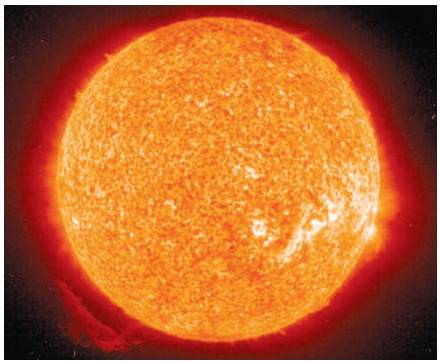
The Sun unplugged



Astrophys. J. (in the press); preprint at <http://arxiv.org/astro-ph/0703535> (2007)
Every eleven years or so, the magnetic poles of the Sun switch positions amid extreme solar activity. The magnetically enhanced regions of the solar chromosphere (the layer between the surface of the Sun and the corona) are characterized by jets. During the active phase of the Sun, the jets are known as spicules or dynamic fibrils, depending on their location. But even during the quiet phase there is some activity, appearing as dark mottles near areas of high magnetic-flux concentration.

Many believe these dynamic features are related, but convincing evidence has been lacking. Using high-resolution spatial and temporal measurements, Luc Rouppe van der Voort *et al.* track quiet-Sun mottles throughout their brief lifetime. The deceleration, maximum velocity and parabolic trajectory of the jets indicate that a subset of mottles are driven by acoustic shock waves produced when convective flows and oscillations enter the chromosphere along magnetic field lines — the same mechanism behind their active counterparts, the dynamic fibrils.

Unseen invisible

Phys. Rev. Lett. **98,** 132001 (2007)
In high-energy physics, a detector is designed to register the visible signatures of particles — the tracks they leave, or the energy they deposit. But an experiment can also be sensitive to the invisible. Using the Belle detector at KEK in Japan, O. Tajima *et al.* have searched for what can't be seen, and their results have implications for dark matter.

Inside the KEKB accelerator, electrons and positrons collide head-on at known energies: non-conservation of energy and momentum among the post-collision fragments can indicate that invisible particles were created. The only known invisible particles are neutrinos (in this context), but supersymmetric neutralinos — candidate particles for dark matter — might exist and, if they are sufficiently light, could also be produced in the KEKB collisions.

Tajima *et al.* have analysed 11 million decays of a particle known as $\Upsilon(3S)$ — comprising a bottom and antibottom quark — to a $\Upsilon(1S)$, which can then decay into invisible particles. They find that the fraction of invisible decays is too small to suit the hypothesis of neutralinos whose mass is less than that of the bottom quark.

Pushy photons

Phys. Rev. Lett. **98,** 133601 (2007)
An intense laser beam can deform the interface between two fluids. For a downward travelling beam, from a higher to lower index of refraction, a jet of the upper liquid will flow into the lower one, ending in a trail of droplets. But a beam travelling in the opposite direction creates an upward deflection — a broad hump — of the interface, which remains continuous, and a central, downward narrow 'tether'.

Robert Schroll and co-workers propose that large-scale fluid flow would explain the effects. For liquids close to the critical phase transition, which marks the miscibility boundary, fluctuations between the two phases are large, and they scatter light. For the broad hump, the scattering results in an upward force that pushes fluid against the interface, while the conservation of mass flow causes a downward flow, which results in a toroidal recirculation of the fluid that can account quantitatively for the shape of the broad hump. The jet is more complicated, but their model provides a reasonable estimate of the jet size and transport flow.

Neutrino news

Preprint at <http://www.arXiv.org/abs/0704.1500v1> (2007)
It might be a null result, but the first data from the MiniBooNE experiment at Fermilab, Chicago, have resolved a decade-old controversy in particle physics.

In 1996, an experiment known as LSND (for 'liquid scintillator neutrino detector') produced data that supported the notion of neutrino oscillations — that the three types of neutrino, electron, muon and tau, can change from one into another — and thereby implied that neutrinos have mass. But the LSND data were out of kilter with the growing body of evidence from other experiments, such as Super-Kamiokande and SNO — the implied ranges of the neutrino masses were inconsistent. Was there some problem with the LSND data, or could they instead be suggesting that there are more than three neutrinos?

Enter MiniBooNE, a small version of the proposed Booster Neutrino Experiment (BooNE), which has now performed a clever cross-check of the LSND result. MiniBooNE sees no signal consistent with that reported by LSND. It seems that the 'LSND anomaly' is no more and there are indeed only three neutrinos (for the moment, at least).

You can tell by the way I use my walk…

Opt. Express **15,** 3271–3284 (2007)
A state-of-the-art system that controls access to a secure facility conjures up images of a fingerprint reader or iris scanner. Few would imagine one that recognizes a person from the way they walk — yet Juan-Shuen Fang and colleagues describe a simple system that does exactly this.

Their system consists of a low-cost pyroelectric infra-red sensor mounted with a multi-element Fresnel-lens array and remotely interfaced to a personal computer. When a person walks past the device it records a time-varying heat signature that is unique to that person and remarkably consistent from one pass to the next. Using a principal-component-analysis algorithm to process the data from the detector, the system was able to recognize the gait of four different subjects, and distinguish them from that of an unknown stranger, with a success rate of 80%.

PYTHON PICTURES/RGA