Electromagnetism and the differential density field

Neal H. Tensor, PhD

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1 Introduction

This document attempts to describe a new fundamental theory of reality which can be viewed in some ways as a completely different way of thinking about reality. But it is a completely new theory. In the end it will be consistent with most of quantum mechanics. The theory also attempts to explain the motion of objects, inertia and the apparent equivalence principle.

The document will firstly establish the mathematical foundations of the theory and the important interpretations associated with the theory. I shall attempt to explain the important concepts I will introduce, as best as I possibly can.

An important thing I should mention is that this theory uses the concept of an aether. Now, you might say "the aether is an archaic concept, long abolished", but I wouldn't agree with you because the aether is simply the medium through which light propagates. You could argue that it is a 0 density region with virtually no material property, which you simply call a vacuum or you could agree that the aether somehow has material properties like density, permittivity and compressibility. The latter view has come under scrutiny mainly because these fundamental properties seem immeasurable, they apparently don't fit the current description of reality, why consider them then?

Some serious questions this view of reality will face include

- Why do the properties of this aether fluid seem virtually undetectable? [Tes93]
- How can a fluid of negative compressibility exist?
- What are the inertial and gravitational properties of this aether?
- Doesn't the invariance of the laws of electrodynamics contradict the aether
- Is the aether made of tiny particles?

In this document I will attempt to answer all these questions. I will set a completely new foundation for aether theory and a completely new way of thinking about the laws of physics.

The mathematical foundations required to understand this theory are simply those of vector calculus and tensor calculus. Though tensor calculus is probably not necessary in principle. I find it important to have formulations of laws independent of the coordinate system.

I find it important to establish some background here. Why I think this way and why I think these laws could potentially replace the current ones in a grand unification of physics. My original idea was first inspired by a simple thought about the theory of general relativity. What if I thought of spacetime as some sort of topological fluid, what properties would it have? You might say this is a meaningless question, and I certainly wouldn't disagree, but at least it's still interesting to ponder. The first thing I noticed is that it seems many of these properties were either infinite or zero. If spacetime was a material it's almost as though it is too perfect a material. But this kind of thinking is rather arbitrary it is neither proving or disproving anything, nor is it adding or subtracting anything from the theory it us merely appealing to intuition.

[Tes16] I still continued pondering this meaningless question because I discovered a problem with my original idea. I treated the time component of spacetime more like space component. At the time I knew clearly this was not the case. But I was reasoning with a static fluid, not considering how fluids evolved in time. To give a good and honest description I really needed to consider the dynamic properties of fluids. This involved all the complicated properties like turbulence and drag.

Knowing this was all an abstract idea with potentially no application, I still persisted. But this inspired me with a new idea and a very different question. If spacetime could be thought of like a fluid, couldn't we make an aether that somehow works?

But I also wanted a theory that explained electromagnetic phenomenon and nuclear phenomenon. The theory I present here is very different to the fluid spacetime I initially thought up. The fluid spacetime idea merely served as an inspiration for rethinking the foundations of physics in a completely new way.

Yes, the aether is not a new idea but my theory is a rethink of even the aether itself. It's completely different from most aether theories preceding it. For one, It doesn't think of the aether as just some abstract frame of reference with coordinate properties. The aether is much more than that.[Lod]

My theory does what no other aether theory has ever done in history. It describes the fundamental interactions between matter and the aether. Historically the aether has been treated as this almost magical substance which does not interact with matter. But in fact what my theory shows that the aether very much interacts with matter. It just does so in a way different to how you would expect ordinary matter to. This shouldn't be too odd.

[Tesb] The theory also describes the interaction between the aether and electromagnetic waves. In fact this is the central study of my thesis *On The Propagation of Electromagnetic Waves in the Aether on a Flat Stationary Earth.*

In this document I attempt to explain in an easy to understand fashion the major ideas of my thesis. But a very important thing I must say before ending this introduction is that my theory is not fundamentally about the aether at all. That might sound strange because I have been talking about nothing but the aether for the past few paragraphs. But what my theory actually is about is the differential density field.

The differential density field is a very simple mathematical field introduced to analyse motion in a density field. The aether is merely a consequence of certain properties of this field. While it is true that I was inspired by the idea of an aether and more so by the abstract idea I thought of as fluid spacetime. but non of these inspired my idea for what should fundamental to my theory, they merely inspired me to rethink completely. [Tesa] My theory is not the kind of theory that reformulates some existing theories, nor is it the kind that attempts to extend an existing theory. It is rather the kind of theory which attempts to encapsulate a set of ideas from other theories and explaining them in a new way as a single unifying theory.

A major goal of my theory is grand unification. Now it is a very different theory to most physical theories so far.

In the next few sections, I'll introduce the mathematical foundations for my theory and the sections following that I'll be discussing some really important consequences of my theory. In the final section I will show the various ways my theory could be proven/disproven.

