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Front-form approach to QED in an intense plane-wave field

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Recent development of the laser technologies for the production of extreme intensities has made high-power lasers a practical tool for studying subatomic world at the intensity frontier [1], complementary to the energy frontier. From the theoretical point of view, an intense laser field can be normally represented as a classical background plane-wave field. Because of the high intensity, the field must be taken into account nonperturbatively, which results, in particular, in the modifications of single-particle fermionic states with definite momentum and spin quantum numbers. These modifications reflect the momentum and spin dynamics of a particle inside the field and, due to the properties of the background field, can be consistently treated on the light cone, with the help of light-cone quantization and also a light-cone gamma-matrix basis [2]. In my presentation, I introduce the light-cone gamma-matrix basis and show how, combining with light-cone quantization, it allows to formulate QED in an intense plane-wave field in a complete front-form fashion. Furthermore, I demonstrate the approach with examples.

[1] A. Di Piazza et al. Extremely high-intensity laser interactions with fundamental quantum systems. Rev. Mod. Phys. 84, 1177 (2012). https://doi.org/10.1103/RevModPhys.84.1177

[2] S. Bragin. Front-form approach to quantum electrodynamics in an intense plane-wave field with an application to the vacuum polarization. Ph.D. thesis (2019). https://doi.org/10.11588/heidok.00026797

Author: BRAGIN, Sergey (Max Planck Institute for Nuclear Physics)

Presenter: BRAGIN, Sergey (Max Planck Institute for Nuclear Physics)

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