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Relativity, Quantum Mechanics, and Classical Physics: Evidence for a Close Link Between the Three Theories

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Abstract: In a series of articles already published in the Journal of Theoretics[1-4], I have presented arguments showing that Relativity is implicitly present in Classical Physics, more precisely in Classical Thermodynamics. In this new paper, after a brief recall of the main points referring to this first link, I present arguments showing that Quantum Mechanics is implicitly present in Classical Physics, more precisely in Classical Mechanics. The suggested conclusion is that Relativity and Quantum Mechanics are closely linked with one another in Classical Physics, their link being detectable through a revision of some basic equations.
Keywords: Relativity, Quantum Mechanics, Classical Physics, Gravitation, Thermodynamics, Mass, Time, Distance, Speed, Entropy, Energy, Reversibility, Irreversibility, Einstein's mass-energy relation, Planck's time, Planck's length.

- 1- Introduction: The idea is often admitted in Science that Classical Physics is convenient in studying bodies of ordinary dimensions but not in other cases. For bodies of astronomical dimensions, the use of Relativity is required as well as that of Quantum Mechanics is required for bodies of atomic dimensions.

Looking at scientific literature, it can be seen that their respective usefulness are not so strictly separated. Both of them play a role in Astronomy and Atomic Physics, so that a better summary of what can be held as a first impression is that bodies of ordinary dimensions are the only ones, in Physics, whose study seems to be not yet concerned with Relativity and Quantum Mechanics.

Such a situation being somewhat astonishing, it is interesting to revisit Classical Physics in order to see if Relativity and Quantum Mechanics are not masked under some basic equations.

- 2 - A brief recall of the link already suggested between Relativity and Classical Physics

The arguments that I have presented upon this first topic (whose detailed analysis is given in the quoted articles) can be summarized as follows:

Let us consider an "isolated" system (in the sense usually given to this expression in thermodynamics) containing two springs initially separated by a locked piston and tightened in conditions such that the first one exerts on the piston a strength F_1 and the second a strength

F_2. If the piston is freed, we know that it will move on a distance dL and that the energies released by the springs can be written respectively:

$$dW_1 = F_1 dL_1 \qquad\qquad dW_2 = F_2 dL_2$$

Since $dL_2 = - dL_1$, we have for the whole system

$$dW = (F_1 – F_2)\, dL_1 \qquad (1)$$

whose value is always positive, although the difference $F_1 – F_2$ goes decreasing with time.

Instead of containing two springs, the system can contain two gases whose pressures are respectively P_1 and P_2. In such a case, the energies released when the piston is freed become

$$dW_1 = - P_2 dV_1 \quad \text{and} \quad dW_2 = - P_1 dV_2$$

Having $dV_2 = - dV_1$, we get for the whole system

$$dW = (P_2 – P_1)\, dV_1 \qquad (2)$$

whose value is always positive too.

In the usual conception of thermodynamics, these positive results are converted in terms of entropy and finally interpreted as increases in entropy, not in energy. The reason is obviously due to the fact that, according to the first law of thermodynamics, the energy of an isolated system is assumed constant, by definition.

In my opinion, the positive results given by equations 1 and 2 have really the dimensions of an energy and are the sign that the system considered is not completely isolated. As explained in the quoted papers, the increase in energy deduced from this elementary calculation can be correlated to a decrease in mass, according to the Einstein mass-energy relation. Being very small, this decrease in mass is not detectable experimentally and, consequently, it has not been taken into account in the expression of the first law of thermodynamics which was stated earlier than the Einstein theory. The energy created is probably gravitational : it can be expected that such processes, which consist of the disappearance of a gradient within a system, contributes to a decrease in the mass of the larger system (the Earth in the present case) to which this first one belongs. All the processes of this kind having a similar effect, their possible consequence is a progressive increase in the distance separating the Earth from the Sun. Generalized to a larger scale, this interpretation seems to be in good accordance with the concept, now widely accepted, of the expanding Universe.

