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TAGGING EFFICIENCY ESTIMATION IN EXPERIMENTS WITH A COHERENT BREMSSTRAHLUNG BEAM

D.D. Burdeinyi, V.B. Ganenko
National Science Center "Kharkov Institute of Physics and Technology", Kharkiv, Ukraine
E-mail: ganenko@kipt.kharkov.ua

The angular dependences of the coherent and incoherent parts of the coherent bremsstrahlung (CB) are different, thus the CB beam tagging efficiency differs from that of the bremsstrahlung. It has energy dependence close to the CB beam spectrum and depends on the CB peak energy. Thus, in the course of the cross section measurements, the systematic, measurements of the tagging efficiency should be usually produced. The paper shows that tagging efficiency can be estimated computationally by taking into account the background contribution to the detectors of the tagging system. This allows one to get cross sections simultaneously with the cross section asymmetry measurements in the case when the systematic tagging efficiency measurements were not performed.

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INTRODUCTION

Some time ago, two experiments on a carbon photodisintegration (1) have been carried out at the MAX-lab nuclear physics facility in Lund [1] in April 2008 (Exp-I) and 2011 (Exp-II),

$$^{12}C(\gamma,p)^{11}B, \quad (1)$$

using a beam of tagged linearly polarized photons [2]. Goal of the experiments, it was to measure a cross section asymmetry of the reaction (1),

$$\Sigma=(d\sigma_{||}-d\sigma_{\perp})/(d\sigma_{||}+d\sigma_{\perp}), \quad (2)$$

when the nucleus ^{11}B was in one of the low excited states [3]. $d\sigma_{||(\perp)}\equiv d\sigma_{||(\perp)}/d\Omega$ is the reaction cross section for the photon polarization direction parallel (perpendicular) to the reaction plane.

The photon tagging technique [1] provides to obtain accurate information about nuclear properties and reaction mechanisms, because it allows one to get value of the photon energy, which produces the reaction. The photon energy, E_γ, is determined as a difference between energies of the incoming, E_0, and residual (post-bremsstrahlung), E_e, electrons, $E_\gamma= E_0 - E_e$. The energy of the post-bremsstrahlung electrons is measured by a tagging system [1], consisted of a special magnetic spectrometer and an array of plastic detectors, placed along focal plane (FP) of the magnet. But a large portion of the photon beam is rejected by a collimator, thus not every electron registered in the focal plane detectors corresponded to a photon incident on the target. This loss is determined by the photon beam tagging efficiency, ε_{tag}, which relates the number of photons, impinging on the target with the number of post-bremsstrahlung electrons, detected by the FP detectors.

The tagging efficiency is important characteristic and should be controlled during experiment, especially when absolute cross sections for nuclear reactions are to be measured. It depends on collimation of the photon beam, material and thickness of the photon radiator, background contribution to the focal plane detectors, and in the case of a crystal radiator, on its orientation and the coherent peak energy. The tagging efficiency may change in the course of an experiment due to changing of the beam parameters, changing the background contribution to the focal plane detectors, or drifts in the detectors power supplies, etc. Thus, regular (every day) measurements of the tagging efficiency are usually produced in the course of the experiments. But in the case of an asymmetry measurement, it is not necessary to know the tagging efficiency because the asymmetry is an observable, which is a ratio of the cross sections. Thus, regular measurements of the tagging efficiency have not been produced in the Exp-I and II, but only episodic ones for some runs.

However, in the course of the data processing, for the asymmetry data control, it was decided to get also the cross sections of the reaction (1), since both these observables, the cross sections and asymmetry, are determined by the same reaction yields. So, a need appeared to get the tagging efficiency values for runs, in which the tagging efficiency was not measured. In these cases, an indirect method was proposed, based on the calculation of "geometrical" tagging efficiency and correction its value due to background contribution to the FP detectors. For final control, the cross sections of a deuteron photodisintegration reaction were used. In this paper, results of such estimations of the tagging efficiency have been discussed.

1. EXPERIMENTAL SETUP FOR TAGGING EFFICIENCY MEASUREMENTS

The experimental setup of the experiments (1) has been described in details in Ref. [1, 3, 4], thus only brief survey is given here, needed for the tagging efficiency measurements discussion.

