Forced oscillator model for entropic potential in the context of superconductivity

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The wave function chosen to establish the superconductivity seems to behave as an order parameter at \( T = T_c \). Hereafter, the research of the cooled and cooling depth penetration allows us to obtain the differential equation governing the entropic potential. As similar to the law of the forced macroscopic oscillator, the plurality of the derivative extremums concerning the entropic potential with regard to the quadratic product of the energy, will lead to the matrix nature of the entropy after the centesimal zero. Such differential equation implies that the reduced entropy components will appear as eigen frequencies of the entropic potential. The macroscopic oscillator concept is introduced to express that the distance between the energy levels, will be decomposed univocally on an extremal length scale and multilocaly as an inner length scale.

**Keywords:** Entropic potential, Macroscopic oscillator, Reduced grandeur, Second order action quantum, Order parameter

1 Introduction

Mathematical modelling and simulation have become an essential part of superconductivity engineering analysis\(^1\). The study of Ginzburg-Landau model allows us a best understanding of eigen energy system\(^2\). It had been demonstrated that the vortex is the leading aim of the particles motion\(^3\). Besides, an alternative approach based on Bardeen Cooper Schrieffer (BCS) theory explores the effects of local pairing correlations and leads to the concept of Cooperon propagator. A recent work concerning entropic superconductivity has been made in this trend. The fact according to which the entropy\(^4\) must be counted as a reduced physical quantity, which is collected as a second order action quantum depending on two temperature length scales.

As in classical mechanics, the evolution of a system governed by canonical equation and variational principle is deterministic. We have to establish the entropic potential differential equation. This will also be the propagation of deflected order parameter with regard to entropic potential action. This action possesses locally the quasi-classic waves representation, and globally the Newtonian limits.

2 Differential Equation for the Entropic Potential

Knowing that

\[
S_{\alpha\beta} = \frac{\partial^2 A_{\alpha\beta}}{\partial E_{\alpha} \partial E_{\beta}} = -k \ln \left( k \ln \Delta \Gamma \right) \quad \ldots (1)
\]

where \( -k \ln \left( k \ln \Delta \Gamma \right) \) represents the computing origin.

The reduced entropy \( S_{\alpha\beta} \) is collected as a second order action quantum depending on the length scales \( \alpha \) and \( \beta \), the plurality of the derivative extremums \( \frac{\partial^2 A_{\alpha\beta}}{\partial E_{\alpha} \partial E_{\beta}} \), will lead to the matrix nature of entropy after the centesimal zero.

Eq. (1), can be written:

\[
\frac{\partial}{\partial E_{\alpha}} \left( \frac{\partial A_{\alpha\beta}}{\partial E_{\beta}} \right) = -k \ln \left( k \ln \Delta \Gamma \right) \quad \ldots (2)
\]

Because \( 5,0396.10^{-15} (\ln \Delta \Gamma) \) represents the computing origin, \( \frac{\partial A_{\alpha\beta}}{\partial E_{\beta}} \) is a first order constant, we write:

\[
\frac{\partial A_{\alpha\beta}}{\partial E_{\beta}} = 5,0396.10^{-15} \int (\ln \Delta \Gamma) dE_{\alpha}
\]

on the other hand, we have:
\[ \frac{\partial A_{\alpha \beta}}{\partial E_\beta} - 5.0396 \times 10^{-15} (\ln \Delta \Gamma) = 0 \]

which is the continuity equation for the entropic potential.

