Justifying the possibility of getting excess heat

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1 Introduction

Many among the LENR community have reported the experimental observation of excess heat. Nevertheless, saying this does not allow us to have a clear meaning of what we could expect. Indeed, we basically know 3 sources of energy:

1- Chemistry
2- Fission
3- Fusion

Of course, we forgot potential energy but it is out of our scope, being caused either by gravitation or electromagnetic fields; the latter generally needing other energy sources to be created. Mass is also energy, but we include it in the fusion process here.

One of the forms of energy is heat and it generally comes from a transformation whose origin comes from one of the 3 sources cited above.

Let us also set here the first principle of thermodynamics which asserts that the energy of a system is a total differential form. This implies the conservation of energy in an isolated system [1].

This brings us to our own view of what should "excess heat" mean. Under the light of what we just said, excess heat for us is energy in addition to what is expected within the framework of the first principle as it is applied at the time of the experiment. Since this is a bit subtle, let us get more accurate about what we want to say.

At the time of the experiment, we have a given knowledge of physics and a set of potential phenomena. We are expecting that the first principle would be verified. But this is expected to occur within the known framework. Measuring excess heat therefore should bring to the conclusion that:

1- Either the first principle is false and the case being cannot be respected
2- Or the first principle is respected, but there are unexpected new phenomena, with, say, "hidden energy" which appears. In that case, we should in some way rebuild our notion of initial energy in the system and verify that in the end, the first principle still works. This second point of view brings to the potential discovery of new sources of energy.

The main problem we face in option 2, which will be the one we shall deal with in this paper, is that our knowledge of the structure of matter, atoms in particular, does not provide any obvious evidence that any alternative source of energy might exist. In fact, this is even exactly the contrary: orthodox physicists do believe that this is not possible and they generally are more than skeptical about those reporting excess heat measurements.

On the other hand, the LENRists, generally are unable to make reproducible experiments on demand. It seems they get their results on some occasions from time to time without being able to find any explanation and any reliable theoretical model.

In this paper, we are going to propose a theoretical approach filling this gap and which gives clues about where a part of this hidden energy might be. It will also give clues about what to do to make it appear. In no case shall we assert that we are right. We only propose a new approach which might be interesting and which calls for deep (and controversial) mathematics. But a potential way remains a potential way and avoiding the debate would be nonproductive.

2 Mathematical Reminder

The infinite appeared in mathematics with Cantor [2] and in the framework of the Zermelo-Fraenkel theory (ZF), it is an axiom known as the one of the infinite. The first encountered such infinite is the one of the natural numbers whose cardinal is named $\aleph_0$. Then, a theorem of Cantor says that the power set of any set has strictly more elements than the initial one. If ω is the (ZF) set of the natural numbers, then 2^{ω} has strictly more elements. Hence we have

$$\aleph_0 < 2^{\aleph_0}$$

For those who are interested in deepening this, we have the following bijection

$$\mathbb{R} \approx 2^{\mathbb{N}}$$

Where $\mathbb{N}$ is the set of intuitive natural numbers and $\mathbb{R}$ the one of the reals.

Now, a natural question can be raised. Are there cardinals between $\aleph_0$ and $2^{\aleph_0}$? This has been the object of intensive work. Finally, in 1963, Paul Cohen proved that assuming the existence of a set of such an intermediary cardinal or not, is independent of the axioms of ZF. And a consensus was established to commonly decide that there is no such set. This is what we call the continuity hypothesis.

One of the many reasons for this is that the closed sets of $\mathbb{R}$ verify the continuity hypothesis[1]. Some attempts have been made through the consideration of the Baire space called ω^{ω}, but there is, at least (and much more) a borelian isomorphism between it and the reals. Therefore, in their turn, the closed sets of ω^{ω} also verify the continuity hypothesis [3].

For being short and a bit more complete, there are some sets of axioms which, added to ZF, bring to the continuity hypothesis as being a theorem and no more an axiom, but we shall not elaborate on this.

3 The Fluid Models in Physics

The students generally face 2 models during their "career". The first they encounter is the Boltzmann one known as the kinetic theory of gases [1]. In it, the fluid is made of the molecules we meet in chemistry and they face thermal motion with elastic shocks.

The second model is the one of fluid mechanics [4]. It considers a concept of a molecule of fluid which would be made of a substantial but not defined number of the molecules of chemistry. But, then, most of the computations are linked to the derivation and integration of a continuous material which seems contradictory with what we know from quantum mechanics.

