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Diffraction radiation of a charged particle from a 1D fractal diffraction grating

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When a charged particle moves parallel to a medium with a periodically changing refractive index, Smith-Purcell radiation occurs. In this report, we consider the radiation that occurs when a charged particle passes parallel to a 1D (one-dimensional) fractal diffraction grating. Such a grating can be considered as an array of sub-gratings similar to the original one. To describe it, we will implement a procedure of replacing a target with a similar sub-targets: this operation is repeated until the period of the subgrating violates the conditions of diffraction of radiation with a wavelength $\lambda \ll d$. One of the first theoretical models of Smith-Purcell and diffraction radiation was the scalar theory considering the diffraction of a charged particle field on a diffraction grating [1]. Using this approximation, we have obtained an analytical formula for the angular distribution of the radiation intensity. The radiation is described as a superposition of scattered fields from each sub-grating. We demonstrated that for some grating's parameters, a constructive interference occurs, as a result of which the angular distribution of diffraction radiation has the form reflecting its fractal nature.

References

[1] B. M. Bolotovskii, E. A. Galst'yan, Diffraction and diffraction radiation, Phys. Usp. **43**, 755 (2000).

Authors: TISHCHENKO, Alexey (National Research Nuclear University (MEPhI)); SHAPOVALOV, Pavel (National Research Nuclear University "MEPhI")

Presenter: SHAPOVALOV, Pavel (National Research Nuclear University "MEPhI")

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