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Finite volume corrections to forward Compton scattering off the nucleon

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The study of the Compton amplitude has gained attention in recent years. It plays a central role in the analysis of many fundamental problems such as, for example, the evaluation of the Lamb shift in muonic hydrogen, or the calculation of the proton-neutron mass difference. Hence, the calculation of this amplitude on the lattice would definitely contribute to the solution of the above problems. However, lattice results are always plagued by the finite-volume artifacts which may be sizable in some cases. In order to carry out a precise extraction of the Compton amplitude, these finite-volume corrections should be reliably estimated and removed from the lattice data.

Different approaches have been proposed so far for the extraction of the Compton amplitude on the lattice. In this talk, I shall discuss an approach based on the background field method. The calculations are done in Baryon Chiral Perturbation Theory, up-to-and including $O(p^4)$, where p is a small momentum/mass. Our study will be focused on the calculation of the so-called subtraction function, which is related to the Compton amplitude in a particular kinematics. In the beginning, the forward doubly virtual Compton scattering amplitude off nucleons will be evaluated, and the behavior of the subtraction function at small values of the photon momentum will be discussed. Furthermore, the full set of the finite-volume corrections to the subtraction function will be evaluated up-to-and-including $O(p^4)$. It will be shown that, despite the poorly known low-energy constants at this order, the finite-volume artifacts can be evaluated quite accurately and do not preclude one from an accurate measurement of the subtraction function on the lattice.

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