CRIMSON PUBLISHERS
Wings to the Research

Academic Journal of Engineering Studies

ISSN: 2694-4421

Mini Review

About the Use of Zero

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Submission: October 17, 2018; **Published:** November 26, 2018

Abstract

There is an absolute need of making the differentiation between two expressions that seem to have a quite similar signification: « parameter of zero value» and «lack of parameter ». Indeed they have a distinct semantic impact. In that purpose, we have introduced an induction rule which is based on the following observation: Assigning a « parameter of zero value » to a system is necessarily inducing that this system possesses the parameter, and that this parameter can take non-zero values.

The Invention of Zero

The Egyptians did not know the « zero », they used to let a space between hieroglyphs [1]. The Olmecs, Maya's predecessors, invented the « zero » few centuries BC [2]. In this part of the World, we owe tribute to Seleucid scholars, whose Hellenistic Dynasty reigned from c.312 BC to 64 BC. Its founder, upon the death of Alexander the Great, was Seleucos Nicator, which means « the Winner », satrap of Babylonia [3]. The conceptualization of the « zero » is a example of polygeny, much more than a « constant of human mind », because the inventors of the « zero » were very few.

The Induction Rule

« Zero » is a value; so that when a system is assigned a « parameter of zero value », it necessarily induces the existence of the parameter inside the system. We have an illustration with the atom : its electrical charge is equal to « zero » because it contains as many positive electrical charges, with protons inside the nucleus, as negative electrical charges with peripheral electrons; but since the atom contains electrical charges, it justifiably possesses an electrical parameter.

By cons the absence of a parameter inside a system, does not allow for assigning a parameter to the system; even if this parameter is assigned with a zero value. We would not say about the one who owns no boat, that he owns « zero boat », or that he owns a boat of « length zero » ; it would be a sophism. No parameter inside a system leads to no parameter of zero value. In other words, when a given parameter does not exist inside a system, the induction rule forbids to assign a parameter of zero value to the system.

The Photon and the Neutrino

The photon which is the quantum of the electromagnetic field, is also called boson of the electromagnetic interaction. It is able to materialized itself into a pair of electron-positron; but it contains no electrical charges and, as it does not interact with the Higgs field, it has no mass. However the photon is inventoried as a particle whose mass and electrical charge are zero ; it arbitrarily imposes to the photon a mass parameter and an electrical charge parameter. We consider that the mass and the electrical charge of the photon are not zero; they just do not exist: the photon has no mass and no electrical charge

In cons-example, the neutrino is a particle without electrical charge ; there are serious presumptions in favor of a very small mass ; so small that it has not been brought to light yet. Therefore it is justified to give the neutrino a mass parameter, and in the meantime to consider this mass parameter equal to zero, in that it is so weak.

The Induction Rule

From an epistemological point of view, « parameter of zero value » and « lack of parameter » have not the same meaning. When a system does not possess a parameter, a model that uses « parameter=zero » is a sophism: the mathematization, by introducing zero value, is going beyond reality. The inappropriate use of zero is an example of transgressive mathematization. In other words, « no parameter » cannot be replaced by « parameter of zero value »: The induction rule prohibits of replacing a non-existent parameter by a parameter of zero value.

The Questioning of Leibniz

« Why is there something instead of nothing ? », the German mathematician and philosopher Leibniz (1646-1716) was wondering : this dichotomous questioning assumed that « nothing » could exist. Well, without physical existence of the empty space, « nothing

» is not an option, but a mathematical construction of thinking : physically, « something » is an obligation. Since Leibniz did not take the precaution to defining space, empty space and the word « nothing »; he assumed a dichotomy, such as his questioning was a sophism [3,4].

The Empty Space

For Einstein, the empty space with no object in it nevertheless contains physical states that propagate by ripples, and also localized fields [4]: to be clear, the empty space of Einstein is not empty. So what is space as such ? The empty space, called vacuum, must be defined without the arbitrary use of an energy density equal to zero. According to the induction rule, the energy density of an empty space is not zero : instead, it does not exist. This rule applies to all other parameters ; so that an empty space has no physical parameter. The lack of physical parameters in the vacuum, prevents one to define the concepts of space, time and spacetime. Therefore an empty space has no physical properties: this is the prognosis of the non physical existence of space as such. The induction rule allows one to demonstrate that space stricto sensu is a mathematical object.

In Brief, Physical Space and Empty Space are Concepts

A. The physical space is conceptualized and defined through what it contains; it corresponds to our ordinary space; it is a physical concept.

B. The empty space is a mathematical concept. Physically, it's a fiction deprived of materiality [5].

Conclusion

« Zero » is a mathematical concept, the use of which should be, in one way or another, restricted. Under certain circumstances, a transgressive mathematization may result in a bad assessment of reality. The research on the nature of space provides an effective illustration.

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