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Electromagnetic Field of a Charge Moving in a Waveguide and Intersecting a Boundary between Vacuum and Resonance Dispersive Medium

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Electromagnetic field of a charge that uniformly moves in a circular waveguide with a semi-infinite dielectric possessing frequency dispersion of a resonant type is under consideration. This problem is a generalization of the case of a nondispersive dielectric (considered earlier). The study can be interesting for development of new methods of generation of electromagnetic radiation and acceleration of charged particles. The main attention is paid to the analytical and numerical investigation of the waveguide modes excited by the charge. We consider two instances in detail: the particle is flying from a vacuum into a resonant medium and, inversely, from the medium into vacuum. In the first case, there is a region where partial compensation of Cherenkov radiation (CR) takes place (as well as in the case of a nondispersive dielectric). However, the electromagnetic field pattern is complex and the role of resonant dispersion is essential. In the second case, CR can penetrate through the boundary, and large Cherenkov-transition radiation (CTR) can be excited in the vacuum region. The conditions for this effect are obtained. It is shown that the CTR can be composed of a single mode (in contrast to the case of nondispersive dielectric, where CTR is multimode).

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