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Propagators for Scalar Bound States at Finite Temperature in an NJL Model

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Abstract: We re-examine physical causal propagators for scalar and pseudoscalar bound states at finite temperature in a chiral $U_L(1) \times U_R(1)$ NJL model, defined by four-point amputated functions subtracted through the gap equation, and prove that they are completely equivalent in the imaginary-time and real-time formalisms by separating carefully the imaginary part of the zero-temperature loop integral. It is shown that the same thermal transformation matrix of the matrix propagators for these bound states in the real-time formalism is precisely the one of the matrix propagator for an elementary scalar particle and this fact shows the similarity of thermodynamic property between a composite and elementary scalar particle. The retarded and advanced propagators for these bound states are also given explicitly from the imaginary-time formalism.

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Key words: NJL model, thermal field theory, the imaginary-time and real-time formalisms, four-point amputated functions, imaginary part of zero-temperature loop

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