

Classical Interpretation of Temperature, Heat, and Entropy in a World of Spiral-Vortical Structures

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Abstract

This work proposes a classical interpretation of the concepts of temperature, heat, and entropy based on the model of spiral-vortical threads of the electromagnetic field. Without resorting to quantum postulates, we show that temperature is proportional to the average length of threads in the network, heat to the absolute change in this length, and entropy to the relative change. This approach resolves the ultraviolet catastrophe and explains thermodynamic laws as a consequence of the dynamics of resonant merging and expansion of structural field elements, offering a unified classical view of thermal phenomena.

1. Introduction

Traditionally, temperature, heat, and entropy are interpreted within the framework of statistical mechanics and quantum theory, where they are linked to discrete energy levels and probabilistic distributions. However, historically, these concepts arose from classical thermodynamics, and their quantum interpretation was introduced to resolve paradoxes such as the ultraviolet catastrophe in the blackbody radiation law. In previous works [1, 2], we showed that Planck's formula and the Schrödinger equation can be derived classically using the model of spiral-vortical threads of the electromagnetic field. Here, we extend this approach to thermodynamics, demonstrating that temperature and entropy arise as geometric and dynamic characteristics of the thread network, without the need for quantization.

2. Model of Spiral-Vortical Threads

The electromagnetic field is modeled as a network of spiral-vortical threads—structured energy flows in the form of spiral vortices. These threads represent force lines that interact resonantly, merging and forming stable nodes. The length of a thread is inversely proportional to its oscillation frequency, and energy is proportional to curvature and flow speed. In thermodynamic equilibrium, the threads form a network where the average length between nodes (L) determines the overall system configuration. Upon heating, the network expands, threads lengthen, leading to changes in merging probability and energy release. This model is classical: all processes are continuous and obey the laws of conservation of energy and momentum in an elastic medium.

3. Temperature in the Classical Model

Temperature (T) is interpreted as a measure of the average length of threads in the network (L). In classical thermodynamics, temperature is related to the kinetic energy of particles, but in our model, it reflects the geometric expansion of the structure: $T \propto L$. This follows from the fact that vortex

energy is proportional to its size, and thermal equilibrium is achieved when the average thread length stabilizes under the influence of external flows. Since L is always positive (threads cannot have negative length), temperature is non-negative, corresponding to the absolute Kelvin scale. In the limit $L \rightarrow \min$ (minimum length determined by vortex stability), temperature approaches zero, and the system crystallizes into an ordered structure of "dead" nodes.

This interpretation resolves the problem of absolute zero: it is achieved not by quantum prohibition, but by the geometric limit of thread compression, beyond which a phase transition to a denser configuration follows.

4. Heat and Its Connection to Structural Change

Heat (Q) is the energy transferred to the system upon change in the average thread length: $dQ \propto dL$. Upon heating, threads expand, absorbing energy from the environment; upon cooling, they contract, releasing energy. This is analogous to classical thermal expansion, but in the thread model, heat arises from resonant merging: when two threads approach and merge, an energy impulse is released, proportional to the change in their length. The overall process is described as a cycle of inhalation (expansion, absorption of Q) and exhalation (contraction, release of Q), similar to vortical cycles in stellar systems.

In phase transitions, such as melting or evaporation, heat is associated with network restructuring: thread contact shifts from inner coils to outer ones, increasing L by a fixed factor (related to geometric proportions, such as the golden ratio). This explains the latent heat of transition without quantum jumps.

Phase transitions in this model represent a restructuring of spiral-vortical structures, where direct transitions (melting, evaporation) occur with energy absorption, and reverse ones (condensation, crystallization) with release. From the perspective of the onion-like model of the atom (or node), where the structure consists of nested shells (layers of vortices, similar to an onion), a phase transition occurs as a shift in contact between nodes from one shell to the next, more external one. This increases the effective thread length L , corresponding to heat absorption and temperature rise.

The phase transition process is divided into three stages, reflecting the fractal nature of the network. The first stage is one-dimensional: the transition of atoms (nodes) to contact with the new shell occurs along lines, where the old phase forms parallel planes, and the new one—lines connecting these planes. The second stage is two-dimensional: from the old phase, threads remain that connect the planes of the new phase. The third stage is three-dimensional: the new phase occupies the entire volume. The first and third stages proceed at approximately the same speed, while the second stage differs, often determining the kinetics of the entire process. The new liquid phase may consist of clusters (e.g., tetrahedrons of nodes), but the general principles remain valid, emphasizing the classical nature of the transition without discrete levels.

5. Entropy as a Measure of Disorder in the Thread Network

Entropy (S) is defined as the relative change in the average thread length: $dS \propto dL / L$. This reflects the measure of "disorder" or diversity of configurations in the network: upon expansion ($dL > 0$), the number of possible mergings grows logarithmically, increasing entropy; upon contraction, it decreases. In thermodynamics, this corresponds to the second law: $dS = dQ / T$, since $dQ \propto dL$ and $T \propto L$, yielding $dS \propto dL / L$.

This interpretation classically resolves the ultraviolet catastrophe: in blackbody radiation, the probability of thread merging at high frequencies (small L) is exponentially suppressed, leading to the exponential factor in Planck's formula derived by us earlier [1]. Entropy here is not a probabilistic quantity, but a geometric measure of network expansion, preserved in isolated systems.

6. Thermodynamic Consequences

In this model, thermodynamic laws arise naturally:

- First law (energy conservation): change in internal energy equals heat minus work, where work is thread deformation under external pressure.
- Second law: entropy increases in closed systems due to irreversible thread expansion.
- Third law: at $T \rightarrow 0$, entropy approaches a minimum, corresponding to complete network order.

This allows for a classical explanation of heat engines, diffusion, and even biological processes, where entropy is linked to the expansion of vortical structures in living systems.

7. Conclusion

The proposed model of spiral-vortical threads offers a classical foundation for understanding temperature, heat, and entropy without quantum postulates. Temperature as average thread length, heat as its absolute change, and entropy as relative change unite thermodynamics into a coherent picture of field dynamics. This opens the way to rethinking quantum phenomena as emergent properties of classical structures, integrating thermodynamics with electrodynamics and vortex hydrodynamics.

References:

- [1] Shulzinger E. A Classical Derivation of Planck's Formula from Electromagnetic Mode Merging Statistics.
- [2] Shulzinger E. A Derivation of the Schrödinger Equation from the Model of Spiral-Vortical Threads of Electromagnetic Field Force Lines.

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