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Generation of Concentrated Radiation of Particle Bunches Using Dielectric Targets and Wire Structures

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We present analytical and numerical investigation of nontraditional methods for obtaining concentrated radiation from particle bunches. The objects considered here are simultaneously "generators" and "concentrators" of radiation. First, we consider dielectric objects which can concentrate radiation near some line or some point. The form of the targets is determined using the ray optics, but the field is calculated using the aperture integration method. Typical spatial distributions of the field outside the targets are presented. They demonstrate large amplification of the field in the focus neighborhood in comparison with the field on the surface of the target.

Further we describe radiation in 3-D wire metamaterial which is a periodic structure of long metal conductors with small spacing. This structure is described by an effective permittivity tensor. The moving charged particle bunch generates non-divergent Cherenkov radiation in the structure at any velocity. We demonstrate typical images of wave field from different bunches and show that these images can be used for the bunch diagnostics. We also consider the 2-D wire structure (planar grid) with small period (using the averaged boundary conditions method). The most interesting part of the radiation is the surface wave which can be useful for the bunch diagnostics.

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