Four super-heavy elements to be added to the periodic table

By Deborah Netburn, Los Angeles Times on 01.13.16

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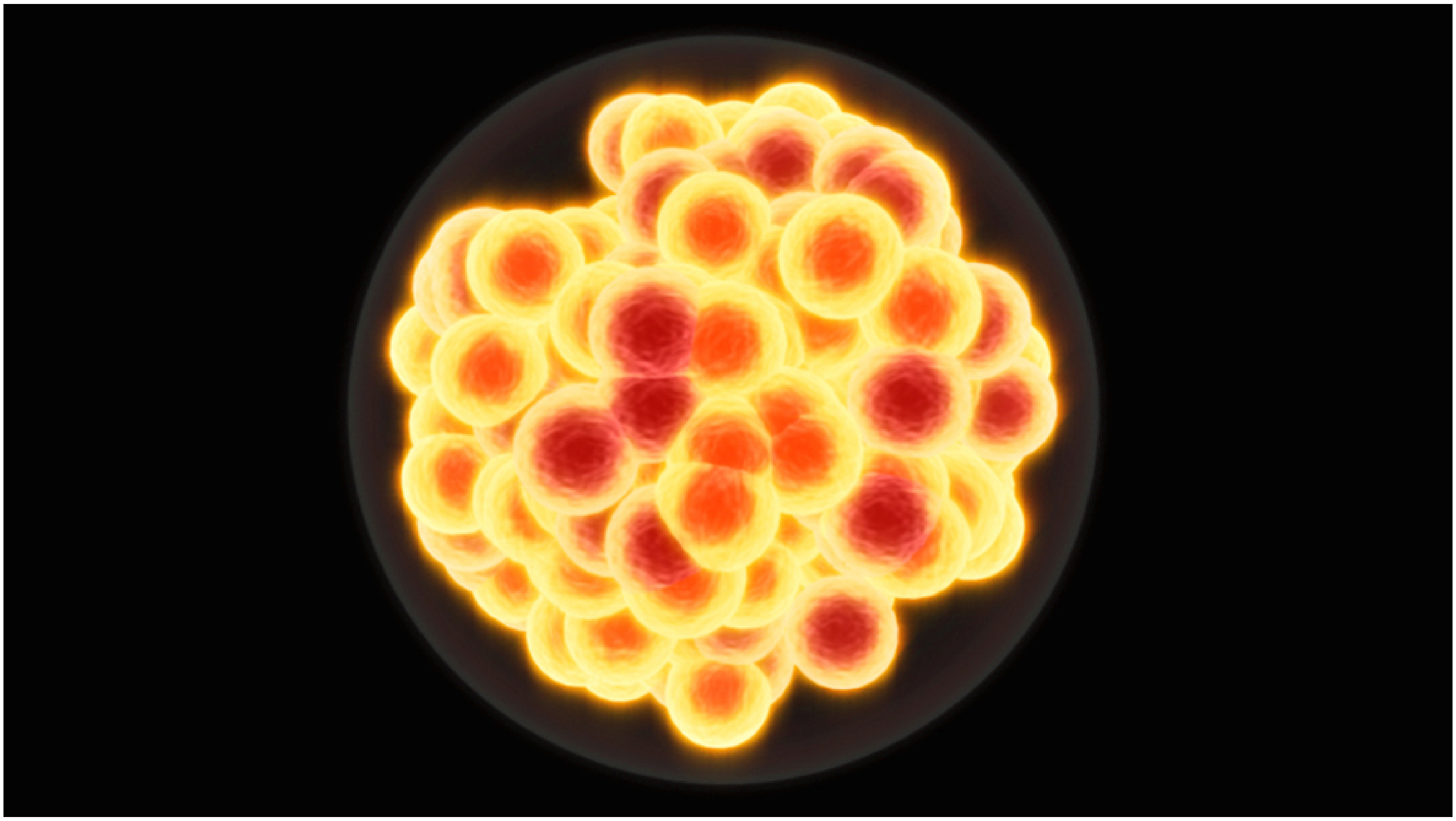

An illustration of the newly created element 117. Kwei-Yu Chu / Lawrence Livermore National Laboratory

The periodic table is about to get a little bit longer, thanks to the addition of four super-heavy elements.

The discoveries of elements 113, 115, 117 and 118 were confirmed last week by the International Union of Pure and Applied Chemistry. The group vets the man-made elements seeking a permanent spot on the chart that adorns chemistry classrooms around the world.

The new elements are known as super-heavy elements because the nuclei of their atoms are so enormous. Element 118, for example, is the heaviest element to date, with 118 protons alongside 176 neutrons.

Elements of this size are not routinely found in nature, and it can take years to make them in specialized laboratories.

“Probably the only other place where they might exist in a short period of time could be a supernova, where you have so much energy and so many particles that are really heavily concentrated," said Dawn Shaughnessy, the principal investigator for the Heavy Element Group at Lawrence Livermore National Laboratory, which had a hand in three of the discoveries.

Super-heavy elements are also highly unstable, existing for just a fraction of a second before they begin to decay.

Scientists never observe these elements directly. Rather, they know they briefly existed because they are able to measure their decay products.

