COMMENTS

Comments are short papers which comment on papers of other authors previously published in the **Physical Review**. *Each Comment should state clearly to which paper it refers and must be accompanied by a brief abstract. The same publication schedule as for regular articles is followed, and page proofs are sent to authors.*

Comment on "Feasibility of measurement of the electromagnetic polarizability of the bound nucleon"

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It is shown that the polarizability of the bound nucleon is, within the errors in the total cross section measurements, the same as that of a free nucleon.

In a recent paper, Baumann *et al.*[1] discuss the polarizability of the nucleon embedded in the nuclear medium. We would like to express a different opinion.

The fact that the total photonuclear cross sections for nuclei in the range lithium to uranium have in the Δ region the very same cross sections per nucleon[2,3] is a very important observation. Namely, the photon interacts with the nucleons and they all participate equally; the polarizability per nucleon is thus the same for this very wide range of nuclei. It is also generally accepted that the polarizabilities of the proton and neutron are, respectively,[4] 14.2 and 15.8×10^{-4} fm^3. If these polarizabilities are preserved in the nuclear medium, then the polarizability per nucleon in a self-conjugate nucleus such as ^{12}C would be 15.0×10^{-4} fm^3/nucleon, and that for a nucleus having a large neutron excess, such as ^{238}U, would be 15.2×10^{-4} fm^3/nucleon.

It is much more straightforward to determine the polarizability from the total photon absorption cross section than from the more complicated photon scattering experiment. The static polarizability of any system[5] is

$$\lim_{\omega\to 0}\frac{\hbar c}{2\pi^2}\int\frac{\sigma(\omega')d\omega'}{\omega'^2-\omega^2}=\frac{\hbar c}{2\pi^2}\int_{\rm th}^{\infty}\frac{\sigma(\omega)d\omega}{\omega^2}\ ,$$

where $\sigma(\omega)$ is the total photon absorption cross section. The polarizability of a nucleon embedded in the nuclear medium is then

$$\frac{\hbar c}{2\pi^2}\int_{\pi}^{\infty}\frac{\sigma(\omega)d\omega}{A\omega^2}\ ,$$

where $\sigma(\omega)/A$ is, for example, the universal curve displayed in Ref. 2. The total absorption cross section includes all absorption mechanisms and all decay modes. It is therefore incorrect to subtract off the partial quasideuteron cross section as is done by Baumann *et al.*[1] Fortunately, they have performed carefully both parts of the integration which can be summed to yield $(14.9\pm0.4)\times10^{-4}$ fm^3, a result in remarkable agreement with the projections given above. Thus we obtain from the absorption measurements a value at the few percent level for the polarizability of the bound nucleon. There is then no need to invoke a swelling of the nucleon in the nuclear medium.

The data reported by Baumann *et al.*[1] do, however, demonstrate that the real parts of the scattering amplitudes resulting from absorption above the pion threshold must be included in the analysis of photon scattering data taken below the pion threshold.

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