Element 105 Synthesized and Named Hahnium by Berkeley Researchers

At the American Physical Society meeting in Washington, D.C., on 27 April, Albert Ghiorso announced that his team from Berkeley's Lawrence Radiation Laboratory has succeeded in synthesizing element 105. They have proposed that it be called hahnium after Otto Hahn, the German chemist who received the Nobel Prize for his observations of nuclear fission in the late 1930's.

Hahnium is the thirteenth transuranium element synthesized since 1940, and the second in a new family of chemical elements. It is also the second element synthesized from a single target—a 60-microgram disk of californium-249 that was used in the synthesis of element 104.

In addition to Ghiorso, the team consists of Jim Harris; Matti Nurmia, a Finnish physicist who now lives in the United States; and Kari and Pirkko Eskola, husband and wife members of the team who are on a research visit from Finland.

Harris synthesized the californium target in the fall of 1968 after he received what was at that time the world's entire supply of the rare element.

The Berkeley Experiment

The HILAC (heavy ion linear accelerator) at Lawrence Radiation Laboratory was used to bombard the californium-249 with nitrogen-15 atoms that had been stripped of their electrons. Hahnium-260 was produced after the emission of four neutrons.

$$Cf_{98}^{249} + N_7^{15} \rightarrow Ha_{105}^{260} + n_0^4$$

Helium gas was used to sweep the reaction products into a partially evacuated detection chamber where they became embedded on the surface of a magnesium wheel. The wheel is surrounded by seven detecting stations, and at each station there are four silicon detectors that are arranged so that it is possible to measure the energies of the alpha particles produced by the decay of both the new element and its daughter (lawrencium-256). By rotating and stopping the wheel while the experiment was in progress, it was possible to collect data continuously for several days at a time.

Although the beam and target were about the same as those used in previous experiments, the detectors and computer analysis of the results were more elaborate; thus, the results were observed sooner and presented with more confidence than is usually the case with new elements.

Hahnium decays with a half-life of 1.6 ± 0.3 seconds to form lawrencium-256 and alpha particles with energies centered around 9.1 million electron volts (Mev). The lawrencium, in turn, decays with a half-life of 30 seconds into mendelevium-252 and alpha particles with energies centered around 8.4 Mev.

Three sets of measurements were made to establish the existence of hahnium and to determine its half-life. These include (i) measurement of the 9.1-Mev energy to identify hahnium; (ii) measurement of the 8.4-Mev energy to identify the lawrencium daughter; and (iii) measurement of both energies with respect to time to demonstrate that the lawrencium was formed from the hahnium.

The Berkeley researchers had evidence for the new element as early as November 1968, but at that time the data was disregarded because the 9.1-Mev peak was partially masked by a peak from a lighter element. With the new auxiliary equipment, the alpha activity of the new element became apparent within a few hours after the experiment was started on 5 March. Since that time they have had "no problem making a dozen counts an hour," and "many hundreds" of atoms have been produced.

Soviet Claims

A Soviet team working at the Joint Institute for Nuclear Research at Dubna has two tentative claims for the synthesis of element 105. In 1967 at an international conference in Japan, Georgii Flerov (director of the Nuclear Studies Laboratory at the Joint Institute) announced that preliminary data indicated that his team may have produced a few atoms of the 260 and 261 isotopes of element 105 by bombarding americium-243 (element 95) with neon-22. Their evidence was also based on time-coincidence measurements of alpha energies, but their data for the 260 isotope differed significantly from the much firmer data obtained at Berkeley.

Ghiorso recently received an internal laboratory report from Dubna dated February 1970 describing experiments which offer some evidence for a spontaneous fissioning element that could be 105. The Soviets have not proposed a name for the element, so they apparently do not feel that their experimental evidence is very strong—a conclusion that Ghiorso agrees with wholeheartedly.

The Future

Harris's californium target is now being used in an attempt to produce element 106 by bombardment with oxygen-18 and oxygen-16. However, this experiment will probably be stopped as soon as Harris and his group prepare an einsteinium-253 target from the 150 micrograms of this element that they received on 30 April from Oak Ridge National Laboratory. Einsteinium-253 has a half-life of only 20 days (the half-life of californium-249 is 350 years), so as soon as the target is available the Berkeley team will begin an effort to synthesize element 107. When talking with members of the press about the possibility of synthesizing elements beyond 105, Ghiorso was careful to point out the difficulties of the experiments and uncertainties of predictions, but he seemed fairly confident that elements 106 and 107 could be synthesized within a year or so.

The consensus of nuclear physicists now seems to be that, although it may be impossible to synthesize elements beyond 107 by present methods, there is an outside chance that there is a stable group of heavy elements centered around element 114 [*Science* **166**, 1254 (1969)]. The ratio of neutrons to protrons in these elements would be higher than that in existing synthetic elements, and plans are now under way to provide machines capable of accelerating neutron-rich particles.

The HILAC will be shut down next January for modification, and when it goes back into operation in the summer of 1971 it should be capable of accelerating ions as heavy as uranium. This is just one of several accelerators that will be used in attempts to produce elements that a few years ago any nuclear physicist would have thought impossible to synthesize.

—ROBERT W. HOLCOMB