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Diffusion coefficient matrix for multiple conserved charges: a Kubo approach

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The strongly interacting matter created in relativistic heavy-ion collisions possesses several conserved quantum numbers, such as baryon number, strangeness, and electric charge. The diffusion process of these charges can be characterized by a diffusion matrix that describes the mutual influence of the diffusion of various charges. We derive the Kubo relations for evaluating diffusion coefficients as elements of a diffusion matrix. We further demonstrate that in the weak coupling limit, the diffusion matrix elements obtained through Kubo relations reduce to those obtained from kinetic theory with an appropriate identification of the relaxation times. We illustrate this evaluation in a toy model of two interacting scalar fields with two conserved charges.

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