Hydrogen atoms chill to quantum sameness

Atoms of the simplest element, hydrogen, have finally yielded to efforts to supercool them into a single quantum-mechanical state. Coaxing hydrogen into a Bose-Einstein condensate—in which millions of ultracold atoms behave as one mega-atom—is a landmark, physicists say, because hydrogen is the lightest, most abundant, and best understood element.

The achievement caps a 20-year effort by physicists Thomas J. Greytak and Daniel Kleppner of the Massachusetts Institute of Technology, who persevered after other hydrogen-research groups gave up. In 1995, a team using the alkali metal rubidium raced past them to make the first sample of the remarkable form of matter (SN: 7/15/95, p. 36), predicted in 1924 by Albert Einstein and Satyendra Nath Bose. Since then, 10 other groups have also made alkali condensates, including sodium and lithium versions (SN: 5/25/96, p. 327).

Word of hydrogen's condensation leaked out of the MIT group soon after Dale G. Fried, Thomas C. Killian, and others working under Greytak and Kleppner spotted a telltale boost in the density of their pooled atoms in June. Kleppner formally described the results early this month at the Summer Course of the Enrico Fermi International School of Physics in Varenna, Italy.

The condensate is made up of an estimated 100 million atoms—the most so far in any Bose-Einstein condensate. Because the coordinated quantum states of condensates allow them to double as atomic lasers (SN: 2/1/97, p. 71), the large population of the hydrogen version could mean brighter, longer-lasting pulses. Such lasers might be used for depositing or etching circuits and other microstructures, researchers speculate.

The new hydrogen condensate may also emit a more focused atomic laser than other condensates, Greytak says, although that has yet to be confirmed by the team.

Physicists particularly welcome the new condensate because hydrogen's minimal one-proton–one-electron structure offers the simplest case to study. "Experiments in this system might give greater understanding about the alkali [condensates]," says Allan Griffin of the University of Toronto. He notes that certain atomic interactions have been calculated exactly for hydrogen but can only be approximated for the more complex alkalis.

Since such interactions are also crucial to atomic flow, the new condensate "might also give us greater understanding of superfluidity," he adds (SN: 2/7/98, p. 95).

In the late 1970s, when chilling atoms to very low temperatures began to become possible, hydrogen was seen as the most promising candidate for a Bose-Einstein condensate. Having the lowest mass of any element, it was expected to condense at the highest temperature.

That prediction has held so far. Hydrogen condensed at 40 microkelvins. By improving upon cooling technology first developed by their hydrogen-research rivals, scientists working on alkali elements were quicker to reach the still lower temperatures—less than 2 microkelvins—needed to make their condensates. —*P. Weiss*

Muscle cells in damaged hearts may divide

Crooners who lament that broken hearts never mend may need to find another tune. New evidence suggests that, contrary to scientific consensus, heart muscle cells do divide and the number of cells can increase.

The vast majority of heart muscle cells, or myocytes, had been thought to stop dividing by the time a person reaches the age of 9. These cells then pump blood for the rest of a healthy person's life. In people stricken by a heart attack, the cells die and are replaced by scar tissue.

The first report of a human myocyte caught in the act of dividing appears in the July 21 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES. The myocyte came from a left ventricle, the most powerful chamber of the heart and the one most afflicted by heart attacks. Piero Anversa of New York Medical College in Valhalla, N.Y., and his colleagues used a powerful optical microscope to look for dividing cells in tissue damaged by heart attacks. They detected cell nuclei that were splitting.

"When we saw that, we really jumped," Anversa says. Other scientists searching for dividing heart cells had not tried that technique, he adds.

The finding strengthens the possibility that scientists can develop medical treatments to enhance cell division and restore healthy heart muscle, says Anversa. It is too soon, however, to know to what extent such treatments might repair damaged hearts, such as those suffering congenital heart disease (see p. 62).

Anversa and his colleagues at the University of Udine in Italy, studied hearts removed from 27 people who had received transplants. The researchers stained slices of heart tissue half a micrometer thick and used a confocal microscope to count the individual cell nuclei caught in the process of division. Judging from these samples, he and his colleagues estimate that 131 to 152 myocytes in every million were dividing.

That proportion suggests that the cells of a damaged ventricle could be replaced within a year, the researchers calculate. However, many heart-attack victims do not recover their previous pumping efficiency nearly that quickly.

Anversa speculates that if new cells merely enlarge the heart, the weakened organ may suffer further damaging strain. If the cells grow in a way that thickens the heart wall, however, they might make the organ stronger. Scientists don't yet know how to influence cell division to regenerate healthy tissue.

The extent of cell proliferation that Anversa observed remains controversial. Myocytes can contain multiple nuclei, so dividing nuclei do not necessarily provide the best measure of cell proliferation, comments Kenneth R. Chien of the University of California, San Diego. However, Anversa says, the proportion of myocytes with multiple nuclei does not increase after heart attacks.

If the findings allow scientists to modify heart cell division, "it will be tremendously important," says Radovan Zak of the University of Chicago. —*J. Brainard*

Zapping curbs alien spinach

Many Asians appreciate the taste of water spinach and its ability to fortify the diet with iron. Considered a nuisance plant in the United States, it's not legally available. Indeed, that's why many immigrants import this *Ipomoea aquatica* and plant it near their new homes. Lacking natural predators, it quickly begins covering lakes, streams, drainage ditches, and even soggy land, choking out native plants. In Florida, where illicit plantings have sprawled over areas spanning up to 50 acres, scientists have been scouting ways to limit the spread of this scourge.

Fla. State DEP

Water spinach.

Thai K. Van at the U.S. Department of Agriculture's Aquatic Weed Research Unit in Fort Lauderdale, Fla., thinks radiation may be one solution.

Scientists suspect that individuals buy black-market water spinach to eat and then root scraps of the stems in water to produce new plants. Preliminary tests that Van has just conducted demonstrate that fresh samples lose their rooting ability once they receive a 500-Gray dose of radiation. This exposure, which leaves no radioactive residue, is half the amount permitted under federal law to curb spoilage in fresh produce.

If Van's finding is confirmed, the State of Florida may license commercial growers to raise the plant under quarantine—provided that all plants will be irradiated before they reach the market. —*J. Raloff*