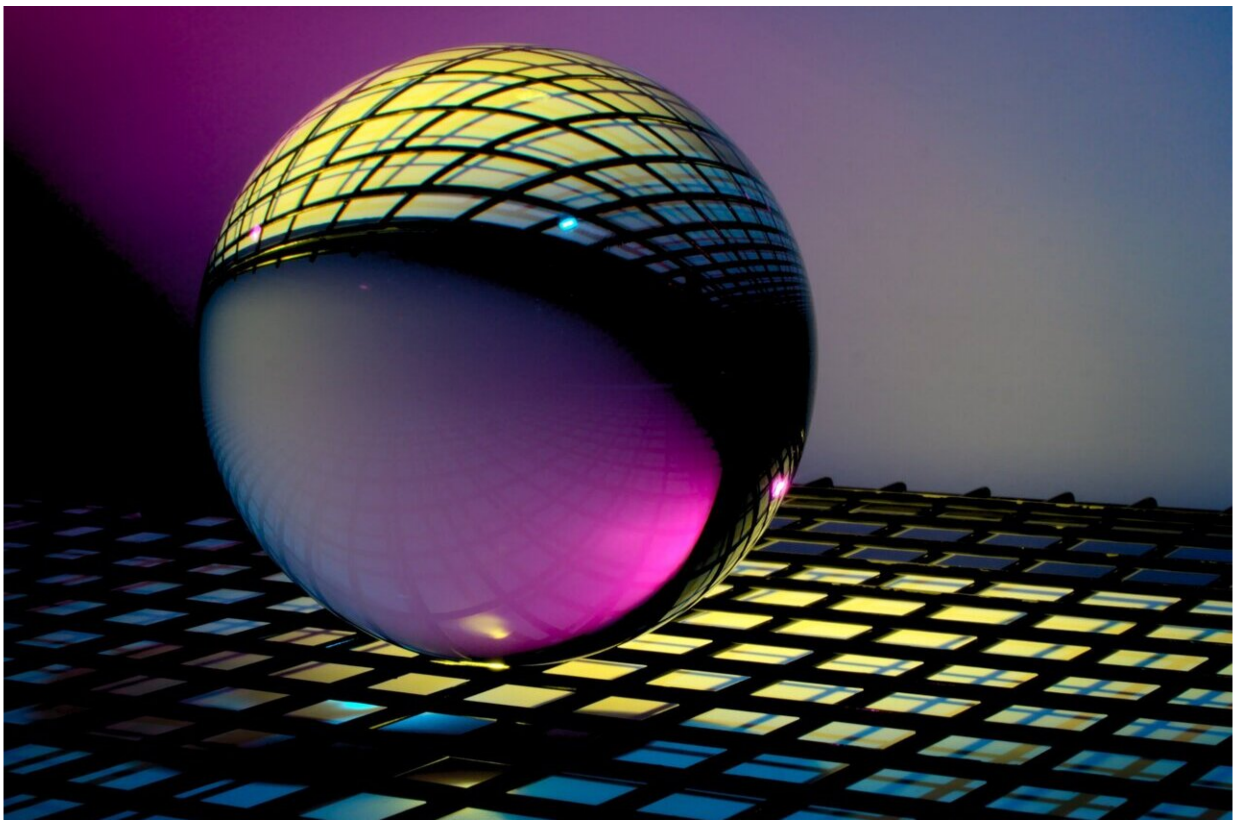
Researchers realize unconventional coherent control of solid-state spin qubits

June 9 2021



Credit: Unsplash/CC0 Public Domain

A research team led by Prof. Guo Guangcan from the University of Science and Technology of China (USTC) of the Chinese Academy of Sciences (CAS), together with Prof. Adam Gali from Wigner Research

Centre for Physics, realized robust coherent control of solid-state spin qubits using anti-Strokes (AS) excitation, broadening the boundary of quantum information processing and quantum sensing. This study was published in *Nature Communications*.

Solid-state color center spin qubits play an important role in quantum computing, quantum networks and high-sensitivity quantum sensing. Considered as the basis of quantum technology application, optically detected magnetic resonance (ODMR) technology offers a readout approach to detect the spin state. Conventional ODMR detection of solid-state spin states is almost all under Strokes excitation, which requires that the excitation laser has higher energy than emitted photons.

To extend the scope of solid-state quantum technologies, the researchers first realized the AS excited ODMR detection of silicon vacancy defect spin in silicon carbide (SiC), where the energy of exciting laser is lower than that of the emission photons.

By investigating the dependence of laser power and temperature on AS excited ODMR signals, the researchers proved that the AS photoluminescence (PL) was induced by phonon-assisted single photon absorption process, and was applicable to all-optical high-temperature temperature sensing.

On the basis of this, they found that AS and Strokes excited ODMR followed similar behavior facing the change of laser power, microwave (MW) power and temperature, while the AS ODMR contrast remained approximately three times larger than the Strokes one.

Furthermore, the researchers realized the coherent manipulation of solid-state spin states in SiC under AS excitation. The results showed that the AS excitation method increased the signal contrast by around three times, enabling the potential applications of AS excited ODMR approach to quantum information processing and quantum sensing.

This study improves any ODMR-based measurement. This AS demonstration can be used in yet unforeseen development.

More information: Jun-Feng Wang et al, Robust coherent control of solid-state spin qubits using anti-Stokes excitation, *Nature Communications* (2021). DOI: 10.1038/s41467-021-23471-8

Provided by University of Science and Technology of China