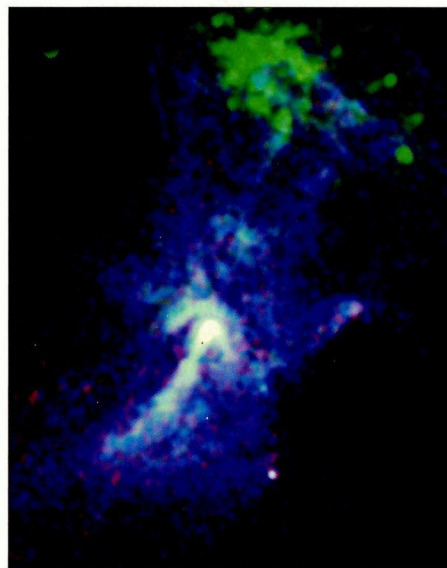


Black holes could act like cosmic particle accelerators

Usually we think of black holes pulling things in rather than hurling them out, but C Chicone and B Mashhoon of the University of Missouri would argue differently. While radially moving particles do get pulled towards the black hole, it turns out that our intuition is not so good when it comes to swarms of ultrarelativistic particles moving tangentially to it.

Tidal forces, the researchers argue, can accelerate the particles to almost the speed of light. The interactions of the charged particles with the ambient medium can then lead to the transfer of this tidal energy to particles in the ambient medium. These can escape from the system to appear far away as ultra-high-energy cosmic rays.

Chicone and Mashhoon say that this acceleration mechanism agrees with observations by the Chandra X-ray Observatory of accelerated motion normal to the radial jets in four neutron stars in our galaxy: the Crab Pulsar, the Vela Pulsar, PSR B1509-58 and SNR G54.1+0.3. The mechanism may also account for ultra-high-energy cosmic rays with energies above the Greisen-Kuzmin-Zatsepin cut-off for extragalactic sources of 10^{20} eV. Microquasars or neutron stars in our galaxy could be sources of the highest-energy cosmic rays – an idea



Neutron stars such as the pulsar PSR B1509-58, observed here by the Chandra X-ray Observatory, could be cosmic particle accelerators. (NASA/MIT/B Gaensler et al.)

that the Pierre Auger Observatory may help to shed light on in the near future.

Further reading

C Chicone and B Mashhoon 2005
<http://arxiv.org/abs/astro-ph/0502560>

Plastic electronics might benefit from memory technology

A new non-volatile rewritable memory device based on an unusual combination of technologies could provide an inexpensive and highly robust way to store information. A team from the University of Groningen and Philips Research in the Netherlands has demonstrated a ferroelectric field-effect transistor (FeFET) made with a ferroelectric fluoropolymer and a bisalkoxy-substituted poly (p-phenylene vinylene) semiconductor material.

The ferroelectric material provides an alternative means of band-bending in the FET, but at greater magnitude than in conventional devices, which are limited by breakdown of the gate insulator. This is the first demonstration of a non-volatile plastic-memory technology that meets the performance needs of commercial plastic electronics applications. It could enable new concepts, such as food packaging that alerts consumers when its contents are getting close to their “use by” date.

Further reading

Ronald C G Naber et al. 2005 *Nature Materials* 4 243.

Role of air pressure in splashes revealed

Suppose that rain fell on the Moon? This is a question that Sidney Nagel of the University of Chicago in Illinois and colleagues have asked and to which they found a remarkable answer: the drops would not splash. It is common in fluid mechanics that things cannot be explained in detail because the Navier-Stokes equations are so complicated, but this finding really flies in the face of intuition. It turns out that splashing is reduced as air pressure drops, so the air plays an integral role in the formation of a splash. Below about 0.2 atm of pressure, drops of alcohol simply do not splash at all. So, suppose vodka spilled on the Moon...

Further reading

New Scientist 2 April 2005 p14.

GIMPS finds largest prime number yet

On 18 February Martin Nowak, an eye surgeon and amateur mathematician from Germany, found the largest prime number yet, with an amazing 7 816 230 digits. He used more than 50 days of CPU time on a 2.4 GHz Pentium 4 computer – plus some additional help. Tens of thousands of participants in the Great Internet Mersenne Prime Search (GIMPS) lent spare cycles to the effort, demonstrating how a computational Grid can do big calculations.

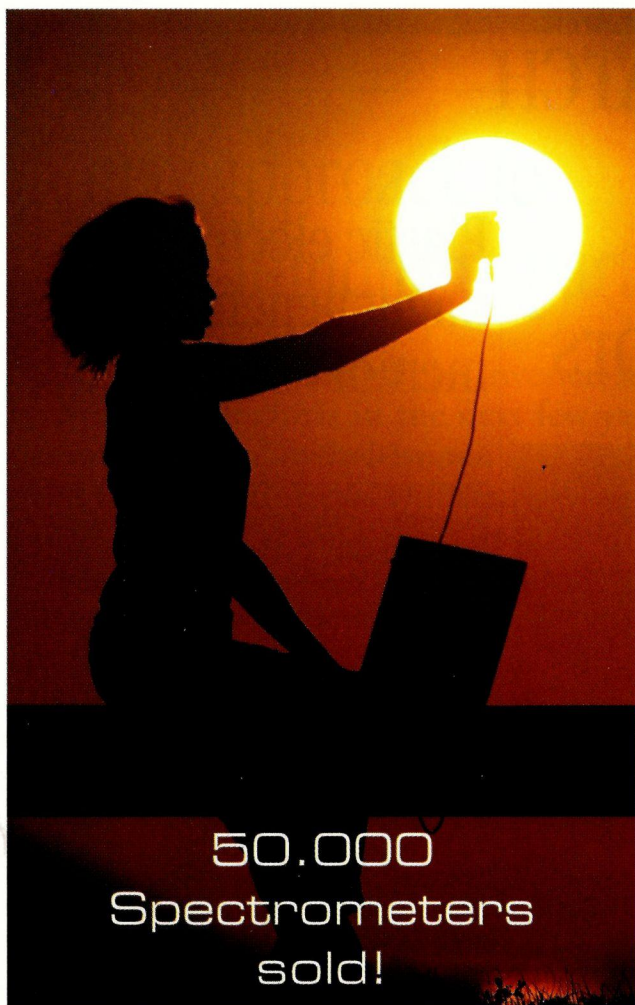
The result was independently verified in five days by Tony Reix of Grenoble, using a 16 Itanium CPU Bull NovaScale 5000 HPC and again by Jeff Gilchrist of Elytra Enterprises in Ottawa, who used 15 days of time on 12 CPUs of a Compaq Alpha GS160 1.2 GHz

CPU server at SHARCNET. The prime is a “Mersenne Prime”, which is of the form $2^p - 1$, where p is a prime. In this case the power is 25 964 951.

There is no immediate application of such an enormous prime, but for those who like a challenge the Electronic Frontier Foundation is offering a prize of \$100 000 for the first prime with 10 million digits and \$250 000 for a prime with 1000 million digits. You can also obtain a poster containing the entire new prime number!

Further reading

www.mersenne.org/
www.eff.org/awards/coop.html



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