Polarizabilities of proton and neutron investigated by Compton scattering on the proton and on light nuclei

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Electromagnetic properties of the nucleon may be parameterized in terms of six invariant amplitudes $A_1(\nu,t)\cdots A_6(\nu,t)$ for Compton scattering [1, 2]. In the Δ-range and below these amplitudes contain structure parameters of which the electromagnetic polarizabilities α and β and the four spin polarizabilities $\gamma_1\cdots\gamma_4$ are of special importance. In the first and second resonance regions and at large scattering angles specific quantities become observable through Compton scattering on the proton, as there are the π°-meson contribution to the backward spin polarizability $\gamma_\pi=\gamma_1+\gamma_2+2\gamma_4$ and the σ-meson contribution to the polarizability difference $\alpha-\beta$, respectively. Since the σ-meson is not a simple particle this ingredient of Compton scattering deserves a special investigation, both experimental and theoretical. Furthermore, it is unknown whether or not these t-channel exchanges have to be supplemented by additional ones. Answers are given by the recent **LAR**ge **A**cceptance experiment, being the first Compton scattering experiment were large ranges of photon energies and scattering angles have been covered simultaneously [3].

Compton scattering by the neutron can be carried out by using a deuteron target and by detecting the recoil neutron in the quasifree kinematics [4, 5, 6]. The method of Compton scattering by the neutron in the quasifree kinematics has been tested and found valid in an experiment on quasifree Compton scattering by the proton bound in the deuteron [7]. New results are available on the polarizability of the neutron, recently obtained in a coincidence Compton-scattering experiment using the large Mainz NaI(Tl) photon-detector and the Göttingen SENECA neutron-detector. This experiment simultaneously provides new data for π^0 photoproduction on the neutron.

Implications of recent developments are discussed for the electromagnetic polarizabilities of the nucleon bound in light nuclei which played a major role in the Compton scattering program on nuclei with $A\geq 4$ [8, 9, 10]. Since the polarizability difference $\alpha-\beta$ is dominated by σ exchange in the t-channel, a relation is expected between this quantity and the internucleon binding force. The experimental data are still controversial [8, 9]. Attempts to extract the polarizability of the neutron from Compton scattering data for the deuteron also lead to controversial results [11, 12, 13].

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