Study of quark structure of protons under nuclear reactions by bremsstrahlung analysis

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We investigate an idea, how to use the bremsstrahlung photons to study the internal structure of proton under nuclear reaction with nucleus [1]. We construct a new model to describe bremsstrahlung emission of photons which accompanies the scattering of protons off nuclei. Our bremsstrahlung formalism uses many-nucleon basis that allows to analyze coherent and incoherent bremsstrahlung emissions (see Ref. [2], reference therein). As scattered proton can be under the influence of nuclear forces and produces the largest bremsstrahlung contribution to full spectrum, we focus on accurate determination of its quantum evolution concerning nucleus basing on quantum mechanics. For that, we at first time generalize Pauli equation with interacting potential describing evolution of fermion inside strong field, including the electromagnetic form factors of nucleon from DIS theory. The full bremsstrahlung spectrum in our model is dependent on form-factors of the scattered proton. For calculations, we choose the scattering of $p + {}^{197}$Au at proton beam energy of 190 MeV, where experimental bremsstrahlung data were obtained with high accuracy. We show that the full bremsstrahlung spectrum is sensitive to the form-factors of the scattered proton. In the limit without such form factors, we reconstruct our previous result.

1. Maydanyuk S. P., Zhang P.-M., and Zou L.-P., Nucleon microscopy in proton-nucleus scattering via analysis of bremsstrahlung emission, arXiv:1812.07180.
2. Maydanyuk S. P., Zhang P.-M., and Zou L.-P., Manifestation of the important role of nuclear forces in the emission of photons in pion scattering off nuclei, Phys. Rev. C, 2018, **98**, 054613; arXiv:1809.10403.