Abstract Submitted
for the HAW09 Meeting of
The American Physical Society

Novel diagrammatic method for computing transport coefficients — beyond the Boltzmann approximation — YOSHIMASA HIDAKA, TEIJI KUNIHIRO, Department of Physics, Kyoto University — We propose a novel diagrammatic method for computing transport coefficients in relativistic quantum field theory. Our method is based on a reformulation and extension of the diagrammatic method by Eliashberg given in the imaginary-time formalism to the relativistic quantum field theory in the real-time formalism, in which the cumbersome analytical continuation problem can be avoided. The transport coefficients are obtained from a two-point function via Kubo formula. It is know that naive perturbation theory breaks down owing to a so called pinch singularity, and hence a resummation is required for getting a finite and sensible result. As a novel resummation method, we first decompose the two point function into the singular part and the regular part, and then reconstruct the diagrams. We find that a self-consistent equation for the two-point function has the same structure as the linearized Boltzmann equation. It is known that the two-point function at the leading order is equivalent to the linearized Boltzmann equation. We find the higher order corrections are nicely summarized as a renormalization of the vertex function, spectral function, and collision term. We also discuss the critical behavior of the transport coefficients near a phase transition, applying our method.

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Date submitted: 30 Jun 2009 Electronic form version 1.4