A similar benefit could accrue to the field of quantum information. Normally, it's desirable for qubits to retain their state for as long as possible, but sometimes it's necessary to wipe the slate clean and start again.

Finally, the results may be applicable to the NMR technique of dynamic nuclear polarization. Because an atom's nuclear spin states are so close in energy, even under a strong applied magnetic field, it can be difficult to coax more of them into one state than the other. In a typical MRI, for example, nuclear polarization is measured in parts per million. Electron spins are easier to polarize because of their stronger magnetic moments, and under some circumstances it's possible to transfer electron polarization into nuclear polarization via a so-called flip-flop transition. The Bi–electron spin pairs undergo just such a transition—due to selection rules, flipping the electron spin necessarily changes the direction of the coupled Bi nuclear spin. It's possible that other flip-flop transitions could also be accelerated on demand.

Bertet and colleagues' next step is to follow their original plan and work toward a nanoscale resonant circuit. The smaller dimensions promise not only single-spin ESR sensitivity but even faster spontaneous emission.

Johanna Miller

References

1. A. Bienfait et al., *Nature* (in press) doi:10.1038/nature16944.
2. E. M. Purcell, *Phys. Rev.* **69**, 681 (1946).
3. T. Sleator et al., *Phys. Rev. Lett.* **55**, 1742 (1985).
4. A. Bienfait et al., *Nat. Nanotechnol.* (in press), doi:10.1038/nnano.2015.282.

USING CARS TO GAUGE TORNADO STRENGTH

NOAA

In the 1996 blockbuster *Twister*, a semi-articulated fuel truck is lofted and flung by a writhing tornado into the path of the movie's storm-chasing heroes. Doubtless the filmmakers conceived the scene to demonstrate the fake tornado's terrible strength, but as a new study concludes, the movement of vehicles can actually be used to evaluate the strength of real tornadoes. Marius Paulikas and Thomas Schmidlin of Kent State University and Timothy Marshall of Haag Engineering examined field surveys of 959 passenger vehicles struck by tornadoes in 1994–2008. After classifying the vehicles according to whether they had been unmoved, displaced, rolled, or lofted, the researchers correlated the movements with the tornadoes' strength as determined by the damage inflicted on houses, trees, and other structures. For category EF3 and EF4 tornadoes, whose 136–200 mph winds can knock over trains and destroy entire stories of houses, 63% of cars were displaced, with 15% rolled or lofted. But for EF1 and EF2 tornadoes, whose 86–135 mph winds can upturn mobile homes and uproot trees, 65% of cars were not moved at all. Currently, wind's impact on cars is not taken into account when assigning an EF category to a tornado. Paulikas, Schmidlin, and Marshall's study suggests that including cars could improve the scale's accuracy, especially in the absence of buildings and trees. It also suggests that cars could be safer havens than mobile homes. (M. J. Paulikas, T. W. Schmidlin, T. P. Marshall, *Weather Climate Soc.* **8**, 85, 2016.) —CD

dub neutrino magnetohydrodynamics (NMHD), systematically extends MHD, which treats a plasma's electrons and ions as fluids and considers the dynamics of the magnetic field they produce, to include the weak interaction, which in particle physics describes the coupling between neutrinos and electrons. Adopting standard simplifying assumptions from MHD theory, the researchers obtain a set of 11 coupled partial differential equations that they show should hold over a range of astrophysical conditions. In particular, they find that neutrinos can prevent magnetic field lines from freezing, even in an ideal plasma. They also derive a new, neutrino-driven plasma instability that should play a central role in a supernova's strongly magnetized environment. (F. Haas, K. A. Pascoal, J. T. Mendonça, *Phys. Plasmas* **23**, 012104, 2016.) —RJF

COMBING FOR A SIGNAL BURIED IN NOISE

Picking out a signal from a sea of noise is a ubiquitous research challenge. If the signal recurs, multiple measurements can be appropriately averaged to improve the signal-to-noise ratio. For a single transient event, Fourier decomposition—breaking the signal down into its frequency components—can help isolate signal from noise. The signal's frequency components are correlated in phase with each other, whereas those of the noise are not. When the components are summed as complex numbers that encode phase and amplitude, only the signal adds up coherently. Calculating the Fourier transform works well enough for slow signals lasting a few microseconds, but faster signals run up against the resolution limits of both detectors and analog-to-digital converters. Now a University of California, San Diego, group led by Stojan Radic has employed tunable optical frequency combs, developed in Radic's lab, to catch those faster signals. (For more on frequency combs, see Physics Today, June 2000, page 19.) The researchers used two phase-locked combs with slightly different spacing between their teeth. They combined a test signal—an 80-ps microwave pulse laden with white noise—with the first comb to make copies of the signal at each tooth. Using the second comb's teeth as reference frequencies, the researchers measured a narrow slice of each copy and thus partitioned the data into frequency bins. The outputs of those bins could then be summed. The gain in signal-to-noise ratio is limited only by the number of copies one can generate. The researchers have tested up to 300 copies for a gain of 25 dB. The group's tunable frequency combs are already commercially available, and Radic is eager to see how other researchers put his setup to use. (V. Ataie et al., *Science* **350**, 1343, 2015.) —SC PT