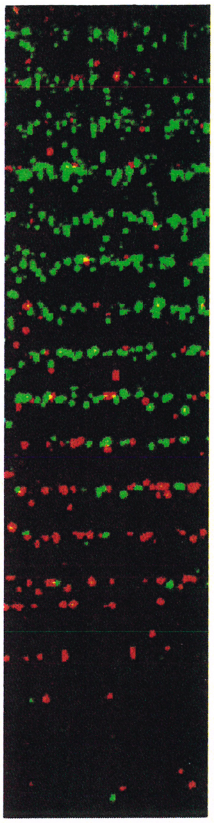
Physics Update

White blood cells sort themselves by type in artificial capillaries. While 7 μm red blood cells (which carry oxygen) easily deform to pass through a 4–5 μm capillary, 10 μm white blood cells (which are essential to the immune system) must squeeze through the entrances and stick at the exits with the help of complex elastic, chemical and hydrodynamic forces. Robert Austin (Princeton University) and his collaborators have built an array of artificial capillaries—rows of side-by-side 5×5 μm polyurethane channels, with lengths ranging from 20 to 110 μm. Sending fluorescently labeled white blood cells through the channels (from top to bottom in the figure), the researchers observed that the orange–red T-lymphocytes (antibody-producing cells from the thymus) penetrated farther into the array than did the green-stained granulocytes and monocytes. Modeling showed that the T-cells lowered their sticking probability in proportion to the local granulocyte cell density, a form of "heteroavoidance." The unexpected self-sorting process suggests that the artificial capillaries could serve as a tool for isolating white blood cell populations and identifying blood cell disorders. (R. H. Carlson *et al.*, *Phys. Rev. Lett.* **79**, 2149, 1997.) —BPS



The smallest nonzero branching ratio to date has been measured. Calculating and then measuring the relative likelihoods (branching ratios) of the different routes of particle decay are important diagnostics for the Standard Model (SM) of particle interactions. A particularly rare form of decay transforms the K^+ meson into a π^+ meson, a neutrino and an anti-neutrino—a flavor-changing neutral current process that could point toward non-SM physics. This particular decay route is quite sensitive to the coupling between top and down quarks. The large E787 Collaboration, working at Brookhaven National Laboratory, has examined more than a trillion K^+ decays and, after years of applying ever tighter constraints, has finally found one event with the telltale signature. The event has an estimated background of 0.08 events. The resulting branching ratio for this particular K^+ decay is $(4.2\,^{+9.7}_{-3.5}) \times 10^{-10}$, consistent with SM expectations, which are centered at 1×10^{-10}. In the next year or so, additional data should help firm up the numbers. (S. Adler *et al.*, *Phys. Rev. Lett.* **79**, 2204, 1997.) —PFS

A DNA–gold biosensor has been demonstrated. Single strands of DNA have a remarkable talent for recognizing and attaching to complementary strands. If one strand is snipped in half, the intact complementary strand will bring the "lost" halves back together. This is the principle used by Northwestern University scientists, who glued various "probe" DNA segments onto 13 nm gold particles suspended in a solution. When an intact "target" strand of DNA in the solution happens to complement DNA segments already stuck to the particles, the probes and target link up, drawing the nanoingots together into a polymer-linked network. The optical properties of this web of gold are very different from those of the original solution—the color changes in a well-defined temperature-dependent way. Should the target have one or two base imperfections (such as base pair mismatches), the color change occurs at a different temperature. The researchers have extended this approach to a simple solid-state spot test, which under unoptimized conditions can detect 10 femtomoles of single-strand target DNA. (R. Elghanian *et al.*, *Science* **277**, 1078, 1997.) —PFS

The oceans' circulation could be halted by the rapid addition of atmospheric greenhouse gases and the associated global warming, according to Thomas Stocker and Andreas Schmittner of the University of Bern in Switzerland. Warm surface currents such as the Gulf Stream transport huge amounts of heat to northern latitudes, and release it to the atmosphere. The loss of heat is accompanied by an increase in water density; the denser water sinks and returns south as a cold, deep flow. The addition of freshwater—less dense than seawater—slows down the overturning. Beyond a critical threshold of freshwater input (first proposed in 1961), the entire "thermohaline circulation" grinds to a stop, with severe consequences for global climate and ocean ecology. Enter global warming, which is expected to both warm the surface waters and increase high-latitude precipitation, pushing the North Atlantic Ocean closer to the threshold; this effect has been seen in models before. The Bern researchers used a simplified coupled ocean–atmosphere climate model—consistent with the more elaborate, more computer-intensive models—and found, surprisingly, that the rate of increase of greenhouse gases is as crucial a parameter for reductions in the thermohaline circulation as the actual amount of the gases. If confirmed by other modelers, the result implies that acting soon to slow down greenhouse gas emissions could help stabilize ocean circulation for the long haul. (T. F. Stocker, A. Schmittner, *Nature* **388**, 862, 1997.) —SGB ■