The electron beam with energy E_0 = 192.7 MeV was extracted from the MAX-I storage ring, which worked in a stretcher mode. Then the beam was delivered into experimental area, shown in [1, 3, 4], and was directed onto photon radiators, a 0.05 mm. Al foil and diamond crystals of 0.1 mm thick in the Exp-I and 0.05 mm in the Exp-II, fixed in a target holder of a goniometer [2].

Then a non-interacting part of the electron beam was deflected to the beam dump by the magnet of the main tagger system (MT) where it was absorbed by a Faraday cup. The post-bremsstrahlung electrons were detected by a focal plane hodoscope placed along the focal plane of the MT magnet. The FP hodoscope consisted of two rows of scintillators 25 mm wide and 3.2 mm thick. The overlap between scintillators of the rows was 50%. The coincidence requirement to overlapping scintillators resulted in 62 channels for detecting the post-bremsstrahlung electrons. To increase statistics at the asymmetry measurements, the data were summed over four adjacent channels. The twelve energy bins were obtained in the Exp-I and nine in the Exp-II, the energy width of the bins was ~ 4 MeV. The details of the tagging system are described in [1].

A photon collimator with total length of 40 cm was placed on the distance 214 cm from the photon radiators before the shielding wall of the experimental area. It consists of heavy metal main collimator of 108.5 mm long, followed by a scrubber magnet of 100 mm long and a scrubber collimator of 200 mm long. Three available inserts with holes 5.4, 6, and 12 mm in diameter were used in the measurements, which corresponded to the photon beam collimation angles of $\theta_c \approx 0.5$, 0.6, and $1.2\theta_\gamma$, respectively. ($\theta_\gamma = m_e c^2/E_0$ is the characteristic angle of bremsstrahlung, E_0 and m_e are the electron energy and mass).

Measurements of the tagging efficiency were performed by two detectors for gamma radiation, a NaI(Tl) detector of 25×25×25 cm and a Pb/SCIFI detector consisting of scintillating fibers embedded in lead [5]. They were placed directly on the photon beam line in the experimental cave and counted the number of photons that comes out of the collimator. The electron beam flux was reduced by a factor ~10^4 in order to avoid pile up in the detectors. Scheme of the setup of the tagging efficiency measurement is shown in Fig. 1.

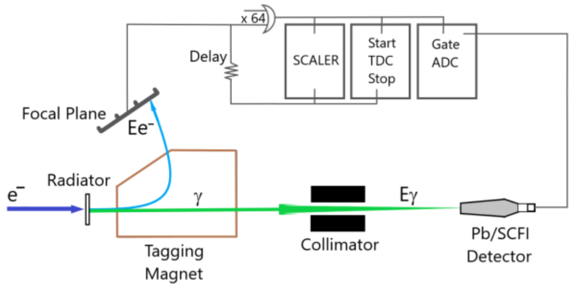

Fig. 1. Scheme of the setup used for tagging efficiency measurements

To trigger the system during a tagging efficiency run, the in-beam gamma detector signal was used with requirement a coincidence between the in-beam and the focal plane detectors. This signal sent to start the TDCs, open the gates for the ADC and inhibits the FP scalers. The numbers of counters recorded by the TDCs, were generated by the photons in the in-beam detector in the coincidence with the particles registered by the hodoscope, and are the number of photons, $N_{\gamma,ch}(i)$, impinging on the in-beam detector, corresponding to the FP channel (i). There is practically no the background counts in the in-beam detector in this case due to low beam intensity. The numbers of photons are also recorded by an ADC and can be determined from ADC spectra of the gamma detector signals, corresponding to the tagged channel (i). The counts registered by the focal plane detectors, $N_{FP}(i)$, besides the post-bremsstrahlung electrons from bremsstrahlung in the radiator, $N_e'(i)$, include a background contribution which may come from various sources. Firstly, the background directly generated by the electron beam, Nbg, beam, which may come from a Meller scattering from the radiator, the beam halo or scattered post-bremsstrahlung electrons, striking a vacuum chamber of the MT magnet, etc. The rate of this background, as well as the $N_e'(i)$ rate, are proportional to the beam intensity. Secondly, a constant background, $N_{bg,const}$, resulting from a cosmic radiation, activation in the experimental room. This background does not depend on the beam intensity. Thus, total number of the FP detector counts is

