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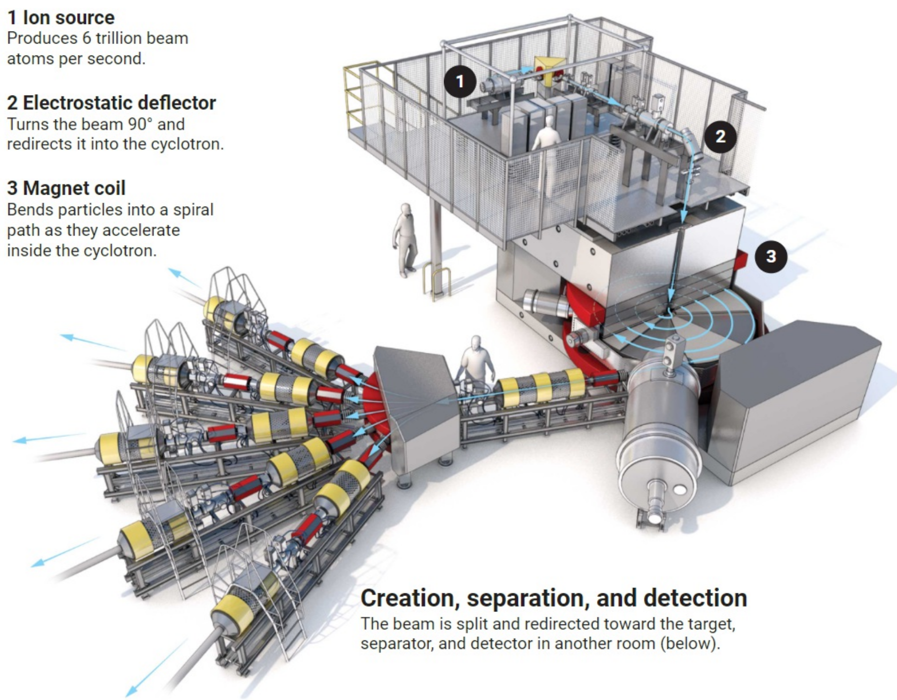
Pushing the element table past the limits: a storied Russian lab is trying to build element 119 & 120, *Science News*

Adopted from *Science News*

Located in the town of Dubna, 130 km northwest of Moscow, the legendary Russian lab, Flerov Laboratory of Nuclear Reactions, have produced nine new elements on the periodic table over the past half-century, including the five heaviest known elements, up to number 118. The man leading that work is physicist Yuri Oganessian, who has been at Flerov since Nikita Khrushchev signed orders in 1956 to establish a secret nuclear lab in the birch forests there. Today, leaded by Oganessian, after whom element 118 (Og, Oganesson) was named, the lab has built a new $60 million facility, dubbed the Superheavy Element Factory (SHEF), to push the table further.

In 1970s, Oganesson developed the technique of cold fusion, which involves uniting beam and target atoms that are more similar in size than those in traditional elementmaking, to create superheavy elements. The technique was later perfected by a team at the GSI Helmholtz Centre for Heavy Ion Research in Darmstadt, Germany, and used to create elements 107 through 112. But the method ran into limitations as the odds of fusion and survival dropped precipitously. Between 2003 and 2012, a team at the RIKEN Institute in Wako, Japan, painstakingly made 3 atoms of element 113 using cold fusion, none of which survived longer than 5 milliseconds before decaying.



Getting beyond 113 required a different approach, hot fusion, which was developed by Flerov scientists in the late 1990s. Hot fusion uses higher beam energies and relies on a special isotope with a large excess of neutrons, calcium-48. Despite the extremely high cost of calcium-48, the investment paid off. By 2010, Dubna—in collaboration with scientists at Lawrence Livermore National Laboratory in California and Oak Ridge National Laboratory in Tennessee—had created element 114-118 and filled the periodic table's seventh row.

