

Measurement of Cross Section for $^{94}\text{Zr}(\gamma, n)$ Reaction Using Laser Inverse Compton Gamma rays

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In recent years, nuclear transmutation of minor actinides (MA) and long-lived fission products (LLFP) has drawn a lot of attention. Nuclear transmutation process of LLFP is based on neutron capture reaction. However, the (n, γ) cross sections for LLFP are not well measured in both quality and quantity. The (γ, n) cross section measurement makes it possible to supplement the (n, γ) cross sections.

In the electron storage ring facility TERAS, quasi-mono-energetic γ rays are produced in the energy range of 1 – 30 MeV by means of inverse Compton scattering with a Nd: YVO₄ laser and its harmonic modules. The inverse Compton beam line is shown in figure 1. The inverse Compton scattered photons passing through a lead collimator was used to irradiate the target. A ^{94}Zr target material was placed at the center of a neutron detector. The number of γ ray was monitored with a NaI(Tl) scintillation detector located behind the neutron counter.

A schematic view of the neutron detector is shown in figure 2. The neutron detector is composed of twenty ^3He proportional counters (CANBERRA/ Dextray: Eurisyss Mesures) embedded in a polyethylene moderator. The ^3He counters are mounted in 3 concentric rings to achieve high detection efficiency. The diameter of each ring is 76mm, 140mm and 200mm, and the number of the ^3He counters of each ring is 4, 8 and 8, respectively.

We measured the (γ, n) cross section for ^{94}Zr from 8.4 MeV to 9.8 MeV in gamma ray energy. Measured cross sections are presented.

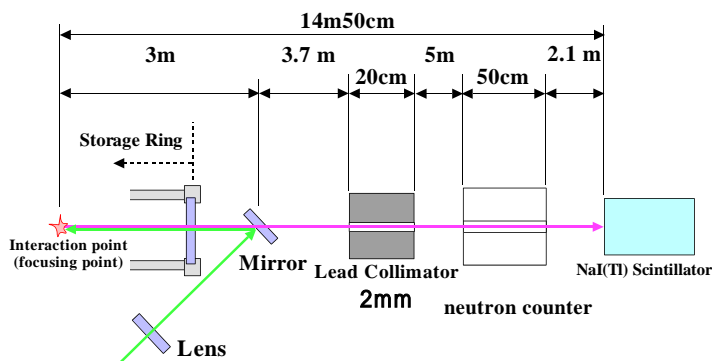


Fig.1. Schematic view of the inverse Compton beam line

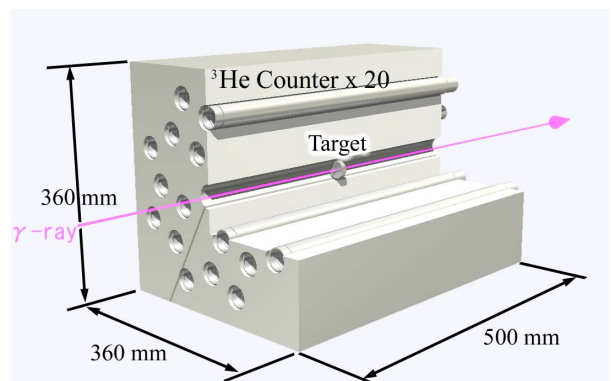


Fig.2. Schematic view of the neutron counter