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NEW RESULTS IN QUANTUM THERMODYNAMICS

Abstract: Classical physics meets the obstacle of describing a point particle because from everyday experience we know that objects occupy a certain volume. We overcome this obstacle by using the equivalence principle for electric energy and describe a curved spacetime of fluid nature. From thereon by using the notion of a point volume the rest of the thermodynamic quantities appear.

INTRODUCTION

In this paper we exploit some new ideas regarding quantum thermodynamics. The basic idea is that the mass of the electron creates a curved spacetime and thus we may use the analogy that it occupies a certain volume. The use of volume in a quantum mechanical description of matter has been discussed by other authors as well[1].

Curved spacetime as referred to our work may be said to be of fluid nature. The various quantities are transformed according to the following formulas:

$$\frac{\overrightarrow{dA}}{dt} = \left(\frac{\overrightarrow{dr}}{dt} \cdot \nabla \right) \vec{A} + \frac{\partial \vec{A}}{\partial t} \quad (1)$$

$$\frac{df}{dt} = \nabla f \cdot \frac{d\vec{r}}{dt} + \frac{\partial f}{\partial t} \quad (2)$$

$$\frac{d\vec{r}}{dt} = \frac{\hbar}{m} \nabla \varphi + \frac{e}{mc} \vec{A} \quad (3)$$

The phase of the wavefunction was assigned to a point flux.

Our work gives an alternative proof of London equations in superconductivity and explains Ginzburg Landau expansion of free energy.

MAIN PART

In a series of published papers [2,3,4,5] we exploited the idea of new volume created to find new thermodynamics.

We find a bulk modulus related to a point surface tension. The model describes a spherical vortex with mass distributed over its surface:

$$\frac{\hbar^2}{2m} \Delta \frac{|\psi|^2}{N} = B = V \frac{dP}{dV} = \sigma(\vec{r}) K = Kc^2 \frac{dm}{dS} = \frac{mc^2}{N\chi} |\psi|^2 \quad (4)$$

The curvature of spacetime K is given below:

$$K = \frac{1}{\alpha \lambda_c} \quad (5)$$

In equation (5) alpha is the fine structure constant and lambda is the Compton wavelength. Our argument originates from manipulation of the relativistic radius of the electron.

In the aforementioned previous work [2,3,4,5] the pressure was found to be:

$$P = \frac{|\psi|^2}{N}(E - U) \quad (6)$$

The volume density of mass is:

$$\frac{dm}{dV} = m\frac{|\psi|^2}{N} \quad (7)$$

If we denote by chi the dielectric susceptibility and K a constant curvature associated with mass we arrive at a definition of surface to volume ratio as has been found elsewhere in the literature[6]:

$$K\chi(\vec{r}) = \frac{dS}{dV} \quad (8)$$

An equation is used which is named the chi Omega law which is written as follows:

$$\frac{\hbar^2}{2m}|\psi|\Delta|\psi| = \chi\Omega \quad (9)$$

Gathering equations (4),(5),(6),(7),(8),(9) a new insight is gained on a fluctuation of pressure if we integrate over volume in the case of real wavefunctions (no magnetic fields applied):

$$\delta P = \frac{c^2\delta m}{N} \quad (10)$$

The formula for the thermal charge density was found to be associated with the energy of the system according to the definition of photon exchange as carriers of heat:

$$\frac{dQ}{dV} = E\frac{|\psi|^2}{N} \quad (11)$$

The coefficient of thermal expansion is:

$$\alpha = \frac{1}{V}\frac{dV}{dT} \quad (12)$$

The Gibbs thermodynamic potential is defined as follows:

$$\Omega = -PV \quad (13)$$

We claim that the following relationship holds:

$$-\frac{\alpha\Omega}{K_B} = \frac{PdV}{K_BdT} = \frac{mc^2}{E} \quad (14)$$

An integration over volume yields the following results:

$$\int PdV = \langle Q \rangle - \langle U \rangle = \frac{mc^2}{E}K_B\delta T \quad (15)$$

CONCLUSION

The results derived give simple answers to the questions raised by quantum thermodynamics. In this paper we did not talk about a possible coefficient of performance as it was not necessary . The variation of temperature may arise from Brownian motion due to vacuum fluctuations. Pressure is related to the normalization constant which has dimensions of volume.

We hope we have contributed to this field of research.

References

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