# Ivariant description of radiation in oriented crystals and in the field of powerful lasers

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Above hundreds GeV electrons (positrons) penetrating through oriented crystals and powerful petawatt laser beams provide an effective tool for studying processes in a strong external field. Recently the test of the strong field QED close to the fully nonperturbative regime using oriented crystals has been proposed [1]. Some other exotic effects are also of interest [2], [3].

We study the radiation of ultrarelativistic electrons in the field of linear polarized strong laser beam with taking into account nonlinear and quantum effects in radiation and compare it with a planar channeling of positrons in oriented. We show that in both cases the radiation spectrum is defined by two Lorentz invariants, i.e. the parameter characterizing the quantum recoil and the "non-dipole" parameter which, in the case of lasers, coincides with the classical field parameter. In the limit where the constant field approximation is valid, both parameters combine as a product giving the Schwinger strong field invariant. Nevertheless, there is a significant difference between lasers and crystals due to different dependence of these invariants on the beam energy.

[1] Di Piazza A e a 2020 *Phys. Rev. Lett.* **124** 044801
[2] Khokonov M K 2019 *Phys. Lett. B* **791** 281
[3] Wistisen T N, Di Piazza A, Knudsen H V and Uggerhoj U I 2018 *Nature Communications* **9** 795