2 The density field

The density field is a field to which all points in space is associated a certain density. The field is described by a function $\rho(x_m)$. where x_m is a coordinate vector where the index m runs over all 3 spacial coordinates.

[Tesc] The density field is a scalar field. The values for density will not change under a coordinate transformation. Every region in the density field has a density which is the average of the density of the density of each points. The mass of a certain region is defined to be

$$m = \int \rho(x) dV$$

which is the average density times the volume of the region.

2.1 Uniformity and the balance operator

If a field is constant everywhere then we can say that such a field is uniform. The gradient of the field at every point in 0. But a field with many small particles distributed equal distances from each other is also uniform, but such a field does not have 0 gradient at every point. My goal is to create an operator that is 0 when a field is uniform. Such an operator I will call the balance operator.

The following seems a very reasonable definition for the balance operator in 1 dimensions.

$$\phi f(x) = \lim_{n\to\infty} \int_0^n f(x) - \int_{-n}^0 f(x)$$

We use ϕ as the symbol for the balance operator. The operator is 0 when $f(x)$ is symmetric in both sides. But much more generally if $f(x)$ uniform, then $\phi f(x) = 0$.

If we want to extend the balance operator to 3 dimensions we can simply find the balance of each x,y and z component. We can do this because the balance operator is additive.

Another thing we would want to do is define the balance operator for every point in the field. The formula earlier only defines balance for a simple function. If $\rho(x)$ was a function describing the field then the balance of this function would represent the distribution of the field around the origin. If we want to find the balance of an arbitrary point (x,y,z). Then all we need to do is to apply a simple transformation to the coordinate system such that (x,y,z) is the origin. Such a transformation is simply a translation. If a field has a balance of 0 everywhere then such a field is uniform. This is a very useful metric, because in addition to constant fields, it also includes many other fields one would consider uniform, fields such as discrete particles distributed over the a certain space.

It is important to note that the balance operator on a scalar field is a vector. The value of the balance is therefore much more useful than just a measure of uniformity. How much useful will become clearer in the sections following this. But for now we are interested in it's use as a measure of uniformity.

We note that the closer the magnitude of the balance stays to 0, the more uniform the field is. To measure precisely how uniform a field is, I'll will use the following metric:

$$U = \frac{1}{\phi\bar{\rho(x)}}$$

where $\phi\bar{\rho(x)}$ is the average of the balance over the entire field. We know from basic calculus that the average is simply an integral over the region divided by the volume of that region. So

$$\phi\bar{\rho(x)} = \frac{\int \phi\rho(x)dV}{V}$$

This then simplifies our formula to

$$U = \int \frac{V}{\phi\rho(x)}$$

If we take V to be the entire field then we consider the uniformity to be the global uniformity of the entire field. But the uniformity of some arbitrary region V does not depend only on that region. It also depends on the global uniformity of the entire field. A field that is uniform has a uniformity of infinity. Any field that has a finite uniformity is nonuniform in some way. The lower the uniformity of a field the less uniform it is and the more random it is.

A nice parallel between the balance operator and the gradient is that when the gradient is 0 everywhere, the balance is also 0 everywhere, this is because a constant field is uniform.

It is important to keep note that the balance, like gradient is a vector field. For now we are mainly interested in whether or not the balance is 0 or close it is to it. But in later sections, the precise. importance of the balance as a vector field will be revealed. While the balance is an extremely powerful operator for studying how uniform a field is, it has a slight shortfall in that it doesn't tell whether or not a local region is uniform. It merely measures distribution relative to the entire region. To measure the distribution over a shorter region, we need to introduce a new operator.

The physical interpretation of all this, is that the density field is a field representing the distribution of matter in the universe. Places where matter exist generally have a higher density than those places where matter is scarce. The motivation for studying matter in this way, as opposed to particulate matter, is plenty and involves grand leaps of intuition in addition to very serious problems with a particulate foundations. The Particulate foundations is only capable of describing interactions between small particles accurately. Complicated interactions have to be left to statistical approximations. Another serious problem at the heart of particulate theory is that they tend to break down when we go one level smaller and it also leads to the tendency for people to think that the smallest particles discovered are the smallest particles. Before the microscope was invented, people thought that dust was the smallest particle. Then when the microscope was invented people discovered even smaller things until the atom was discovered, and people thought it was smallest possible thing. Then electrons and protons were discovered people thought these were fundamental. Now we have the standard model particles and we consider this fundamental, and for good reasons. We haven't seen anything smaller.

But the point of the density field is to rethink completely the fundamental theory. I want laws that are true at all levels, at all sizes and all speeds. I don't want laws that work on a small scale, then approximating a new set of rules for a larger scale which then turn out to only be approximations at an even larger scale etc. We want one set of rules that are fundamental at all possible scales. Density doesn't vary with size, which means that laws stated in terms of density will have a promising chance of been size invariant.

