Reply to "Comment on 'Electromagnetic dissociation of ^{59}Co and ^{197}Au targets by relativistic ^{139}La projectiles'"

John C. Hill and F. K. Wohn
Ames Laboratory and Iowa State University, Ames, Iowa 50011
(Received 29 December 1988)

We reply to the preceding comment.

In a recent paper[1] we reported measurement of the electromagnetic dissociation (ED) of ^{59}Co and ^{197}Au targets by 1.26 GeV/nucleon ^{139}La projectiles. The ED cross sections were calculated using the Weizsäcker-Williams (WW)[2] method of virtual quanta. In the preceding comment,[3] Norbury has redone our calculation using the same photonuclear data and cutoff radii. His results are different from ours, the differences being especially great for the heavy La projectiles where the ED effects are the largest.

We have carefully examined the computer code used for the WW calculation. We found that the variable x (the argument for the Bessel functions) was $\omega b_c/1.123\gamma v$ instead of $\omega b_c/\gamma v$. (The factor of 1.123 is used in the low frequency approximation but was inadvertently included for our calculations.) This made the cross sections too large by effectively decreasing the cutoff radii. We have recalculated the ED cross sections for work carried out at the Bevalac[1,4] on ^{59}Co and ^{197}Au targets using projectiles ranging from 2.1 GeV/nucleon ^{12}C to 1.26 GeV/nucleon ^{139}La. Our new values are compared with our earlier values and those of Norbury in Table I (^{59}Co) and Table II (^{197}Au). Our new values are in satisfactory agreement with those of Norbury.

It is instructive to fit the ED results to a power law approximation $\sigma=\sigma_1 Z_p^b$ (see Fig. 6 in Ref. 1). For point sources the WW calculation gives $b=2$, but due to the increase in the minimum impact parameter b_c with Z_p, fits to the theory (both ours and Norbury's) give $b=1.71$ and 1.76 for ^{59}Co and ^{197}Au targets, respectively. On the other hand, the experimentally determined values are $b=1.48$ and 1.46 for ^{59}Co and ^{197}Au, respectively, with standard deviations for the power law fit of 3.4 and 13.6 mb, respectively. With the modified WW calculation, it is clear that the experiment and theory are in better agreement for ^{139}La projectiles, but the slopes for the σ vs Z_p power law curves indicate a systematic discrepancy indicating that the WW calculation may not be a complete description of the observed phenomena.

TABLE I. ED cross sections (σ) for ^{59}Co(RHI,X)^{58}Co reaction.

RHI	Energy (GeV/N)	σ_{expt} (mb)	σ_{theory} (mb) Refs. 1 and 4	Norbury	This work
^{12}C	2.1	6±9	8.7	7.7	8.1
^{20}Ne	2.1	32±11	23	20	21
^{56}Fe	1.7	88±14	122	105	111
^{139}La	1.26	280±40	430	358	376

TABLE II. ED cross sections (σ) for the ^{197}Au(RHI,X)^{196}Au reaction.

RHI	Energy (GeV/N)	σ_{expt} (mb)	σ_{theory} (mb) Refs. 1 and 4	Norbury	This work
^{12}C	2.1	75±14	42	40	39
^{20}Ne	2.1	153±18	113	105	103
^{40}Ar	1.8	348±34	322	297	292
^{56}Fe	1.7	601±54	631	578	569
^{139}La	1.26	1970±130	2340	2089	2058

[1] J. C. Hill, F. K. Wohn, J. A. Winger, M. Khayat, K. Leininger, and A. R. Smith, Phys. Rev. C **38**, 1722 (1988).
[2] J. D. Jackson, *Classical Electrodynamics* (Wiley, New York, 1975), p. 719.
[3] J. W. Norbury, Phys. Rev. C **39**, 2472 (1989), preceding Comment.
[4] M. T. Mercier, J. C. Hill, F. K. Wohn, C. M. McCullough, M. E. Nieland, J. A. Winger, C. B. Howard, S. Renwick, D. K. Matheis, and A. R. Smith, Phys. Rev. C **33**, 1655 (1986).

