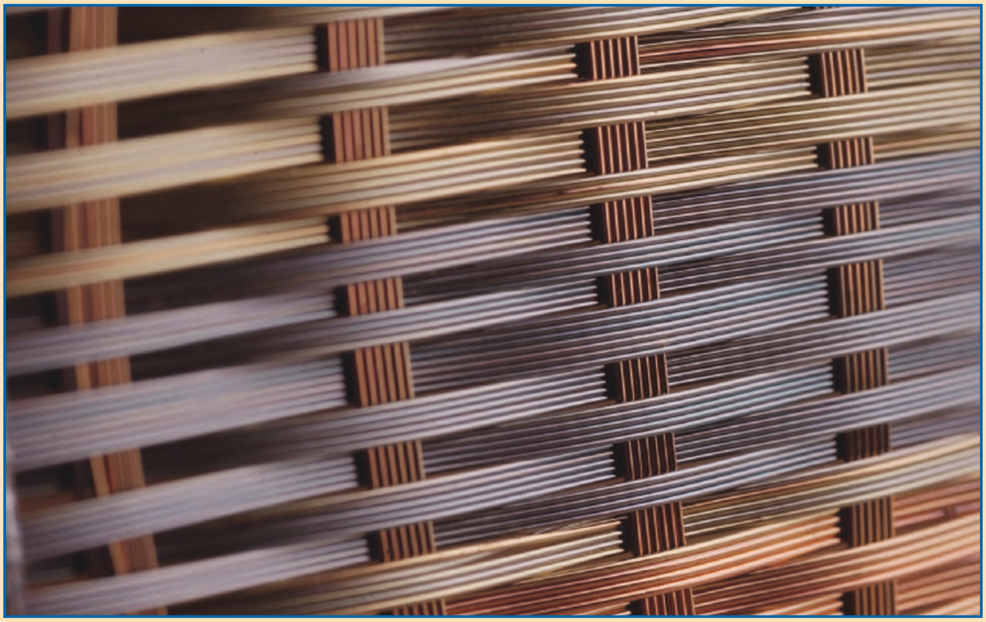
Optical fibres

A light fabric



It might seem an unlikely addition to the world of fashion design, but the creators of this new fabric (right) claim that it is wearable. Mehmet Bayindir and colleagues have melted together strands of optical, metallic and insulating materials to form fibres that are then woven into what they call a "spectrometric fabric" (*Nature* **431,** 826–829; 2004). Each fibre has separate channels for transmitting light and electrical currents, and these affect each other in subtle ways to create an intricate web of optical and electrical patterns.

The fabric would make curious clothing indeed, but it serves to demonstrate the level of sophistication reached in the design of optical fibres. We are all familiar with their use in high-speed telecommunication networks, but the past decade has seen the development of a new range of optical fibres with periodic structures along their length that are on the scale of the wavelength of the light transmitted. This microstructure dramatically affects the way the light is guided through the fibres. By choosing the right pattern, fibres can be made to transmit a certain range of wavelengths, or optical pulses with specific shapes. Such tailored properties could be used, for example, in beam delivery for medical or industrial laser applications, or even in the all-optical processing of data.

Bayindir *et al.* go a step further and consider what fibre-based applications could benefit from both electronic and optical functionality. The main challenge is to find the right combination of metallic, insulating and semiconductor materials that can be drawn together into metres of fibres with continuous structures along their entire lengths. Using a low-melting-point material such as tin for the metal parts is crucial, the authors report.

They have come up with an application that makes the most of all the favourable features of these new fibres: a two-dimensional photodetector based on an interwoven grid. The fibres generate electrical currents when they sense light anywhere along their length, and the grid geometry provides an effective means of determining the exact location of an illuminating spot. **Liesbeth Venema**

neutrons increases the total binding energy of the system[2]. This is always the case in reactions between a halo nucleus and a stable nucleus. In contrast to these fusion-enhancing mechanisms, it has been demonstrated that even stable nuclei, if weakly bound, can break up before reaching the fusion-barrier radius, resulting in a suppression of complete fusion if one or more of the fragments escape the target nucleus[3]. So, is the probability of fusion in reactions involving halo nuclei enhanced or suppressed compared with reactions involving non-halo isotopes?

In an earlier experiment that compared the reactions of ^{4}He and ^{6}He nuclei when fired at a uranium (^{238}U) target, much-increased product yields — attributed to fusion — were found for ^{6}He, at energies below the fusion barrier[4]. But were these large yields really due to fusion, or to other processes? Fusion with a target nucleus of ^{238}U results in fission, which is used as a robust signal of the preceding fusion. However, fission can also result from the transfer of neutrons from ^{6}He to ^{238}U. Raabe and colleagues[1] have disentangled these two processes, by looking both for fission fragments and for the ^{4}He core that remains following neutron transfer. Fission events that are detected in coincidence with ^{4}He nuclei are attributed to transfer reactions; those with no coincidence are attributed to complete fusion. Raabe and colleagues' data provide a clear demonstration that the large fission yields below the fusion barrier do not result from fusion with ^{6}He, but from neutron transfer. This conclusion is in line with other measurements[5,6] that have identified large probabilities for neutron transfer in the reactions of ^{6}He and ^{8}He with lighter target nuclei — copper, zinc and osmium.

Quantum-mechanical calculations by Nakatsukasa *et al.*[7] offer some insight into what is happening to the halo during the collision. They have modelled the behaviour of the halo neutron of the beryllium isotope ^{11}Be in collisions with another heavy nucleus, the lead isotope ^{208}Pb. They find that the deceleration of the ^{10}Be core in the Coulomb field of the ^{208}Pb nucleus is sufficient for there to be a substantial probability that the halo neutron will be torn from the ^{11}Be nucleus. If the nuclear attraction between the halo neutron and the ^{208}Pb nucleus is also taken into account, that would further enhance the probability of transfer. In the reaction studied by Raabe *et al.*[1], the energy gained through the transfer of the two halo neutrons to the ^{238}U target nucleus is much larger still, so transfer should be even more favourable. The weak coupling of the halo neutrons to the ^{4}He core, together with the wide extent of the halo, leads to a picture in which the halo neutrons can be grabbed from the ^{6}He nucleus by the ^{238}U nucleus when the two are still some distance from each other. Thus at smaller separations, close to the fusion-barrier radius, there is little chance of this transfer assisting the fusion process.

A strange new picture is emerging of the interaction of the neutron halo. We speculate that a largely sequential process occurs. The halo extends to such a large radius, and its coupling to the target nucleus is so strong, that the nuclei finally coming into contact at the fusion-barrier radius are most likely to be the core of the projectile nucleus and a target nucleus that has already 'eaten and digested' the halo neutrons. Thus there is little or no fusion of the halo nucleus itself but — and this *is* novel — we have fusion of the projectile core with a more neutron-rich, possibly unstable, excited target nucleus. ■

David Hinde and Mahananda Dasgupta are in the