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PS2-19: Analogue of Anomalous Reflection of X-Rays from Rough Surface in X-Ray Transition Radiation

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The phenomenon of anomalous reflection of X-rays, i.e. origination of non-mirror peak of angular spectrum of scattered radiation from rough surface near angle of total reflection, was discovered about fifty years ago [1]. The same phenomenon was discovered for thermal and diffusive Compton-scattered gamma-rays as well [2]. Later works demonstrated that when grazing angle is close to angle of total reflection, the fact that the crest of wave field is located at the boundary of two medias leads to non-symmetrical profile of angle distribution [3,4].

For being present a lot of modern researches have something to do with the problem of wave scattering from rough surfaces. In most of them numerical methods of solution are used (as Monte-Carlo modelling). However, even such accurate methods like Monte-Carlo do not reveal the anomalous behaviour described above, probably because the theory which it is based on [5] was not completed, or because of having comparison with not appropriate experimental data [6].

In this report we present both theoretical and mathematical theory of X-ray transition radiation in conditions that lead to the anomalous reflection. This theory is of practical interest in the channelling phenomena of charged particles. Capillary systems are well-known to have non-ideal inner surface that could lead to the phenomenon discussed in this report, especially if the process of channelling is long. The non-symmetrical profile of angle distribution in this case is a potential source of extra radiation that can be caught by capillary the same or the other channel and therefore may increase the intensity of the radiation channelled.

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