Elementary Concepts of Material World 1

Aleksandar Vukelja
aleksandar@masstheory.org

http://www.masstheory.org

March 2005

Translated to English from original in Serbian
“OSNOVNE OSOBINE SVETA 1”

1. Concept of Field

In order to discuss laws that rule material world we must first define the concept of matter itself. To do so, we will create an abstract model – a completely theoretical paradigm that will allow us to understand how natural laws function. We will develop this abstract model starting with a simple definition and continuing throughout this book to add features and properties – until the model matches the actual physical reality in all important issues that we will discuss.

Let us start by using geometric concepts of point and direction. The reason why we choose point and direction to start with – is that the concepts of point and direction are elementary and cannot be deduced to any simpler concepts by logic.

Definition 1.1. Matter is union of points in space.

This is our basic definition of matter. We will assume that matter cannot take just about any form, but only a very specific form which we will also express through a definition. We will now use the concept of line. Line is not elementary concept as it can be logically deduced to a finite number of points on a direction, or an infinite number of points on a segment of finite length.

Definition 1.2. Matter or *field* is union of lines which intersect in a single point.

Here we introduce the word "field" which in this book has the same meaning as the word "matter". We will accept by this definition that field is either a single line of arbitrary length, or any number of such lines arbitrarily placed in space with the only condition that they all intersect in a single point.

Definition 1.3. Field in the state of uniform motion is composed of straight lines.

In the section 3 where relativity of motion is shortly discussed, we will define still state of motion and uniform motion as equivalent. That simply means that definition 1.3. equally applies to field which is, according to observer, standing still.

Definition 1.4. Changes in field propagate with finite speed.

With this definition we state that field is a body which exists in space and in time. And when we say that field exists in time, it is the same as if we said that events happen at finite speed.

At this point the concept of field is defined with a minimum set of features which allow us to derive the theorem of mass.

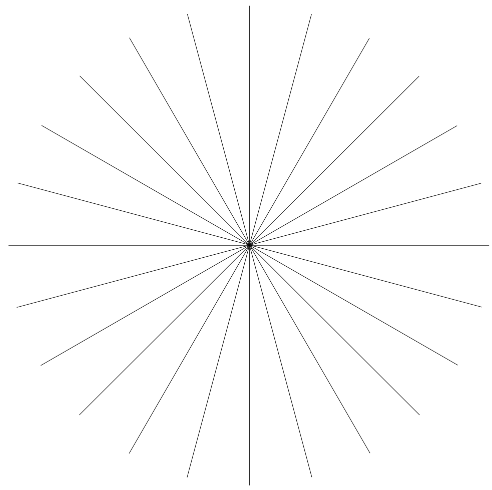


Figure 1. Example of a simple still field laid out in a plane.

1.1. Theorem of Mass

Based on definitions 1.3 and 1.4 we can derive an elementary conclusion, theorem which adds property of mass to the field.

Theorem 1.5. Field has a feature to resist every change in its motion.

> **Proof:** Let us examine the field at figure 2, which is composed of several lines. The field is still on figure 2a.
>
> From a starting moment central point of the field is being accelerated in a given direction with constant acceleration (figure 2b). During entire period of acceleration we have the following state:
>
> The central point and parts of field are being accelerated and they travel a certain distance, while at the same time peripheral points of the field have not even moved since information that acceleration began has not reached them (outside dotted circle field is still).
>
> Since information of change in motion travels at finite speed (imposed by definition 1.4), the field between central point and the border to which the information arrived (dotted circle) will be distorted.
>
> As of the moment when acceleration stops – with the reestablishment of uniform motion, the field will reclaim the initial shape (figure 2a), union of straight lines (imposed by definition 1.3). From here follows simple conclusion: The field resists acceleration by thriving to reclaim the shape it has in the state of uniform motion. ■

This theorem essentially states that mass is immanent feature of matter: Matter cannot exist in space and time and have no mass. Without mass, matter would not have the means to maintain its form in dynamic world.

