Physics News Update

The AIP Bulletin of Physics News

Number 793, September 20, 2006 by Phil Schewe, Ben Stein, and Davide Castelvecchi

Stronger Hurricanes Linked to Climate Change

A new study of climate data suggests that global warming is causing the Atlantic Ocean to generate deadlier hurricanes. Hurricanes have become stronger in recent decades, in apparent correlation with the raise in atmospheric temperatures. Indeed James Elsner of Florida State University in Tallahassee reports in Geophysical Research Letters that there is in fact a clear cause-and-effect link.

Less than three weeks after Hurricane Katrina, a study published in Science showed that, while the number of tropical cyclones had not increased between 1970 and 2004, their strength had surged: Category-4 or -5 hurricanes where more than 50 percent more frequent in the second half of that period than in the first (**Webster *et al.***, Science, 16 September 2005).

The same period saw a rise in global atmospheric temperatures -- widely attributed to the accumulation of greenhouse gases such as CO_2 -- and in sea-surface temperatures in the Atlantic, where hurricanes are born. Some climatologists believe that global (atmospheric) warming is causing the oceans' temperatures to rise, and that warmer sea surfaces can in turn add to a hurricane's strength. But others attributed nature's increased wrath to a long-term cyclic fluctuation in sea temperatures called the Atlantic Multidecadal Oscillation. Opinions also varied on whether a warmer atmosphere can significantly make the oceans warmer, and on the extent to which sea temperatures contribute to hurricane strength.

Elsner (jelsner@garnet.acns.fsu.edu, 850-644-8374) used an elaborate statistical method (first devised by economics Nobel Prize winner Clive Granger) to answer the first of those two questions. He examined spikes in global atmospheric temperature (using satellite and ground-based data collected by the Intergovernmental Panel on Climate Change) and compared them to seasonal changes in average sea-surface temperatures for the entire northern-hemisphere part of the Atlantic (based on National Atmospheric and Oceanic Administration data). His analysis showed that the spikes in atmospheric temperature mostly tended to come right before hurricane-season spikes in oceanic temperature, suggesting that the first were causing the second. Global warming could indeed be causing stronger hurricanes.

Elsner, Geophysical Research Letters, 23 August 2006

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Room-Temperature Spin Hall Effect

A new experiment by David Awschalom and his colleagues at the University of California, Santa Barbara, plus collaborators from Pennsylvania State University, shoots a stream of electrons through a sample of a non-magnetic semiconductor, and segregates the electrons in such a way that those with spins pointing up are steered to the left while those with downward pointing spins deflect to the right. They also demonstrated that they could polarize the electrons (orient their spins) using only electric fields at room temperature as well, a great boon for prospective spintronics circuitry that would fashion a new form of electronics in which both charge and spin provide ways of storing and processing data.

Strangely, Awschalom's new results -- showing a spin current all the way up to room temperature -- is conducted not in Gallium Arsenide, where most previous observations of the spin Hall effect have been made, but in Zinc Selenide, which should not be as efficient at electrically polarizing spins.

Awschalom (awsch@physics.ucsb.edu, 805-893-2121) says that the evidence that the spin Hall effect is strong even in a material where it should be weak will kindle further an interesting controversy swirling around interpretations of the spin Hall effect. The new experiment is a spin equivalent of the conventional Hall effect known since the 19th century.

In the old Hall effect electrons, moving longitudinally through a sample under the force of an applied electric field will, if exposed to a vertically oriented magnetic field, be deflected slightly to one side of the sample. Two years ago physicists showed that a kind of Hall effect could be used to steer spins (to be more exact, electrons polarized with spins up or down) so that even while no pileup of electric charges at the edge of the sample would occur a net pileup of spins would occur (see Physics Today, February 2005).

In another recent experiment, Awschalom and colleagues showed that the spins wouldn't just pile up; they could be led off into a wire and constitute a polarized current, where they would be to a spintronic circuit of spin transistors what an ordinary current is to ordinary electronics.

Two articles in Physical Review Letters:
Sih *et al.*, in the 1 September 2006 issue, and
Stern *et al.* in the 22 September 2006 issue
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