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Novel relaxation time approximation to the relativistic Boltzmann equation

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In 1974, J. L. Anderson and H. R. Witting proposed the Relaxation Time Approximation (RTA) to the relativistic Boltzmann equation [1], following all the development already made in the non-relativistic case by Bhatnagar, Gross and Krook [2]. This approximation is used in several fields of physics and has been recently employed to study the hydrodynamization of the matter produced in ultrarelativistic heavy ion collisions [3]. However, we shall demonstrate that the approximation proposed by Anderson and Witting contains basic flaws, not being consistent with fundamental properties of the collision operator. The main issue is that this approximation is in general inconsistent with microscopic and macroscopic conservation laws, which leads to several problems when trying to model relativistic gases using energy dependent relaxation times or general matching conditions. In this contribution, we propose a new relaxation time approximation which fixes these basic flaws. We then show how such a new formulation of the approximation affects the expression of transport coefficients and the energy dependence of the nonequilibrium single particle distribution function.

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