Spacetime deformations concept

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Abstract

The spacetime deformations concept proposes a road to unification of general relativity and quantum mechanics i.e. unifies all interactions, answers the questions: why particles have mass and what they are, answers the question: what is energy and dark energy, unifies force fields and matter, implies new theories like the spacetime deformations evolution.

I propose a new definition of matter and energy however not contradictory to current theories but totally contradictory to everyday experience. The new quality here is that the definition is supposed to be free of human being's perception and as far as possible also free of our language and culture limitations. I present also some points of view on computability of the actual Universe.

This is a concept of principle (an universal concept delivering a description of nature) and not constructive one (describing a particular phenomenon using specific equations).

The concept is background independent (the space has no fixed geometry).

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Contents

1. Introduction

Human being's specific perception

Let us start from the perception of reality to understand a physical reality essence. The stages of perception process are: detection, interpretation and record. At the moment I need to explain shortly only the first and second stage. The detection is a wave reception using a detector e.g. an ear, camera, LHCb etc. In the detector one wave is changed into another one e.g. inside the inner ear an acoustic wave (longitudinal) is changed into an electromagnetic wave (a transverse wave in a nervous system). An interpretation is a process of comparison the current and previous (recorded) detections with future detections (expectations usually based on the past).

"Our perceptions are a species-specific user interface. Space, time, position and momentum are among the properties and categories of the interface of H. sapiens that, in all likelihood, resemble nothing in the objective world… I don't carelessly drag a file icon to the trash bin. I don't take the icon literally, as though it resembles the real file. But I do take it seriously. My actions on the icon have repercussions for the file"[1].

Strongly deformed spacetime region

With that in view let us start out with a very simple "thought experiment": we observe a small region in spacetime (the size of an elementary particle radius) deformed in the way that the wave we actually detect is not emitted or reflected by the observed object but it comes back to us along the geodesic (the notion of a "straight line" in general relativity). In fact we observe only a strongly deformed spacetime region, "empty" inside and redirecting our wave but apparently… we perceive a particle. Our measuring instruments and our language out of the force of habit say so. The fact that deformations of spacetime exist is generally recognized as a part of general relativity theory. By contrast, <u>the shape, the average density gradient along with its changes and the average size of deformation</u> under consideration are different here than in GR.

Before we proceed we need to take some assumptions (postulates) regarding the spacetime properties to decide what could possibly emerge out of our reasoning.

2. Postulates of spacetime deformations theory

2.1. Spacetime is continuous, i.e. not perforated, not torn and has a homeomorphism property.

2.2. Spacetime has elastic properties.

2.3. The elastic properties of the spacetime are isotropic.

2.4. Any spacetime deformation is unlimited (because, to some extent, deforms the entire spacetime, due to its elastic and homeomorphism properties).

Human being's perception of Strongly deformed spacetime region

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New definition of matter and energy

Taking into consideration the specific to humans perception and assumed properties of the spacetime, I propose the new definition of matter: the region in spacetime so deformed that our perception process and our language tell us we detect a matter. Or simply: the matter is only a spacetime deformation (a contraction type). This seems to support the Clifford's hypothesis that the matter is nothing more but a kind of exotic space. But what about the second element of physical reality – the energy? Following the assumed properties of spacetime we can easily deduce that the energy is just the complementary deformation (but an expansion type) to that region we perceive as the matter. A differentiation of the matter and energy depends only on the shape, the average density gradient along with its changes and the average size of deformation subject to our detection.

Einstein said: ”reality is merely an illusion, albeit a very persistent one”.

3. Some implications of the spacetime deformations concept

3.1. If the deformation is a local spacetime contraction (we detect it as a particle) it simultaneously causes the surrounding spacetime becomes expanded (we can detect an accompanying force field) - Fig. 1. Consequently this single deformation we perceive (and interpret) as separate matter and energy because our measuring instruments and our language out of the force of habit say so.

In brief: **matter and energy are only a spacetime deformations.**

3.2. Any interaction between spacetime deformations we notice as a force: we named them gravitational, strong and weak nuclear, electromagnetic and dark (energy). Any spacetime deformation (a physical object) interacts (a force) with all other objects (being the force itself).

A differentiation of forces depends only on average gradient and its changes, size and shape of the deformation subject to our detection.

In brief: **all interactions (forces) are only spacetime deformations with different geometry.**

3.2.1. Gravity and strong nuclear

The size is of an astronomical (very large) object radius. The average gradient is tiny (very weak spacetime deformation). The shape is complementary to the object called matter and changing, following “the object”. An average spacetime density gradient inside an astronomical (very large) object like a planet is very tiny in relation to elementary particle density gradient. The reason of the gravity phenomenon is that the gravity force of e.g. a planet is a sum (wave packet) of many tiny spacetime deformations (elementary particles) resulting in far-reaching, but relatively weak interaction (the surrounding spacetime expansion). The gravity is not a fundamental but emergent interaction.

Let us consider as an example the interaction between a star and a distant galaxy: The error arising from combining all the stars in the distant galaxy into one point mass is negligible. So-called tree algorithms are used to decide which particles can be combined into one pseudoparticle. These algorithms arrange all particles in an octree in the three-dimensional case [3].