$$N_{FP}(i)= N_e'(i)+N_{bg,beam}(i)+N_{bg,const}(i). \quad (3)$$

The signals from the FP array are sent to scalers that count the events in each FP channel unless they are inhibited. These signals also stop the TDC connected to the certain channels. The main problem is that it is impossible to correctly determine the real background contribution to the FP detectors, since removing the photon radiator from the beam changes the background situation that existed when the radiator was in the beam. Thus, when it is removed, there are no Möller electrons, as well as residual low-energy electrons that could be produced in the case of striking of the bremsstrahlung radiation to the beam pipe on its way to the beam dump. The radiator-off measurements give only lower estimation of the background contribution and usually it was ~0.5...1%. As a rule, the real background was much more.

The room background is usually low. Its average value was determined in the beam-off measurements and was ~0.1 Hz for all FP channels. But at low intensity measurements its contribution can reach some percents and should be taken into account. Thus, the tagging efficiency measured at low beam intensity is

$$\varepsilon_{tag}(i) = N_{\gamma,ch}(i)/N_{FP}(i), \quad (4)$$

where $N_{FP}(i)$ coincides with (3). But at high intensity, the room background becomes negligible on comparison with the count rates of the residual electrons and the background generated by the electron beam, and the tagging efficiency is determined by (4), where

$$N_{FP}(i)=N_{FP,h}(i)=N_e'(i)+N_{bg,beam}(i). \quad (5)$$

Because the needed quantity is the tagging efficiency at high intensity, since this is what determines the number of photons hitting the target during data taking, to get right its value the tagging efficiency measured at low intensity should be corrected on room background. The corrected tagging efficiency value using for cross sections determination in high intensity measurements is determined by relation given in [6],

$$\varepsilon_{tag}(i)=N_{\gamma,ch}(i)/(N_{FP,l}(i) - (t_{liv,on}/t_{liv,off})N_{bg,const}), \quad (6)$$

where $t_{liv,on}$ and $t_{liv,off}$ are the beam-on and beam-off live times (time of the measurement with taking into account time for computer data processing during which the electronics is closed). So, the measured tagging efficiency is no corrected for the beam-related background. It is assumed that this background presents in the same proportion in the low and high intensity runs, and one may relate the number of photons with sum value $N_e'(i)+N_{bg,beam}(i)$. But if the high-intensity beam produces a background that is not linear with the intensity or unstable, the tagging efficiency would be different at different intensities and will change during the run. It should be noted that the measured tagging efficiency $\varepsilon_{tag}(i)$ differs from the “geometrical” one,

$$\varepsilon_{tag,g}(i) = N_{\gamma,ch}(i)/N_e'(i), \quad (7)$$

due to presence of the background.

2. RESULTS OF TAGGING EFFICIENCY MEASUREMENTS

Measurements of the tagging efficiency were performed for the collimator openings of 12 and 5.4 mm in diameter for the bremsstrahlung beam from the Al radiator, and for the coherent bremsstrahlung beam (CB) from both diamond crystals at the coherent peak energies of $E_{\gamma,d} \approx 51$ and 61 MeV.

2.1. TAGGING EFFICIENCY OF BREMSSTRACLUNG BEAM

The tagging efficiencies of the bremsstrahlung beam from the Al radiator were measured by the NaI detector in Exp-I and by Pb/SCIFI detector in Exp-II. Preliminary results, obtained in the first experiment, were presented in work [7]. Final results of the both experiments are shown in Fig. 2.

