Changes to Delayed Neutron Measurements at RMCC and their corresponding MCNP6 Simulations

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1. Experimental Data Sets

Solutions were prepared from CRM standards and further diluted with nitric acid and distilled water. Samples were placed in polyethylene vials before transport to an inner SLOWPOKE-2 irradiation site where they were exposed to a predominately thermal neutron flux for 60 *s*. After irradiation the samples were sent to an array of ^{3}He detectors which recorded the DN emissions as a function of count time up to 3 minutes. Further details regarding the delayed neutron counting system and these measurements can be found in references 1 and 2 respectively. Experimental data has been corrected for dead time effects and neutron background contributions [3]. **Measurements have been normalized by fissile mass [*g*] and detection efficiency (33 %) to obtain DN emission rate, *Q(t)* [$s^{-1}g^{-1}$].** Each isotope (^{233}U, ^{235}U and ^{239}Pu) was irradiated and counted in triplicate, the provided measurements represent their average *Q(t)*.

2. MCNP Simulations

Atomic Energy of Canada Limited has provided a MCNP input deck containing LEU SLOWPOKE-2 dimension and material specifications, the contents of which are detailed in Ref. 4. This input deck was modified to include a polyethylene vial within an inner irradiation site to determine a higher fidelity neutron flux spectrum. This flux was recreated within the vial solution of a second input deck, which includes the irradiation of a fissile solution for 60 *s* and the recording of subsequent DN emissions from the vial. The DN emission Rate, *Q(t)* [$s^{-1}g^{-1}$] was compared to the normalized measurements described in the previous section. The final deck simulated energy deposition within the ^{3}He detectors, Figure 4. MCNP6v1 was used in the following simulations (load date: 05/08/13).

3. **Comparisons**

Measurements and simulations are now compared as DN emission rates, *Q(t)* [$s^{-1}g^{-1}$]. Examples are shown in Figures 1-3. This work has been submitted for publication in the Journal of Nuclear Technology.