2.2 Local Uniformity and Symmetry

The uniformity of a field is a very great way to measure the distribution of a field and tell whether or not this distribution is uniform. It is not in general a very good metric when measuring local regions however. For example, If you have a field made up of 2 regions left and right of different densities then a subregion of any of these fields will have a non-zero balance even when the region is uniform. This is because the balance measures how particles are distributed and if all the particles are distributed to one side, the balance will be tilted to that side. We need a new way to tell whether or not a local region is uniform.

To measure uniformity at a point we could make up a completely new operator that integrates over just that particular region instead of the entire field. To avoid introducing a completely new operator we will note that it is equivalent to multiplying by the following in 1 dimension:

$$\phi_L = \phi \int \delta(x+a)dx - \int \delta(x+b)dx$$

Where δ is the Dirac delta function. This operator is the local uniformity balance for some local region (a, b).

The important point to note here is that different regions will have a different local balance operators, you can find it by applying the balance operator to some function that is 1 in that region and 0 outside the region.

$$\phi f(x)\rho(x)$$

For arbitrary functions this can get complicated, but the important thing to note is that it can be done.

Fields that are uniform everywhere also tend to be similar everywhere. If we take some arbitrary region and translate it and the region is similar to the original then we can be certain that such a region is uniform or close to uniform.

The property by which an something remains invariant under a transformation is called symmetry. For uniform fields we can find symmetries. For the constant field every translation is a symmetry since it is the same everywhere. For a slightly more interesting field, like particles distributed over a region the symmetries are discrete. For many interesting fields the symmetries are discrete.

If we have a grid of particles equal distance away from each other and a region covering 4 particles, then to get a symmetry we must do a translation that moves us in another frame that has 4 particles. Such a translation is clearly discrete.

Let's assume that these particles are a distance s apart. and we have a region that covers s^2 particles, then obviously any translation by a distance s in the x or y direction will give a symmetry, any integer multiple of these give a symmetry as well.

An important and obvious property is that symmetric regions have equal local balance because they are essentially the same.

2.3 Entropy

The uniformity is a very important property in our study of the density field for matter. It tells us about the distribution of matter. The Entropy of a field is clearly related in some way to the balance. but precisely how is not immediately clear.

A uniform distribution has a low entropy, a highly non uniform distribution has a very high entropy. It seems as though uniformity could also be used to derive a measure for entropy.

Entropy is a measure of how disorderly a field is. In statistical mechanics this is given as

$$S = kln\omega$$

Where ω is the number of possible configurations. This formula is called Boltzmann's formula named after the great German scientist Ludwig Boltzmann. Entropy is in many ways related to how particles are distributed in the density field. Uniform fields generally have a lower entropy, non uniform fields have a higher entropy.

2.4 Isotropy and Anisotropy

A field is isotropic if it's distribution is independent of direction. Isotropic fields are best described in terms of polar coordinates and spherical coordinates. We say that a field is isotropic if it's direction components are uniform. Anisotropy is a measure of nonuniformity in the direction components in spherical or polar coordinates.

Clearly if a field is uniform then it is isotropic. So a field of particles distributed over a region is isotropic. Anisotropy is a very important property in the study of the density field that it is given it's own operator ϕ_A. Which in polar coordinates is:

$$\phi_A \rho(x) = \phi \rho_\theta$$

In spherical coordinates:

$$\phi_A \rho(x) = \phi(\rho_{\theta 0} + \rho_{\theta 1})$$

In a general n+1 dimensional coordinate system this is just the balance of the direction

$$\phi_A \rho(x) = \phi(\rho_{\theta 0} + \rho_{\theta 1} + ... + \rho_{\theta n})$$

An important theorem which will not be proven here is that if a field isotropic everywhere then it is uniform.

Isotropic fields are uniform. The really interesting property about anisotropy is how it varies over the field. precisely how important this is will be important later. But for now we will just focus on what anisotropy is and what are some examples of anisotropic fields.

The simplest example of an anisotropic field is a field made up of strings pointing in one direction. These strings could be made up of particles a distance ϵ apart, and each string a distance s apart. If $s > \epsilon$ then the field is not uniform and has a greater balance in 1 direction which means it is anisotropic.

The importance of anisotropy become important later when we want to study the directional properties of the field. We can infer a lot about a field just by knowing it's anisotropy.

2.5 The Gradient

The gradient is a very well understood operator. It is a vector representing the direction of greatest increase. The gradient vector in Cartesian coordinate is a vector of partial derivatives of the field with respect to each coordinate.

Traveling along the gradient of a field increases the value of the field by the greatest amount. Travelling along the negative gradient decreases the value of the field. The process of traversing the negative gradient is called gradient descent.

The gradient is a very important in the study of the density field because it allows a neat way to formulate the concept of inertia. The gradient is like an "infinitesimal" inertia, in the sense that travelling along the gradient has more resistance than travelling along any other infinitesimal vector. Traveling along the negative gradient of the density field is generally easier than travelling in any other direction, this is because it has the least inertial resistance.