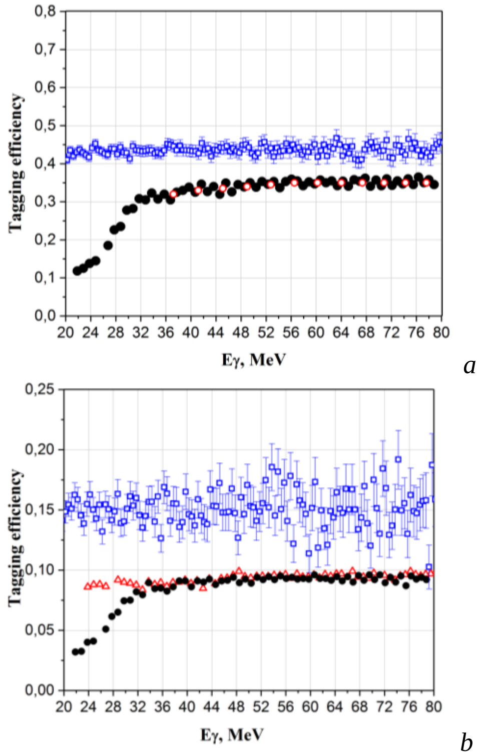

Fig. 2. Tagging efficiency of bremsstrahlung beam from 0.05 mm Al radiator at collimator ∅12 mm, measured in Exp-I (black circles). Empty circles are the tagging efficiency averaged over energy bin width, squares – results of simulation, see text (a). The same for the collimator ∅5.4 mm. Triangles are results of Exp-II measurements (b)

The tagging efficiency has smooth shape and somewhat decreases with photon energy decreasing, due to increasing the background contribution, when energy of the post-bremsstrachlung electrons is approached to the energy of primary electrons. The average values within energy interval of 40…80 MeV are $\varepsilon_{tag,h}(i) \approx 0.35$ and 0.095 for the collimator with openings of 12 and 5.4 mm, respectively. One can see that ~35 and ~10% photons for the above collimators passed their and hit the target. The results of two measurements for the latter collimator are in good agreement that point out to identical beam parameters and the background conditions in these measurements.

The figures show also the results of the tagging efficiency simulation (described in [4]), performed using the GEANT-4 package. The numbers and energies of the simulated initial electrons (N_e), the post-bremsstrahlung electrons ($N'_{e,m}$), which passed the MT magnet chamber and detected by the FP detectors, the emitted bremsstrahlung photons ($N_{\gamma,tot}$) and the photons, which passed the photon collimator and hit the target ($N_{\gamma,hit}$), were fixed in the data base. Then the secondary particles were sorted into the energy bins, corresponding to the FP channels energy and width. The tagging efficiency was calculated by relation,

$$\varepsilon_{tag,m}(i)= N_{\gamma,hit}(i)/N'_{e,m}(i). \qquad (8)$$

It practically coincides with the "geometrical" tagging efficiency, because only small background contribution due to Meller scattering was taken into account. The average values in the interval E_γ= 40…80 MeV are $\varepsilon_{tag,m}$= 0.436±0.002 for collimator of 12 mm and $\varepsilon_{tag,m}$= 0.151±0.002 for 5.4 mm that is more ~25 and 59%, respectively, then the measured values. Such difference is due to the beam dependent background contribution to the FP detectors, which was not taken into account in the simulation. The background contribution estimated by the relation

$$f_{bg}=1-\varepsilon_{tag}/\varepsilon_{tag,m} \qquad (9)$$

is about $f_{bg}\approx 0.2$ and 0.37 for the collimator holes of 12 and 5.4 mm, respectively.

The differential cross section of the d(γ,p)n reaction at θ_p=90° obtained with the bremsstrahlung beam using the measured tagging efficiency is shown in Fig. 3 (from Ref. [4]). It well agrees with the literature data.

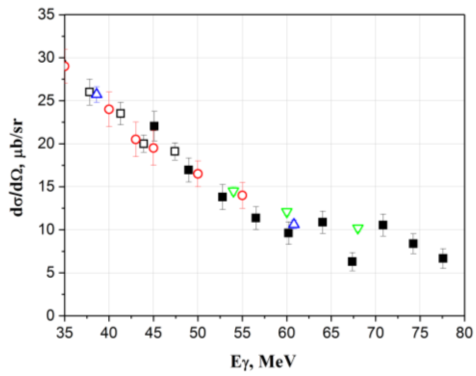

Fig. 3. Differential cross section of the d(γ,p)n reaction at θ_p=90° (full squares). Empty squares are data [8], circles [9], triangles [10], down triangles [11]

