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Chiral perturbation theory of hyperfine splitting in muonic hydrogen

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We present the predictions of baryon chiral perturbation theory (BChPT) for the proton polarizability contribution to the 2P −2S Lamb shift and the 2S hyperfine splitting (HFS) in muonic hydrogen, and compare them to the results of dispersive calculations. The spin-dependent part of the forward doubly-virtual Compton scattering amplitude (S1,2) contributes to the 2S HFS, whereas the spin-independent part of the amplitude (T1,2) to the 2P −2S Lamb shift. All invariant amplitudes are related to photoabsorption cross sections by dispersion sum rules, however the amplitude T1 requires a subtracted dispersion relation. Therefore, in contrast to the HFS, the polarizability contribution to the Lamb shift is not determined by the empirical information (on structure functions) alone and requires a rigorous theoretical input. Such an input has been provided by recent ChPT calculations, cf. [1] and references therein. We extend the calculation of Ref. [1] to the HFS, where the reliability of both ChPT and dispersive calculations is put to the
test.

References

1. J. M. Alarcon, V. Lensky, V. Pascalutsa, Eur. Phys. J. C74 (2014) 2852.

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