In equations 1 and 2, the energy taken into account is mechanical. I have suggested an extension of the reasoning to processes consisting of an exchange of heat between two parts of an "isolated" system. The thermodynamic tool used in such a case is the equation

$$dS = dQ/T_e + dSi \qquad (3)$$

which has the dimensions of an entropy.

Converted into the form

$$T_e dS = dQ + T_e dS_i \qquad (4)$$

equation 3 takes the dimensions of an energy and its meaning becomes

$$dU^* = dU_e + dU_i \qquad (5)$$

Equation 5 is a general expression for any kind of energetic exchange concerning a system. The term dU_i refers to the energy created (eventually destroyed) within the system, as was the case for the energy dW of equations 1 and 2. The term dU_e refers to the energy exchanged between the system and its surroundings. It corresponds to the so called "change in internal energy" in the classical language of thermodynamics. In this usual conception, the energetic quantity dU_i is not recognized, so that dU* is not recognized either and dU_e is the only energetic variation taken into account, generally noted dU.

Having in mind the enlarged conception admitted here, we easily conceive that an "isolated system" is a system corresponding to the condition $dU_e = 0$, condition which cannot be extended to dUi, nor consequently to dU*.

In my previous papers, referring to the general context of an isolated system, I have presented some examples of calculation of ΔU* and of the correlative change in mass, Δm. An important imply is that the time Δt required to obtain the disappearance of a gradient - i.e to cross from a state of irreversibility to a state of reversibility - seems to be directly correlated to ΔU* and therefore to Δm. If this assertion is correct, it would certainly be of interest that the precise relation Δt = f(ΔU*), and therefore Δt = f(Δm), be studied.

- 3 - About the link between Quantum Mechanics and Classical Physics.

As concerns this topic, which is the second and main objective of this paper, let us consider the very simple graph presented on Fig.1, where t is the time and L the distance (length of the way).

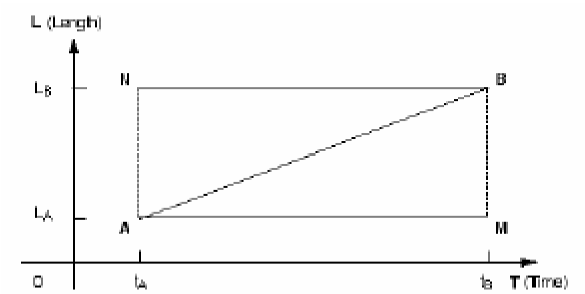

Figure 1.

We have no problem to understand that line A B represents the path of an object which has moved between time t_A and time t_B, covering a distance $L = L_B - L_A$. Since AB is a straight line passing through the origin, we also have no problem to understand that the motion has been done at constant speed (and more precisely, in this case, at constant velocity).

Now, if we consider an object whose initial point is A and which remains motionless, it is thought at first that it will stay at this point. Yet, remembering that the horizontal axis plots for time, we easily conceive that between time t_A and time t_B, this object follows the line AM, and reaches point M at time t_B.

Then a correlative question comes to mind : is it possible that instead of being AM, the path followed by an object would be AN? At first glance, the question seems unrealistic, since a positive answer would mean that, at the same time t_A, this object would be located both in A and N, i.e. in two different points of space.

Actually, one of the main ideas of Quantum Mechanics concerns the possibility for an object to be located in two points of space at the same time. The objects studied in Quantum Mechanics being generally of very small dimensions, such as atoms and particles, can we imagine that the same possibility would exist for objects of ordinary dimensions? This seems all the more doubtful that their behavior is described with an indisputable efficiency by the laws of Classical Physics which, generally, are not suspected to cancel such a strangeness.