This way of thinking about inertia makes sense since forces act over an infinitesimal area rather than an entire region, although their entire effect is generally through the region, the collision happens at a single point. The inertia is generally proportional to the mass of a region of particles. This view of inertia is both naive and brilliant, but as will be shown later it's not the full truth. There is more to inertia than just the gradient of the density field.

The gradient has much more use than that. In addition to being an important term for inertia in the density field, it is also important in the construction of various vectors and tensors for studying the density field.

An immediate implication of the gradient is that the density field must be continuous and differentiable at every point. This is because we are going to need the gradient to be defined at every point. If we are going to be using the gradient for inertia we can't have infinite or undefined inertia. The implication of this is that we can't have point particles or particles as just regions of a certain density. Particles have to be modelled as a certain distribution where most of the mass density is concentrated at a central point. How exactly the density is distributed in a particle will be made clear in the next sections. For now, it's an important thing to point out.

The implications of particles as continuous and differentiable distributions are many. But precisely how much is dependent on what distributions particles follow. Various possibilities were suggested by my collogues and professors. One possibility, suggested by my advisor Robin Vodka,is that particles follow a Gaussian distribution. If this is the case, then the implications are huge. One of the first implications of this is that the vacuum would not have 0 density, the combined effect of all particles would leave a very low density region. A friend of mine, Michael Carton, suggested this could be the aether.

Another suggestion by 5 of my friends is that particles are finite spheres with the density distributed within them. The density would approach 0 as you approach the edge of the particle. The case for this isn't very strong. The only reason for it is to closely match with our current idea of a particle and to avoid the concept of an aether. But there are some implications of this model, on the rigidity of a particle for example. I will speak about Rigidity and it's relation to the density field in a later section.

Various arguments have been suggested about which is correct, but if we want to know the truth about particle distribution, we must let nature speak for itself, with an experiment. But these aren't the only possibilities for the distribution. There were 5 other suggestions, all of which were mentioned in my thesis. But the possibilities are endless. Particles could be distributed in almost any possible way, as long as the density field remains differentiable.

The next section explains one of the most important concepts in this documents. The differential density field.

3 The Differential Density Field

The differential density field is the heart and soul of this document. It is a field created from the density field for the purpose of explaining motion in the density field. The differential density field is a vector field. The differential density field isn't itself velocity, acceleration or force, nor is it a force. It is a quantity representing motion in some way. It describes how the density field changes. But precisely how this change occurs will become clear later in this section.

Firstly, what is the differential density field? Well when you might be thinking something like $\vec{dx}$ or even $d\rho$. But the differential density field doesn't really have much to do with differentials. You might be thinking it has something to do with the gradient and you'd be right.

The differential density field represents two main components of motion in matter when not affected by electromagnetic fields. The attractive component and the inertial component. A particle is generally attracted to another massive particle, this phenomenon is commonly called "gravity". But this description isn't exactly possible when we are describing things in terms of the density field. To describe the phenomenon we must observe that particles tend towards areas where there is more mass in general. This description should remind us of the balance operator. Yes, particles tend to move in the balance of the density field.

As we have already explored, particles tend to experience more resistance passing through denser regions than through less dense regions. This idea is roughly the concept of inertia and the negative gradient of the density field can represent inertia.

These two components come together to form the differential density vector. The vector mathematically is:

$$\vec{\rho}(x) = \phi\rho(x) - \nabla\rho(x)A$$

The first component of this vector is called the balance component of the density field and it represents the apparent attractive motion. The second component is called the gradient or the inertial component of the density field. This component represents the resistive motion in the density field.

It is important to note that the differential density field is not a complete description of motion. At this point you can say it hints at motion, but precisely how it relates to motion will become clearer as the chapter progresses.

3.1 The Inertial Component of the Differential Density Vector

The term $-\nabla\rho(x)A$ is called the inertial component of the density field. It consist of two parts. The first part is the gradient of the density field, which we are familiar with. The second component is a term required for dimensional consistency. I will not assume it's a constant because I have no reason to. What exactly this A is will be established later on. For now we will focus on the gradient of the density field.

Inertia is a quantity that represents the resistance to motion provided by a mass. It is generally proportional to the mass. In fact do proportional that we often consider it the mass itself. But is it? The question as to whether or not mass is equivalent to inertia has been a raging one for centuries, since Newton of course. But the general consensus is that it is. Inertia is clearly proportional to mass, why consider them different?

While it is true that they are proportional, the exact resistance is happening over an infinitesimal region. Now you could say that the force is really just the sum of all inertial forces contributed by each particle, but this doesn't really make sense in our differentiable density view with particle distribution.

The gradient is the best description of inertia so far, but it isn't complete. The inertia clearly isn't determined by just the local gradient, it is determined by the entire mass of the particle. Whatever is in the A component must explain it, but what that is isn't clear yet, but will be clear by the end of this section.

