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Radiation of a Moving Charge at the Interface Between Vacuum and Chiral Isotropic Medium

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We consider radiation produced by a point charge flying through the plane interface between vacuum and half-infinite isotropic chiral medium. For description of chiral medium, we use symmetrized material relations and Condon dispersion model [1]. We deal with charge motion from vacuum into medium and backwards. In the case where charge enters medium, we perform generalization of paper [2], where authors considered only slow charge motion case. We deduce analytical expressions for Fourier components of electromagnetic field for arbitrary charge velocity. Further, we pay the main attention to investigation of the far field in vacuum. Total field in vacuum is a sum of a field with polarization coinciding with that of self-field of a charge (co-polarization) and a field with polarization orthogonal to that of self-field of a charge (cross-polarization). These waves are coherent and result in total spherical wave with elliptical polarization, with the polarization coefficient being connected with chirality parameter of the medium. We present typical radiation patterns and ellipses of polarization.

We also deal with the case where charge flies from medium into vacuum area. In our previous paper [3], we investigated Cherenkov radiation in infinite medium described by Condon model. In certain frequency ranges, Cherenkov radiation propagates at small angle with respect to charge trajectory. In the present report, we investigate penetration of this radiation into vacuum area.

It should be noted, that the interest to radiation of moving charged particles in media with chiral properties is connected with relatively new and prospective method for diagnostics of biological objects which uses the Cherenkov radiation –Cherenkov luminescence imaging [4]. Chirality (also referred to as optical activity or gyrotropy) is typical for biological matter and is caused by mirrorless structure of molecules.

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