Study of Maxwell-Liouville-Vlasov Equations for Media with Discontinued Dielectric Properties

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The work presented is devoted to research into methods of analysis which maybe used for the systems of conservation laws, including Maxwell, Liouville and Vlasov equations. These systems are used for describing the movement of elementary charged particles in medium with discontinued parameters (dielectric and magnetic characteristics, propagation speed etc.). It is known, that the presence of such a discontinued interface can act as a source of electromagnetic radiation when it is traversed by a charged particle - transition radiation (the theory of Ginzburg-Frank for transition radiation, 1946 [1])

The solution of the given problem is connected with the occurrence of non classical solutions of Kashi's task, due to the discontinuity of medium parameters and the representation of an elementary charge as a Dirac Delta Function. Generally solutions of such problems belong to the area of functional solutions [2]. A detailed analysis of boundary conditions for the system of equations which describe the movement of a charged particle is given, including a case for the introduction of an arbitrary border creating two semi-infinite areas.

The mathematical description of allowable indignations of systems of Maxwell-Liouville-Vlasov conservation laws for the case of medium with discontinued dielectric parameters and study of global convergence of the approximations determined by indignations, determined by indignations to non classical solution of Kashi tasks will be achieved on the basis of modern calibration and functional solutions. This approach was developed by S.N.Kruzhkova in his theory of generalized solutions for scalar conservation laws, which is based on a limited description of the approximations of the boundary conditions. Special attention is given to the development of algorithms for Maxwell-Vlasov equations, on which fundamental conservation laws of a charge, pulse and energy are strictly carried out. The results of this research will help provide solutions for one of the main problems related to the practical application "the analysis and modeling of a relativistic charged particle moving in a periodic media with discontinued dielectric properties [3].

For practical modeling of a charged particle moving in media with discontinued dielectric properties and arising effects, an approach is being developed based on the use of algorithmically obvious schemes, which is convenient for their adaptation on modern multiprocessing computer clusters.

References

1. Frank I., Ginzburg V. Radiation of uniformly moving electron due to its transition from one medium into another. Journal of Physics, 1945, vol. IX, N5, 353--362.
2. Smoluchowski Equation. Moscow: FIZMATLIT, 2001, 336 P, (in russian).
3. Simulation of transition radiation. Mathematical Modeling RAS, 2002, vol. 14, N11, 93-112.

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