To answer the question, let us come back to the basic concepts of time and distance (length of the way) and to the first combination made with them when we define the average velocity of an object, and in a wider sense its average speed, by the relation

$$V = \frac{L}{t} \qquad (6)$$

Being a particular case of the general expression V = f(x, y), equation (6) can be differentiated in the form

$$dV = \left(\frac{\partial V}{\partial L}\right)_t dL + \left(\frac{\partial V}{\partial t}\right)_L dt \qquad (7)$$

$$\text{i.e} \qquad dV = \left(\frac{1}{t}\right)_t dL - \left(\frac{L}{t^2}\right)_L dt \qquad (8)$$

Referring to Fig.1 and integrating dV from point A to point B, we can follow a path such as AMB or ANB (which, mathematically, are the simplest ones), so that we obtain :

$$\Delta V = \frac{1}{t}\int_{L_A}^{L_B} dL - L\int_{t_A}^{t_B} \frac{1}{t^2}\, dt \qquad (9)$$

$$\text{i.e.} \qquad \Delta V = \frac{1}{t}\left(L_B - L_A\right) + L\left(\frac{1}{t_B} - \frac{1}{t_A}\right) \qquad (10)$$

From the practical point of view, this kind of calculation is not of great usefulness since the results to which it leads are more often than not already known or are obtainable in a simpler way. It is just interesting to observe that, in equation 10, if the value entered for t is t_A (or respectively t_B), the corresponding value which needs to be entered for L is L_B (or respectively L_A). In both cases, we obtain the evident result $\Delta V = L_B/t_B - L_A/t_A$ which leads itself to $\Delta V = 0$ for a motion at constant speed.

From the theoretical point of view, there is something more remarkable to underline, although it is closely related to the detail just evoked. It concerns the fact that, in equations 7 and 8, the first partial derivative implies that time is constant - i.e that the course of time is stopped - as is recalled by the small letter t written at the right-down of the parenthesis. Therefore, the corresponding path dL is covered in a part of space-time where time does not exist and only space is present. Referring to Fig. 1 and remembering that the way really followed is AB, this means that this little path dL plots as a vertical segment whose extremities are reached at the same time by the moving object that we are considering. The same peculiarity is true for all the paths dL concerned by the first integral of equation 9, although their positions are successively moving towards the right relatively to the time axis.

Such an observation shows us that in Classical Physics as well as in Quantum Mechanics, the idea that an object can be in two different points of space at the same time is not a dream. It is a fundamental data implicitly written in the basic equations of Physics and Mathematics, whose credibility has been warranted for long time by their ability to describe (and often forecast) experimental observations.

As can be easily understood from equations 6 to 10, the integration of dV implies that the distance separating points A and B in space - i.e the distance between lines AM and NB - is exclusively covered at constant time. In a similar way, the distance separating points A and B in time - i.e the distance between lines AN and MB - is exclusively covered at constant space. In other words, we can keep in mind that **an object does not move in space when it moves in time and does not move in time where it moves in space**. Both time and space are quantified, even in the everyday context of Classical Physics, but they are complementary, not simultaneous.

Confronted with Fig.1, this principle means that the motion of an object along path AB consists of an accumulation of small stairs having the form mdt + ndL, where m and n are integer numbers, dt and dL the elementary dimensions now often designated Planck's time and Planck's length. Knowing that it is possible to advance in time without moving in space, it can be expected that a runner who goes faster than another is probably the one who, during the run, stays motionless as infrequently and briefly as possible. Conversely we can see on Fig.1 that the motion of an object, in space, cannot go at infinite speed, otherwise the length of path AN would be itself infinite. Finally it is not impossible that all motions go at the speed of light, the difference between them depending on the number and duration of the stops.

- 4 - Conclusion. We have seen in paragraph 2 (equations 1 to 5) that "Relativity" is implicitly present in the field "Thermodynamics" of Classical Physics and we have seen in paragraph 3 (equations 6 to 10) that Quantum Mechanics is implicitly present in the field "Mechanics" of Classical Physics. This seems sufficient to conclude that Relativity and Quantum Mechanics are closely linked together in Classical Physics, since the concepts that have been used above to detect their presence - respectively irreversibility and speed - are among the main bases of Physics.

Of course, the propositions presented in this paper only deals with general ideas which need - if recognized true - to be submitted to more extensive analysis. I would like to thank the

readers of the Journal of Theoretics who sent me comments upon my previous articles and I hope that the new opening suggested here could be found useful.

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