Affection of field to resist acceleration is called inertia or mass. The two names are introduced in this book as synonyms, which means that they both represent exactly the same property of matter.

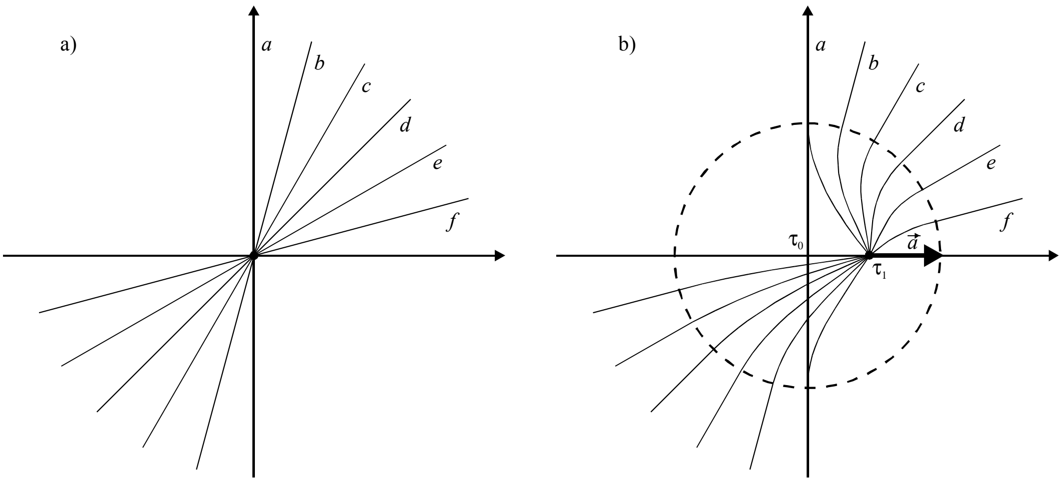


Figure 2 a) Field in state of uniform motion, before and after acceleration. **b)** Field in state of constant acceleration. Dotted circle represents the border to which information of acceleration has reached up to the given moment. Outside dotted circle the field had no way of knowing that acceleration even began.

Here arise a few questions: How successful a field can be in maintaining its form? Can the acceleration be applied for any length of time? What happens to the field if parts of the field are accelerated to the speed greater than the speed at which information travels through field? We will answer all these questions with the next two definitions.

Definition 1.6. Field is indestructible.

Definition 1.7. Deformation of a field can only be finite.

These two definitions imply that mass of field is not a constant value. If deformation is expressed as ratio of lengths of accelerated and still lines of the field, this ratio can only be finite. This feature, combined with indestructibility of the field, implies that no matter what force is applied on the field, its inertia – the resistance to acceleration, must grow as the deformation grows to maximum.

If the field would be destructible, then parts of the field could be accelerated until field breaks apart due to deformations higher than maximum possible deformations at which the field can still retain its wholeness. Since we defined field as indestructible, no part of the field can have deformation higher than maximum.

This implies that mass of the field grows to infinity when deformation, due to acceleration or other cause, approaches maximum.

This simple logical conclusion only states that mass cannot be a constant value in dynamic world. However, based only on current definitions, we cannot derive a mathematical expression which would describe how inertia increases with deformation of real world fields.

2. Space and Time

Space and time are elementary concepts in science, and as with abstract elementary concepts of point and direction in geometry, the attribute "elementary" here simply says that these concepts are not logically deducible to some even simpler concepts.

During history, except for most of XX century, it was considered that space and time exist separately from matter – and that space and time cannot be changed or affected by state of matter.

In the year 1905. The Special Relativity Theory was published which essentially stated that speed limit is elementary concept of nature. According to that theory, space and time change in order to keep the maximum speed – the speed of light, the same, regardlessly from where it is observed.