However, Boltzmann's model also has its flaws. Indeed, from elastic shocks you cannot get any viscosity… But if there was no viscosity in the air, planes could not fly… While they do! In addition, in a linear approximation when treating the Navier-Stokes set of equations [4], we get at least 2 different viscosity coefficients with 2 different interpretations. More accurately, a local Fourier transform would give an infinity of such coefficients all having different explanations. We see that the point is pretty complicated. And whatever trick you can use out of Boltzmann's theory will not bring you to this, while it has been experimentally verified.

Therefore, we shall privilege here the approach of fluid mechanics and of continuous materials. At least because planes fly! And we shall modify the approach while keeping its essential features.

[1] As a consequence of the Cantor-Bendixon theorem.

4 Basic Thermodynamics

We are interested in phase change. Let us begin with a traditional diagram.

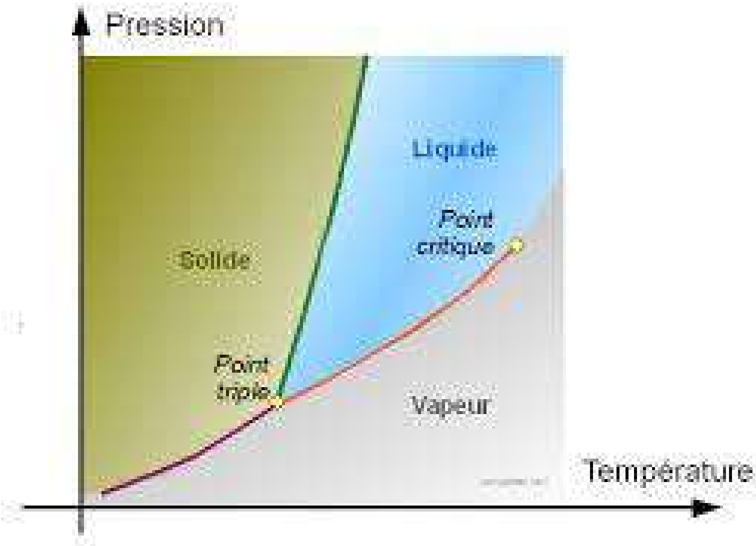

Figure 1: Water phase change diagram

What we are interested in is the critical point.

Now, let us consider a transformation like the one indicated by the dotted line on the figure hereafter.

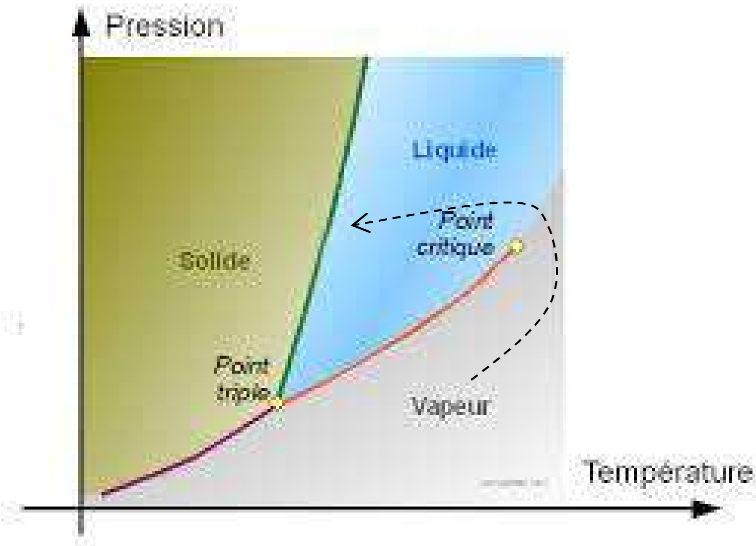

Figure 2: Continuous phase change

It is well known that in such a case, not crossing any of the phase change lines, we shall go through a continuous transformation during which we shall not be able to see the transition between liquid and gas. This is what generally is called the fluidic phase, which is neither gas nor liquid.

5 Antique Greece Physics

Let us recall how the atom was discovered by the Greeks of the Antiquity as Schrödinger [5] tells it. Indeed, considering water, they noticed that the same matter could exist under 3 different forms: solid, liquid and gas. And this is how they came to the existence of the atom, the unit of water. For the gas, the density of atoms in a volume had to be less than in the liquid and itself less than in the solid. We know that this is false for the latter part and very specifically for water. But this is true between the gas and the liquid.

For the following of this text, we shall therefore consider that the density of the number of molecules in a gas is less than in its liquid form. We shall therefore have

$$\begin{cases} \rho_g \propto \alpha \\ \rho_l \propto \beta \end{cases}$$

Where ρ_g is the density of the gas, ρ_l the one of the liquid, α is the number of molecules of gas per unit of volume and β the one of the molecules of liquid per volume unit and, of course, $\alpha < \beta$. These data have obviously to be considered under certain conditions of pressure and temperature.