2.2. TAGGING EFFICIENCY OF A COHERENT BREMSSTRACLUNG BEAM

There were only three measurements of the CB beam tagging efficiency performed during Exp-I and II for diamond crystals of 0.1 and 0.05 mm thick, and some collimator holes and CB peak energies. Results of the measurements are shown in Fig. 4. One can see a typical shape of the measured tagging efficiency of the CB beam, similar to the CB beam spectrum. There is a peak corresponding to the CB maximum. To the left side from the peak the tagging efficiency fluently decreases with energy, and the right side is sharper. In the range above the peak, the tagging efficiency is mainly due to incoherent part of the radiation, so it is close to the one of the bremsstrahlung beam. For collimator holes with diameter of 12 and 5.4 mm, the tagging efficiency reaches its maximum value at the CB maximum, respectively, ε_{tag}≈0.39 and 0.12.

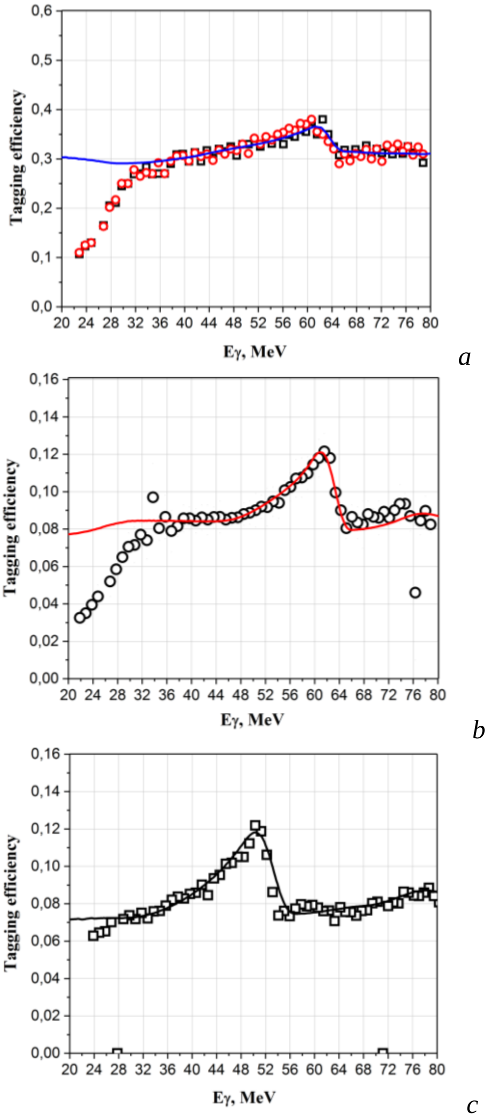

Fig. 4. Tagging efficiency of CB beam from diamond 0.1 mm thick for collimator ∅12 mm for PARA (squares) and PERP (circles) orientations (Exp-I). CB peak energy is $E_{\gamma,d}$≈61 MeV. Curve is calculation by ANB code [12]. See text for details (a). The same for the collimator hole of 5.4 mm in diameter, averaged over PARA and PERP orientations (b). Tagging efficiency of CB beam from diamond of 0.05 mm thick for collimator ∅5.4 mm (Exp-II). CB peak energy is $E_{\gamma,d}$≈51 MeV (c)

In Fig. 5 it is presented results of simulation of the tagging efficiencies for disorientated crystals, which is close to the amorphous matter of the same thickness. For the collimator holes of 12 and 5.4 mm in diameter their average values over interval 40…80 MeV are ε_{tag}≈0.396±0.002 and 0.125±0.002 for the disorientated diamond of 0.1 mm thick, and ε_{tag}≈0.449±0.002 and 0.169±0.002 for the one of 0.05 mm thick, respectively. The tagging efficiencies for the 0.05 mm crystal are more ~1.13 and 1.35 times then for 0.1 mm one for the collimator holes of 12 and 5.4 mm, respectively.