Mathematical expressions which connect space and time measures as observed from different coordinate systems which move relative to each other, are the Lorentz transformations[1]. Expressions for length of a physical body and period of time are as follows[2]:

$$\Delta x' = \Delta x \sqrt{1 - \frac{v^2}{c^2}}, \quad \Delta \tau' = \frac{\Delta \tau}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Consequences of this way of thinking can be shortly illustrated with an example like this: Let person A stand still, while person B travels uniformly in any direction with the speed $v = \frac{\sqrt{3}}{2} c$, where c is the speed of light. We picked this speed for ease of presentation – it causes coordinates in above equations to be doubled. So we get the following connection between lengths of space and periods of time:

1 Lorentz Transformations are mathematically invalid. They are discussed in length in a separate paper called "Triangle of Velocities". However, for the purpose of this book, we will discard them by analyzing not their derivation, but their consequences.

2 Context of application of Δ symbol to space coordinates is measuring length of a physical body. Context of application of Δ symbol to time coordinates is measuring time in the same location.

$$\Delta x' = \frac{1}{2}\Delta x,\quad \Delta\tau' = 2\Delta\tau$$

Now what does it mean? According to the theory, it means exactly the following: space in coordinate system of person B (marked with single quote), as observed and measured by person A, contracted by half to accommodate requirement of theory that speed of light remains constant. The time in coordinate system of person B, observed and measured by person A slowed to accommodate requirement of theory that speed of light remains constant.

2.1. Reductio ad absurdum

Now let us prove that above mentioned understanding is wrong. There is no speed limit in material world. The proof that follows is a classical example of proof by contradiction (lat. Reductio ad absurdum). Proof of this kind requires that statements of a theory are strictly followed until conclusion is reached that does not make sense.

Theorem 2.1. There is no speed limit in material world.

> **Proof:** Let persons A and B stand still on a distance of 6 hours travel at the speed of light *c*. Both persons A and B carry a watch.
>
> In a given moment persons A and B start to approach with speed $v = \frac{\sqrt{3}}{2}c$. We intentionally do not say who is moving and who does not, we only know that distance between them falls down by $v = \frac{\sqrt{3}}{2}c$ meters every second.
>
> After around 7 hours of this uniform approaching, when persons A and B reach each other, they stop approaching and start a conversation:
>
> **Person A:** My watch shows that 7 hours have passed, and I can see yours shows 3 hours and 30 minutes have passed on this journey. That is normal, because I stood still while you were uniformly moving towards me, so your time slowed.
>
> **Person B:** You do not see right. My watch shows that 7 hours have passed, and I see yours shows 3 hours and 30 minutes have passed on the journey. That is because I stood still while you were uniformly moving towards me, so your time slowed. ■

Since motion is relative (according to relativity theory, both uniform and accelerated), both persons A and B are right when they say that only the other person was moving. But where is the error then? They are both in the same coordinate system now, and they both see opposite things. How can that be?

This problem has a simple solution. If we assume that speed limit does not exist in material world, transformation of coordinates would not exist either and in our example persons A and B would be all the time in unique reality, regardless of their state of motion.

This solution comes from Lorentz's transformations if they are understood as limits when c grows to infinity:

$$\Delta x' = \lim_{c \to \infty} \Delta x \sqrt{1 - \frac{v^2}{c^2}} = \Delta x, \quad \Delta \tau' = \lim_{c \to \infty} \frac{\Delta \tau}{\sqrt{1 - \frac{v^2}{c^2}}} = \Delta \tau$$

or shortly:

$$\Delta x' = \Delta x, \quad \Delta \tau' = \Delta \tau$$

This is simply interpreted that persons A and B observe exactly the same measures of space and time regardless of their state of motion.

Without speed limit in material world, the speed of light is to be treated like any other speed. If two galaxies are moving in opposite directions with speed of say, 0.9c each, their speed relative to one another is 1.8c, where c is the speed of light.

