comment on the paper by F.Rambo *et al.* "coherent π^o photoproduction"

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Abstract

We comment on sec 4.2 of the draft by Rambo *et al.* [2] which is not consistent with previous results with the "Rambo"-code. Furthermore, our calculations disagree with the data - however some clarification on the parameters used in the draft is needed for a precise, final judgement.

1 Comments to the draft by "Rambo"

The description of the experiment (sec. 2 of the draft [1]) is rather short, it states the following:

- the lattice vector $[02\bar{2}]$ was used to produce linearly polarised photons with the discontinuity set at 360 MeV.
- the polarisation reaches 50-60%
- collimators of 3 mm, 4 mm and 6 mm at a distance of 2500 mm downstream the radiator have been used

In fig. 6 of the draft [2] the results for the degree of linear polarisation obtained from the ^{4}He(γ,π^o) experiment are compared with calculations with the "Rambo"-code.

The three data sets shown in fig. 6 have not been accumulated for the same diamond settings. The discontinuity of the 0.6 mrad/3 mm collimation is lower than the other two by about 10 MeV.

For all 3 collimators the degree of polarisation is 45%, clearly below the 50% which were stated in sec. 2. Trusting the calculations one has to conclude that the experiment results in too small polarisations (sic!).

Also a comparison with previous experiments with NaJ crystals [2] exhibits an unexplained discrepancy to the present data: The NaJ experiment was performed at an diamond-angle which places the discontinuity at 320 MeV. There polarisations of 48% and 56% have been seen (see fig. 9). Extrapolating the energy dependence of the photon intensity at the discontinuity - which represents to first order the polarisation - one cannot explain the low polarisation seen in the TAPS experiment.

No comparison of the original "tagger" spectra – coherent and incoherent – is given which would permit some checks.

The authors assess the overall agreement as being satisfactory or even excellent (see abstract).

2 own Monte Carlo predictions

The Tübingen group has produced two new codes for predictions of the degree of polarisation for linearly polarised photons: i) an analytical version which includes some assumptions and simplifications in order to circumvent the multiple integrations ii) a full Monte Carlo version (MCB) for coherent bremsstrahlung. Here we refer to the MCB, which differs from the "Rambo" code by considering the beam profile and the multiple scattering by MC techniques, the angular distribution (Hubbel) with a correct Debye-factor and the Z dependence of the incoherent contribution (Nickel vs. Diamond). An Internal Report can be found on our WWWpage, a full paper is in preparation. To demonstrate our points of arguments we enclose some figures from the forthcoming conference contribution (Granada). The respective data were taken in 1996 during the ^{4}He(γ,NN) data taking period of the PiP/TOF group for a nominal energy of 350 MeV at the discontinuity.

Fig. 1a shows the photon intensity $I^{Ni} = k \cdot \sigma^{Ni}$ for incoherent bremsstrahlung obtained from the 4 μm Ni foil which is well described in the photon range from 40 to 800 MeV except for the very ends. The measured yields have been divided by the reduced cross section $\overline{\sigma} = Z^2\alpha^3$ and are compared to the MCB prediction. The effect of collimation is clearly visible. Fig. 1b shows the intensity $I^{cry} = k \cdot \sigma^{cry}$ from the 100 μm thick diamond. The histogram and curve for the relative intensity $I^{rel} = I^{coh}/I^{Ni}$ are compared in Fig. 1c. The respective parameters used are given in tab. 1. Note, that the beam divergence has been set to 1.5 mrad instead of the 0.9 mrad quoted by Kaiser. Finally a prediction of the degree of polarisation shown in Fig. 1d.

In Fig. 2 we demonstrate that our code can reproduce the ^{4}He(γ,π^o) taken with the NaJ detectors [2]. The discontinuity is set at 320 MeV and two collimations of 0,5 and 0,7 mrad have been employed. The degree of polarisation is indeed between 50 and 60%. The data are well described within the statistical errors given. This holds also for the region above the discontinuity. The parameters used are given in tab. 1 for sets A and B; note the slight increase for the beam size and divergence. No offsets of collimators were assumed. Please compare with the original curves from the paper [2].