3.2 Differential density 4-vector

Inspired by relativity, we will be viewing various quantities as 4 vectors. The point of this isn't to say space and time are the same thing unified by one geometry, but rather an arbitrary convention, which is useful. It allows us to formulate things in a way where the rules by which they evolve are much more natural. Rather than making random assumptions about how things should evolve based on our judgement, we examine how they should evolve based on the 4-vector, because far from just been an ex dimension time is very much related to spatial distance and very well within our 3 dimensions. more on that in the very last chapter.

This section is about the differential density 4-vector. We already know 3 components of this vector from the differential density 3-vector. The 4th component is the time component and it is important in understanding how this field evolves over time.

For all 3 spatial components, the value for the differential density is

$$\phi\rho_x(x) - \frac{\partial\rho(x)}{\partial x}A$$

Replace x with y or z, for the other 2 spatial components. But the time component is as follows:

$$c\phi\rho_t(t) - \frac{1}{c}\frac{\partial\rho(t)}{\partial t}A$$

The value c is a speed component needed for dimensional consistency. It turns out to be the speed of light. Precisely why will be addressed later. The second component is very important. It is the time component of the inertial component of the differential density field and can be simply called the inertial time. It is clearly related to the rate at which the density field is changing over time. Inertial time is a very interesting concept to think of, but its use only becomes clear with the introduction of concepts in the upcoming section.

The first component is the time component of the balance. It can by simply called the time density. It is such an important quantity, because it changes everything. The next section is dedicated entirely to the time density.

3.3 Time Density

The time density is the first term in the time component of the density field. It completely changes our understanding of the density field. It's value is simply $\phi\rho_t(t)$. This quantity is far more important than inertial time. The differential density vector is the most important concept in this document, time density is the most important component in that vector.

Why is the time density such an important concept? It's a game changer. It is the very first thing to tell us something about the density field that we don't have to assume. To understand this let's just look at what it is.

The time density simply represents the balance of the density field over the time component. If this is 0, then density is distributed uniformly over time, if it's titled to one side, then the balance is to that side. But there is an apparent paradox here. It seems like the immediate future of the particle is determined by the complete history and complete future of the particle, how can this be?

Recall, the balance operator is defined the limit of a certain definite integral over the entire field. For the time component, this is an integral over the historical densities of the particle minus the future densities of the particle. This is suggesting that what the particle will do next is somehow determined by what it will do years ahead in the future?

To resolve this we must realize something very important about the time density and this is why it's the game changer. If we move forward in time then the time density must either decrease in time or remain constant. This is because the balance is the integral future densities minus the integral past densities. If the time density is 0 throughout time then the density is uniform throughout time.

$$\frac{\partial\phi\rho(t)}{\partial t} < 0$$

One can easily show that the balance operator commutes with the derivative.

This means that our constraint is also:

$$\phi\frac{\partial\rho(t)}{\partial t}$$

Which is saying that the balance of the inertial time is negative (assuming the constant A is positive). This means that unlike in space, inertial time is not a resistance, it is much more like a force, pushing things through time.

The constraint establishes a relationship between inertial time and the time density. This relationship is very important and understanding it is key to understanding the differential density field.

The Inertial time is proportional to how fast the density is changing at a certain point. If the balance of the inertial time is negative then that means there is a greater amount of inertial time in the past than the future.

Now in a very strange way, the balance of the inertial time been negative, corresponds. to the idea of less action in the future than the past. I haven't defined what action means in terms of the density field yet, but the general idea is that there has to be less changes in density in the future than the past, this also means less inertial time in general (assuming the quantity A is constant on average). As we all already know and will see later, entropy is always increasing. These two facts together combined seems to be saying that as time progresses more things can happen, but less things will.

The most important relationship here so far is that the balance of the inertial time is proportional to the rate of change of the time density (assuming A is constant) and both these quantities are negative. I will call the balance of the inertial time, the inertial balance.

3.4 Divergence of the differential density field

The divergence of a point in a field represents the amount by which the vectors diverge from that point. The divergence is defined as follows:

$$\nabla\cdot\vec{v}=\frac{\partial v(x)}{\partial x}+\frac{\partial v(y)}{\partial y}+\frac{\partial v(z)}{\partial z}$$

A negative divergence means convergence. The divergence is a scalar value.

The divergence of the density field is found by simple applying the divergence operator $\nabla\cdot$ to the density field.

$$\nabla\cdot\vec{\rho}(x)=\nabla\cdot\phi\rho(x)-\nabla\cdot\nabla\rho(x)$$

We can show that the divergence operator commutes with the balance operator and simplify the expression to as follows:

$$\nabla\cdot\vec{\rho}(x)=\phi\nabla\rho(x)-\nabla^2\rho(x)$$

In the first term we can just flip the position of the divergence operator and the balance operator because they commute. But the divergence of a scalar is simply the gradient or the ordinary derivative of the scalar. For the second term, the dot product of ∇ with itself is ∇^2.

