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**Thermodynamic potential in the spin polaron formulation****Marcelow Jocson Callelero and Danilo M Yanga**  
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The thermodynamic potential is calculated in this work using the linked cluster expansion theory in the spin polaron formulation. We implement this in the finite temperature (Matsubara) green's function method in a representation, where holes are described as spinless fermions and spins as normal bosons. The spins are characterized by the hard core bosonic operators in linear spin wave theory by the way of the Holstein-Primakoff transformation. The hole-spin wave interaction in the Spin Polaron Hamiltonian resembles the classical polaron problem and is used as the interaction term in the S-matrix expansion. The cumulants in the expansion of the thermodynamic potential is obtained using the Feynman diagrammatic techniques and this is done for normal state cuprates without vertex corrections. This is expressed in terms of the first order spin wave green's function and self-energy term.

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