Finally in fig. 3 we show the data from the present draft (sets C,D and E) together with our calculations. The full curves have been obtained for one crystal angle pair (Θ, α) to give the discontinuity for set D. Beam spot size and divergence had to be increased strongly to roughly reproduce the data. The dashed curves represent results for individually "improved" angles with "our" beam parameters. The agreement of none of these curves is satisfactorily.

3 resume

The data and the calculations of Rambo *et al.* [2] seem inconsistent between each other.

Our own calculations confirm the discrepancies.

However, to point out more clearly we need to refer also to the photon spectra which at present we don't have. Likewise, a comparison by Rambo of his calculations to the photon spectra and a list of the parameters used would be useful for clarification.

References

[1] F. Rambo *et al.* ; present draft

[2] F. Rambo *et al.* ; Phys Rev **C58** (1998) 489

Figures and Tables

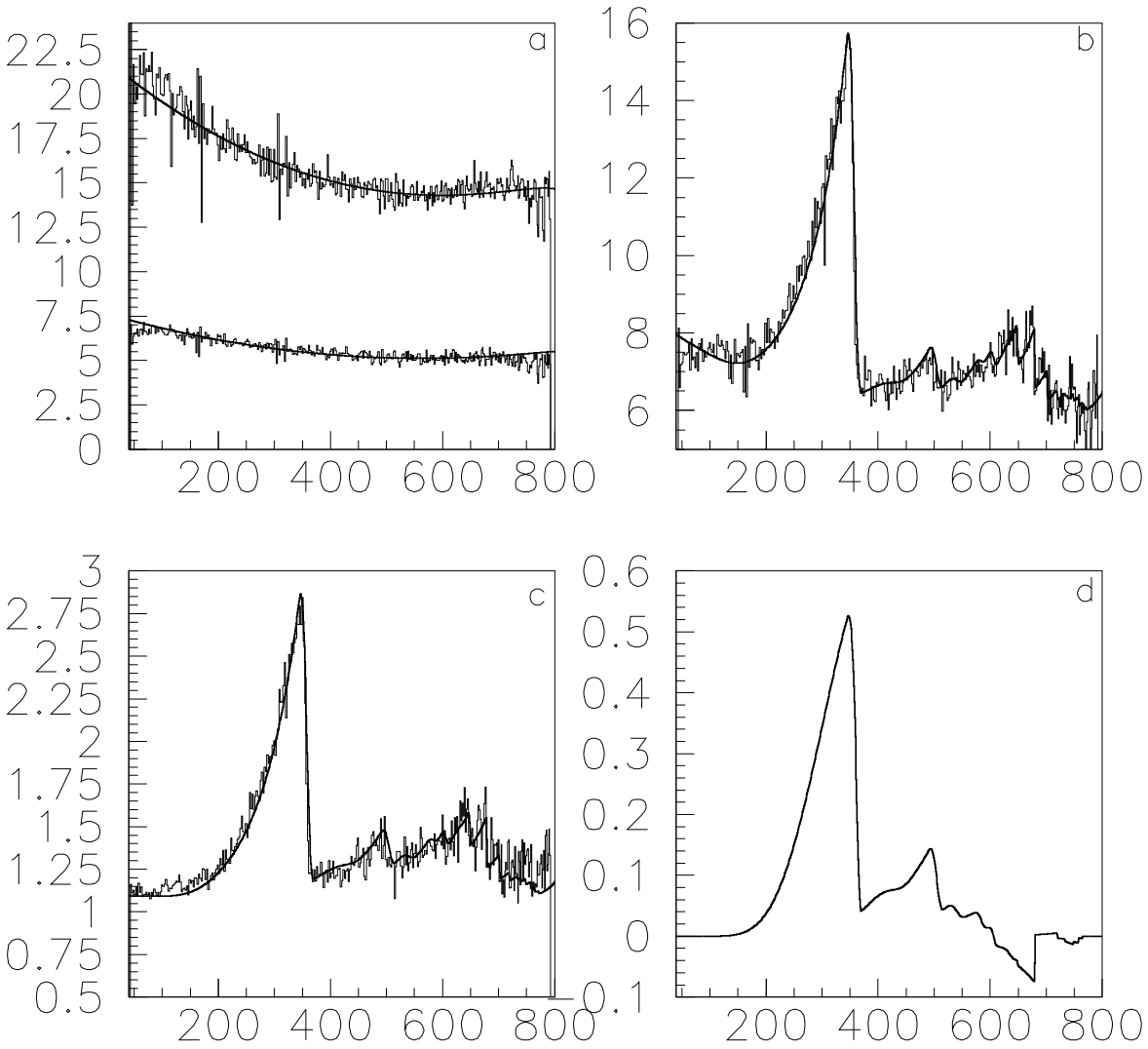

Figure 1: Comparison of measured and calculated photon spectra (note the suppressed zero in b and c; collimation angle ϑ_c=0,6 mrad): (a) Intensity distributions for incoherent bremsstrahlung from Nickel I^{Ni} with and without collimation and (b) total from diamond crystal ($I^{\mathrm{cry}} = I^{\mathrm{coh}} + I^{\mathrm{inc}}$). (c) Relative intensity $I^{\mathrm{rel}} = I^{\mathrm{coh}} / I^{\mathrm{Ni}}$ and (d) prediction of the polarisation.

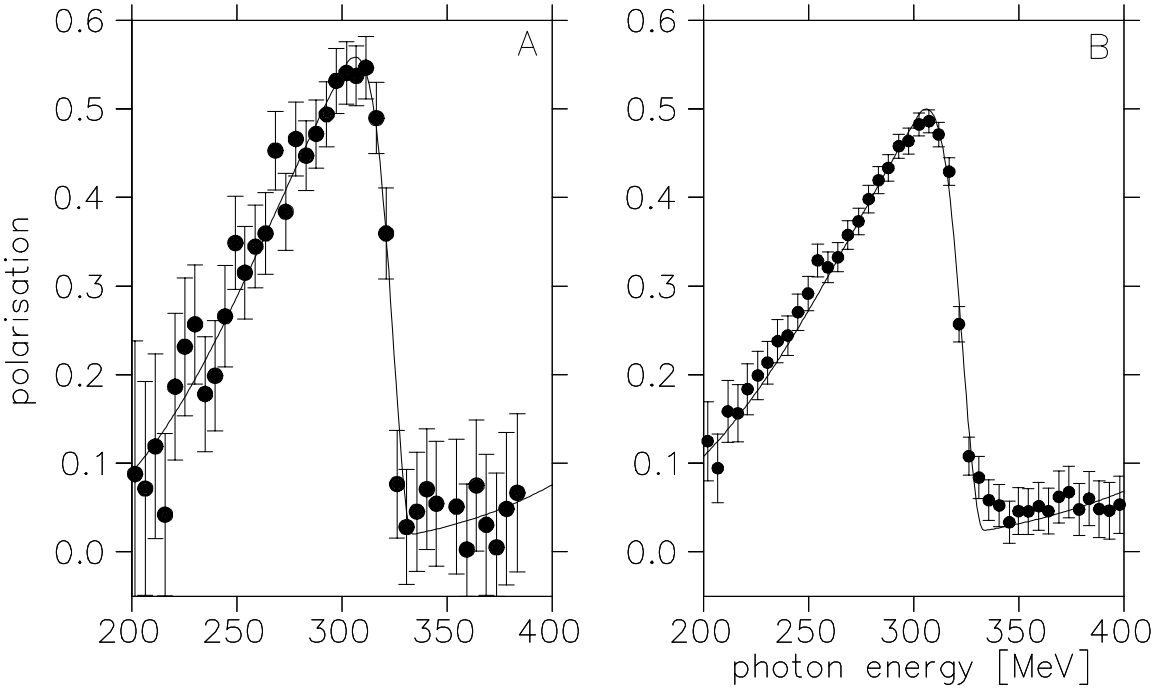

Figure 2: Polarisation for set A,B; the data are from ref. [2].