Having,

\[ \frac{d}{dt} \left( \frac{i}{\hbar} \left[ \mathbf{H}^b - \mathbf{E}^b \right] \right) \Delta F = S_a (E) S_b (E) A_{\alpha \beta} + |c|^2 \]

and \[ \frac{\partial A_{\alpha \beta}}{\partial E_\beta} = 5.0396 \times 10^{-15} \int (\ln \Delta \Gamma) dE_a \]

we obtain:

\[ \frac{\partial A_{\alpha \beta}}{\partial E_\beta} + S_a (E) S_b (E) A_{\alpha \beta} = \frac{d}{dt} \left( \frac{i}{\hbar} \left[ \mathbf{H}^b - \mathbf{E}^b \right] \right) \Delta F \]

\[ + 5.0396 \times 10^{-15} \int (\ln \Delta \Gamma) dE_a + |c|^2 \quad \text{... (3)} \]

As limit conditions

\[ -5.0396 \times 10^{-15} \int (\ln \Delta \Gamma) dE_a + |Cte|^2 = 0 \], and when \[ \left[ \mathbf{E}^b, \mathbf{H}^b \right] \] are commuting, the Eq. (3) will be written:

\[ \frac{\partial A_{\alpha \beta}}{\partial E_\beta} + S_a (E) S_b (E) A_{\alpha \beta} = 0 \quad \text{... (4)} \]

We identify the second member to the computing origin, then, the constant \[ |c|^2 \] is the order of \[ \left( i^2 5.0396 \times 10^{-15} \int (\ln \Delta \Gamma) dE_a \right)^{1/2} \], we obtain the entropic potential equation:

\[ \frac{\partial A_{\alpha \beta}}{\partial E_\beta} + S_a (E) S_b (E) A_{\alpha \beta} = \frac{d}{dt} \left( \frac{i}{\hbar} \left[ \mathbf{H}^b - \mathbf{E}^b \right] \right) \Delta F \]

\[ \int (\ln \Delta \Gamma) dE_a + |c|^2 \quad \text{... (5)} \]

When considering:

\[ \frac{\partial A_{\alpha \beta}}{\partial E_\beta} = -(-5.0396 \times 10^{-15}) \int (\ln \Delta \Gamma) dE_a \]

We mention the transition of Meissner effect, the minus expresses the universal exclusion of entropic potential by recursive configurations proportional to Boltzmann constant (excluded by the second order statistical weights represented by the integral, \[ -(-5.0396 \times 10^{-15}) \int (\ln \Delta \Gamma) dE_a \].

The exclusion of the entropic potential mean, that the linear dimensions and orientations deflections cannot go beyond the threshold mentioned by the limit conditions:

\[ \frac{\Delta \Psi \Delta \Psi'}{\Delta \xi (T) \Delta \xi (T')} = 7.63 \times 10^{-12} \]

\[ \frac{\nabla \Psi \nabla \Psi'}{\nabla \xi (T) \nabla \xi (T')} = 2.76 \times 10^{-6} \]

\[ \frac{\Delta \Psi \cdot \nabla \Psi'}{\nabla \xi (T) \Delta \xi (T')} = (7.63 \times 10^{-12})^2 - (2.76 \times 10^{-6})^2 \]

The wave functions chosen to establish the superconductivity produces order parameter fluctuations corresponding to state densities less than \[ 1/k \] (k is the Boltzmann’s constant). The deflection caused by such wave functions produced an entropic potential with mean intensity\(^{6,6}\) less than:

\[ -8.75 \times 10^{-13} \frac{\Delta \Gamma \Delta \Gamma'}{\Delta \xi (T) \Delta \xi (T')} \quad \text{... (6a)} \]

\[ -8.75 \times 10^{-13} \frac{\nabla \Gamma \nabla \Gamma'}{\nabla \xi (T) \nabla \xi (T')} \quad \text{... (6b)} \]

\[ -8.75 \times 10^{-13} \frac{\Delta \xi (T) \Delta \xi (T')}{\nabla \xi (T) \Delta \xi (T')} \quad \text{... (6c)} \]

### 3 Implications of the Entropic Potential Equation

We write:

\[ \frac{\partial A_{\alpha \beta}}{\partial E_\beta} + S_a (E) S_b (E) A_{\alpha \beta} = \frac{d}{dt} \left( \frac{i}{\hbar} \left[ \mathbf{H}^b - \mathbf{E}^b \right] \right) \Delta F \]

\[ -k \int (k \ln \Delta \Gamma) dE_a + |c|^2 \]

