

Alfvén waves may solve solar-corona mystery

The outer parts of the solar corona are millions of degrees hotter than the surface of the Sun – a fact that has puzzled astrophysicists for quite some time (*CERN Courier* June 2008 p8). Now David Jess of Queen's University Belfast and colleagues have made major progress in unravelling this mystery. Using the 1 m Swedish Solar Telescope on La Palma in the Canary Islands they observed a tiny conglomeration of highly magnetized bright points on the Sun's surface. Their observations show evidence for Alfvén waves, oscillations of magnetized plasma, moving up from the lower solar atmosphere, which may hold the key to the coronal heating.

Hannes Alfvén predicted such waves in his seminal paper of 1942. Their incompressible nature and ability to penetrate the solar atmosphere have made them likely candidates for heating the solar corona. However, Alfvén waves on the Sun had evaded unambiguous observation until now, owing to difficulties in getting clear-enough images of small parts of the Sun using Earth-based telescopes. The long-wavelength plasma oscillations that Jess and colleagues have observed appear to follow magnetic field lines towards the corona. They seem to be capable of carrying enough heat to the corona to explain its high temperature.

Further reading

H Alfvén 1942 *Nature* **150** 405.

David B Jess et al. 2009 *Science* **323** 1582.

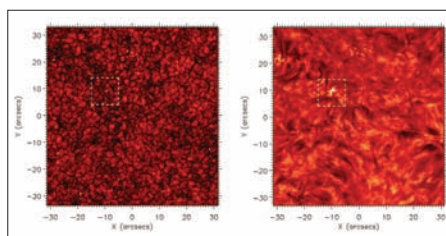


Fig. 1. Simultaneous hydrogen-alpha images in the photosphere (left) and chromosphere (right), obtained with the Swedish Solar Telescope. The square marks the group of bright points investigated. (The scale is in heliocentric coordinates, where 1 arc sec is around 725 km.)

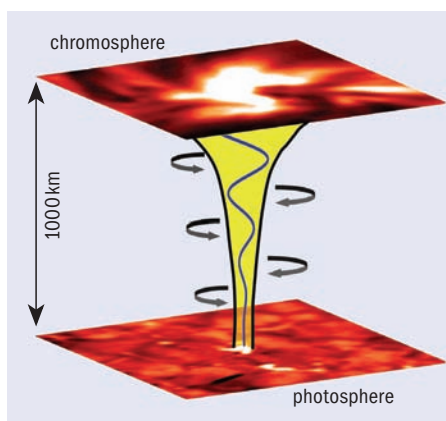


Fig. 2. An expanding magnetic-flux tube between images obtained for the photosphere and chromosphere (not to scale) undergoes a torsional perturbation and generates a wave that propagates longitudinally in the vertical direction.

Noise can make itself logically useful

Traditional logic represents “1” and “0” by rather sharp voltage levels – something that noise makes difficult to control in nanoscale circuitry. William Ditto of Arizona State University in Tempe and colleagues have built reliable logic circuits that rely on noise to work.

The idea is to exploit stochastic resonance, whereby noise can boost the detectability of an otherwise low “1” signal, while not driving

a “0” signal to look like a “1”. The nonlinear circuitry used for the logic gates offers another advantage: suitable control voltages used rapidly to make a single gate act as a NAND or a NOR – enough for any other logic circuit.

Further reading

K Murali et al. 2009 *Phys. Rev. Lett.* **102** 104101.

Carbon nanotubes make ‘muscles’

Aerogel ribbons drawn from forests of carbon nanotubes can act spectacularly as an artificial muscle of sorts. Ali Aliev and colleagues of the University of Texas at Dallas have created the material that, in response to an applied voltage, rapidly and reversibly triples in width and thickness while contracting in length.

With the strength and stiffness of steel in one direction and more flexibility than rubber in the other two, such ribbons can operate over temperatures ranging from that of liquid nitrogen to the melting point of iron. Perhaps even more remarkable, the ribbons are optically transparent.

Further reading

Ali E Aliev et al. 2009 *Science* **323** 1575.

Brain patterns show sleep deprivation

When you lose concentration and “tune out” your brain activates what is called the “default network” – rather like a screen saver of the mind. However, it does so differently if you’re sleep deprived compared with if you’re not. Ninad Gujar of the University of California, Berkeley, and colleagues used functional magnetic-resonance imaging to observe the workings of the brains of sleep-deprived and well rested people as they pushed a button in response to viewing a picture.

In both cases the “default network” was activated between pictures, but there were significant changes in the activation patterns of sleep-deprived brains. It was possible to gauge with 93% accuracy if a volunteer was sleep deprived or not from the altered activity in only two areas of the brain – both associated with decreased performance on memory tests. Being tired really does appear to have major impacts on the functioning of the brain.

Further reading

Tina Hesman Saey 2009 *Science News* **23** March web edition (http://www.sciencenews.org/view/generic/id/42054/title/Tired_brain_defaults_differently).