We can now repeat introduction of this section, as our final conclusion: Space and time exist separately from matter. Space and time cannot be changed or affected by state of matter.

3. Relativity of Motion

3.1. Mathematical and physical relativity

In Elementary Concepts of Material World we distinguish between mathematical and physical relativity. Mathematical relativity means that for the purposes of kinematic explanations we can regard any physical system regardless of its nature as a union of points in space: Since points are dimensionless abstracts without any distinguishing features, their motion can be mathematically described relative to any coordinate system regardless of its own motion, uniform or accelerated. Mathematically, all motion can be treated as relative.

However, physically there are differences between uniform and accelerated motion which will be shortly discussed.

Definition 3.1. Uniform motion is physically relative.

Uniform motion is a theoretical possibility. If we imagine a universe comprised of bodies which do not interact, then each of them would retain its velocity constant forever. Although in reality there is no such condition of zero interactions (each body is affected by the gravity of the whole cosmos), by separating bodies with large distances their state of motion approximates uniform. In truly uniform state their motion would have no distinctive attributes, and would thus be relative. Relativity means that each of the bodies in uniform motion can be considered to be standing still, while other bodies are moving. And each of these respective views would be equally true both physically and mathematically.

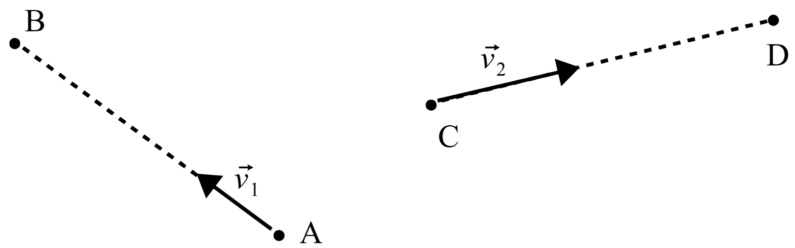


Figure 3. In universe consisting of bodies which do not interact, each of the bodies retains constant velocity forever.

Now let us see how is accelerated motion special. On fig. 2b, we have seen a field under acceleration. The extent of deformation shown there is rather extreme (a field would like like on fig. 2b under accelerations in order of 10^{18} m/s^2), but it will make the next theorem obvious.

Theorem 3.2. Accelerated motion is physically absolute.

> **Proof:** The basic unit of matter is field, as defined with **definition 1.2.**. As the field is accelerated it suffers structural changes of its form, which yields resistance to acceleration. Thus the accelerated motion of matter is not relative. It is absolute, meaning that accelerated motion of a field cannot be truly attributed to arbitrary fields. ■

Throughout XX century, accelerated motion was believed to be relative equally as uniform, based on experience that state of free fall is normal to us humans, and that by falling in gravity field of Earth we are in weightless state, not essentially different from weightless floating in space of astronauts. In mechanics, it was the concept of "material point" that also made the same conclusion plausible.

However, elementary unit of mater is field, and matter in macroscopic world is a composition, or collection of fields. Accelerated field is uniquely distinguished from any other field, thus making its motion absolutely real. This is self evident, but we can still illustrate it with a very simple comparison:

We can imagine several light bulbs in motion. If one of them is emitting light, that fact cannot be denied to that particular light bulb and attributed to others by changing the frame of reference. Similarly, deformation of a field can not be attributed to other fields by changing the point of view. Physical change which has occurred to that particular accelerated field is its own property.

Appendix

Hypothesis On The Nature of Gravity

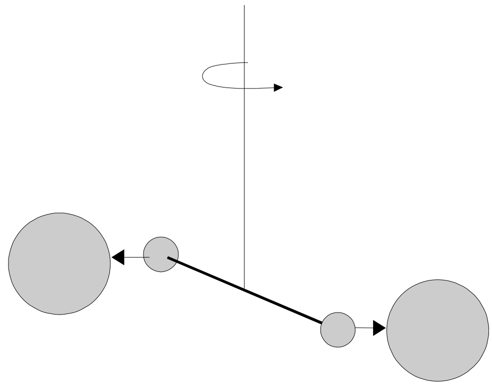
In Elementary Concepts of Material World mass is inertia – a quality of matter and not matter itself, thus literal consideration of mass for the cause of gravity is absolutely meaningless. Because of this we must try to answer the question – what the real carrier of gravity could be?

