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Modified Baier-Katkov Method for Twisted Photon Radiation

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Nowadays the Baier-Katkov (BK) semiclassical method [1] is a standard tool to describe radiation of plane wave photons by ultrarelativistic charged particles in external electromagnetic fields of a general form. The BK method is realized in several computer codes [2,3] and proved to be very successful. We use this method to derive the radiation probability of one twisted photon [4] by an ultrarelativistic charged particle with account for the quantum recoil. In the case of negligible quantum recoil, the obtained general formula reduces to the one derived in [5].

The derived formula is used to describe the radiation of twisted photons by charged particles in undulators and laser waves. The explicit formulas for the probability to record a twisted photon are obtained in these cases. The manifestation of the blossoming out rose effect [6] in the nonlinear Compton process in a strong laser wave with circular polarization and in the wiggler radiation is revealed. Several examples are studied: the radiation of MeV twisted photons by 180 GeV electrons in the wiggler; the radiation of twisted photons by 256 MeV electrons in strong electromagnetic waves produced by the CO₂ and Ti:Sa lasers; and the radiation of MeV twisted photons by 51.1 MeV electrons in the electromagnetic wave generated by the FEL with photon energy 1 keV.

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