= Einsteinium =

Einsteinium is a synthetic element with symbol Es and atomic number 99 . It is the seventh transuranic element , and an actinide .

Einsteinium was discovered as a component of the debris of the first hydrogen bomb explosion in 1952 , and named after Albert Einstein . Its most common isotope einsteinium @-@ 253 ( half life 20 @.@ 47 days ) is produced artificially from decay of californium @-@ 253 in a few dedicated high @-@ power nuclear reactors with a total yield on the order of one milligram per year . The reactor synthesis is followed by a complex process of separating einsteinium @-@ 253 from other actinides and products of their decay . Other isotopes are synthesized in various laboratories , but at much smaller amounts , by bombarding heavy actinide elements with light ions . Owing to the small amounts of produced einsteinium and the short half @-@ life of its most easily produced isotope , there are currently almost no practical applications for it outside of basic scientific research . In particular , einsteinium was used to synthesize , for the first time , 17 atoms of the new element mendelevium in 1955 .

Einsteinium is a soft , silvery , paramagnetic metal . Its chemistry is typical of the late actinides , with a preponderance of the + 3 oxidation state ; the + 2 oxidation state is also accessible , especially in solids . The high radioactivity of einsteinium @-@ 253 produces a visible glow and rapidly damages its crystalline metal lattice , with released heat of about 1000 watts per gram . Difficulty in studying its properties is due to einsteinium @-@ 253 's conversion to berkelium and then californium at a rate of about 3 % per day . The isotope of einsteinium with the longest half life , einsteinium @-@ 252 ( half life 471 @.@ 7 days ) would be more suitable for investigation of physical properties , but it has proven far more difficult to produce and is available only in minute quantities , and not in bulk . Einsteinium is the element with the highest atomic number which has been observed in macroscopic quantities in its pure form , and this was the common short @-@ lived isotope einsteinium @-@ 253 .

Like all synthetic transuranic elements , isotopes of einsteinium are very radioactive and are considered highly dangerous to health on ingestion .

= = History = =

Einsteinium was first identified in December 1952 by Albert Ghiorso and co @-@ workers at the University of California , Berkeley in collaboration with the Argonne and Los Alamos National Laboratories , in the fallout from the Ivy Mike nuclear test . The test was carried out on November 1 , 1952 at Enewetak Atoll in the Pacific Ocean and was the first successful test of a hydrogen bomb . Initial examination of the debris from the explosion had shown the production of a new isotope of plutonium , 244

94Pu , which could only have formed by the absorption of six neutrons by a uranium @-@ 238 nucleus followed by two beta decays .

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At the time , the multiple neutron absorption was thought to be an extremely rare process , but the identification of 244

94Pu indicated that still more neutrons could have been captured by the uranium nuclei , thereby producing new elements heavier than californium .

Ghiorso and co @-@ workers analyzed filter papers which had been flown through the explosion cloud on airplanes ( the same sampling technique that had been used to discover 244

94Pu ) . Larger amounts of radioactive material were later isolated from coral debris of the atoll , which were delivered to the U.S. The separation of suspected new elements was carried out in the presence of a citric acid / ammonium buffer solution in a weakly acidic medium ( pH ? 3 @.@ 5 ) , using ion exchange at elevated temperatures ; fewer than 200 atoms of einsteinium were recovered in the end . Nevertheless , element 99 ( einsteinium ) , namely its 253Es isotope , could be detected via its characteristic high @-@ energy alpha decay at 6 @.@ 6 MeV . It was produced by the capture of 15 neutrons by uranium @-@ 238 nuclei followed by seven beta @-@ decays , and had

a half @-@ life of 20 @.@ 5 days . Such multiple neutron absorption was made possible by the high neutron flux density during the detonation , so that newly generated heavy isotopes had plenty of available neutrons to absorb before they could disintegrate into lighter elements . Neutron capture initially raised the mass number without changing the atomic number of the nuclide , and the concomitant beta @-@ decays resulted in a gradual increase in the atomic number :

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Some 238U atoms , however , could absorb another two neutrons ( for a total of 17 ) , resulting in 255Es , as well as in the 255Fm isotope of another new element , fermium . The discovery of the new elements and the associated new data on multiple neutron capture were initially kept secret on the orders of the U.S. military until 1955 due to Cold War tensions and competition with Soviet Union in nuclear technologies . However , the rapid capture of so many neutrons would provide needed direct experimental confirmation of the so @-@ called r @-@ process multiple neutron absorption needed to explain the cosmic nucleosynthesis ( production ) of certain heavy chemical elements ( heavier than nickel ) in supernova explosions , before beta decay . Such a process is needed to explain the existence of many stable elements in the universe .

Meanwhile , isotopes of element 99 ( as well as of new element 100 , fermium ) were produced in the Berkeley and Argonne laboratories , in a nuclear reaction between nitrogen @-@ 14 and uranium @-@ 238 , and later by intense neutron irradiation of plutonium or californium :

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These results were published in several articles in 1954 with the disclaimer that these were not the first studies that had been carried out on the elements . The Berkeley team also reported some results on the chemical properties of einsteinium and fermium . The Ivy Mike results were declassified and published in 1955 .

In their discovery of the elements 99 and 100 , the American teams had competed with a group at the Nobel Institute for Physics , Stockholm , Sweden . In late 1953 ? early 1954 , the Swedish group succeeded in the synthesis of light isotopes of element 100 , in particular 250Fm , by bombarding uranium with oxygen nuclei . These results were also published in 1954 . Nevertheless , the priority of the Berkeley team was generally recognized , as its publications preceded the Swedish article , and they were based on the previously undisclosed results of the 1952 thermonuclear explosion ; thus the Berkeley team was given the privilege to name the new elements . As the effort which had led to the design of Ivy Mike was codenamed Project PANDA , element 99 had been jokingly nicknamed " Pandamonium " but the official names suggested by the Berkeley group derived from two prominent scientists , Albert Einstein and Enrico Fermi : " We suggest for the name for the element with the atomic number 99 , einsteinium ( symbol E ) after Albert Einstein and for the name for the element with atomic number 100 , fermium ( symbol Fm ) , after Enrico Fermi . " Both Einstein and Fermi died before the names were announced . The discovery of these new elements was announced by Albert Ghiorso at the first Geneva Atomic Conference held on 8 ? 20 August 1955 . The symbol for einsteinium was first given as " E " and later changed to " Es " by IUPAC .

= = Characteristics = =

= = = Physical = = =

Einsteinium is a synthetic , silvery @-@ white , radioactive metal . In the periodic table , it is located to the right of the actinide californium , to the left of the actinide fermium and below the lanthanide holmium with which it shares many similarities in physical and chemical properties . Its density of 8 @.@ 84 g / cm3 is lower than that of californium ( 15 @.@ 1 g / cm3 ) and is nearly the same as that of holmium ( 8 @.@ 79 g / cm3 ) , despite atomic einsteinium being much heavier than holmium . The melting point of einsteinium ( 860 ° C ) is also relatively low ? below californium ( 900 ° C ) , fermium ( 1527 ° C ) and holmium ( 1461 ° C ) . Einsteinium is a soft metal , with the bulk modulus of only 15 GPa , which value is one of the lowest among non @-@ alkali metals .