Newton's gravity law states that gravitational attraction is proportional to the product of masses of two bodies. Mathematical proportionality however does not necessarily have anything to do with the "cause" or the "carrier" of gravity. If you like, the intensity of electrostatic field of large number of electrons can be expressed as proportional to their mass. Yet it is clear in this case that mass of electrons has nothing to do with electrical field.

Newton's law of gravity was first confirmed in laboratory conditions when in 1798. Henry Cavendish performed an experiment with torsion scale, with a goal to determine attraction between massive lead spheres. In original experiment, and in later more accurate measures results were retrieved which showed very weak, but measurable attraction. Experiment served to calculate very important proportionality constant γ of Newton's gravity theory. We will try to answer what Cavendish actually measured here.

The effect of molecular forces among macroscopic bodies can be seen in the form of surface tension with drops of liquids. Under effect of surface tension drops of a liquid tend to form spherical shapes. While this occurrence is rendered for all liquids in zero gravity conditions, in everyday conditions it is strongly visible with drops of mercury. Scattered mercury from a broken thermometer forms tens of tiny drops of almost perfect round shape. It can be observed that drops of mercury attract when placed near one another – they tend to form a larger drop. This attraction exists among all substances of the same kind, but among macroscopic bodies, with rare exceptions such as mercury, it is weak and imperceptible. Today it is widely accepted that this attraction is caused by molecular forces. The same fields which are responsible for forming the structure of matter on molecular level and for chemical reactions among substances, cause this macroscopic phenomenon. Molecular forces are of electromagnetic nature and follow very complex patterns of behavior. Due to complexity of molecular fields, it remains unexplained what resulting field can be experienced neither in vicinity of molecules nor at macroscopic distances. However we know for a simple empirical fact that these forces determine chemical properties of all substances and also phases and mechanical features such as elasticity. On distances that by far surmount dimensions of molecules, affection of molecular forces drops sharply below threshold of detectability of instruments typically used for this purpose.

If we wanted to perform an experiment to determine behavior of molecular fields on macroscopic distances, we would be left with perhaps no other apparatus but essentially the one Cavendish used: with as much matter concentrated in two or four points, we would measure their attraction with torsion scale. But if we do the same as Cavendish what are we measuring then?



Torsion balance for measuring molecular forces between macroscopic bodies. Weak forces are magnified by using as much matter as possible concentrated in two or four spheres, and then measuring torsion of the wire which holds smaller weights.

Based on this we can formulate the following hypothesis on the origin of gravity:

Molecular forces on distances comparable to the size of molecules determine chemical and mechanical features of all substances. On large distances all substance-specific chemical qualities diminish and what remains of molecular forces is equable weak attraction towards all other substances. The remnant attractive molecular force is proportional to the quantity of matter (expressible through mass), and reverse proportional to the square of distance between bodies. This attraction is gravity.

About this work

ELEMENTARY CONCEPTS OF MATERIAL WORLD is an ambitious project that I started more than a decade ago. The objective is to explain fundamental laws of nature with use of precise and clear logic only.

On this occasion I publish only the first chapter – the rest of the book is much more complicated, and I might need another 10 years or more to finish it. Chapter one is simple and concise, and it should not be a problem for anyone to understand it. I have intentionally avoided certain issues, precisely with the goal of keeping the essence easy to comprehend.

The first chapter was created in 1994, 1995.

March - April 2005.
http://www.masstheory.org

Aleksandar Vukelja,
aleksandar@masstheory.org