CERENKOV PHENOMENON VIEWED AS AN ELECTROSTATIC PROBLEM IN A MOVING MEDIUM

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Abstract

The theory of Cerenkov radiation was developed by Frank and Tamm (Doklady An SSSR, 14, 107, 1937) as an electrodynamic problem of a moving charge in a material medium with a speed greater than that of the speed of light in the medium. Nag and Sayied (Proc. of Royal Soc. A235, 544, 1956) treated the same problem by considering it as an electrostatic problem of a charge placed in a moving medium. They used Minkowski's original constitutive relations for a moving medium as the foundation of their theory. In the present work we have adopted the same point of view but have simplified the treatment by introducing the proper steady-state vector potential and scalar potentials to facilitate the formulation of the problem. Minkowski's relations have also been reduced to a more attractive form to enhance the description of the gauge condition between the potential functions. The formulation is first applied to a static charge in a moving loss-less isotropic medium. It is then extended to a lossy moving medium. Cerenkov phenomenon in a circular waveguide is investigated for a static charge and for an oscillating dipole. Some of the unfamiliar aspects of the fields in this class of problems will be pointed out.