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SOLUTION OF THE KADANOFF-BAYM EQUATIONS BY ITERATED EXPANSIONS

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Abstract. In this paper, we will show how the general nonlinear Kadanoff-Baym equations can be solved with iterated series expansion. In this regard, we will neglect vertex corrections. Further, we will obtain a formal solution in terms of colored tree graphs. The iteration procedure will show that after proper discretization, well-structured matrix equations would be obtained which are easy to implement in numerical simulation.

1. Introduction

Quantum field theory is a very successful physical theory which has proven to be very successful in the description of the fundamental forces of nature [1]. Also, this theory is frequently used in condensed matter physics [2]. Frequently, this theory is formulated in a background where besides the (few) particles on interest, no other surrounding particles are considered. Thus, effects of an ensemble of particles, e.g. effects of finite temperature are not included in the theoretical description [3]. Ordinary (zero-point) Quantum field theory is formulated theoretically on a single time contour, while the finite temperature formalism allows to use Quantum statistical density matrices [4]. Two time branches instead of one time branch is used in the finite temperature formalism. In the case for which the correlation with an initial density matrix, a third time branch that analytically continues the time integration contour to the imaginary time axis is also included [5, 6].

We neglect the occurrence of initial correlations and therefore, imaginary time (Matsubara) contour is also omitted. This paper gives the solution structure of the two-time Kadanoff-Baym equation that has the general form

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