Preliminary Results from ^{238}U(n,f) Studies Using 1.6 MeV Neutrons from LICORNE at Orsay

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The neutron induced fission of ^{238}U has been studied using a source of fast neutrons from the LICORNE facility at IPN Orsay, impinging on a thick, self-supporting natural uranium target. The LICORNE (Lithium Inverse Cinematiques ORsay NEutron source) setup at the IPN Orsay provides a versatile tool for the study of neutron-rich nuclei populated following fast neutron-induced fission. The inverse kinematic reaction used in LICORNE of p(^{7}Li,n)^{7}Be produces a focused neutron source with a well-defined energy and time structure. This LICORNE neutron beam contributes far less neutrons to the room background in comparison to the usual d(d,p)n or ^{7}Li(p,n)^{7}Be reaction where typically 99% of neutrons are not incident on the target material[1]. HPGe can then also be used at large opening angles and relatively close to the target when a kinematically-focused neutron beam is deployed, coupled with techniques for suppressing secondary neutrons from parasitic reactions, as the risk of excessive neutron damage is very much diminished. In the current study, eight, three-element MINIBALL HPGe cluster detectors were placed around the uranium target for direct measurement of gamma rays emitted from both prompt-fission events and following the delayed isomeric decays within the fission-product daughters still within the target. The nanosecond pulsing profile associated with the RF used to pulse the primary ^{7}Li beam from the Orsay Tandem was used to provide standard time references from for gamma-ray coincident events measured over the course of the three week experiment. The pulsing, coupled with the full-energy gamma-ray peak resolution of the MINIBALL detectors allowed a clean selection of gamma-ray cascades following the depopulation of isomeric states with half-lives in the $\sim$50 ns to 10 μs regime from the strongly populated primary fission fragments. These isomeric decays can then be used as clean, co-incidences identifiers of prompt gamma rays from binary partner nuclides associated with the prompt fission propulation. Details of the experimental set-up will be presented, together with preliminary yield studies on the population of previously reported fission fragments in the Kr-Sr-Zr region [2] and with results from an analogous study by Phillips et al., [3], who used a similar methodology to study prompt neutron fission on uranium using the CEASAR array at the ANU. The application of the isomer tagging technique, using as an example, decays from the $T_{1/2}$=164 ns isomeric decay in ^{134}Te [4–6] will be presented to demonstrate the effectiveness of isomeric binary partner tagging in the yield and analysis of these data.

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