

IDENTITY BETWEEN SPACE-TIME AND PHYSICAL SUBSTANCE'S EXTENSION

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This paper argues the identity between space-time and physical substance's extension following Descartes and Einstein. Field and particles' distinct spatiotemporal attributes are derived from their different extension types. Through elucidating the continuous space-time of the field world, we can supersede the genesis of the universe by the beginning of the particle world. Given two proposals: (i) any fundamental particle is finite but unbounded, (ii) a singularity is the only site for transformations of two extension types of physical substance, and then by the general theory of relativity, we determine the flexible intertwined structure of the cosmological time and its irreversibility. The thermodynamic entropy can only be applied in the particle world, which indicates that the thermodynamic time is a constituent part of the cosmological time. The indestructibility of physical substance reveals that the reciprocal transformations of two extension types of physical substance enable a self-sufficient universe.

Key Words: Identity, Space-time, Physical Substance, Extension, Self-sufficient Universe

1. Introduction

After Descartes, Einstein argued the identity between space (space-time) and physical reality's extension. The word body used by Descartes means corporeal substance. Thus a vacuum, nothing in it, is impossible from the view of Descartes [Descartes, 1988: p.185-186]. By the general theory of relativity and the definition of field, Einstein interpreted the concept vacuum as the space 'empty of field' and declared that space-time cannot exist independently, but works as 'a structural quality of the field' [Einstein, 2001: p.139-158].

Field and particles, both derived from one and the same physical substance, should be differentiated by their contrary extension types, i.e. continuousness and discreteness. Considering the strict opposition of these two extension types, we can separate the universe as a physical object into the field world and the particle world, and then analyze their spatiotemporal attributes by turn.

2. Field world

Field extends spatially and continuously. Continuity means indivisibility. Although there are many appellations for 'different' fields, changing field strength cannot be interpreted as localizing or separating a kind of field from the whole field world. The field world could be treated as the only total field in this sense.

Considering the field's extension only, all physical concepts based on discrete statistics, or dependent on references, lose their efficacies. Imagining an unbounded space without any particle, all sorts of terms about locations like length, distance, and volume cannot be applicable anymore. Then so-called movements and velocities are no point in a pure field world.

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Although information takes rank with energy, it is hard to be defined. In view of quantization of energy, we can endow information with physical substantiality. Information could be to field as energy is to particle. A signal differs from information in existing in the particle world. In appearance we discuss the propagation velocity of a signal, but in reality what we mean is the movements of particles as the carriers of information in the particle world. Information is no-local and unconcerned with movements or velocities. No-local effects do not require a superluminal hypothesis, even any hypothesis associated with velocity.

3. Particle world

Usually the spatial form of a fundamental particle is supposed ideally as a point without volume or a micro-sphere without inner structure. Before analyzing its spatial attributes, we need introduce two premises: (a) the proposal of a finite but unbounded universe, first propounded by Einstein [*Einstein*, 2001: p.110-114]; (b) the existence of singularities.

By the definition of discreteness, strictly and thoroughly, i.e. no continuousness at any level, the premise (a) could be extended as: any fundamental particle is finite but unbounded. That means:

- (i) According to the differentiation of two extension types, 'finite but unbounded' is confined to the discrete distribution state of physical substance, i.e. the particle world only.
- (ii) The idea of micro-sphere without inner structure should be abandoned. This hypothesis equals the description of a localized field. The bounded continuous spatial distribution state implies a paradox that discreteness occurs in a continuous distribution.
- (iii) The idea of ONE point without volume is untenable also. It does not agree with observed data and can be applied in approximate calculation only.
- (iv) There are endless spatial levels in the discrete distribution state of physical substance. Or there are endless sequences on scale in the particle world. Every particle world is a fundamental particle of the particle world on the upper level, and vice versa.
- (v) No two absolute identical particles. The articulation of particles of a kind is only an approximate argument.
- (vi) Space roots in the coexistence of two extension types of physical substance. Volume and distance result from discreteness against a background of continuous distribution, infiniteness results from the contrary. The discrete distribution state of physical substance does not possess volume.
- (vii) Unlike Einstein's interpretation of a finite but unbounded universe by 'the closed spaces without limits' [*Einstein*, 2001: p.141], 'finite but unbounded' in this study corresponds with the concept discreteness. The word finite implies metric relations for the discrete distribution state of physical substance. Another word unbounded comes from the endless sequences on scale discussed above. Strictly, the common concept bound cannot be used in our analyses of two extension types of physical substance.

By the existence of singularities, in combination with our analyses about two extension types, we suggest that a singularity is the only site for transformations

between these two types of physical substance. This inference bases on the law of indestructibility. It means:

- (i) The idea of indestructibility refers conservation. Now we understand the law of the equivalence of mass and energy. By the foregoing extension analyses, the concepts of ‘mass and energy’ are on the side of the discrete distribution state of physical substance. This analysis radicalizes opinion on the law of indestructibility to both extension types of physical substance.
- (ii) The semi-discrete or semi-continuous distribution state of physical substance cannot claim its existence.
- (iii) The particle world which we have been resident in, not the whole universe, was born from a singularity.
- (iv) Any fundamental particle referred in this study means that it is born from a singularity directly.
- (v) Transformations of two extension types of physical substance cannot be described by the transformations of the coordinates in the general theory of relativity. It is reasonable to say those transformations admitted need to be ‘free from singularities’ [*Einstein*, 1950: p.81].

4. Time

Time is the abstract presentation of changes in a spatial distribution state of physical substance. Therefore, space can be taken as the first-order attribute of physical substance and time as the second-order.