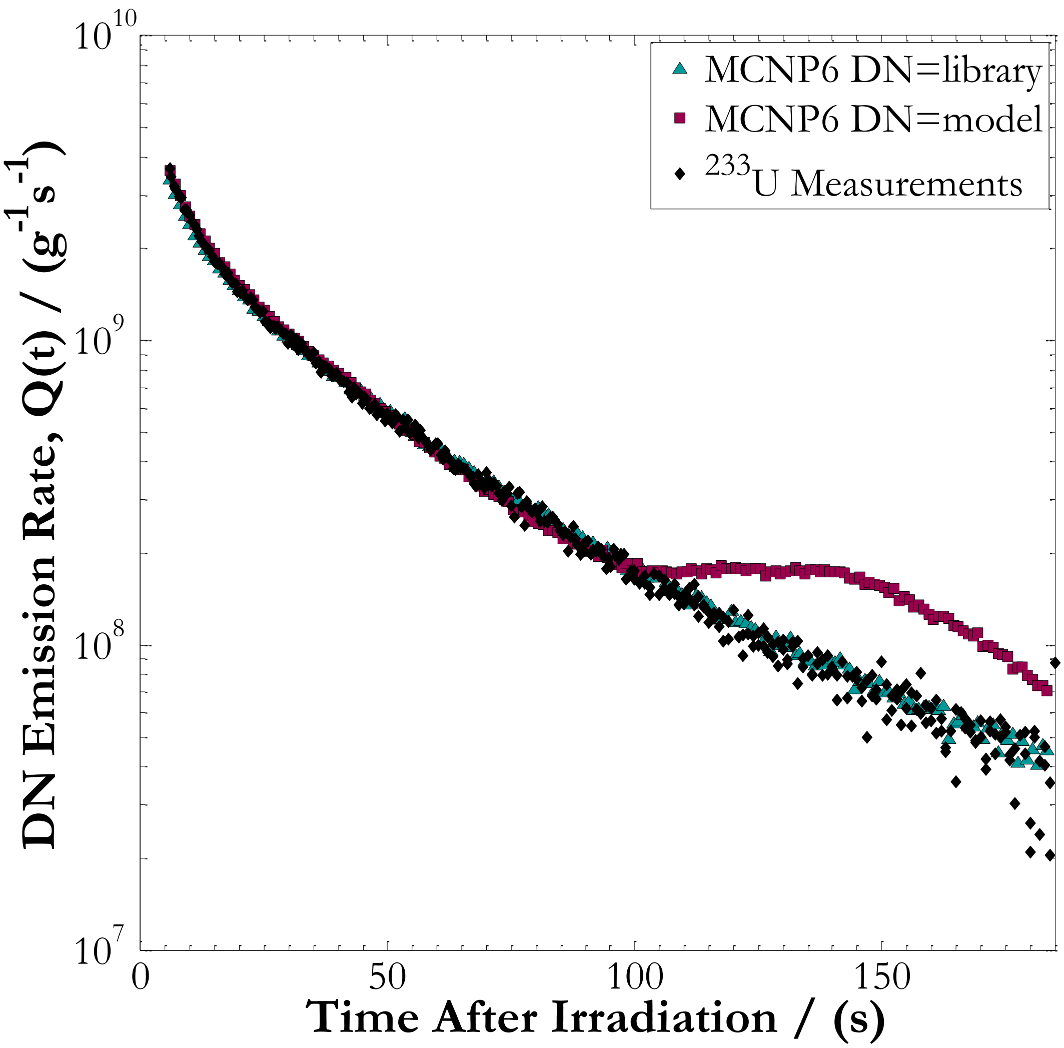

Figure 1: DN Emission Rates from U-233

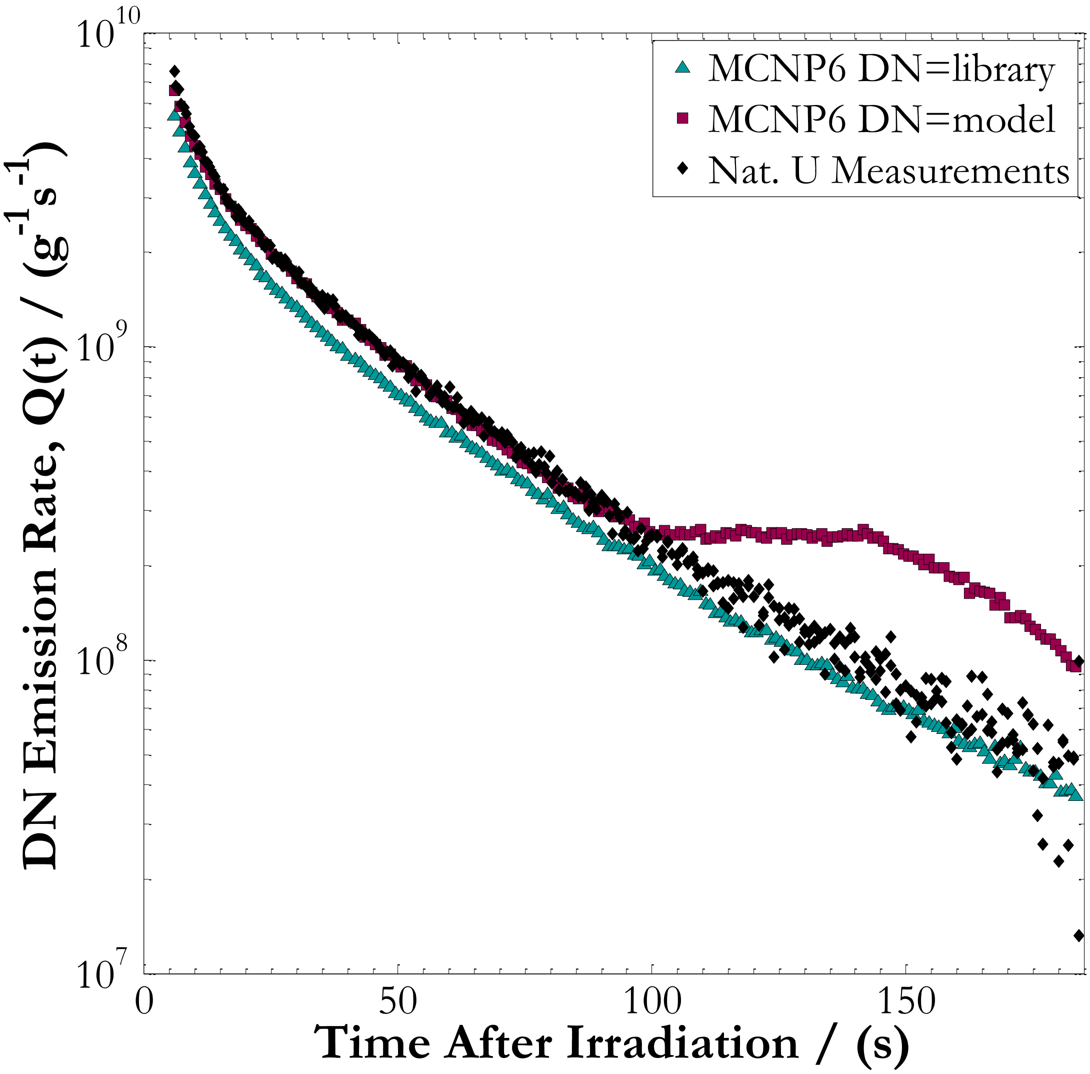

Figure 2: DN Emission Rates from Nat U.

