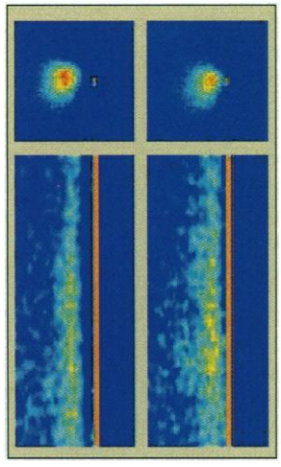
ATOM OPTICS

Attractive Wire Guides Atoms Out of Trap

It's not easy to manipulate individual atoms. For a start, you must confine them in a magneto-optical trap—a device that holds a small cloud of atoms in a magnetic field and cools them down to almost absolute zero—and then your options are still pretty limited. The most researchers have been able to do is to tweak the trap's magnetic field to move the atoms around, allow them to drop under gravity, or kick them out with pulses of light (see p. 1611). But now, researchers at Innsbruck University in Austria have gained a new mastery of atoms with current-carrying wires that can guide atoms just as optical fibers guide light.



Riding the tube. Atoms caught in magnetic field tube next to current-carrying wire.

The technique, described in the 8 March issue of *Physical Review Letters*, could be used in small nanostructures that would manipulate atoms as handily as integrated circuits guide electrons. Ultimately such "atom optics" might even provide components for quantum computers. This research is a "step in the right direction" toward the creation of integrated atom optics, says physicist Wolfgang Ketterle of the Massachusetts Institute of Technology.

The Innsbruck researchers, led by physicist Jörg Schmiedmayer, took advantage of the small magnetic field that atoms gain from the quantum mechanical "spin" of their electrons. An atom is repelled by an external magnetic field if it is parallel to its own and attracted to one that is antiparallel. So the researchers took some cold lithium atoms from a trap and nudged them in the direction of a current-carrying wire that generates its own magnetic field, looping around the length of the wire. Any approaching atoms with a magnetic field antiparallel to the wire's get caught up in this field and begin to orbit the wire. If they also have momentum parallel to the wire, they will spiral along it, guided by the magnetic field.

There are not many circumstances when you can spiral atoms down a free-floating wire, so the team also attempted a slight variation on the technique. They superimposed an additional magnetic field across the wire that has the effect of canceling the wire's field on one side, creating a "tube" of field parallel to the wire that has a minimum in its center. Atoms whose parallel field would normally be repelled by the wire can get trapped in the region of low field and channeled along the tube next to the wire. The team was able to take pictures of the atoms following the wire by briefly illuminating them with lasers, causing them to luminesce.

This side-guiding technique is particularly appealing to atom opticians because it could allow them to construct wires on a surface and, with the help of an external magnetic field, channel atoms along specific paths just above the surface. Says Schmiedmayer: "You could mount the side-guide wire on a surface and use nanofabrication technology to produce very small wires and structures," devices that might serve as the hardware for a quantum computer. "In fact, we are trying to make such small structures now." Ketterle adds that the Innsbruck group isn't the only one developing techniques to guide atoms. "There are quite a few efforts made now to use magnetic fields, wires, miniaturized permanent magnets, and laser light to build new traps, new guides, and new mirrors for atoms," says Ketterle.

—ALEXANDER HELLEMANS

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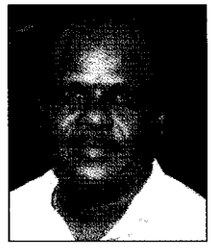
BIOPROSPECTING

Model Indian Deal Generates Payments

NEW DELHI—A native community and an Indian research institute this month will collect the first payment from a landmark agreement to market a herbal tonic derived from a local plant. The agreement is seen as a model for so-called bioprospecting efforts endorsed by the 1992 Convention on Biological Diversity.



The medicine is based on the active ingredient in a plant, *Trichopus zeylanicus*, found in the tropical forests of southwestern India and collected by the Kani tribal people. Scientists at the Tropical Botanic Garden and Research Institute (TBGRI) in Trivandrum, Kerala, isolated and tested the ingredient and incorporated it into a compound, which they christened "Jeevani"—giver of life. The tonic is being manufactured by the Aryavaidya Pharmacy Coimbtore Ltd., a major Ayurvedic drug company.

The process marks perhaps the first time that cash benefits have gone directly to the source of the knowledge of traditional medicines, says Graham Dutfield, an ecologist with the Working Group on Traditional Resource Rights at the University of Oxford, U.K. "It is a replicable model because of its simplicity," he says about a chain of events that began well before the international biodiversity treaty was signed.

TBGRI scientists learned of the tonic, which is claimed to bolster the immune system and provide additional energy, while on a jungle expedition with the Kani in 1987. A few years later, they returned to collect samples of the plant, known locally as arogyapacha, and began laboratory studies of its potency. In November 1995, an agreement was struck for the institute and the tribal community to share a license fee and 2% of net profits. Another agent from the same plant is undergoing clinical tests for possible use as a stamina-building supplement for athletes.

The first $21,000 payment, to be shared by the tribal community and the institute, is due later this month. P. Pushpangadan, until last month the institute's director, predicts that the deal will "not only generate mass employment but also be a money spinner for the poverty-stricken tribals." He compares its potential value to the booming market for ginseng, cultivated in Southeast Asia.

But some scientists are skeptical of such claims, and a few even question the agreement's underlying principles. Dan Janzen, an ecologist at the University of Pennsylvania, Philadelphia, who works in Costa Rica and helped broker a deal between the government and Merck for bioprospecting there, calls it a "publicity and political move by the participants, the benefits of which may disappear within a few years." Although he acknowledges the value of drug search and discovery in the wild, he deplores a mindset that assumes the "produce of those at some lower class" should be readily available for exploitation "by the decision-makers of a given society."

Rich harvest. A team led by P. Pushpangadan, left, helped develop a popular tonic from an extract of India's arogyapacha plant.

CREDITS: (TOP) *PHYSICAL REVIEW LETTERS* **82** (10), 2014 (1999); (BOTTOM) TBGRI