From the equation,the divergence of the differential density field is determined by the divergence of the balance component minus the divergence of the inertial component. The balance component is actually simple, the divergence of the balance is simply $\rho(x)$. The divergence of the divergence inertial component is simply the inertial component is simply the laplacian of $\rho(x)$. The laplacian can also be denoted Δ. So now we have:

$$\rho(x) - \Delta\rho(x) = \nabla\rho(x)A$$

The divergence of the differential density field, is itself a density field, in the sense that it has the same dimensions as density, it is also a scalar and is directly proportional to the density.

3.5 Motion in the density field

At this section, you are finally one step closer to understanding how motion works in the density field. Firstly we must discuss the velocity field. The velocity field is a vector field to which every point has an associated velocity. But what exactly does velocity mean in the density field? At this point you might have some rough idea of particles traveling a certain speed. but how does one describe this in terms of the mathematics of the density field?

At first sight it is not obvious, it might even seem impossible, but the insight comes from trying to find a relationship between the inertial time and the inertial gradient (the inertial component of the 3-vector). But before we do that let's just start with a simple fact from calculus.

$$\frac{\partial\rho}{\partial t} = \frac{\partial\rho}{\partial x}\frac{dx}{dt} + \frac{\partial\rho}{\partial y}\frac{dy}{dt} + \frac{\partial\rho}{\partial z}\frac{dz}{dt}$$

This is just the chain rule. You will notice that on the left hand side, there is the important term of the inertial time. But you should also note that on the right hand side the term there is equivalent to a dot product between the gradient of the density field and some velocity vector. I assume that this velocity vector is in fact the velocity vector from the velocity field for each particle and I will prove later that this is in fact the case. The equation is thus:

$$\frac{\partial\rho}{\partial x} = \nabla\rho(x) \cdot \vec{v}(x)$$

At this point you might have 2 questions. How do I know the velocity vector is really the velocity of each particle in the field? and what's the point of the differential density field if we don't need it for the velocity equation? I will attempt to answer both questions throughout this chapter and the next few, I will attempt to answer these questions, this chapter and the next will focus mostly on the latter of the two questions. But gradually it shall become clear.

But let's get back to inertial time and the inertial gradient too. Let's recall the inertial time is defined as follows:

$$m_t = \frac{1}{c}\frac{\partial \rho}{\partial t}A$$

I shall use the symbol m_t to represent inertial time.

Let's not that the inertial component of the differential density field, which is simply:

$$m_x = \nabla \rho A$$

I will be using the the symbol m_x for the inertial gradient. Now the reason I reminded you of this is because I want you to realize something:

$$v(x) = c\frac{m_t}{m_x}$$

The velocity is equal to the inertial time divided by the inertial gradient multiplied by the speed of light. This is all derived from our equation above.

An interesting thing we will show later is that the inertial time can never be greater than the inertial gradient. This is actually saying that the fastest speed possible is c. This is all derived without any assumptions about space or time other than that we can use Cartesian coordinates to describe it. This is reason for me and advocates of my theory to be proud.

Showing this explicitly from our formula is actually very simple, but for those who still aren't seeing it. you can just expand the following to get my original equation times A.

$$m_t = m_x v(x)$$

I have yet to explain what this quantity A is, but at this point it's not relevant, since it cancels out of my equation. What's important to note is that A is never 0.

At this point you may reflect. What's the point of all this inertial time and inertial gradient, can we measure it? Well, what we need to keep in mind is that the inertial gradient is simply the gradient of density at a point and the inertial time is nothing but the time derivative of the density, up to a constant yes, but that's essentially what it is. It is nothing complicated. I have introduced nothing complicated yet.

3.6 Acceleration

Now that we have a good idea of what velocity means in terms of the density field, what is acceleration, how cloud we find it? Well, one could simply take the derivative of the velocity and see where the laws of calculus take you. But this doesn't give us much information, but it is still a very important start.

The formula is:

$$(m_x)^2\vec{a}(x) = m_t' m_x - m_t m_x$$

This is simply using the quotient rule to find the derivative.

An interesting consequence of this is that constant velocity means:

$$m'_t m_x = m_t m'_x$$

The immediate implication of this is that if $m_x = m_t$ then there is no acceleration, this means that objects travelling at the speed of light do not accelerate. more on this later.

I will now focus now on a separate idea.

$$v_b = c\frac{\phi\rho_x}{\phi\rho_t}$$

The quantity v_b I will call the velocity balance, it's not exactly a velocity, but it has units of velocity. What I am interested in the time derivative of this quantity. We already know that the time balance is negative and that the inertial time is less than the inertial gradient. What we don't know much about is the time derivative of the inertial time, which is relevant to our formula.

