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Coherent Parametric X-Radiation: Conditions of Observation

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Parametric X-radiation (PXR) is generated by electrons of crystalline target when the projectiles (electrons) pass through the target. The radiation is amplified at the specific directions due to the periodicity of crystallographic structure, i.e. due to diffraction.

One of the technical challenges in the commissioning and operation of modern accelerators is the measurement and diagnostics of beams. Transverse beam size diagnostics may be realized based on measurement of PXR angular distribution [1-3].

PXR generated by separate electrons of the beam is coherent at certain distribution of beam particles. As the result, the intensity of PXR could be significantly amplified. This kind of radiation is called Coherent PXR (CPXR). CPXR photon energies is order of keV and wavelength is less than 1 nm. Therefore, the use of CPXR to determine the length of extremely short bunch (order of attoseconds) was suggested.

While incoherent PXR was already investigated in details theoretically and experimentally [4], coherent PXR (CPXR) was not observed up to now due to the lack of extremely short electron bunches.

In the work the CPXR from single bunch as well as from the train of bunches is considered. The features of CPXR: amplification, suppression and fine structure - are analyzed. Conditions for CPXR generation and observation are discussed.

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References

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