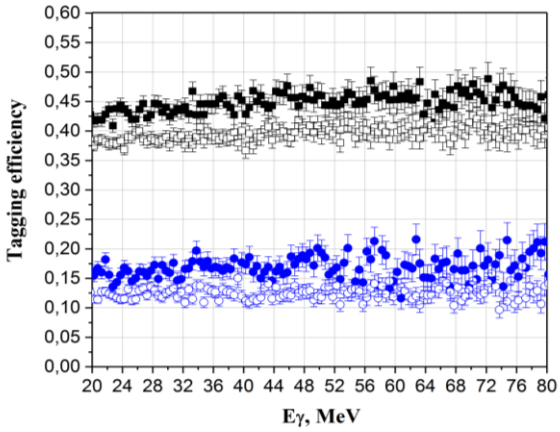

Fig. 5. Simulated tagging efficiency for the disorientated diamond crystals of the 0.1 (empty points) and 0.05 mm thick (full points), for collimator ∅12 (squares) and ∅5.4 mm (circles)

Using relation (9), one can estimate the background contribution to the tagging efficiencies presented in Fig. 4, by comparing the measured and simulated ones in the range above the coherent maximum. The estimations give values of the background contribution, f_{bg}≈0.21, 0.33, and 0.55 for the data in Fig. 4,a,b,c, respectively, which are close to the data presented in Fig. 2 and are typical for the MAX-lab facility. With the same collimation, the relative background for the 0.05 mm crystal is greater than for the 0.1 mm crystal.

From formulas (4), (5), and (7) one can obtain a ratio relating the actual tagging efficiency to the "geometric" one,

$$\varepsilon_{CBtag} = \varepsilon_{CBtag,g}/(1+f_{bg}), \quad (10)$$

where $f_{bg} = N_{bg,beam}(i)/N_e'(i)$ is the relative background contribution. The "geometrical" tagging efficiency of the CB beam can be calculated by relation

$$\varepsilon_{CBtag,g} = Sp(D)_{col}/Sp(D)_{no}, \quad (11)$$

where $Sp(D)_{col}$ and $Sp(D)_{no}$ are the collimated and non-collimated CB spectra from the diamond, calculated by the ANB code [12]. For the crystal of 0.1 mm thick, in the MAX-lab facility conditions the typical background contribution is f_{bg} ~ 20% for the collimator opening of 12 mm in diameter and f_{bg} ~ 35% for the opening of 5.4 mm. By using these values and correcting them, a good agreement can be obtained between the calculated and measured tagging efficiencies, as shown in Fig. 4. Thus, it is possible to obtain correct tagging efficiencies in cases where they have not been measured by using information about the real background contribution.

There were five runs in Exp-I and Exp-II in which the tagging efficiency has not been measured. Results of the tagging efficiency calculations for these measurements by the method described above are presented in Fig. 6.

The final control was carried out by comparing the calculated d(γ,p) reaction cross sections with the existing experimental data. Fig. 7 shows the d(γ,p) cross sections, obtained with the calculated tagging efficiency, and averaged over all runs of Exp-II. They agree well with the literature data.

