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Bat 703, p 45, CEA Saclay, Orme des Merisiers

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High Fidelity Measurements of Reactions Induced by Neutrons

Many areas of applied nuclear science such as nuclear forensics, stockpile stewardship, nuclear non-proliferation, and nuclear energy require new or improved cross sections of neutron-induced reactions. The state-of-the-art Detector for Advanced Neutron Capture Experiments (DANCE) was designed and built to deliver high fidelity measurements of neutron capture and neutron-induced fission cross sections on various isotopes needed for these applications, using the neutron spallation source at the Lujan Jr. Center, Los Alamos Neutron Scattering Center (LANSCE). The DANCE array consists of 160 BaF₂ gamma-ray detectors which nearly covers the full 4π solid angle. This enables DANCE to use total gamma-ray calorimetry for the neutron capture, neutron-induced fission and background characterization. A modern data acquisition is composed of 324 channels of 500 MHz Acqiris digitizers and uses sophisticated on-line and off-line data analyzers. With DANCE, we have successfully measured neutron capture cross section on ²⁴¹Am over seven orders of magnitude of neutron energy, from thermal to 320 keV. The methods for the absolute cross section determination using the DANCE detectors array were developed to extract cross sections and fit resonances below 20 eV using an R-matrix analysis. An accurate modeling of the capture process coupled with a Geant4 software model of the DANCE detector array was benchmarked against the experimental results to an accuracy of a few percent. A variety of neutron capture measurements for other actinide isotopes (²³³U to ²⁴³Am) and other selected isotopes have also been undertaken and are currently being analyzed using the methods developed for ²⁴¹Am. Techniques and results of measurements of neutron capture on fissioning actinides at DANCE using a fission-tagging Parallel Plate Avalanche Counter (PPAC) will also be presented. The first time observation of the neutron capture on radioactive ^{242m}Am in the resonance region was performed. Future projects will be briefly mentioned.