Scientists Discover Heavy New Element

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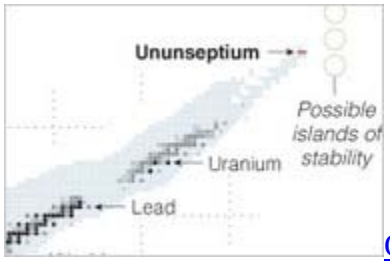
A team of Russian and American scientists has discovered a new element that has long stood as a missing link among the heaviest bits of atomic matter ever produced. The element, still nameless, appears to point the way toward a brew of still more massive elements with chemical properties no one can predict.

Multimedia



Graphic

Elusive Atoms

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The team produced six atoms of the element by smashing together isotopes of calcium and a radioactive element called berkelium in a particle accelerator about 75 miles north of Moscow on the Volga River, according to a paper that has been accepted for publication at the journal Physical Review Letters.

Data collected by the team seem to support what theorists have long suspected: that as newly created elements become heavier and heavier they will eventually become much more stable and longer-lived than the fleeting bits of artificially produced matter seen so far.

If the trend continues toward a theorized “island of stability” at higher masses, said Dawn A. Shaughnessy, a chemist at Lawrence Livermore National Laboratory in California who is on the team, the work could generate an array of strange new materials with as yet unimagined scientific and practical uses.

By scientific custom, if the latest discovery is confirmed elsewhere, the element will receive an official name and take its place in the periodic table of the elements, the checkerboard that begins with hydrogen, helium and lithium and hangs on the walls of science classrooms and research labs the world over.

“For a chemist, it’s so fundamentally cool” to fill a square in that table, said Dr. Shaughnessy, who was much less forthcoming about what the element might eventually be called. A name based on a laboratory or someone involved in the find is considered one of the highest honors in science. Berkelium, for example, was first synthesized at the University of California, Berkeley.

“We’ve never discussed names because it’s sort of like bad karma,” she said. “It’s like talking about a no-hitter during the no-hitter. We’ve never spoken of it aloud.”

Other researchers were equally circumspect, even when invited to suggest a whimsical temporary moniker for the element. “Naming elements is a serious question, in fact,” said Yuri Oganessian, a nuclear physicist at the Joint Institute for Nuclear Research in Dubna, Russia, and the lead author on the paper. “This takes years.”

Various aspects of the work were done at the particle accelerator in Dubna; the Livermore lab; Oak Ridge National Laboratory and Vanderbilt University in Tennessee; the University of Nevada, Las Vegas; and the Research Institute of Atomic Reactors in Dimitrovgrad, Russia.

For the moment, the discovery will be known as ununseptium, a very unwhimsical Latinate placeholder that refers to the element’s atomic number, 117.

“I think they have an excellent convincing case for the first observation of element 117; most everything has fallen into line very well,” said Walter D. Loveland, a professor of chemistry at Oregon State University who was not involved in the work.

Elements are assigned an atomic number according to the number of protons — comparatively heavy particles with a positive electric charge — in their nuclei. Hydrogen has one proton, helium has two, and uranium has 92, the most in any atom known to occur naturally. Various numbers of charge-free neutrons add to the nuclear mass of atoms but do not affect the atomic number.

As researchers have artificially created heavier and heavier elements, those elements have had briefer and briefer lifetimes — the time it takes for unstable elements to decay by processes like spontaneous fission of the nucleus. Then, as the elements got still heavier, the lifetimes started climbing again, said Joseph Hamilton, a physicist at Vanderbilt who is on the team.

The reason may be that the elements are approaching a theorized “island of stability” at still higher masses, where the lifetimes could go from fractions of a second to days or even years, Dr. Hamilton said.

In recent years, scientists have created several new elements at the Dubna accelerator, called a cyclotron, by smacking calcium into targets containing heavier radioactive elements that are rich in neutrons — a technique developed by Dr. Oganessian.

Because calcium contains 20 protons, simple math indicates scientists would have to fire the calcium at something with 97 protons — berkelium — to produce ununseptium, element 117.

Berkelium is mighty hard to come by, but a research nuclear reactor at Oak Ridge produced about 20 milligrams of highly purified berkelium and sent it to Russia, where the substance was bombarded for five months late last year and early this year.

An analysis of decay products from the accelerator indicated that the team had produced a scant six atoms of ununseptium. But that was enough to title the paper, “Synthesis of a new element with atomic number Z=117.”

That is about the closest thing to “Eureka!” that the dry conventions of scientific publication will allow. The new atoms and their decay products displayed the trend toward longer lifetimes seen in past discoveries of such heavy elements. The largest atomic number so far created is 118, also at the Dubna accelerator.

Five of the six new atoms contained 176 neutrons to go with their 117 protons, while one atom contained 177 neutrons, said Jim Roberto, a physicist at Oak Ridge on the project.

Atomic nuclei can be thought of as concentric shells of protons and neutrons. The most stable nuclei occur when the outermost shells are filled. Some theories predict this will happen with 184 neutrons and either 120 or 126 protons: the presumed center of the island of stability.

What happens beyond that point is anyone’s guess, said Kenton Moody, a radiochemist on the team at Livermore. “The question we’re trying to answer is, ‘Does the periodic table come to an end, and if so, where does it end?’ ” Dr. Moody said.

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