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Brachy vs. Beam Therapy

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**Historical Review of Californium-252 Discovery and  
Development**

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The first isotope of californium ( $^{245}\text{Cf}$ ) was produced in 1950 by S. G. Thompson, K. Street, Jr., A. Ghiorso, and G. T. Seaborg at the Radiation Laboratory of the University of California at Berkeley. They used the Berkeley 60-inch cyclotron to bombard curium-242 targets with helium ions having energies of 35 million electron volts. Only a very small amount of the isotope was produced.

The isotope californium-252 was first identified along with isotopes of curium and berkelium in the debris from a thermonuclear test explosion in 1952. During the explosion, uranium was subjected to an intense, although short, neutron irradiation so that the uranium atoms absorbed many neutrons before decaying by beta emission to form these isotopes of higher atomic number.

Larger quantities of californium-252 can be synthesized by irradiating plutonium-239 or its transmutation products ( $^{242}\text{Pu}$ ,  $^{243}\text{Am}$ , and  $^{244}\text{Cm}$ ) with neutrons in a nuclear reactor. Elements of higher atomic number are built up by successive neutron captures interspersed with beta decays. Thirteen successive neutrons must be added to each nucleus of  $^{239}\text{Pu}$  to convert it to  $^{252}\text{Cf}$  (Figure 1).

The first macroscopic amounts of  $^{252}\text{Cf}$  were produced by long-term irradiations in the Materials Testing Reactor at the National Reactor Testing Station in Idaho (Figure 2). B. B. Cunningham and S. G. Thompson at Berkeley succeeded in isolating this product in 1958.