On the other hand a relatively small in size and strongly contracted deformation, that we interpret to be an elementary particle, interacts in a small distance but relatively strong (weak and strong interactions) and it deforms the spacetime very weakly in long distance (can be neglected).

3.2.2. Dark energy

The dark energy is a spacetime stretching surrounding galaxy or another object. The size is of an astronomical (very large) object radius scale. An average spacetime density gradient is very tiny in relation to elementary particle density gradient just like in the case of gravity. But it is not a sum (wave packet) of many tiny spacetime deformations (elementary particles). However similarly resulting in far-reaching, but relatively weak interaction. The dark energy is also regarded to be an anti-gravity. But it is not. It acts like anti-gravity so the effect is a repulsive “gravitational” field. The dark energy is a <u>fundamental and not emergent</u> interaction.

3.2.3. All interactions

Every elementary particle is inseparable from the force it affects other objects, so at the same time it “creates” a force field and it is the field itself (a contraction inside and corresponding stretching outside or vice-versa). An example: a photon is elementary particle and also an electromagnetic field quantum.

We assume the matter can be created out of a force field and vanish transforming into the field and we assume not only the matter deforms spacetime. An example: electron – positron pairs are created in (and out of) the vacuum (vacuum polarization).

Any interaction between spacetime deformations we perceive as a force: we have named them gravitaional, strong and weak nuclear, electromagnetic and dark energy (in my concept this is different type of interaction and the gravitation is only emergent from the strong). Any spacetime deformation (a physical object) interacts (a force) with all other objects. A differentiation of forces depends only on the shape, the average density gradient along with its changes and the average size of deformation subject to our detection.

3.3. Spacetime deformations must not relocate itself on a distance significantly greater than its average size. In the result it would cause an unlimited spacetime density gradient (an unlimited potential energy accumulation). That is the reason why any spacetime deformation can move only as a wave.

In brief: <u>**every particle (spacetime deformation) movement is a wave and every particle is a wave (wave packet)**</u> and <u>**not: it only possesses a wave properties.**</u>

Copenhagenists claim that interpretations of quantum mechanics where the wave function is regarded as real have problems with EPR-type effects, since they imply that the laws of physics allow for influences to propagate at speeds greater than the speed of light. Einstein–Podolsky–Rosen paradox refers to a dichotomy, where either the measurement of a physical quantity in one system affects the measurement of a physical quantity in another, spatially separated system or the description of reality given by a wave function is not complete. The EPR effects are not paradoxical when we look at the listed in paragraph 2 properties of spacetime. The systems in question have never been spatially separated as they have been entangled since the creation moment as two halves of an apple taken away.

The wave-particle duality notion is not necessary any more as wave and particle are the same thing.

A gravitational wave is commonly defined as a fluctuation in the curvature of spacetime which propagates as a wave, traveling outward from the source. The spacetime deformations concept gives quite different outlook.

In brief: <u>**every “massive” object e.g. the earth is a gravitational wave itself**</u>. And the wave is not traveling outward from the source. There is no source e.g. the Earth is a gravitational wave orbiting the Sun along the geodesics.

3.4. The matter and energy does not exist as separate and spacetime independent objects. They are only notions describing human being’s perception of spacetime local deformations having different geometry.

The physical objects division (classification) to matter and energy becomes only a useful notion.

The matter and energy transformation becomes clear and natural.

Neutrino oscillations can occur only if neutrinos have mass, making it very difficult to explain using current theories. An explanation of neutrino oscillations (if any) is natural using the spacetime deformations concept (see 3.5) [2].

3.5. The objects we call particles (or any other objects) do not have sharp (distinct) boundaries because they are spacetime dynamic deformations. They are wave packets [2].

3.6. An absolute vacuum in the meaning of not deformed spacetime does not exist because all spacetime deformations have non limited range.

A result of that property is the vacuum polarization or Casimir effect.

So the vacuum can be an illusory matter free and including a force field at the same time. As a matter of fact the vacuum differs from the matter only with spacetime density gradient and shape.

Sładkowski in "Strongly gravitating empty spaces"[4] says: *on some topologically trivial spaces there exist only "complicated" solutions to the Einstein equations. By this we mean that there may be no stationary cosmological model solutions and/or that empty space can gravitate. Such solutions are counterintuitive but we are aware of no physical principle that would require rejection of such spacetimes.*

3.7. The dark matter is invisible (does not absorb or emit light) and does not collide with atomic particles but exerts "gravitational" force) because in this case an average spacetime density gradient is very tiny in relation to elementary particle density gradient and it is not a sum (wave packet) of many tiny spacetime deformations (elementary particles) just like in the case of gravity. So the force is not a gravity! However similarly resulting in far-reaching and relatively weak interaction. It acts like a gravity so the effect is similar to gravitational field (e.g. gravitational lensing).

So WIMP and Super-WIMP, weakly interacting massive particles, any of various hypothetical particles which interact with other particles by the force of gravity alone and considered to be candidates for the dark matter do not exist.

