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Features of Non-Dipole Radiation by Relativistic Electron in Thin Crystal

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The multiple scattering of ultrarelativistic electron on atoms of matter conduces to violation of the dipole regime of radiation process. It occurs when the mean-square angle of electron scattering within the coherence length of radiation θms exceeds the characteristic angle of radiation of relativistic particle θ ~ 1/γ, where γ is the electron Lorenz-factor. One of the well-known examples of the non-dipole regime is the Landau-Pomeranchuk-Migdal effect of suppression of radiation in amorphous medium [1]. Another manifestation of the non-dipole regime of radiation is the effect of radiation suppression in a thin layer of matter, which was predicted and theoretically studied in [2, 3] and recently discovered experimentally in SLAC E-146 [4] and CERN NA63 [5]. Now this effect is called as the Ternovskii-Shul'ga-Fomin effect (TSF effect) [5]. One of the most unusual features of radiation process in a thin target at the TSF effect conditions is the logarithmic dependence of radiation yield in the soft part of the spectral density from the target thickness [3, 5, 6].

In crystals, the condition of non-dipole regime of radiation, namely θms > 1/γ, can be fulfilled at less thickness than in amorphous target due to the coherent electron scattering on atomic rows, known as the "doughnut scattering"effect (see, e.g. [7]). In a thin crystal, when the coherence length of radiation process is bigger than the crystal thickness, there are some interesting features of angular distributions and polarisation characteristics of radiation at the non-dipole regime [6, 8], which may be used for polarized gamma-quanta beam production.

We present here a brief review of theoretical and experimental studies of the features of the non-dipole regime of radiation in amorphous and crystalline targets and our propositions for a new experimental investigation in this field, especially concerning the angular distributions and polarisation characteristics of the non-dipole radiation in a thin crystal.

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Primary author: Dr FOMIN, Sergii (National Science Center "Kharkov Institute of Physics and Technology")

Co-authors: Mr FOMIN, Aleksey (National Science Center "Kharkov Institute of Physics and Technology"); Prof. SHUL'GA, Nikolai (National Science Center "Kharkov Institute of Physics and Technology")

Presenter: Dr FOMIN, Sergii (National Science Center "Kharkov Institute of Physics and Technology")

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