

ON THE DISCRETE NATURE OF PHYSICAL LAWS

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Abstract.-The discrete nature of certain physical magnitudes, such as electric charges, which participate in certain laws, such as Coulomb's law, has inevitable and highly significant consequences for many other physical magnitudes. To such an extent that it becomes inevitable to consider the possibility of a single finitist and discrete physics. This consideration is obviously supported by the inconsistency of the actual infinity that underpins the infinitist mathematics with which physicists construct their physical theories.

Keywords: discrete electric charges, Coulomb law, discrete laws, discrete physics, inconsistent actual infinity.

1. Introduction

After a brief summary of the argument published in [3] and in [1] by the author, which highlights the indifference of most physicists over the last 125 years to the possible formal inconsistency of the infinitist mathematics with which they invariably construct all their theories (even quantum mechanics!), the case of Coulomb's law is discussed here, an inverse square law involving a discrete magnitude (electric charge) with a (usually assumed) continuous magnitude: space. The resulting electric force could be considered a continuous magnitude due to its mathematical dependence on continuous space. The discussion quickly leads to a problem of logical incompatibility between the two types of physical magnitudes, continuous and discrete.

The only solution to this incompatibility would be the discretization of physical space and electric forces, a solution that would be confirmed by the inconsistency of the actual infinity that underpins the supposed continuum of space and time. The discrete nature of electric charges, space and electric force now allows us to apply the same argument applied to Coulomb's law to all physical laws involving any of these discrete magnitudes (electric charges and/or space and/or electric force) with other supposedly continuous magnitudes, for instance time. And the conclusion would be the same: the discretization of the supposedly continuous magnitudes. This path of discretization of physical magnitudes can be extended to all supposedly continuous magnitudes that are mathematically related to some discrete magnitude, leading to an inevitable discretization of physics.

2. An inconsistency in field theory

I reproduce here in a very summarized form an argument developed in [3]:

Let us consider a field of force whose lines of force extend radially from its origin (for example, the electric field of a proton p^+), and let us also consider several concentric spheres with that origin. Invariably, the loss of intensity of that field with distance from its origin is explained in any physics literature by the loss of spatial density of its lines of force, because those (radial) lines of force separate with distance. But this separation with distance is impossible because the lines of force are densely ordered (Figure 1): between any two of these lines of force there will always be the same uncountable infinite number of other different lines of force, exactly 2^{\aleph_0} lines of force.

This incredible error, which has persisted in primary and secondary physics literature for over a century, shows that most physicists do indeed follow the recommendation to "shut up and

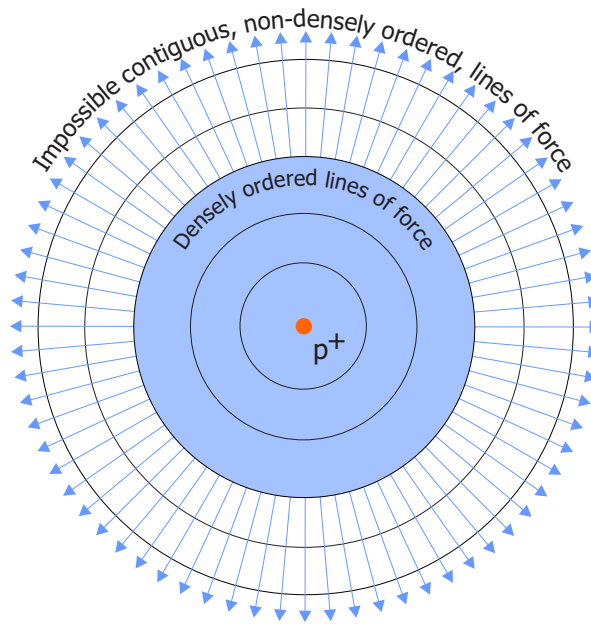


Figure 1 – Assumed lines of force of the electric field of a proton p^+ , which are assumed to separate with distance to the center of the field. A separation that is mathematically impossible because between any two of them there will always be the same uncountable infinite number (2^{\aleph_0}) of other lines of force.

calculate.” And even if the calculations are excellent, with the underlying infinitist mathematical language, it will never be possible to adequately explain the nature of the physical world if that actual infinity is formally inconsistent. In reality, the very brief argument above can be considered a proof of the inconsistency of the actual infinity on which these mathematics are built [2], and also a proof of physicists’ blind trust in that infinitist mathematical language, however inconsistent it may be.

3. Coulomb’s law

One of the physical magnitudes whose discrete nature is already accepted is electric charge: there is a universal minimum charge $q_m = 1.602176634 \times 10^{-19}$ coulombs, that can be either positive or negative. Consequently, any other charge q is an integer multiple of that universal minimum charge:

$$\forall q : q = n q_m, n \in \mathbb{N} \tag{1}$$

where \mathbb{N} is the set of natural numbers. This discretization of the electric charge allows us to write Coulomb’s well-known law as follows:

$$F = K \frac{n q_m m q_m}{d^2}, n, m \in \mathbb{N} \tag{2}$$

From (2) we immediately deduce:

$$n m = \frac{F d^2}{K q_m^2} \tag{3}$$

$$F d^2 = K' n m \tag{4}$$

where $K' = K q_m^2$ is a constant, so that $K' n \times m$ can only take discrete values determined by the natural numbers n and m (remember that the set \mathbb{N} of natural numbers is a discrete set). In consequence, equation (4) implies that both the electric force F and the distance d must be discrete magnitudes; otherwise, it would be necessary to specify which of their values are permitted in Coulomb’s law and which are not; or in geometrical terms it would be necessary to specify which points the lines of force pass through and which they do not. Which are obviously not the case.

Another law of the inverse square is the law of universal gravitation, identical in form to Coulomb's Law but with masses instead of electric charges (and naturally with another constant and another resulting force). In effect, all objects are made up of an integer number of atoms, and each atom of an integer number of subatomic particles, each with its corresponding discrete and universal mass. It should only be taken into account that the mass of a macroscopic object is not exactly the sum of the masses of all its respective subatomic particles due to atomic and subatomic interactions that slightly modify their respective masses, although always in the same way.

4. Consequences

The discrete nature of electric charges, and then of the electric force and distance (and therefore space), allows us to apply the above argument based on Coulomb's Law to other physical laws involving some of these discrete magnitudes and other supposedly continuous magnitudes. The consequences can only be the same and for the same reasons as in the case of Coulomb's Law: the new supposedly continuous magnitudes must also be discrete. This process of extending the discretization of physical magnitudes can only result in a physics of discrete magnitudes. A physics that could be constructed without the mathematics of the inconsistent actual infinity [2].

5. Towards a discrete physics

The undeniable operational success of infinitesimal calculus in physics is due, in my opinion, to a fact that has never been pointed out. Indeed, in infinitesimal calculus (differential and integral), variables are used that tend toward a limit value, but that tendency is not, nor can it be, a tendency through a continuous sequence of immediately successive values of the corresponding continuous variables: between each two of those values taken on their way to the limit value, there is always the same number of values that are skipped: exactly 2^{\aleph_0} values (real numbers). So the way towards any mathematical limit is ALWAYS IN JUMPS. And in jumps over the same number of values that are impossible to consider or reduce due to the dense order of real numbers. All of which is compatible with finitist and discrete mathematics, which avoid the formal inconsistency of the actual infinite [2].

Bibliographical References

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