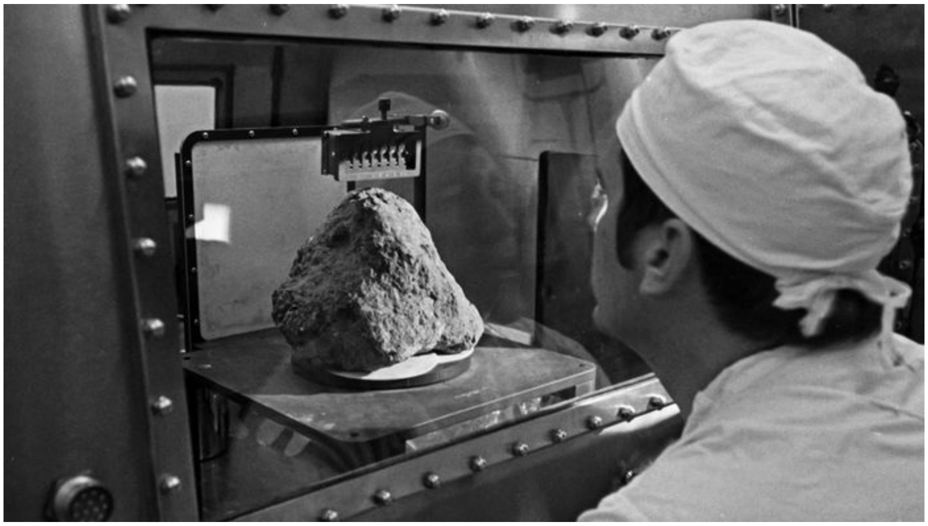
After 118, however, things stalled again. Some researchers proposed replacing calcium-48 with titanium-50, which has two more protons, and then firing it at elements 97 and 98 to produce 119 and 120, respectively. But for technical reasons, the likelihood of fusion is just one-twentieth as high with titanium as with calcium.

The SHEF was built to overcome those obstacles. The stronger beam and more generous separator of SHEF should, in theory, cancel out the lower odds of titanium-50 fusion. That gives the Dubna team hope that atoms of 119 or 120 will soon reveal themselves. A team at RIKEN is also searching for 119, albeit using a different and perhaps harder method (firing vanadium, element 23, onto curium). Between the two labs, scientists are confident that 119 and 120 will appear somewhere within about 5 years.

A wild experiment showed evolution in real time, *Science*

Adopted from *Nature Briefing*

An ambitious experiment has illuminated the full process of evolution by natural selection in a wild population, from the effects on genes and physical traits to those of the environment. The exhausting task took around 500 mice, outdoor enclosures built from nearly 14 tonnes of steel plates filled with light or dark soil, and keeping the mice from escaping or being eaten by snakes and owls for three months — all in a state where many people flinch at the word ‘evolution’.



Ancient Earth Rock Found on the Moon, *Earth and Planetary Science Letters*

Embedded in a larger rock collected by Apollo astronauts from the Moon, a 2-centimeter chip of rock was believed by scientists to a 4-billion-year-old fragment of our own planet. According to David Kring, a lunar geologist at the Lunar and Planetary Institute in Houston, Texas, shortly after the rock was formed, the piece was likely ejected from the Earth by an asteroid impact and found its way to the Moon, which was three times closer to Earth than it is today. The small piece was preserved because the Moon lacks the weather and geologic processes that erase ancient rocks on Earth.

Trace elements in the rock's minerals provided clues to its origin. By measuring uranium and its decay products in the zircons, the team dated the formation of the rock, while titanium levels helped reveal the temperature and pressure at the time, which corresponded to 19 kilometers beneath the surface of Earth. Still other trace elements, such as cerium, pointed to the amount of water likely to have been present.

If the rock is truly terrestrial, it holds clues about an ancient time called the Hadean. For starters, it confirms Earth was being hit by asteroids big enough to blast rocks all the way to the moon. It also shows that the granitic rocks that make up Earth's continents were already forming, Kring says. "That's a big thing."

MIT robot could beat you at Jenga!

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