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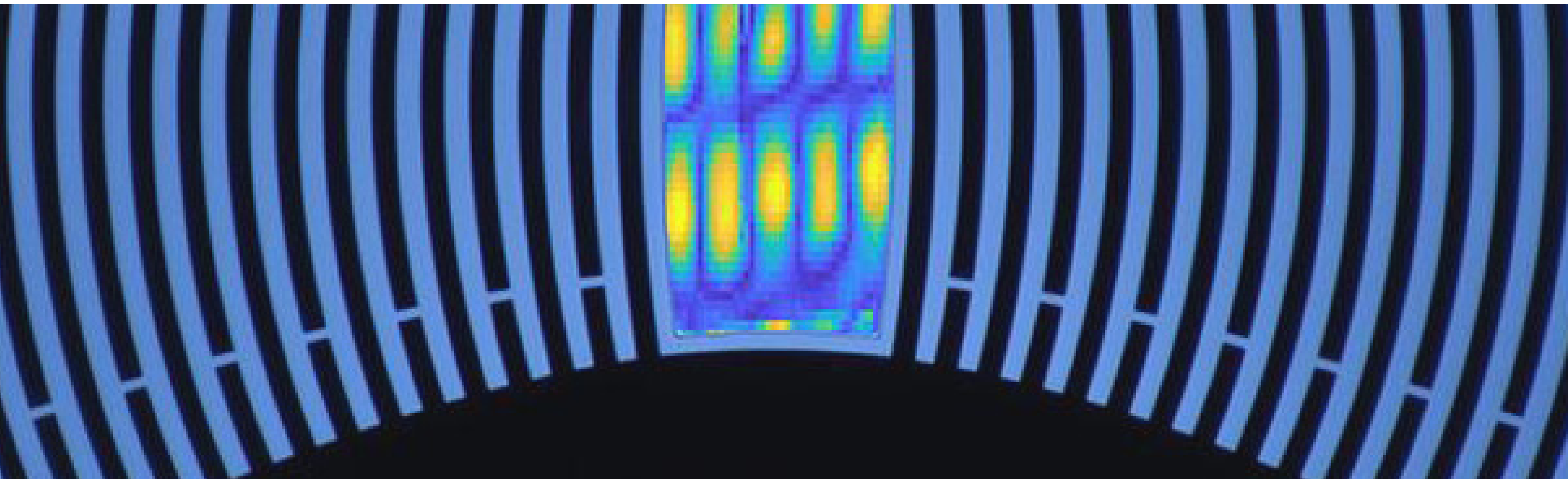

SOUND WAVES **CARRY INFORMATION BETWEEN QUANTUM SYSTEMS**

THE IMPETUS

Communicating quantum information is a challenging task — it is difficult to move the information more than a few microns — but, since different quantum systems represent quantum information in different ways, combining more than one type into a hybrid system could take advantage of the strengths of each one. For instance, optical photons can send quantum states across long distances, and an electron's spin state stores information, a means to expand the binary information storage system used in traditional computing. Researchers at the Center for Nanoscale Materials (CNM), a U.S. Department of Energy (DOE) Office of Science user facility located at Argonne National Laboratory, studied a hybrid quantum system that acoustically drives transitions in electron spin, demonstrating a basis for mechanical (strain) control of three-level spin systems.

THE WORK

CNM researchers together with collaborators from the University of Chicago, Argonne, Tohoku University in Japan and the University of California at Santa Barbara, developed a theoretical model from a combination of direct experimental observation and density functional theory calculations, which illustrated the types of mechanical strain that drive longer-lasting spins. The researchers used silicon carbide, which has been shown recently to support long-lived spin states that can be accessed optically.

The researchers demonstrated spin transitions driven by sound waves on long-lived spin ensembles in silicon carbide through different quantum systems and compared their relative coupling strengths.

This work used the Hard X-ray Nanoprobe beamline at the CNM and Advanced Photon Source, another DOE Office of Science user facility.

THE IMPACT

The results offer theoretical understanding and experimental demonstrations of controlling the spin states in silicon carbide. They provide a basis for quantum sensing with microelectromechanical systems as well as applications in electromechanical frequency filters, micro-fluidic devices and sensors in diverse areas.

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