JOURNAL OF APPLIED PHYSICS VOLUME 95, NUMBER 8 15 APRIL 2004

Electromagnetic wake-field due to surface roughness in an optical structure

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(Received 26 September 2003; accepted 28 January 2004)

In this study we investigate the properties of the electromagnetic wake-field generated by an electron bunch moving in the vicinity of an optical structure of finite roughness. The model employed consists of a metallic cylindrical waveguide to which grooves of *random* width, height, and location are attached. Based on this model analytic expressions have been developed for the average energy emitted per groove and for its standard deviation. As expected, both quantities are virtually independent of the momentum in a highly relativistic regime and the average energy emitted per groove is proportional to the roughness parameter. Moreover, it has been found that the standard deviation of the energy emitted per groove is proportional to the standard deviation of the roughness parameter to the power of 1/4. The cumulative effect of surface roughness was studied resorting to both periodic and quasiperiodic structures—significant differences in the spectrum have been observed only for low frequencies.
[DOI: 10.1063/1.1687974]