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Updating of the Knowledge about Energy and Time

Ge Guangzhou
Harbin Institute of Technology, 92 West Dazhi St, Nangang District, Harbin, Heilongjiang Province, China.

Abstract

The author attempts to explore the correlation between energy and time, and endeavors to approach this by employing the idea of relativity theory and thus comes upon with the equation that could formulate the relationship between energy and time. And then the author proceeds with the preliminary research into the unification, conservation and relativity of energy and time and further puts forward the concept of time quantum.

Keywords: Energy, Time, Unification, Conservation, Relativity, Time Quantum

1. THE EQUATION ABOUT THE RELATIONSHIP BETWEEN ENERGY AND TIME

Approaching the energy and time from the perspective of relativity theory, we need to understand how the methodology of relativity theory works. For example, when the relationship between the energy and mass was examined by the relativity theory, the energy and mass have since been unified by the introduction of mass-energy equation, and when the relationship between the time and space was researched by the relativity theory, the boundary between space and time has been broken through and the concept of four dimensional space time was so put forward. The author would then take about the same methodology for the exploration of the relationship between energy and time, and thus the author finds the Hamilton Principle could be employed to formulate the relationship between energy and time.

According to the literature of analytical mechanics, **Hamilton Principle is the variation principle which is applicable to dynamic holonomic system, that is, in**

the space $(q_1, q_2, \ldots, q_N; t)$ of (N+1) dimensions, the time integral of kinetic potential $L(q, \dot{q}, t)$ of the line linking any two points will get the stationary value in its real movement path.

Suppose

$$S = \int_{t_1}^{t_2} L\,(q, \dot{q}, t)dt \quad (1)$$

S is referred to as the Hamilton action quantity, then

$$\delta S = 0 \quad (2)$$

And then its variation form is

$$\delta S = \delta \int_{t_1}^{t_2} L\,(q, \dot{q}, t)dt = \int_{t_1}^{t_2} (\frac{dL}{dq}\delta q + \frac{dL}{d\dot{q}}\delta \dot{q} + \frac{dL}{dt}\delta t)dt = 0 \quad (3)$$

And so the dynamic problem of mechanical system should come down to be a variation principle, that is, as far as the holonomic system is concerned, among all the possible movements of the system, which is conditioned by the same start and finish time, the same start and finish locations and the same constraints, the movement that enables Hamilton action quantity S to be the stationary value should be the one that really occurs in the system, and this is referred to as Hamilton Principle. Thus Hamilton Principle should depict the system's action quantity with the integral equation and use the variation method to calculate the motion equation of overall system. And thus the nature of Hamilton Principle is that it should represent the law of locating the real movement from all possible movements.

The aforementioned is the description in the literature about the Hamilton Principle and Hamilton action quantity. And the author would analyze their physical meanings from the perspective of further exploring relationship between energy and time.

In the formulation of Hamilton action quantity $\mathbf{S} = \int_{\mathbf{t_1}}^{\mathbf{t_2}} \mathbf{L}\,(\mathbf{q}, \dot{\mathbf{q}}, \mathbf{t})\mathbf{dt}$, Lagrange function **L** is the function that depicts the dynamic states of the whole physical system, which is normally defined as the difference between the kinetic energy T and potential energy V, that is L = T – V, and then what the Lagrange function L represents should actually be the energy, and thus what the Hamilton action quantity represents should be the correlation between energy and time of the physical system, or exactly the integral of energy to time in the physical system, which could then be referred to as Energy time action quantity. Now that the Hamilton action quantity serves as the Energy time action quantity of the physical system, the Hamilton Principle acting as the motion equation of the whole physical system should have become the equation that depicts the motion of energy and time in the physical system, which could then be referred to as the energy time equation. And it should be noted that the energy time equation so produced should represent the law of locating the real movement from all possible movements in the physical system.

2. FURTHER DISCUSSION ON THE RELATIONSHIP BETWEEN ENERGY AND TIME

(1) Unification , conservation and relativity of energy and time

According to the above energy time equation as represented by the Hamilton Principle, the energy and time have achieved direct and quantitative correlation with each other without any other intermediate quantities involved, which is expressed by the integral equation and variational method. Thus based on the energy time equation it should be assumed that the energy and time are to be unified as a whole, that is, the energy is time or vice versa.

Now that the energy and time are unified, the energy conservation law should be further expanded, or in a larger sense, the energy time conservation law should substitute for the energy conservation law, that is, as far as a whole physical system is concerned the energy could be transformed into time or vice versa as per the energy time equation aforementioned and in the course of this transformation the sum of energy and time should keep invariable.

Furthermore, now that the energy and time are unified with each other, the time in itself serving as some sort of energy should be just the same as any other types of energy, or exactly the difference between energy and time, if any, should be undistinguishable in nature, as could be referred to as the Relativity of energy and time. Therefore, the time could be regarded as the representation of energy due to this relativity of energy and time.

(2) Time quantum

According to the Relativity of energy and time, the time could be deemed as a representation of energy, and the author would then otherwise consider to interpret the time with energy, and thus put forward the concept of time quantum considering the energy could be quantized.

Then it'll need to find the appropriate formulation of time quantum, and thus it occurred to the author that some sort of action quantity that reflects the relationship between energy and time should be able to represent the time quantum. Therefore, the Hamilton quantity action in the form of integral equation, serving as the energy time action quantity, could be employed to formulate the time quantum, which is $\mathbf{S} = \int_{\mathbf{t_1}}^{\mathbf{t_2}} \mathbf{L}\,(\mathbf{q}, \dot{\mathbf{q}}, \mathbf{t})\mathbf{dt}$. Or it could be concisely formulated as

$$\mathbf{S} = \int_{\mathbf{t_1}}^{\mathbf{t_2}} \mathbf{L}\,\mathbf{dt} \qquad \mathbf{(4)}$$

This formula could then be referred to as the expression of time quantum.

Now that the Hamilton action quantity could be used to formulate the time quantum, what the Hamilton Principle represents should also be deemed as the law of distribution of time quantum. Now that Hamilton Principle should formulate the system's action quantity with the integral equation and in the meanwhile use the variational method to calculate the motion equation of overall system, the distribution of time quantum as represented by the Hamilton principle should be continuous, or in a larger sense, if the distribution of some quanta could be formulated by the integral equation, this quanta in themselves should not be discrete as demonstrated in the case of time quantum.

Now that the time quantum is formulated in the form of integral equation, a new form of quantum is thus being introduced which could then be referred to as the integral quantum. Through the process of time quantum formation we know that the integral quantum is not discrete but continuous, as could be regarded as the most distinctive characteristic of the integral quantum. The integral quantum could be regarded as the redefinition of the quantum from a new perspective.

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