



# Model independent analysis in ( $\gamma$ , n) reactions using deuterium targets

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## Abstract

Photonuclear reactions play an important role in nuclear physics, astrophysics and in various applications such as non-destructive measurement of nuclear materials (NDT). The study of ( $\gamma$ , n) reactions using deuterium targets i.e., photodisintegration of deuterons in addition to all the other ( $\gamma$ , n) reactions, is of considerable interest to these fields. In this contribution, we have studied the photodisintegration of deuterons with unpolarized photons. The angular dependence of the differential cross section is studied by expressing it in terms of Legendre polynomials. The analysis of differential cross-section is presented using the model-independent irreducible tensor formalism.

## Section snippets

### Introduction:

The importance of precise knowledge on  $d+\gamma\rightarrow n+p$  was highlighted by Burles et al. [1] and this led to series of experimental measurements [2] on this reaction at the Duke free electron laser laboratory using 100% linearly polarized photons from the high intensity  $\gamma$ -ray source. Neutron angular distribution in ( $\gamma$ , n) reactions [3] was reported recently in view of the importance of photonuclear reactions [4] for science as well as various applications [5]. Uncertainties in the reaction rates...

### Theoretical formalism

We choose z-x plane as the reaction frame and represent the photon polarization following Rose [19] through

$$u_{\mu} = -\mu \in \mu, \mu = \pm 1$$

Following [16], [17] the reaction matrix  $T(\mu)$  which is proportional to the on-energy shell transition matrix, is given by  $T(\mu) = \sum_{s=0}^1 \sum_{\lambda=|s-1|}^{s+1} S^{\lambda}(s, s') \cdot t^{\lambda}(s, \mu)$  where  $S_{0}^{\lambda}(s, \mu)$  are irreducible tensor operators of rank  $\lambda$  connecting initial spin state of deuteron with the final spin state of neutron and proton.  $t_{0}^{\lambda}(s, \mu)$  represent the irreducible tensor amplitudes of rank  $\lambda$  which are...

### Results and discussion

In this contribution we have presented model independent theoretical analysis of ( $\gamma$ , n) reaction using deuterium target i.e.,  $d+\gamma\rightarrow n+p$ . The discussion presented here on  $d+\gamma\rightarrow n+p$  can readily be extended to all other ( $\gamma$ , n) reactions which are of importance to the developing technology of non-destructive measurements of nuclear materials.

In equation (5),  $p_l^{m_i}(\cos\theta)$  represents the associated Legendre function and from the experimental measurements, the co- efficient of Legendre functions...

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper....

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