stellar processes[2]. In this case, the key is to weigh the relevant nuclei, and hence determine what role they will play in the stellar environment. It sounds straightforward, but when the object of attention is ^{65}As (containing 33 protons and 32 neutrons) with a half-life of only 130 ms, nothing should be taken for granted. As they report in *Physical Review Letters*, Tu *et al.*[1] — who are an international team of scientists from China, France, Germany, Japan and the USA — have achieved that feat, using a new ion storage ring built in Lanzhou, on the banks of the Yellow River. The dams along the Yellow River act as waiting points in the river's progress towards the sea, so this is perhaps a fitting location in which to tackle the puzzles surrounding astrophysical waiting points.

The core of the Lanzhou facility is the experimental cooler storage ring (Fig. 1), which is part of an accelerator complex at the Institute of Modern Physics. It is only the second storage ring of its kind in the world, the first being at the Helmholzzentrum für Schwerionenforschung in Darmstadt, Germany[3]. There has been close cooperation between the two centres, and now the Chinese facility has produced its first high-profile results[1].

For the first step of the laboratory measurement, a beam of ^{78}Kr ions (36 protons, 42 neutrons) was accelerated, using the Lanzhou cyclotron and main storage ring, to an energy of 31 GeV (71% of the speed of light). Beam bunches, each containing about 10^8 krypton ions, were then steered into a beryllium target. Any nucleus-on-nucleus collisions result in pieces being sheared off the beam nucleus, a process known as fragmentation. The fragments were separated in flight using a magnetic device, and — with now only some 20 ions in each bunch — steered into the cooler storage ring, where they circulated for about a millisecond before losing too much energy.

Inside the ring, a thin carbon foil recorded the passage of each ion for more than 300 revolutions. This provided sufficient information for simultaneous calibration of the ring properties (using ions of known mass) and measurement of new masses. It took only 200 μs to measure the mass of ^{65}As, so its 130-ms half-life proved to be more than adequate. After 49 such measurements of ^{65}As, the final result has an energy-equivalent uncertainty of just 85 keV, out of a total of 60 GeV.

With this excellent precision, and comparing with the known mass of ^{64}Ge (which has one proton less than ^{65}As), the final proton in ^{65}As was determined to be unbound by only 90 ± 85 keV. This is a small amount and less than was expected. The timescale for proton emission depends sensitively on this energy, because, for the proton to get away from the nucleus, it must tunnel through a Coulomb barrier. In this case there is therefore more time than had been assumed for ^{65}As to capture another proton in the X-ray burst environment.

Consequently, ^{64}Ge is no longer thought to be a waiting-point nucleus — at least not for the expected X-ray-burst conditions — with the result that the whole timescale for X-ray bursts is predicted to be shorter. This means that the nuclear physics parts of the process are now better defined, and it will be possible to make more reliable comparisons with X-ray-burst observations. ❐

Philip Walker is in the Department of Physics, University of Surrey, Guildford GU2 7XH, UK.
e-mail: p.walker@surrey.ac.uk

References

1. Tu, X. L. *et al. Phys. Rev. Lett.* **106,** 112501 (2011).
2. Schatz, H. *et al. Phys. Rep.* **294,** 167–263 (1998).
3. Franzke, B. *Nucl. Instrum. Methods Phys. Res. B* **24–25,** 18–25 (1987).

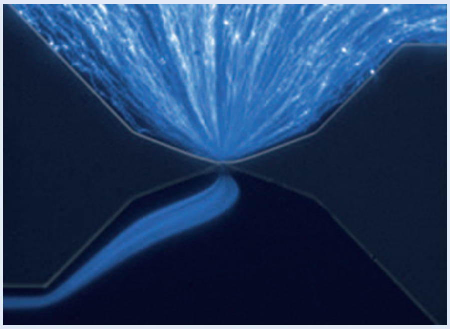
MICROFLUIDICS

Catching (and counting) a cold

A detector that is able to count viruses one by one at a rate of up to 500,000 every second has been constructed by Jean-Luc Fraikin and colleagues (*Nature Nanotechnol.* doi:10.1038/nnano.2011.24; 2011).

Rapid improvements in materials engineering and imaging technology has brought us face to face with the tiny world of the nanoscale — structures too small to be seen by conventional optical microscopes. Nanoparticles, both man-made and natural, abound and there is a growing need, particularly in medical applications, to analyse them quickly. But present separation techniques, such as a centrifuge, tend to only produce averages over necessarily large samples. Fraikin *et al.* now show how microfluidics provides a solution that is far more precise.

Microfluidic systems, in which liquids flow along micrometre-wide channels, are fast developing into an important analysis tool because they operate in a flow regime very different from the one that governs bulk liquids. The rewards are a far higher degree of analyte control and a route towards so-called lab-on-a-chip technology.



J. FRAIKEN *ET AL.*

The sensor designed by Fraikin *et al.* comprises two 'fluidic resistors', which resist an ionic electrical current passing along the microfluidic channel. The first resistor has a fairly constant resistance, but the second is a nanoconstriction in the channel (pictured), and its resistance depends heavily on whether there is a particle present or not. A sensing electrode between the two resistors measures the corresponding changes in electrical potential.

This approach is sensitive enough to distinguish between particles of different sizes by recording the length of time each one spends in the constriction. Constriction times down to two or three microseconds are readily detectable, which equates to a maximum count rate of approximately 500,000 particles per second.

Fraikin *et al.* tested the applicability of their system using an archetypal bacterial virus known as the T7 bacteriophage suspended in both salt solution and blood plasma. Intriguingly, the experiment could detect both a 60-nanometre-diameter singlet version of the virus and a larger dimer version, a distinction not possible using laser-based measurement techniques.

The device is made from low-cost materials using tools that are already available and so it should be cheap and simple to mass produce. Importantly, and unlike many other detection schemes, the particles do not need to be labelled.

DAVID GEVAUX