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Non-divergent surface waves from charged particle bunch moving along semi-infinite wire planar structure

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In this work, we continue investigations of non-divergent radiation in volume and planar wire structures with small period. Unlike previous works, we consider the bunches moving along the semi-infinite planar wire structure. Besides, we consider not only thin bunches, but also bunches with finite cross-section.

We analyze surface waves generated by a charged-particle bunch at the semi-infinite planar periodic wire structure. It is supposed that the bunch moves parallel to the edge of the structure and perpendicularly to wires. The influence of the grid is described by the averaged boundary conditions. Initially, we consider bunches with negligible thickness and finite length. Further, bunches with finite thickness are considered as well.

The analytical results are given for a general case, which takes into account the finite period of the structure and wires radius. It is shown that the surface waves excited by the bunch propagate along wires with the speed of light in vacuum. The number and the structure of these surface waves depend on relative location of the bunch path and the grid. One type of wave is always excited, but its magnitude decreases with distance from the bunch to the structure edge. If the bunch projection falls on the half-plane occupied by wires, then additionally three surface waves are generated: two of them are equivalent to ones excited at infinite wire structure and another one is a surface wave reflected from the edge. Typical numerical results are presented. They show that the structure of surface waves allows to determine both the length and the thickness of the bunches.

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