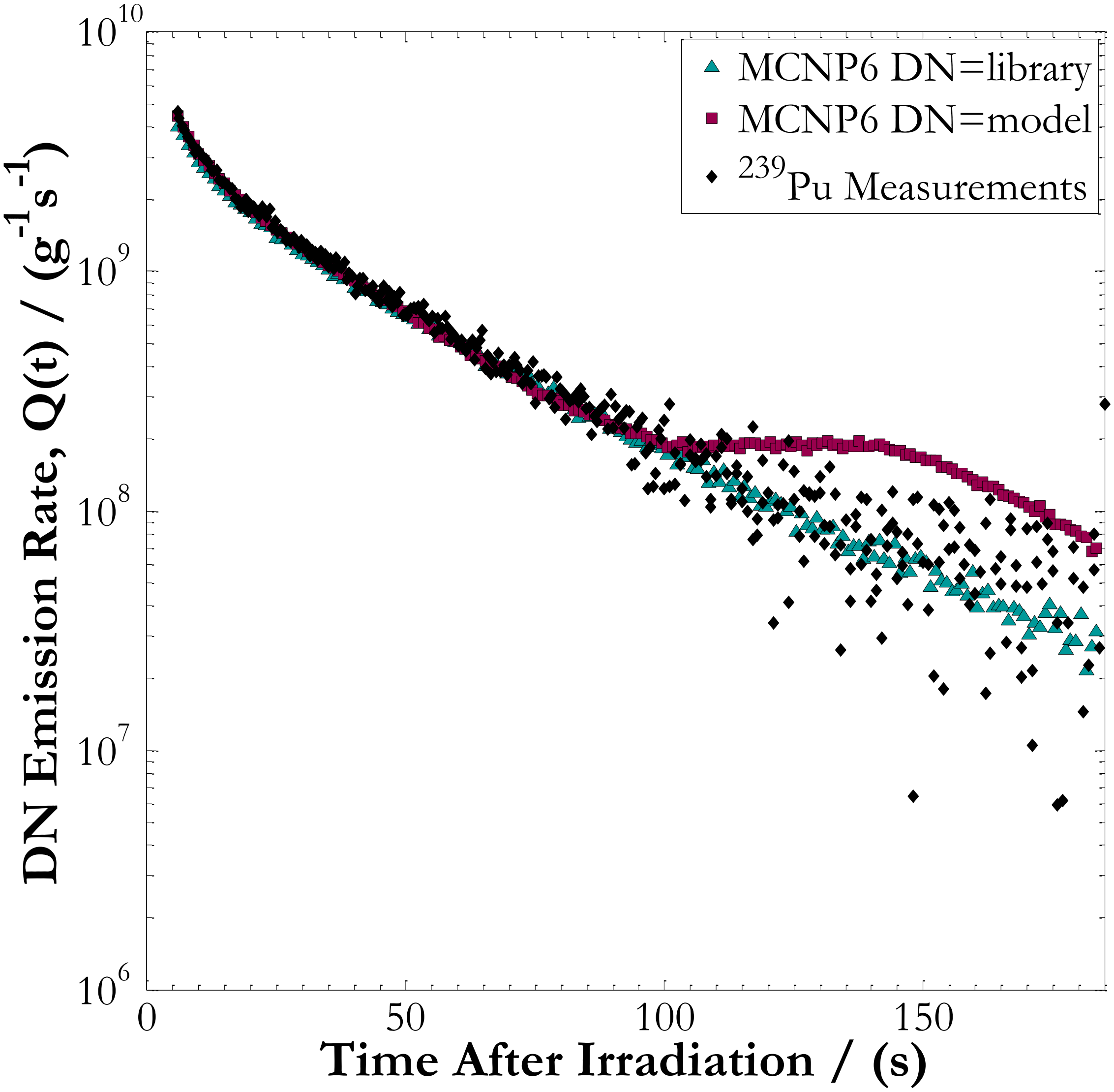

Figure 3: DN Emission Rates from Pu-239.