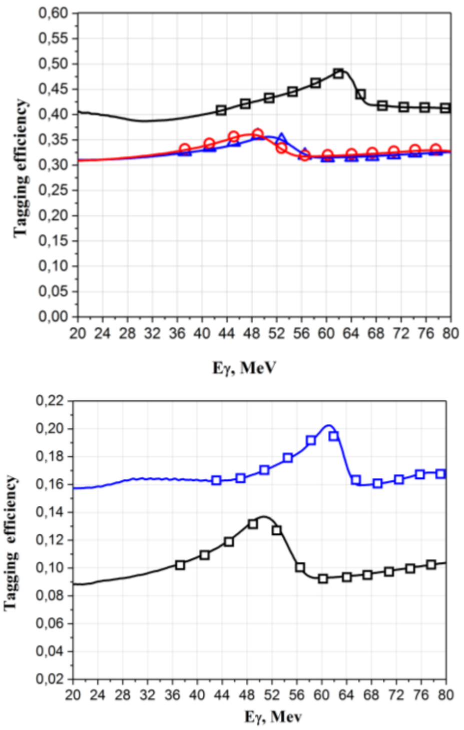

Fig. 6. Calculated tagging efficiencies of the CB beam for collimator ∅12 mm. Points are the tagging efficiencies averaged over width of FP energy bins: triangles and circles – diamond of 0.1 mm thick and CB peak energies of $E_{\gamma,d}$≈51 and 48 MeV (Exp-I), respectively, squares – crystal of 0.05 mm, $E_{\gamma,d}$≈61 MeV (Exp-II) (a). The same as in (a). Top curve the crystal of 0.05 mm thick, collimator ∅6 mm and CB peak energy $E_{\gamma,d}$≈61 MeV (Exp-II), bottom – crystal of 0.1 mm thick, collimator ∅5.4 mm, CB peak energy $E_{\gamma,d}$≈51 MeV (Exp-I) (b)

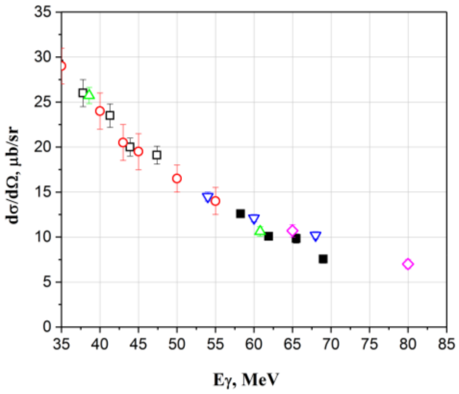

Fig. 7. Differential cross sections of the d(γ,p) reaction for proton emission angle θ_p=90^0, average over all runs of Exp-II (full squares). Literature data: [8] (empty squares), [9] (circles), [10] (triangles), [11] (down triangles), [14] (rhombus)

The approach presented in this paper is a generalization of the version of the tagging efficiency calculation used in the previous paper [13], in which the experimental results obtained in Exp-I were discussed. In [13], the tagging efficiency was obtained using the calculated relative spectra of the CB and the measured tagging efficiency of the bremsstrahlung beam from a 0.05 mm Al radiator to take into account the influence of the background contribution. The obtained cross sections [13] are in good agreement with the literature data in the entire energy range of E_γ = 45…78 MeV.

The tagging efficiencies values averaged over width of FP energy bins, which should be used for calculations of the cross sections reaction (1) and d(γ,p) are presented in the Table.

Tagging efficiency averaged over energy width (~4 MeV) of FP channel bins, Exp-I

Diamond 0.1 mm				
E_γ, MeV	∅12 mm Alu	∅12 mm $E_{\gamma,d}$ ≈ 51 MeV	∅12 mm $E_{\gamma,d}$ ≈ 48 MeV	∅5.4 mm $E_{\gamma,d}$ ≈ 51 MeV
37.2	0.32	0.326	0.325	0.094
41.2	0.33	0.333	0.337	0.101
45.1	0.33	0.342	0.352	0.110
49.0	0.34	0.355	0.357	0.121
52.8	0.34	0.352	0.327	0.117
56.5	0.35	0.324	0.310	0.093
60.2	0.35	0.317	0.311	0.085
64.0	0.35	0.318	0.314	0.086
67.4	0.35	0.320	0.316	0.088
70.8	0.35	0.322	0.319	0.090
74.2	0.35	0.324	0.322	0.092
77.6	0.35	0.327	0.323	0.095

Continue for Exp-II

Diamond 0.05 mm			
Eγ, MeV	∅5.4 mm $E_{\gamma,d}$≈51 MeV	∅12 mm $E_{\gamma,d}$≈61 MeV	∅6 mm $E_{\gamma,d}$≈61 MeV
43.1	0.093	0.408	0.163
47.0	0.106	0.421	0.165
50.8	0.114	0.433	0.170
54.6	0.085	0.445	0.179
58.3	0.075	0.462	0.192
61.9	0.076	0.481	0.195
65.5	0.078	0.440	0.163
69.0	0.079	0.418	0.161
72.4	0.082	0.415	0.164
75.8	0.085	0.414	0.167
79.1	0.086	0.413	0.168

SUMMARY

The tagging efficiency is important characteristic and should be controlled during experiment, especially when absolute cross sections for nuclear reactions are to be measured. The angular dependences of the coherent and incoherent parts of the CB radiation are different, thus the CB beam tagging efficiency differs from that of the bremsstrahlung, and has complicate energy dependence. Thus, in the course of the cross section measurements, the systematic, measurements of the tagging efficiency should be usually produced.