When \[ |c|^2 \], is in the order of

\[ \left( i^2 k \int (k \ln \Delta \Gamma) dE_a + |c|^2 \right)^{1/2} \]

we have:

\[ \frac{\partial A_{\alpha \beta}}{\partial E_\beta} + S_a (E) S_b (E) A_{\alpha \beta} = \frac{d}{dt} \left( \frac{i}{\hbar} \left[ \mathbf{H}^b - \mathbf{E}^b \right] \right) \Delta F \]

When the commutator is in the order of zero, we must have:
\[ \frac{\partial A_{a\beta}}{\partial E_\beta} + S_a(E)S_\beta(E)A_{a\beta} = -k \ln_a \int (k \ln_\beta \Delta \Gamma) dE_\alpha + Cte \]  \quad \ldots (7)

Eq. (7) means that the reduced entropy components will appear as eigen frequencies of entropic potential. The constant \( |c|^2 \) indicates that the stability of those eigen frequencies and, their definition will be extracted from the computing origin by reheating and observing the linear dimensions and the orientations of the fundamental states and also the interference of current densities matrices.

When the commutator is in the order of zero, and \( |c|^2 \) is in the order of \( i^2 k \ln_a (k \ln_\beta \Delta \Gamma) dE_\alpha \), we obtain:

\[ \left\{ \frac{\partial A_{a\beta}}{\partial E_\beta} + S_a(E)S_\beta(E)A_{a\beta} \right\} = 0 \]

\[ \frac{d}{dt} \left( \frac{i}{\hbar} \left[ \hat{H}, \frac{\hat{\mathbf{S}}_a}{a} - \frac{\hat{\mathbf{S}}_\beta}{\beta} \right] \right) \Delta F : |c|^2 - k \int \ln_a (k \ln_\beta \Delta \Gamma) dE_\alpha \]  \quad \ldots (8)

The coupled conditions mean that, the action of the commutator on the free energy density variation will be collected as a second order curvature, locally defined through the entropic potential manifold (this curvature is caused by the order parameter deflections, and the curvature itself will dictate the eigen deflections).

The constant \( |c|^2 \), means that

\[ \frac{d}{dt} \left( \frac{i}{\hbar} \left[ \hat{H}, \frac{\hat{\mathbf{S}}_a}{a} - \frac{\hat{\mathbf{S}}_\beta}{\beta} \right] \right) \Delta F + k \int \ln_a (k \ln_\beta \Delta \Gamma) dE_\alpha \]

will be an invariant of the symmetry group transformations acting on the entropic potential.

When writing,

\[ \frac{\partial^2 A_{a\beta}}{\partial E_\alpha \partial E_\beta} = -k \ln_a (k \ln_\beta \Delta \Gamma) \]

we obtain:

\[ \frac{\partial^2 A_{a\beta}}{\partial E_\alpha \partial E_\beta} + S_a(E)S_\beta(E)A_{a\beta} = 0 \]  \quad \ldots (9)

The cold causes the superconductivity phenomenon, as a measurement process generating a phase transitions of second order and also permits the rise of phenomenological parameters. This stability is to be supported by a new kind of physical quantity, such as entropic potential, which direct to the system how to display over all the possible micro configuration. In the other hand, systems by their faculties to increase their standard entropies, dictates the form of this potential. This will be written as a recursive operatorial equations.

4 Conclusions

The cold causes the superconductivity phenomenon, as a measurement process generating a phase transitions of second order and also permits the rise of phenomenological parameters. This stability is to be supported by a new kind of physical quantity, such as entropic potential, which direct to the system how to display over all the possible micro configuration. In the other hand, systems by their faculties to increase their standard entropies, dictates the form of this potential. This will be written as a recursive operatorial equations.

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