3.8. An observer consists of matter and energy so is a set of spacetime deformations (a wave packet) and constitutes a frame-of-reference (a coordinate system).

Only a conscious observer is able to interpret his detections (spacetime deformations' transformations) creating some interpretations called physical theories.

There are theories of perception, which discuss the general phenomenon of biological perception of so called reality by an observer, but without specifying its physical basis [1]. Within the spacetime deformations concept we can find a perception theory that specifies its physical basis.

3.9. The spacetime is an elastic medium so we can determine its bulk modulus, determining in turn the spacetime deformations' velocity, including the speed of light. The speed of light c is limited due to the bulk modulus of the spacetime, so it represents the possibility of the spacetime deformation.

3.10. Virtual particles are not necessary any more to explain particles interactions. According to the spacetime deformations concept particles and force fields are the same thing. However the virtual particle notion could be useful to acquire a visual feel of how interactions work.

4. Mathematics and digital computation

The Universe modeled as a digital computation

The digital physics' point of view, in principle, is that a program for a universal computer exists that is able to compute the evolution of universe. The computer could be a cellular automaton or a universal Turing machine.

The loop quantum gravity (LQG) supports digital physics assuming that the spacetime is quantized. The theories that combine digital physics with loop quantum gravity are formulated by Paola Zizzi (Computational LQG) and some other scientists: *In the quantum computer view of space-time at the Planck scale quantum space-time is a universal quantum computer that quantum-evaluates recursive functions which are the laws of Physics in their most primordial and symbolic form. In other words, at the Planck scale because of the isomorphism between a quantum computer and quantum space-time (quantum gravity), the laws of physics are identified with quantum functions. This is the physical source of computability, and leads to the conclusion that at the Planck scale, only computable mathematics exists. We would like to make a remark: Deutsch says that all computer programs may be regarded as symbolic representations of some of the laws of physics, but it is not possible to interpret the whole universe as a simulation on a giant quantum computer because of computational universality. We fully agree with that, and we wish to make it clear that, in our view, quantum space-time is not a simulation but is itself a quantum computer, and, by quantum evaluating the laws of Physics, it just computes its own evolution.* [5] This is very interesting point of view and according to Lee Smolin (LQG) self-organized critical systems are statistical systems that naturally evolve without fine tuning to critical states in which correlation functions are scale invariant [6].

My own view seems to support the view of Smolin in the meaning that the universe is a dissipative coupled system* that exhibits self-organized criticality. The structured criticality is a property of complex systems where small events may trigger larger events. This is a kind of chaos where the general behavior of the system can be modeled on one scale while smaller- and larger-scale behaviors remain unpredictable. The simple example of that phenomenon is a pile of sand.

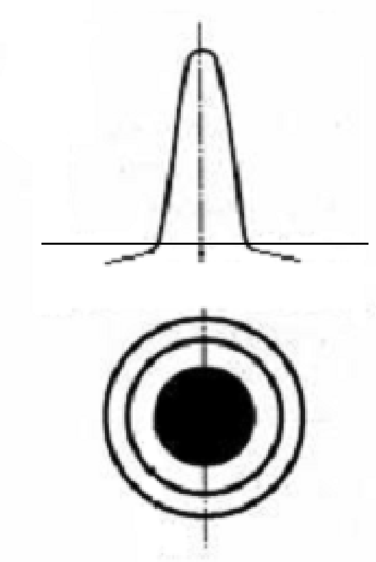
**Dissipative systems are dynamical systems that are characterized by some sort of "internal friction" that tends to contract phase space volume elements. Phase space contraction, in turn, allows such systems to approach a subset of the space called an Attractor (consisting of a fixed point, a periodic cycle, or Strange Attractor), as time goes to infinity. A strange attractor is an Attractor that displays sensitivity to initial conditions. That is to say, an attractor such that initially close points become exponentially separated in time. This has the important consequence that while the behavior for each initial point may be accurately followed for short times, prediction of long time behavior of trajectories lying on strange attractors becomes effectively impossible. Strange attractors also frequently exhibit a self-similar or fractal structure [9].*

When QM and GR are computable and deterministic, the universe evolution (naturally evolving self-organized critical system) is non-computable and non-deterministic. It does not mean that computability and determinism are related. Roger Penrose proves that computability and determinism are different things [7].

Let me try to summarize the computability: the actual universe is computable during Lyapunov time but its evolution is non-computable.

The mathematics we need is partly existing and ready to use for decades because GR and QM math are probably only special cases of the spacetime deformations theory (being only the concept today). But these equations are useful only in Lyapunov time. The crucial issue is the perception and interpretation. The new approach is required to use and develop the existing mathematics. We need to engage the quantum chaos physics.

Another issue is that the constants' values in standard model of particle physics and cosmological standard model are determined experimentally and not theoretically. In my opinion it is not possible to determine them theoretically. The explanation you will find in Spacetime deformations evolution concept that will be published later on.



The black circle is an exemplary, simplified spacetime contraction – a particle surrounded by a stretching – a force field

The surface projection (inside and outside of the black circle different spacetime density gradients can exist)

Figure 1 Exemplary spacetime density distribution

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