Table 1: Parameters used for the calculation in fig. 1,3,2. The diamond thickness and crystal angle was taken as $d = 0.1$ mm and $\Phi = 0.785398$ rad, respectively.

set		θ	α	σ_{bspot}	σ_{bdiv}	ϑ_c
		[rad]	[rad]	[mm]	[mrad]	[mrad]
fig. 1		.0607	.602	0.2	0.15	0.6
fig. 2	A	.0607	.634	0.3	0.2	0.5
	B	.0607	.634	0.3	0.2	0.7
	C	.0607	.5956	0.4	0.25	1.2
fig. 3,solid	D	.0607	.5956	0.4	0.25	0.8
	E	.0607	.5956	0.4	0.25	0.6
	C	.06	.5905	0.2	0.15	1.2
fig. 3,dashed	D	.06	.5934	0.2	0.15	0.8
	E	.06	.5993	0.2	0.15	0.6

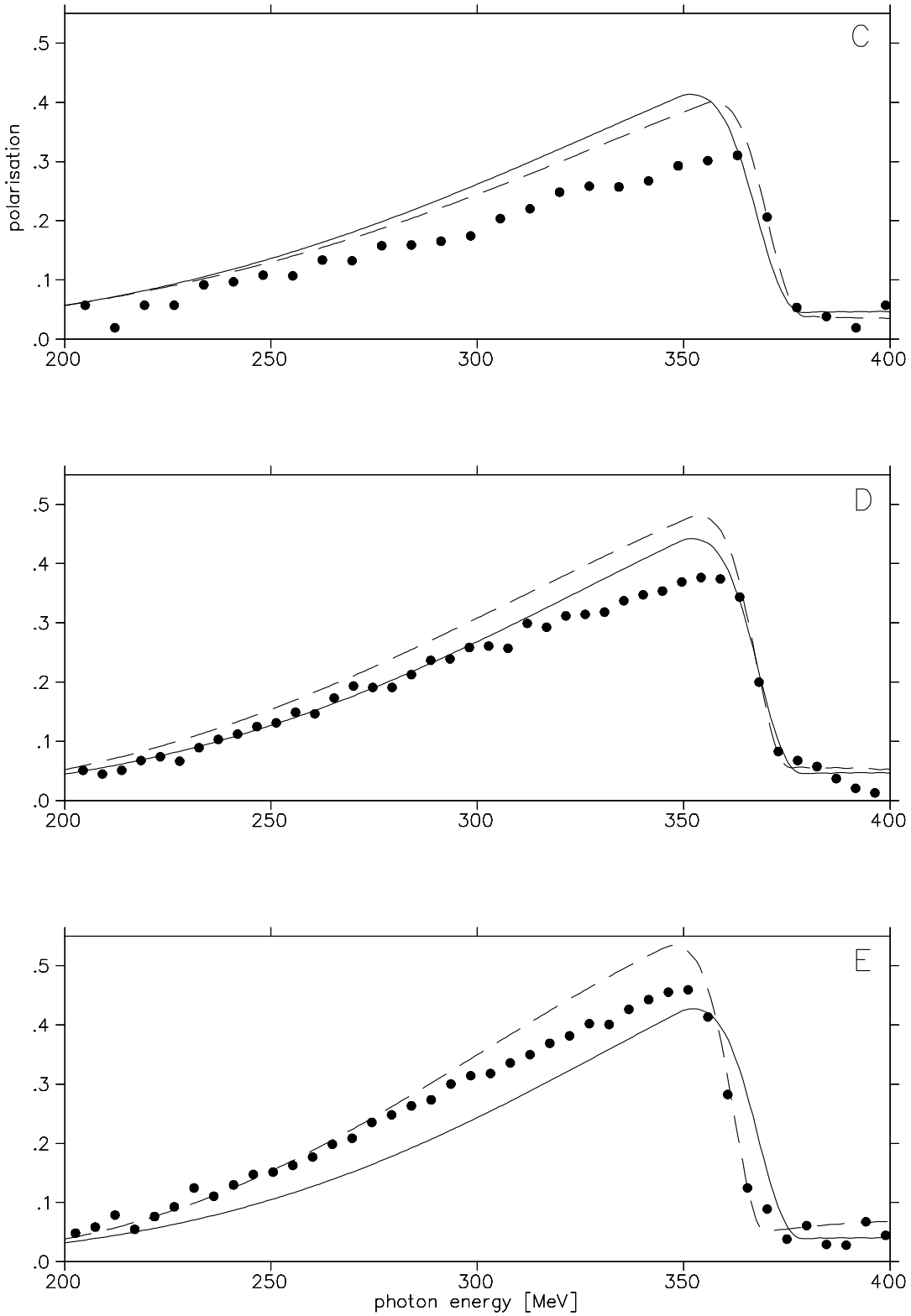

Figure 3: Prediction of polarisation for set C,D,E from table 1 with data from [1].