The time balance minus the time derivative of the inertial time is equal to the time derivative of the time component of the differential density 4-vector.

We can take the time balance as $-\rho(t)$ since the rate at which the time balance changes at a point is generically equal to the minus density at that point (there are special situations where this is not the case).

It is vital to know what the time derivative of v_b is, which we shall call a_b. By the quotient rule we get: (in the generic case)

$$\phi\rho_x^2 a_b = \rho(x)\phi(\rho_x - \rho_t)$$

The time has come to understand what the derivatives of m_x and m_t are, and what this quantity A really is. To do this we need to introduce something new to the density field.

3.7 Density Waves

If we take the time laplacian of the density field, which is just the second derivative with respect to time of density, then we get some quantity which is exactly m'_t, assuming the quantity A is a constant and we can set it to 1. We simply call this the time derivative of the inertial time. We can set an equation as follows

$$\rho = f^2 m'_t$$

Where f is some frequency quantity and ρ is the density at that point. But what could f be the frequency of? maybe it's some arbitrary abstract thing with no use? What is it?

Let's recall that the inertial time at a point is proportional to the velocity of motion at that point. But the velocity is inversely proportional to the inertial gradient.

What we can do is take the quantities in the wave equation, solve for them our resulting solution is the density wave in a later document you will see how that works.

4 Equations of Motion in the density field

As we have already seen motion in the density field is described by the inertial time and the inertial gradient, both of which constitute the two parts of the inertial component of the differential density tensor.

The equations of motion in the density field is described by the inertial components and their derivatives. The velocity as we have already seen is

$$v(x) = \frac{m_t}{m_x}$$

To the acceleration is:

$$a(x) = m_t' m_x - m_t m_x'$$

Now at this point I am going to just leave out the speed of light. Let's set it to 1. Those who have done relativity would be familiar doing this. However, when doing actual calculations you may want to insert c where it should be.

The second equation determines the acceleration. Often times m_x' and m_t' are unknown. We have to solve for them.

4.1 Solving for acceleration

In the introduction of section 3, I mentioned that the differential density vector determines motion. So far I have only shown 1 component, a half of the density vector at work. So far I have only shown the inertial component. So what then is the point of the other component? what's the point of the differential density vector? This section is devoted partly to answer this question.

As I have already shown, the acceleration is determined by:

$$a(x) = m_t' m_x - m_t m_x'$$

But I also showed that we have to solve for this acceleration. But how?

Let's look at a very important result.

$$\nabla \cdot \nabla \rho(x) = \Delta \rho(x)$$

Now, all this says is that the divergence of the gradient of the density field is the laplacian. What's so important about that, you may ask. Well it's not exactly important, but it's something to consider.

The thing I want to bring your attention to is the velocity balance. The velocity balance is not a velocity, but it acts very much like it.

4.2 Energy and Momentum

Momentum is mass times velocity. But when we take things in terms of the density field, we want to talk about density, so what's the quantity we get when we multiply density by velocity? Well a useless concept it may sound, I will call it the inertial momentum. At constant velocity the integral of the inertial momentum over the volume would be equal to the actual momentum. But in general I will call this quantity the integral momentum.

Let's give th

4.3 The Energy Density

The energy density is a measure of the amount of energy in a certain region. Much like the mass density, the energy density is a differentiable field. The energy density can be defined at every point and forms a distribution. In many ways it is related the distribution of matter in the density field.

5 Electromagnetism

Electromagnetism is the phenomenon by which electrically charged particles are attracted or repelled based on their electric charges. I will describe the electric field and it's relationship with the differential density field.

5.1 Charge Density and the divergence of the electric displacement field

It is a well known fact that the charge density is related to the divergence of the electric field. This is one of Maxwell's equations.

$$\nabla \cdot E = \frac{q}{\epsilon}$$

I use the symbol q for charge density rather than charge because I am never going to use charge in this document. I will acknowledge you get charge by integrating the charge density over a region but I will not use the concept. The quantity ϵ is the electric permittivity, but what really is the electric permittivity? A part of this chapter will be dedicated to answering that question.

But what's the relationship between the density field and the charge density field? Well, firstly, if the density field at a point is 0 then the charge density field at that point must also be 0.A non zero density field does not however imply a non zero charge density field.

Let's take q_m to be the mass to charge ratio, which is also the ratio between mass density and charge density. We then find that the divergence of the electric displacement field is equal to

$$\nabla \cdot D = \frac{\rho(x)}{q_m \epsilon}$$

The reason I do this is because I want to see the relationship between the electric displacement field and the density field. We can rewrite this as follows:

$$q_m \epsilon \nabla \cdot D = \rho(x)$$

What this is basically saying is that the Electric displacement field is proportional to the density field. Now at this, let's recall something very wonderful.

$$-\nabla \cdot \rho(\vec{x}) = \rho(x) + \Delta\rho(x)$$

This means that that

$$-q_m \epsilon \cdot D = \nabla \cdot \vec{\rho}(x) + \Delta\rho(x)$$

What this suggests is that assuming $\Delta\rho(x)$ is 0 and the permittivity and mass charge ratio is a constant, then the electric displacement field behaves in essentially the same way as the differential density field.

