Analytical treatment of the radiative transfer by means of matrix functions

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Abstract

The transport equation of BOLTZMANN is formulated and solved by means of an infinite equation of matrices for the case of the stationary rectilinear propagation of radiation with respect to energy scattering only. It is shown that the matrix formalism is the proper one to explain the qualities of transformations and the non-commutativity of the radiation transmitted through compound, heterogeneous layers of material.
The resolving matrix is represented as an expansion of a matrix exponential function, yielding at once the algorithm for the numerical calculation in a computer program. The linearity of the system of differential equations offers also the solution by using the LAPLACE-transformation, which reveals the structure of the resolving matrix in comparison with the expansion of the matrix exponential function.
The matrix formalism renders a comprehensive method for analytical derivation, numerical computation, and definition of relations among different interacting physical magnitudes. Thus, using the matrix calculus, a new definition for the average length of reach of the radiative transfer through an absorbing medium could be given in form of the inverse kernel matrix of the transport equation.

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