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Non-Dipolarity of Channeling Radiation at GeV Beam Energies

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The concept to create a non-conventional intense positron source by application of channeling radiation (CR) generated in a crystalline target by electrons of energy of several GeV was proposed in [1] and experimentally proven later on [2]. In a hybrid-source setup, the generation of radiation in a single radiator crystal is separated from the successive conversion into e^+e^- pairs in an amorphous target.

The simulation of that part of radiation which is connected with the crystalline structure of the radiator presupposes to account for [3]

- the realistic continuous potential of the crystal plane or axis considered
- the contributions from CR and coherent bremsstrahlung (CB)
- the process of dechanneling in thick crystals due to multiple scattering
- the non-dipolarity of CR at energies higher than about 1 GeV [4]

The latter circumstance is usually neglected in relevant calculations, although non-dipolarity changes the CR spectrum and intensity as well [4] and, therefore, should also influence the positron spectrum. At sufficiently high particle energy, the effect of non-dipolarity pronounces in a coupling of longitudinal and transverse motion of the channeled particles, when at lower energies the transverse motion is assumed to be independent from the longitudinal one and is governed by the continuous potential only. We present a classical method for calculation of CR in the non-dipole case.

References

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2. T. Suwada, M. Satoh, K. Furukawa et al., Phys. Rev. Spec. Topics –Accelerators and Beams 10 (2007) 073501 (and Refs. therein)
3. B. Azadegan, S. A. Mahdipour and W. Wagner, Journal of Physics: Conf. Series 517 (2014) 012039.
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Summary

Method for calculation of channeling radiation in the non-dipole case.

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