E. R. MacQuarrie, T. A. Gosavi, N. R. Jungwirth, S. A. Bhave, and G. D. Fuchs

Mechanical Spin Control of Nitrogen-Vacancy Centers in Diamond

Phys. Rev. Lett. ***111**, 227602 (2013)*

We demonstrate direct coupling between phonons and diamond nitrogen-vacancy (NV) center spins by driving spin transitions with mechanically generated harmonic strain at room temperature. The amplitude of the mechanically driven spin signal varies with the spatial periodicity of the stress standing wave within the diamond substrate, verifying that we drive NV center spins mechanically. These spin-phonon interactions could offer a route to quantum spin control of magnetically forbidden transitions, which would enhance NV-based quantum metrology, grant access to direct transitions between all of the spin-1 quantum states of the NV center, and provide a platform to study spin-phonon interactions at the level of a few interacting spins.

M. Warner, S. Din, I. S. Tupitsyn, G. W. Morley, A. M. Stoneham, J. A. Gardener, Z. Wu, A. J. Fisher, S. Heutz, C. W. M. Kay, and G. Aeppli

Potential for spin-based information processing in a thin-film molecular semiconductor

Nature ***503,** 504–508 (2013)*

Organic semiconductors are studied intensively for applications in electronics and optics, and even spin-based information technology, or spintronics. Fundamental quantities in spintronics are the population relaxation time (T_1) and the phase memory time (T_2): T_1 measures the lifetime of a classical bit, in this case embodied by a spin oriented either parallel or antiparallel to an external magnetic field, and T_2 measures the corresponding lifetime of a quantum bit, encoded in the phase of the quantum state. Here we establish that these times are surprisingly long for a common, low-cost and chemically modifiable organic semiconductor, the blue pigment copper phthalocyanine, in easily processed thin-film form of the type used for device fabrication. At 5 K, a temperature reachable using inexpensive closed-cycle refrigerators, T_1 and T_2 are respectively 59 ms and 2.6 μs, and at 80 K, which is just above the boiling point of liquid nitrogen, they are respectively 10 μs and 1 μs, demonstrating that the performance of thin-film copper phthalocyanine is superior to that of single-molecule magnets over the same temperature range. [*...continues*]

Y. E. Kraus, Z. Ringel, and O. Zilberberg

Four-Dimensional Quantum Hall Effect in a Two-Dimensional Quasicrystal

Phys. Rev. Lett. ***111**, 226401 (2013)*

One-dimensional (1D) quasicrystals exhibit physical phenomena associated with the 2D integer quantum Hall effect. Here, we transcend dimensions and show that a previously inaccessible phase of matter—the 4D integer quantum Hall effect—can be incorporated in a 2D quasicrystal. Correspondingly, our 2D model has a quantized charge-pump accommodated by an elaborate edge phenomena with protected level crossings. We propose experiments to observe these 4D phenomena, and generalize our results to a plethora of topologically equivalent quasicrystals. Thus, 2D quasicrystals may pave the way to the experimental study of 4D physics.

J. Lee and F. Wilczek

Algebra of Majorana Doubling

Phys. Rev. Lett. ***111**, 226402 (2013)*

Motivated by the problem of identifying Majorana mode operators at junctions, we analyze a basic algebraic structure leading to a doubled spectrum. For general (nonlinear) interactions the emergent mode creation operator is highly nonlinear in the original effective mode operators, and therefore also in the underlying electron creation and destruction operators. This phenomenon could open up new possibilities for controlled dynamical manipulation of the modes. We briefly compare and contrast

related issues in the Pfaffian quantum Hall state.

A. Shuvaev, V. Dziom, A. Pimenov, M. Schiebl, A. A. Mukhin, A. C. Komarek, T. Finger, M. Braden, and A. Pimenov

Electric Field Control of Terahertz Polarization in a Multiferroic Manganite with Electromagnons

Phys. Rev. Lett. ***111****, 227201 (2013)*

All-electrical control of a dynamic magnetoelectric effect is demonstrated in a classical multiferroic manganite $DyMnO_3$, a material containing coupled antiferromagnetic and ferroelectric orders. Because of intrinsic magnetoelectric coupling with electromagnons a linearly polarized terahertz light rotates upon passing through the sample. The amplitude and the direction of the polarization rotation are defined by the orientation of ferroelectric domains and can be switched by static voltage. These experiments allow the terahertz polarization to be tuned using the dynamic magnetoelectric effect.

S. Kim, S. Yoshizawa, Y. Ishida, K. Eto, K. Segawa, Y. Ando, S. Shin, F. Komori

Unexpectedly robust protection from backscattering in the topological insulator Bi$_{1.5}$Sb$_{0.5}$Te$_{1.7}$Se$_{1.3}$

arXiv:1312.0073 [cond-mat.mes-hall]

Electron scattering in the topological surface state (TSS) of the bulk-insulating topological insulator Bi$_{1.5}$Sb$_{0.5}$Te$_{1.7}$Se$_{1.3}$ was studied using quasiparticle interference observed by scanning tunneling microscopy. It was found that not only the 180° backscattering but also a wide range of backscattering angles of 100°--180° is effectively prohibited in the TSS. This conclusion was obtained by comparing the observed scattering vectors with the diameters of the constant-energy contours of the TSS, which were measured for both occupied and unoccupied states using time- and angle-resolved photoemission spectroscopy. The unexpectedly robust protection from backscattering in the TSS is a good news for applications, but it poses a challenge to the theoretical understanding of the transport in the TSS.

A. L. Falk, P. V. Klimov, B. B. Buckley, V. Ivády, I. A. Abrikosov, G. Calusine, W. F. Koehl, Á. Gali, D. D. Awschalom

Electrically and mechanically tunable electron spins in silicon carbide color centers

arXiv:1311.6832 [cond-mat.mes-hall]

The electron spins of semiconductor defects can have complex interactions with their host, particularly in polar materials like SiC where electrical and mechanical variables are intertwined. By combining pulsed spin resonance with ab-initio simulations, we show that spin-spin interactions within SiC neutral divacancies give rise to spin states with an enhanced Stark effect, sub-10**-6 strain sensitivity, and highly spin-dependent photoluminescence with intensity contrasts of 15-36%. These results establish SiC color centers as compelling systems for sensing nanoscale fields.

P. Pirro, T. Brächer, A. Chumak, B. Lägel, C. Dubs, O. Surzhenko, P. Görnet, B. Leven, B. Hillebrands

Spin-wave excitation and propagation in microstructured waveguides of yttrium iron garnet (YIG)/Pt bilayers

arXiv:1311.6305 [cond-mat.mes-hall]

We present an experimental study of spin-wave excitation and propagation in microstructured waveguides patterned from a 100 nm thick yttrium iron garnet (YIG)/ platinum (Pt) bilayer. The life time of the spin waves is found to be more than an order of magnitude higher than in comparably sized metallic structures despite the fact that the Pt capping enhances the Gilbert damping. Utilizing microfocus Brillouin light scattering spectroscopy, we reveal the spin-wave mode structure for different excitation frequencies. An exponential spin-wave amplitude decay length of 31 {\mu}m is observed which is a significant step towards low damping, insulator based micro-magnonics.