Isotope Research – ^{229}Th production

We recently completed an ARRA-funded project of this type on ^{229}Th production reactions [Str11]. This long-lived isotope is important as a precursor to ^{225}Ac and ^{213}Bi, which are relatively short-lived alpha-emitters that are of great interest in alpha-radioimmunotherapy procedures in nuclear medicine. The current stockpile of ^{229}Th is insufficient to meet the demands for clinical trials of this new type of therapy. The goal of this project was to assess the viability of accelerator production of ^{229}Th via the ^{230}Th(p,2n)^{229}Pa reaction. The ^{229}Pa decays primarily by electron capture to ^{229}Th with a half-life of 1.5 days. Proton beams from the Tandem bombarded stacked ^{230}Th target foils [Fig. 3], and the yields in the foils were determined post-bombardment by gamma-ray spectroscopy, in some cases after a chemical separation to reduce background levels. Three different irradiations of copper foils were first made to develop and benchmark the technique via comparisons to established literature cross section values for a variety of isotopes with half-lives ranging from a few hours (^{61}Cu and ^{62}Zn) to many days (^{65}Zn). Two irradiations of nickel foils were also made for technique development and benchmarking. With beam energies ranging from 25 MeV to 40 MeV and intensities up to 50 nA, an irradiation was made of stacked thin ^{232}Th foils (~100 ug/cm^2) electroplated on an aluminum backing. This was done to evaluate cross sections of other Pa isotopes via (p,xn) reactions. A thick ^{232}Th target was also irradiated to measure integral cross sections for ^{229}Th and neighboring nuclei. Finally, two irradiations of thin ^{230}Th electroplated foils were made and an excitation function for the production cross section of ^{229}Th was determined. The experimental setup is shown in Fig. 4.

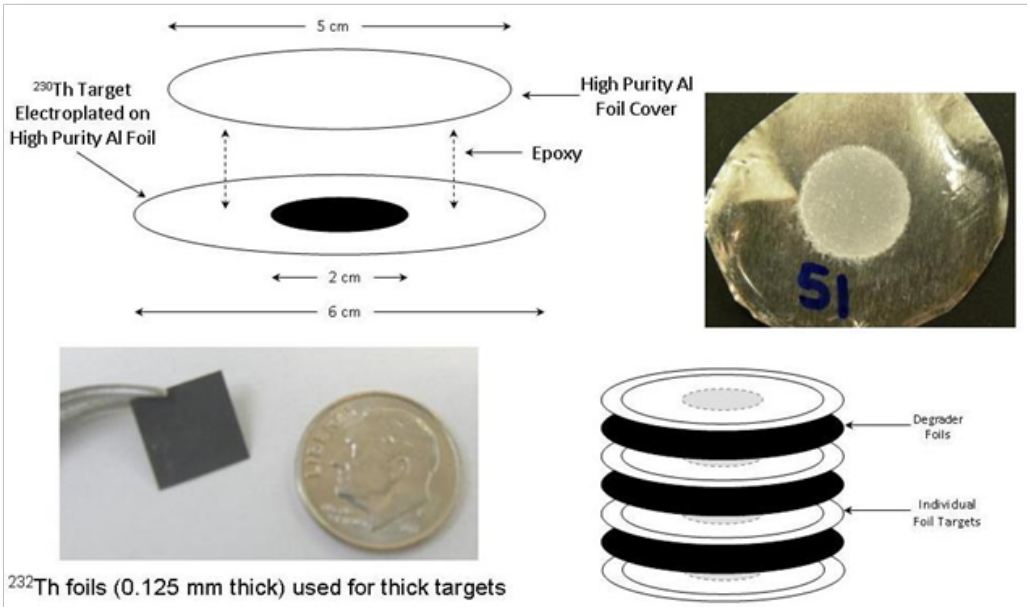

Fig. 3. Stacked foils of Thorium used for tests of accelerator production of ^{229}Th [Str11]

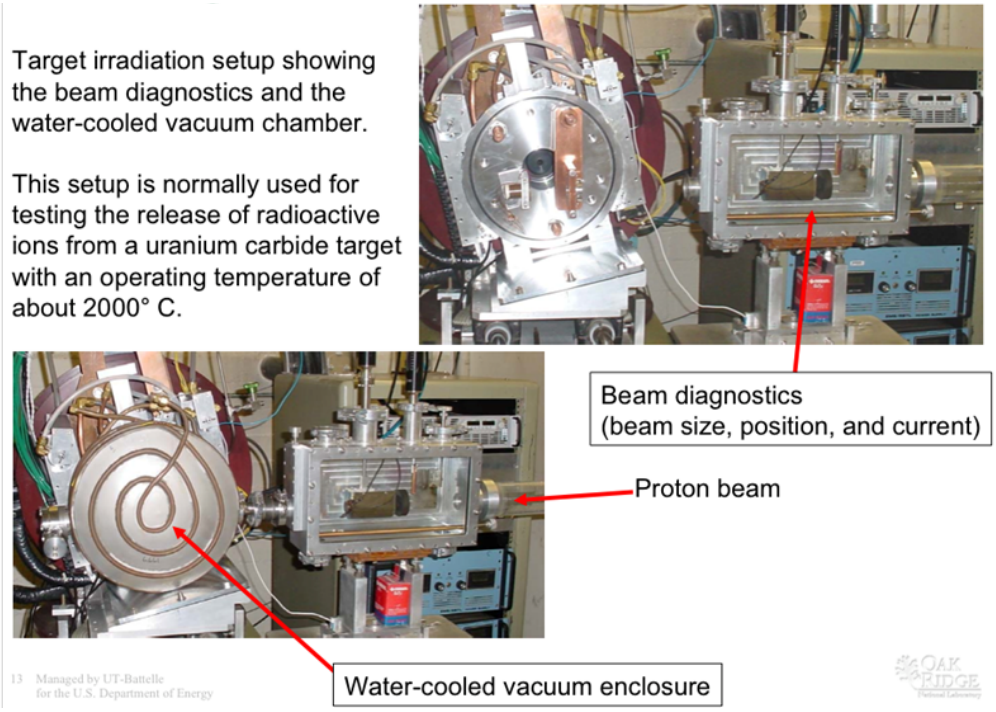

Fig. 4. Experimental setup for bombardment of stacked Thorium foils [Str11]

[Str11] D.W. Stracener, S. Mirzadeh, “R&D on Accelerator-Based Production of ^{229}Th”, (2011) unpublished.