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Generation of Superradiant Parametric X–rays (SPXR)

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In the contribution we will describe generation mechanism of SPXR and will provide results of the theoretical research for characteristics of this new type of the coherent x-ray radiation.
In fact, we are considering the case of SPXR as result of interaction of mini-bunched electron beam modulated in density inside the undulator of a XFEL [1] and crystalline target, where the parametric x-rays are generated with the frequency ω dependent on a crystal structure and on the angle between the crystallographic planes and the electron velocity. As was recently considered, the highest intensity of PXR can be generated when the electrons propagate via the crystal target in the grazing geometry, i.e., within a thin layer inside the crystal parallel to the crystal-vacuum interface and the x-ray photons are emitted under the large angle to the electron velocity (PXR-EAD) [2]. This angle can be chosen in such a way that the resonant condition ω=ω0 is fulfilled (ω0=2π/d0 (h=c=1); d0 is the spatial modulation of the electron density which is directly defined by the period of an undulator).
As a result, in addition to the main XFEL pulse, generation of SPXR will originate the pulse with the intensity also proportional to the square of the number of electrons in the bunch. According to [3], the spectral density of PXR photons emitted by a single electron can be larger than the corresponding density of the undulator radiation. Consequently, the quantity of SPXR photons can exceed the corresponding number at the XFEL output. Besides, the SPXR pulses can be guided under the large angle to the electron velocity, that is can improve the applicability of a XFEL by the formation of additional channels for coherent x-rays.

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