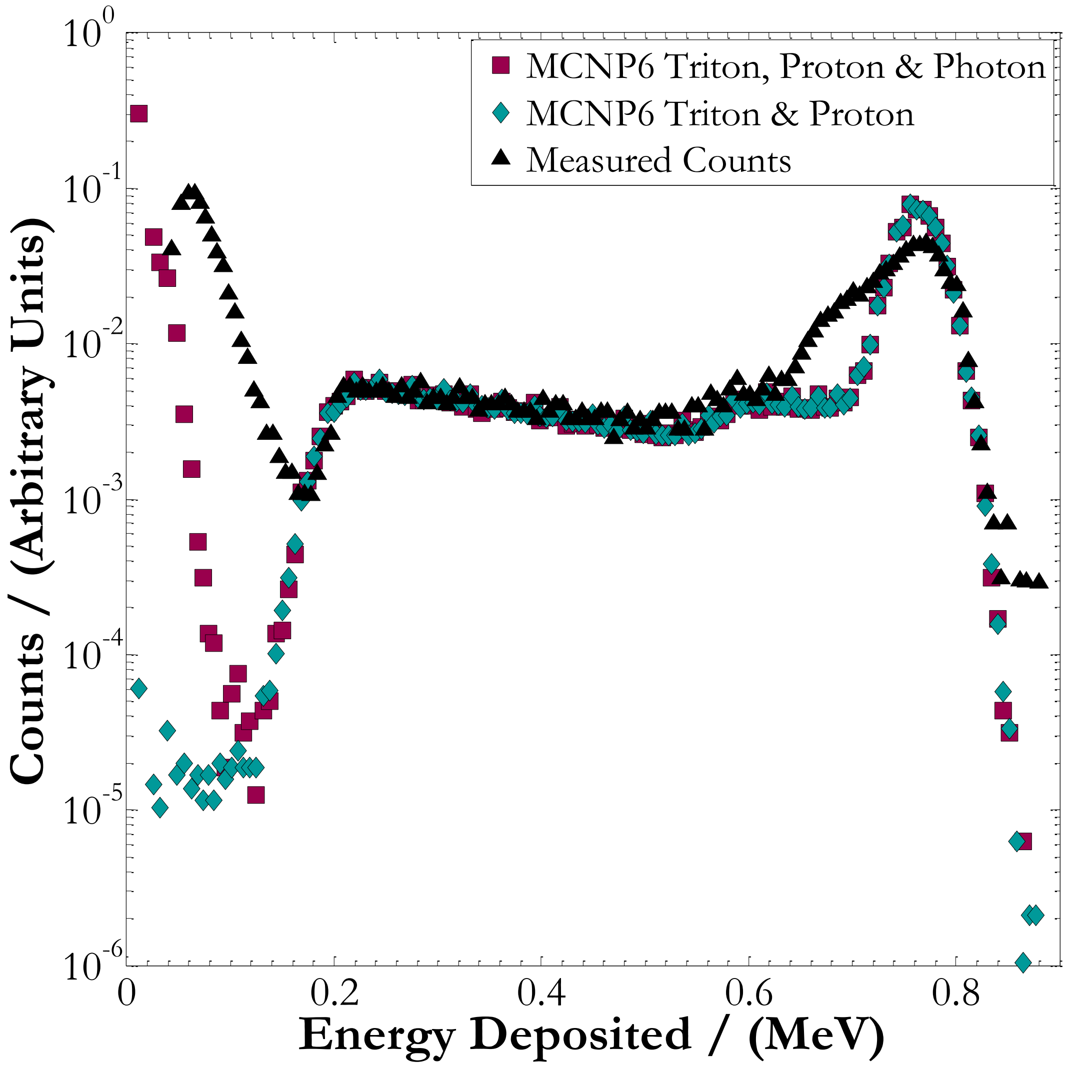

Figure 4: Energy Deposition in ^{3}He Detectors

Acknowledgements

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References

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2. M.T. Sellers, J.T. Goorley, E.C. Corcoran, D.G. Kelly. "Modeling the detection of delayed neutron signatures in MCNP6 and comparisons with experimental ^{233}U, ^{235}U and ^{239}Pu Measurements" LA-UR-13-22525, Los Alamos National Laboratory Report, (2013).

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