The heaviest known elements are made by smashing two particles together and hoping they will stick. It's a probability game with extremely long odds.

Scientists first create a target out of a carefully chosen atom with a particular number of protons and neutrons — a process that can take months. Then they purify it and bombard it with another specialized atom that they think has the best chance of recombining with the target.

"It's really hard to smash two things together and get them to stick," Shaughnessy said. "There is so much positive charge — they want to repel each other."

It takes several months to try this smashing experiment roughly 10 quintillion times (10 followed by 18 zeros). If just one of those attempts works, the experiment is considered a success.

"And we're not always successful," she said. At most, it will work about three times in 10 quintillion tries, she said.

There are only a few laboratories around the world equipped to do this work. The experiments generate so much data that supercomputers are required to sift through it all and search for signs of a successful mash-up.

Elements 115, 117 and 118 were created in Russia, at the Joint Institute for Nuclear Research. Scientists from Lawrence Livermore worked on all three discoveries, and the consortium that created element 117 also included researchers from the Oak Ridge National Laboratory in Tennessee and the University of Nevada, Las Vegas.

The international chemistry body credited a Japanese group with the discovery of element 113. Led by Kosuke Morita of RIKEN, they are the first Asian scientists to find a new element.

Morita and his team spent several years searching for conclusive proof of element 113. During that time, whenever Morita visited a Japanese shrine, he gave an offering of 113 yen.

"It's not really a question of whether I believed it or not," Morita told Asian Scientist Magazine. "The reason I did it is that I wanted to know that I had done everything humanly possible to get credit for the discovery of the element."

Until now, these elements have been known by the generic Latin names ununtrium, ununpentium, ununseptium and ununoctium. Their confirmation paves the way for them to get permanent names. Traditionally, that honor falls to the researchers who first found them.

The team from Lawrence Livermore and their Russian colleagues had previously named element 116 Livermorium in honor of the Northern California lab. No word on what 115, 117 and 118 might be called.

With last week's announcement, 26 elements have been added to the periodic table since 1940. But Shaughnessy said her team isn't done.

The scientists will continue trying to make heavier elements until they hit a wall where there are just so many protons that they won't stick together.

"These super-heavy elements help us understand how the nucleus functions and redefines our ideas of matter and how it behaves," she said. "We're really studying the physics of what the extreme limits of matter might be."

Quiz

1 Which of the following excerpts from the article illustrates the difficulty of interpreting results from the experiment?

(A) Scientists first create a target out of a carefully chosen atom with a particular number of protons and neutrons — a process that can take months. Then they purify it and bombard it with another specialized atom that they think has the best chance of recombining with the target.

(B) “It’s really hard to smash two things together and get them to stick,” Shaughnessy said. “There is so much positive charge — they want to repel each other.”

(C) It takes several months to try this smashing experiment roughly 10 quintillion times (10 followed by 18 zeros). If just one of those attempts works, the experiment is considered a success.

(D) Super-heavy elements are also highly unstable, existing for just a fraction of a second before they begin to decay.

Scientists never observe these elements directly. Rather, they know they briefly existed because they are able to measure their decay products.

2 Read the following selection from the article.

It takes several months to try this smashing experiment roughly 10 quintillion times (10 followed by 18 zeros). If just one of those attempts works, the experiment is considered a success.

“And we’re not always successful,” she said. At most, it will work about three times in 10 quintillion tries, she said.

Which of the following conclusions can be drawn from the selection above?

(A) Experiments that try to find new super heavy elements take many attempts.

(B) Experiments involving super-heavy elements are repeated until the successful combination is found, no matter how long it takes.

(C) Experiments involving super-heavy elements do not yield reliable data unless they are repeated many times.

(D) Experiments involving super-heavy elements are successful only if they can be repeated three times.

3 Read the following two paragraphs from the article.

The scientists will continue trying to make heavier elements until they hit a wall where there are just so many protons that they won’t stick together.

“These super-heavy elements help us understand how the nucleus functions and redefines our ideas of matter and how it behaves,” she said. “We’re really studying the physics of what the extreme limits of matter might be.”

How does paragraph 1 reinforce paragraph 2?

(A) It reflects how scientists intend to keep trying to make heavier elements even if they hit a wall.

(B) It describes how scientists will go to any extreme to learn about super-heavy elements.

(C) It shows how scientists will continue to work together to redefine the nucleus.

(D) It explains the lengths scientists are willing to go to extend understanding of physics.

4 Which paragraph from the article BEST summarizes a central idea from it?

(A) It takes several months to try this smashing experiment roughly 10 quintillion times (10 followed by 18 zeros). If just one of those attempts works, the experiment is considered a success.

(B) The new elements are known as super-heavy elements because the nuclei of their atoms are so enormous. Element 118, for example, is the heaviest element to date, with 118 protons alongside 176 neutrons.

(C) There are only a few laboratories around the world equipped to do this work. The experiments generate so much data that supercomputers are required to sift through it all and search for signs of a successful mash-up.

(D) Until now, these elements have been known by the generic Latin names ununtrium, ununpentium, ununseptium and ununoctium. Their confirmation paves the way for them to get permanent names. Traditionally, that honor falls to the researchers who first found them.