Diagrammatic Expansion for Positive Spectral Functions in the Steady-State Limit

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Recently, a method was presented for constructing self-energies within many-body perturbation theory that are guaranteed to produce a positive spectral function for equilibrium systems, by representing the self-energy as a product of half-diagrams on the forward and backward branches of the Keldysh contour. We derive an alternative half-diagram representation that is based on products of retarded diagrams. Our approach extends the method to systems out of equilibrium. When a steady-state limit exists, we show that our approach yields a positive definite spectral function in the frequency domain.