Microscopic description of irreversible processes in quantum Lorentz gas with resonance state of the Liouvillian

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We investigate irreversible processes in a weakly-coupled one-dimensional quantum perfect Lorentz gas by means of the resonance state of the Liouville-von Neumann operator (Liouvillian). The resonance state of the Liouvillian is constructed by solving the non-linear eigenvalue problem of the effective Liouvillian, which is obtained by extending the well-known Brillouin-Wigner-Feshbach formalism to the Liouville-von Neumann equation. We solve the non-linear eigenvalue problem without making any phenomenological operations, such as a coarse-graining of space-time, or the molecular chaos. As a result, we obtain irreversible processes in a purely dynamical basis in all space and time scale including the microscopic atomic interaction range that is much smaller than the mean-free length. In this talk, we discuss a limitation of the usual phenomenological Boltzmann equation, as well as an extension of the Boltzmann equation to entire space-time scale based on the solution.