6 New Physics!

Until now we only have reminded the reader current scientific facts. We need to bring in something new. For this, let us keep on the remarks of paragraph 3. Indeed, we have treated the two ways fluids are tackled in physics and none is satisfactory on the point of view of rigor. We said we prefer the continuous materials approach, but, once again, it is internally logically contradictory: continuous treatment on the one hand but a molecule of fluid made of a certain number of true molecules.

At that point, let us remark that when deriving and therefore calculating df / dx or when integrating $\int f(x)dx$, the dx in non-standard analysis is an infinitesimal, that is, very far away from any size of any molecule[2]!

Now, standard physics has elaborated the famous concept of material point, that is a geometric point with, say, a mass. Despite the wide use of this concept, let us just quickly prove that it should definitely be abandoned. Indeed, let us just use the gravitation law and drop any 2 material points wherever they a

will notice that wherever they were at t_0 they will collide with an infinite speed and therefore with an infinite relative kinetic energy.

This contradiction can be surmounted if we can affect any material point with an infinitesimal mass. We can justify this, but this is out of the scope of this paper.

This allows us to consider truly continuous materials (i.e., fluids), but if some characteristics are infinitesimal, this means that the number of points must be infinite. And this is where things are becoming interesting!

The numbers α and β of §5 need therefore be infinite cardinals. What we bring as a novelty here is that we assume that

$$\begin{cases} \alpha = \aleph_0 \\ \quad and \\ \beta = 2^{\aleph_0} \end{cases}$$

This allows us to interpret the phase change transition when we cross the line in the phase change diagram above. The change is abrupt because, following the continuity hypothesis, we have an instantaneous change of density from, say $\aleph_0$ to $2^{\aleph_0}$ if we move from gas to liquid.

[2] i.e., much smaller and even not any real number!

The question we raise now is to know what happens when we make the move in Figure 2: Continuous phase changeFigure 2. Our proposition is that in such a case we could be outside the continuity hypothesis. What we mean is that we would go through densities

$$\aleph_0 < \kappa_1 < \ldots < \kappa_\alpha < \ldots < 2^{\aleph_0}$$

7 A Proposal for LENR

Generally, the canonical sets in thermodynamics are tackled in classical physics through the consideration of continuous materials while dealing with the kinetic theory of gases, and let us notice, once again, that it is contradictory with the existence of the chemistry molecules [6]. The contradiction generally is removed through the use of quantum physics and what could be called "Heisenberg boxes" linked to the uncertainty principle [6] which has become, with time, a theorem in the framework of a more mathematical and axiomatized approach.

Our proposal here is to abandon such a point of view and give momentum to the classical approach removing the problem by considering infinite cardinals which are quite natural to deal with.

Now, writing the Hamiltonian of an isolated thermodynamics system brings to

$$H\left(p_1,\ldots;q_1\ldots\right) = E$$

Where the $p_i s$ and $q_i s$ are the generalized coordinates and E is the energy of the system[3]. It is to be noticed that the number of indices in this writing is infinite, for example $\aleph_0$.

Now, we know [6] that the creation of heat can be achieved through the creation of entropy and the latter can be generated through breaking the preceding order into a new one with less "strength". If we have access, as proposed above, to cardinals strictly between $\aleph_0$ and $2^{\aleph_0}$, then we have additional choices to create excess heat compared to the ones expected in the traditional description of our world.

Doing this, we have saved the commonly accepted laws of physics which have been established since the 19th century. Only the description of our world is a bit different and LENR becomes possible without questioning the basic laws.

Indeed, LENR would occur in the range of cardinals strictly between $\aleph_0$ and $2^{\aleph_0}$. This means, according to our approach, that we should have a very special type of phase change in the system which would trigger new, formerly hidden variables, which we could play with to obtain excess heat. Beyond the theory itself, we have a clue of what kind of experimental conditions have to be met and as far as the author of these lines is aware of, all the successful experiments could have claimed to meet such requirements.

8 Conclusion

We have, in this paper, just used the mathematics which has been developed from the 19th century in order to describe a possible framework for the observation of new phenomena which gives momentum to the numerous testimonies of physicists working in the field of LENR. Our approach is rigorous and, of course, can stand criticism. But it should not be underestimated because it tackles the problem in the very place where the traditional approach is not satisfactory, as we underlined it.

9 References

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[3] Please notice that in this case, we need to deal with infinitesimal masses and therefore quantities.

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