But if such measurements were not performed the tagging efficiency can be estimated by the calculations if to take into account the background contribution to the detectors of the tagging system. Using of the CB beam for the cross section measurements allows one to obtain information on the cross section and asymmetry of the (γ,p) reactions on nuclei, simultaneously.

REFERENCES

1. J.-O. Adler et al. The upgraded photon tagging facility at MAX-lab // *Nuclear Instruments and Methods in Physics Research*. 2013, A715, p. 1-10.
2. V. Ganenko, J. Brudvik, D. Burdeinyi, et al. Linearly polarized photon beam at MAX-lab // *Nuclear Instruments and Methods in Physics Research*. 2014, A763, p. 137-149.
3. D. Burdeinyi, J. Brudvik, K. Fissum, V. Ganenko, et al. Cross Section Asymmetry of two-body Carbon Disintegration $^{12}C(\gamma,p)^{11}B$ with Polarized Photons at Energy 40…50 MeV // *Nuclear Physics*. 2017, A957, p. 321-331.
4. G. Brudvik, D. Burdeinyi, V. Ganenko, et al. Measurement of (γ, p) Reaction with ΔE-E telescope at MAX-lab Facility // *Problems of Atomic Science and Technology. Series "Nuclear Physics Investigations"*. 2015, № 3, p. 97.
5. D.W. Hertzog. *Nucl. Inst. and Meth*. 1990, A294, p. 446.
6. *Summary of the MAX-lab Run Period* 2008.06.02 - 2008.06.30.
7. *Summary of the MAX-lab Run Period* 2008.04.14 - 2008.04.28.
8. D. Babusci, V. Bellini, M. Capogni, et al. // *Nucl. Phys.* 1998, v. A633, p. 683-694.
9. B. Weissman and H.L. Schultz // *Nucl. Phys.* 1971, v. A174, p. 129.
10. M.P. De Pascale, G. Giordano, G. Matone, et al. // *Phys. Rev*. 1985, v. C32, p. 1830.
11. K.-H. Krause, J. Sobolewski, J. Ahrens, et al. // *Nucl. Phys.* 1992, v. A549, p. 387-406.
12. F.A. Natter et al. // *NIM* B211. 2003, p. 465.
13. G. Brudvik, D. Burdeinyi, V. Ganenko, et al. Measurement of d(γ,p) Reaction Cross Sections and Asymmetry with Linearly Polarized Coherent Bremsstrahlung Beam // *Problems of Atomic Science and Technology. Series "Nuclear Physics Investigations"*. 2018, № 3, p. 132-139.
14. E. Whalin, B. Dwight Schriever, A. Hanson // *Phys. Rev*. 1956, v. 101.

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ОЦІНКА ЕФЕКТИВНОСТІ МІЧЕННЯ В ЕКСПЕРИМЕНТАХ З КОГЕРЕНТНИМ ГАЛЬМІВНИМ ВИПРОМІНЮВАННЯМ

Д.Д. Бурдейний, В.Б. Ганенко

Кутові залежності когерентної та некогерентної частин когерентного гальмівного випромінювання (КГВ) відрізняються, тому ефективність мічення пучка КГВ відрізняється від ефективності мічення гальмівного випромінювання. Вона має енергетичну залежність, близьку до спектра пучка КГВ, і залежить від енергії піка КГВ. Таким чином, під час вимірювань поперечного перерізу зазвичай слід проводити систематичні вимірювання ефективності мічення. Показано, що ефективність мічення можна оцінити шляхом розрахунків, якщо врахувати фоновий внесок у детектори системи мічення. Це дозволяє отримати поперечні перетини одночасно з вимірюваннями асиметрії поперечних у випадку, коли систематичні вимірювання ефективності мічення не проводились.