HORIZON 2020

HORIZON 2020 RESEARCH AND INNOVATION FRAMEWORK PROGRAMME OF THE EUROPEAN ATOMIC ENERGY COMMUNITY

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CEA/DIF has built up a program at the new neutron facility, NFS at GANIL, in order to measure (n,xn) reaction cross sections, and also to study neutron induced fission on actinides. Precise cross sections are targeted and concerning fission, neutron-γ competition, neutron emission and γ emission are the goals. Both types of reactions are measured simultaneously thanks to a new setup based on the SCONE detector and an active target.

The SCONE detector is a classical Gd loaded neutron long counter: it is able to detect prompt γ-rays and prompt neutrons on a fast time scale, and it is also able to count the neutron through delayed neutron captures on natural gadolinium. In such kind of detector, fast neutrons are slowed down and then thermalized in the detector by typically few micro-seconds. Then the neutron capture probability is maximum and neutron are captured independently. Thus a precise neutron counting can be performed by detecting the emitted γ-rays. The detection of prompt γ-rays allows to perform γ calorimetry in fission. The setup include and active target which is used to distinguish fission events from other reaction channels. It also include an internal BGO detector in order to optimize triggering on (n,xn) reaction. This setup was built from end of 2020 until the first test experiment at GANIL in November 2021.

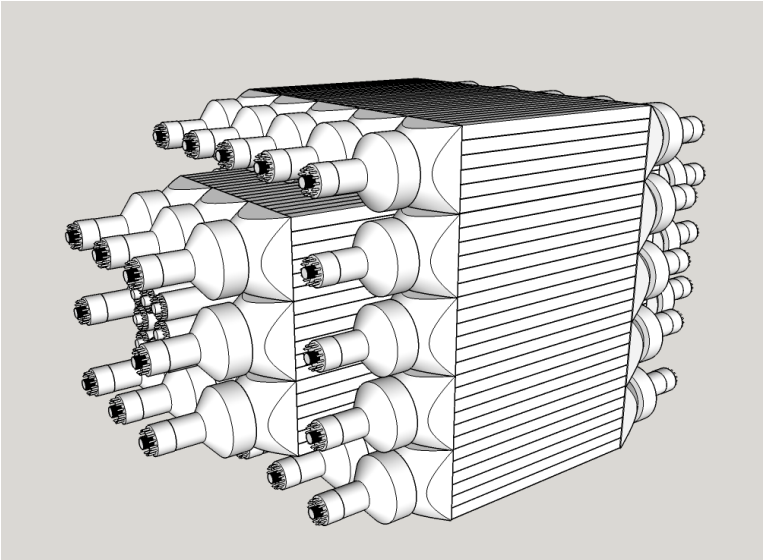

Figure 1 Three-dimensionnal drawing of the SCONE detector

Contrary to classical detectors SCONE (see Figure 1) is made of 896 EJ200 plastic scintillator bars (25x25 mm wide), each surrounded by a Gd loaded sheet. These bars are grouped in squared assemblies of 36 bars. The SCONE is composed of:

- Eight 1 m long assemblies (36 bars)
- Sixteen 50 cm long assemblies (36 bars)
- Eight 40 cm long central assemblies

The first test experiment was performed with a compact ^{238}U fission chamber (Left part Figure 2), which has been optimize in order to minimize the material budget in the beam. This is particularly important for measuring (n,xn) reaction cross-sections. Inside SCONE and around the fission chamber an internal BGO (Right part Figure 2) detector was placed for triggering optimization on (n,xn) reactions.

The test experiment was successful, and interesting data in neutron induced fission are already obtained. Especially total prompt neutron multiplicity distributions were obtained.

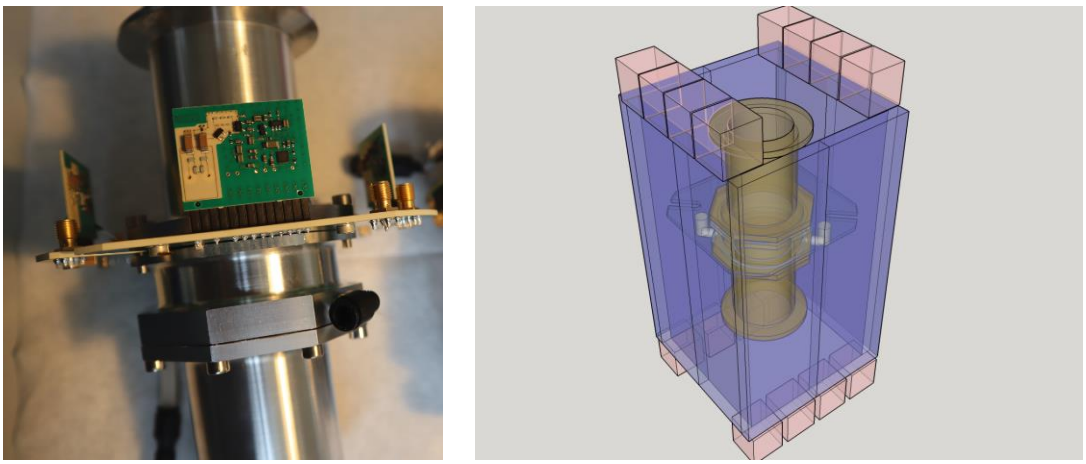

Figure 2 Left: Uranium 238 fission chamber. Right: BGO internal trigger.