The intrinsic time of a fundamental particle is its time maintaining as the discrete distribution state of physical substance. It is finite, starts at a singularity and will also end at a singularity. This period cannot be treated as continuous. We know that a fundamental particle is a particle world on the lower level, then the intrinsic time of this fundamental particle is constituted by the intrinsic time of all fundamental particles of that lower particle world. Additionally there are endless levels downward. When physical substance exists in the discrete spatial distribution state, its intrinsic time is discrete.

The relativity of simultaneity caused by light spreading from multiple locations is just suitable for the particle world, not for the field world. Since the concept location cannot be usable in the field world anyway, the simultaneity in the field world should be absolute. Furthermore, the concept simultaneity implies comparisons among different locations and cannot be applied in the field world either. Thus the exact statement is: there can be but one time in the field world, and this time does not refer to simultaneity.

To the discrete category belong beginning, interval, end, etc. By the continuity attribute, we cannot claim a field’s born after a fundamental particle’s arrival at a singularity or a field’s end after a fundamental particle’s born. As the only total field, the field world has a sole continuous time, no beginning or end. In other words, the field world has no origin or finality. It exists eternally.

5. Irreversibility and time direction

After discussed identity between two distinct spatiotemporal attributes and physical substance’s different extension types, we can further analyze how irreversibility and time direction lie on spatial attributes of physical substance.

One-way membrane regions surrounding singularities ensure that no particle can experience its life in the reverse way. That results in two related conclusions.

On one side, in combination with the proposal 'any fundamental particle is finite but unbounded', the possibility of time reversal in a particle world is completely rejected. From a movement point of view, any fundamental particle is of endless discrete levels, thus the REAL time reversal of a fundamental particle must include the reversal of the motion direction in any one-way membrane region of this particle world on endless levels downward. The T of CPT theorem means the reversal of the motion direction of every particle. As we discussed, the reversal of the motion in normal visual space does not equal the REAL reversal of the direction of time. Hence the T of CPT theorem is untenable under this proposal. From a physical substance point of view, there does not exist two absolute identical particles, and each particle has its unique intrinsic space-time. Consequently the particle dropped in a black hole cannot be equivalent to any particle of the same kind ejected from a whitehole. Neither black holes nor white holes can be treated as mutual time reversal. Then definitely the general theory of relativity shows the time direction by joining this proposal.

On the other side, the changes in the field world actualize by reciprocal transformations between field and particles. One-way membrane regions prohibit the reverse time of any particle, thus reciprocal transformations can be realized in only one way. That means the intrinsic time of the field world has but one direction.

Under the framework of reciprocal transformations between field and particles, we have two times with certain directions: the discrete time t_{dc} for particles with the direction from the discrete distribution state of physical substance to the continuous distribution state; the continuous time t_{cd} for field with the inverse direction. One time direction cannot be treated as the other's reversal. These two times, t_{dc} and t_{cd} , are the component parts of the cosmological time T . The irreversibility of the cosmological time T depends on that of t_{dc} and t_{cd} . Their directions can be described as: T is in the same direction with t_{dc} or t_{cd} , and T in the opposite direction with t_{dc} . An intuitive explanation is that t_{cd} and t_{dc} intertwine like a linear double strand DNA chain. This intertwining mode is flexible. One can be straightened as the other is compressed. Accordingly, one can be regarded as straight enough when the other is compressed to a very slight scale, i.e. Planckscale.

6. Entropy and thermodynamic time

The thermodynamic time has internal coherence with the cosmological time analyzed above. The well-known thermodynamic entropy can be interpreted as a measure of disorder in statistical mechanics. This concept is only for the discrete distribution state of physical substance. The thermodynamic time is a certain articulation of a particle world's intrinsic time from a disorder point of view and is a constituent part of the cosmological time also.

Since the field world does not refer to disorder, or its disorder value can be treated as zero, the entropy of the field world can be endowed with zero value. Based on no thermal motion, the temperature of field world can be considered as absolute zero also. Reciprocal transformations between field and particles exist in any isolated system.

The universe is always treated as a perfectly isolated system. Indeed, the universe, including the unique field world and all particle worlds in endless levels,

is the total of physical substance and also an absolute isolated system. Any particle world combines the field world to form an ultimately isolated system. The change of entropy of our particle world results from the cosmic evolution, and they keep the same direction in appearance. But in fact, both of them are determined by the way of reciprocal transformations of two extension types of physical substance. Once the part transformed from field to particles is less than the part transformed in the reverse direction, our particle world will be in a contracting phase, as the entropy of our particle world will reduce and time will maintain its original way.

7. self-sufficient universe and singularities

Here we propose a kind of thought based on the indestructibility of physical substance. The universe is the intelligible physical substance itself. Every deviation from the base of two extension types of physical substance endangers our understanding about space-time. Any attempt to treat either of field and particles as the only fundamental state of physical substance ignores the other's space-time nature unavoidably.

It is inaccurate to use discreteness terms to describe the whole universe. We need to supersede the genesis of the universe by the beginning of the particle world and the eternity of the field world. Although the birth and death of any particle world through singularities are required by discrete attributes, the law of indestructibility of physical substance shows that a particle world does not come from NOTHING. With singularities acting as the key role, the universe realizes self-sufficiency by reciprocal transformations between two extension types of physical substance.

8. Summary

Space-time equals physical substance's extension rather than physical substance itself. By the identity analysis of two kinds of spatiotemporal attributes corresponding to two extension types of physical substance, our study showed the imperfection of the articulation about the genesis of the universe, and revealed the flexible intertwined structure of the cosmological time and the self-sufficiency of the universe. It improves our knowledge about this universe in an easy-to-understand way.



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