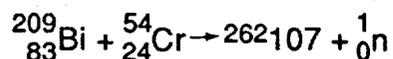


shown to decay to the known nuclide $^{255}_{102}\text{No}$. Thus the atomic number of the new nuclide was firmly established by a genetic link to its daughters. Oganessian, Y. P. Tretyakov, A. S. Ijginov, A. G. Demin, A. S. Pleve, S. P. Tretyakova, V. M. Plotko, M. P. Ivanov, N. A. Danilov, Y. S. Korotkin, and G. N. Flerov (41) (Figure 20) reported the observation of a spontaneous fission activity with a half-life of 4-10 ms, produced by bombarding $^{207}_{82}\text{Pb}$ with $^{54}_{24}\text{Cr}$, which they assigned to $^{259}_{106}$ on the basis of reaction systematics. We now know this assignment was erroneous in that the observed spontaneous fission activities were primarily due to the daughters of element 106, i.e., $^{256,255}_{104}$, and not element 106 (42). The isotope $^{260}_{106}$ (which may have been produced also in the Oganessian et al. work) is now known to have a half-life of ~4 ms with a partial half-life for spontaneous fission of ~7 ms. Neither group has suggested a name for element 106.

Element 107

In 1976 Oganessian and co-workers (43) reported the production of a spontaneous fission activity with a half-life of ~2 ms from the reaction of $^{209}_{83}\text{Bi}$ with $^{54}_{24}\text{Cr}$ which they attributed to $^{261}_{107}$. In 1981 G. Münzenberg, S. Hofmann, F. P. Hessberger, W. Reisdorf, K. H. Schmidt, J. R. H. Schneider, W. F. W. Schneider, P. Armbruster, C. C. Sahm, and B. Thuma (44) working at the Gesellschaft für Schwerionenforschung (GSI) at Darmstadt, West Germany, identified the nuclide $^{262}_{107}$ produced in the "cold fusion" reaction



The recoiling product nuclei from the nuclear reaction were passed through a velocity separator (called SHIP) which guaranteed that they had the characteristic velocity of the product of complete fusion of projectile and target nuclei. The mass number of the velocity-separated product nuclei was roughly determined using a time-of-flight spectrometer and the atomic number and mass number were determined by observing the time correlated α -decay of $^{262}_{107}$ to its decay products (see Figure 21). One sequence of correlated decays ended in the known nucleus $^{254}_{103}\text{Lr}$, one ended in $^{246}_{98}\text{Cf}$, two ended in $^{250}_{100}\text{Fm}$ decay, and one ended in $^{250}_{101}\text{Md}$. Five decays of $^{262}_{107}$ were observed with $E_\alpha = 10.4$ MeV and $t_{1/2} \sim 5$ ms. The cross section for producing these nuclei was $\sim 2 \times 10^{-34}$ cm² (approximately 1/5,000,000 of the production cross section assumed in the first one-atom-at-a-time experiments with Md!) It is a remarkable tribute to the quality of this experiment that the results of this experiment have found rapid, universal acceptance despite the exceedingly low production rate involved. By 1988 a total of 38 atoms had been observed. Subsequent experiments (45) identified three 107 species, $^{261}_{107}$ ($t_{1/2} = 11.8^{+5.3}_{-2.8}$ ms, $E_\alpha \sim 10.2$ MeV), $^{262}_{107}$ ($t_{1/2} = 102 \pm 26$ ms; $E_\alpha \sim 9.9$ MeV) and $^{262m}_{107}$ ($t_{1/2} = 8.0 \pm 2.1$ ms; $E_\alpha \sim 10.3$ MeV). Contrary to the initial observations of the Dubna group, no spontaneous fission activities with $t_{1/2} = 1-2$ ms were observed. No name has been suggested for element 107.