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LLNL-TR-471080

Neutron Capture Cross Section Measurement on {238}Pu at DANCE

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February 17, 2011

Disclaimer

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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The proposed neutron capture measurement for ^{238}Pu was carried out in Nov - Dec, 2010, using the DANCE array at LANSCE, LANL. The total beam-on-target time is about 14 days plus additional 5 days for the background measurement. The target was prepared at LLNL with the new electrplating cell capable of plating the ^{238}Pu isotope simultaneously on both sides of the 3-μm thick Ti backing foil. A total mass of 395 μg with an activity of 6.8 mCi was deposited onto the area of 7 mm in diameter. The ^{238}Pu sample was enriched to 99.35%. The target was covered by 1.4 μm double-side aluminized mylar and then inserted into a specially designed vacuum-tight container, shown in Fig. 1, for the ^{238}Pu containment. The container was tested for leaks in the vacuum chamber at LLNL. An identical container without ^{238}Pu was made as well and used as a blank for the background measurement.

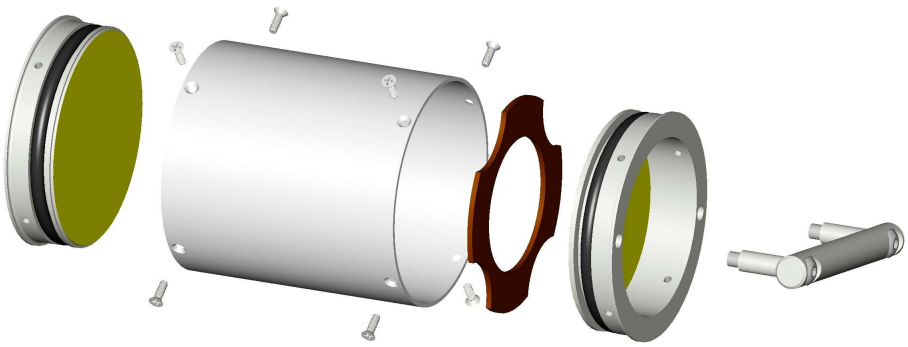

FIG. 1: RTH for ^{238}Pu. The aluminum can is closed with 2 caps and covered with 2 capton windows. Each closed cap is vacuum sealed with the rubber O-ring and being holded with 4 screws. The handle bar is used to open one of the cap for accessing the Ti foil with the ^{238}Pu deposition.

The data was collected for the incident neutron energy between 0.02 eV and 100 keV. The preliminary off-line analysis indicates that the current data is much superior than the previous date sets that begin from 18 eV, and almost certainly a reevaluation ^{238}Pu(n,γ) cross section is needed. The relative yield of neutron capture cross section as a function of the neutron incident energy is shown in Fig. 2. The nonnegligible amout of contribution from the daughter nucleus, ^{234}U, discovered during the analysis was subtracted from the data shown in Fig. 2. Also the (n,el) background from Ti backing foil and ^{238}Pu was subtracted

using the blank data. The full analysis is still in progress.

In the meantime, we are preparing the second phase of the experimental effort to measure the neutron capture reaction together with the fission reaction by employing the newly LLNL designed fission counter for ^{238}Pu. From the previous experiment we know that the activity of the target is not a problem because the dominant γ-rays and X-rays from the α-decay products of ^{238}Pu are below the 150-keV hardware detection threshold. The unaccounted systematic error bar in this data set (Fig. 2) is from the prompt fission γ-rays of ^{238}Pu. This experiment was performed without PPAC, thus, we did not tag fission γ-rays directly. We can minimize the fission contribution by setting the gate $E_{\sum} = 5.7 - 6.5$ MeV, but cannot completely eliminate it. Fission tagging with PPAC would enable to eliminate fission background completely.

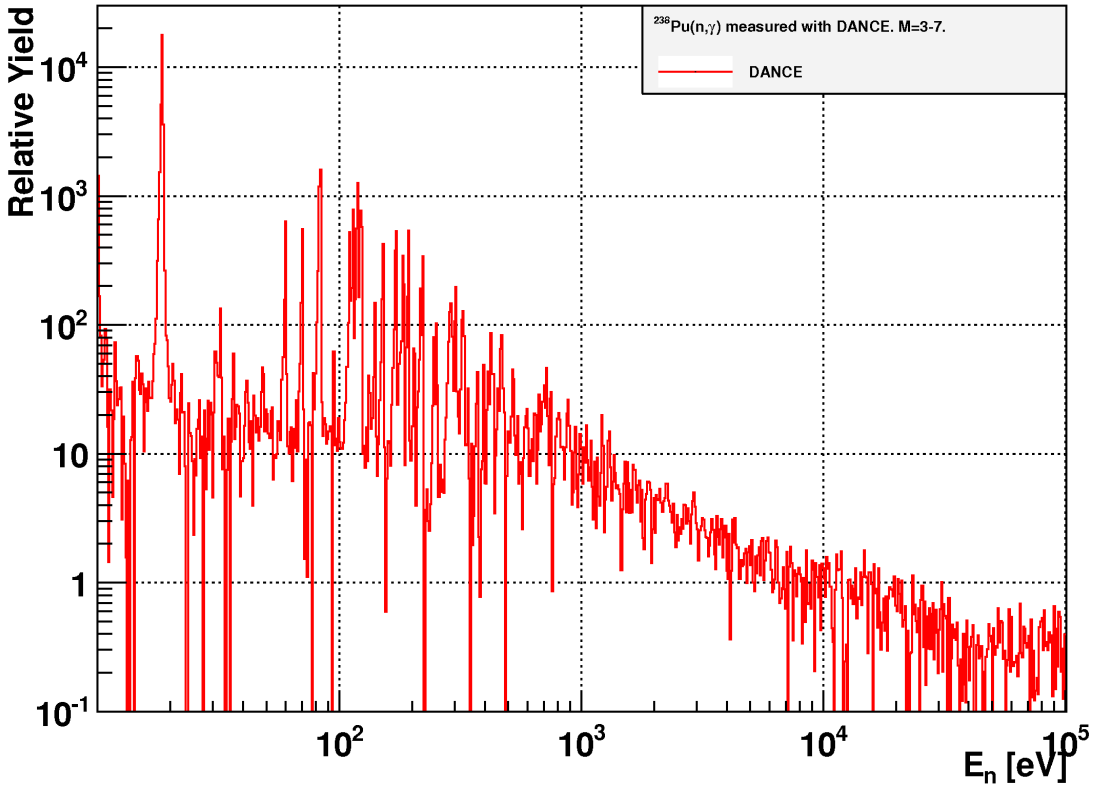

FIG. 2: The relative yield of the ^{238}Pu(n,γ) cross section.