But let's get back to the original equation relating the density field directly to the electrical displacement field. Essentially, this is saying, that in a field of constant mass charge and a constant electric permittivity, the magnitude of the divergence of the electric displacement field is equal to the mass density at that point.

Let's assume a constant mass charge and a constant permittivity then we find the following. relationship between the electric displacement field and the velocity field.

$$q_m \epsilon \frac{d\nabla \cdot D}{dt} = \nabla\rho(x) \cdot \vec{v}(x)$$

This means that the inertial time is proportional to the rate of change of the divergence of the electric displacement field, in a field of constant mass charge and constant permittivity.

$$m_t = \frac{p_m \epsilon}{c} \frac{d\nabla \cdot D}{dt}$$

5.2 Permittivity field

We can create a field $\epsilon(x)$ for which each point has an associated permittivity. This field will be called the permittivity field. The permittivity at each point in the field determines the electric permittivity at that point. The electric permittivity is also time dependent.

The electric permittivity of a field

5.3 The Electromagnetic Nature of materials

Materials are electromagnetic by nature. We know that matter is made from electrons, protons and neutrons. These particles interact with the electromagnetic field. Many material properties are determined by how they interact with the electromagnetic field. The electric and magnetic properties, thermal properties, metallic properties, optical properties etc.

A material with high permittivity, for example is a dielectric material and is very useful for making a capacitor. Conductors are materials that that allow electric current to flow through. The permeability of a material affects how well it can produce magnetic fields. Materials that have high heat capacity and high boiling point generally have a motion higher intermolecular force. these intermolecular forces are at the most fundamental level electromagnetic. Many properties of matter are dependent on how they interact with the electromagnetic field, which in turn depends on their structure, which in turn depends on the density field.

What this chapter is mainly about is discussing how some common properties of matter relate to how the density field and the mass charge field are distributed throughout the material. These fields determine the electric displacement and the differential density field which determines the evolution of these fields.

The first property I want to talk about in details is

5.4 Magnetic B and H fields

Those who have studied Electromagnetism and related fields already know about magnetic fields, so I won't spend much time on it. What I want to focus on is the relationship between the B field and the H field and it's importance to our theory.

I want to first start with the fact that the B field has a divergence of 0.

$$\nabla \cdot B = 0$$

The curl of the H field is as follows:

$$\nabla \times H = \frac{\partial D}{\partial t} + J$$

Now these are just Maxwell's equations. But what I want to know is how these fields relate to the density field. Since I have 3 of 4 equations, I will just write the 4th

$$\nabla \times E = \frac{\partial B}{\partial t}$$

Now these equations relate various fields we collectively call the Electromagnetic field. Now the purpose of this document isn't to describe how this works. This document intends to describe the relationship between these fields and the density field.

6 Practical Application of the theory

This section is very important. Especially for those wondering what's the point of my theory. The first part of this section will explain with an example how to use the theory in a simple example. The second part is devoted to exploring some implications of this theory, the third part is dedicated to the possible advances in technology this theory might bring once it is demonstrated true.

The importance of this section is to show what this theory brings to table. previous sections have been all about how this theory relates to other things we know, now it's time to talk about what distinguishes it, and how we could potentially falsify or prove it.

6.1 A simple example: moving particle

The first example showing how you can apply this theory is a particle moving at constant velocity through the density field. I will assume no forces acting on the particle and that the particle follows a Gaussian distribution. I will also assume that the particle starts at the origin. We know that the velocity. I will keep it one dimensional for simplicity, but extending it to 3 dimensions should not be terribly difficult.

If a particle follows the Gaussian distribution, then in one dimensions it's density is determined by the function.

$$\rho(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2}$$

Now we also assume the velocity v is a constant. Let's recall the formula

$$\frac{\partial \rho}{\partial t} = \nabla \rho(x) \cdot \vec{v}(x)$$

Since this is one dimensions, and our velocity is constant, this means that our dot product formula just becomes an ordinary product. Also note that the gradient in 1 dimensions

$$\frac{d\rho}{dt} = \frac{d\rho}{dx} v$$

We know how to. differentiate a Gaussian distribution, so we can simply take the derivative of the density field to get the time derivative.

$$\frac{d\rho}{dx} = -\frac{x}{2\pi} e^{-\frac{1}{2}x^2}$$

I will also note that this is proportional to the inertial gradient, but since the quantity A cancels out in the velocity equation I will not include it in the calculation

$$m_x = -\frac{x}{2\pi} e^{-\frac{1}{2}x^2}$$

Finding the rate of change of the density field with respect to time is as simple as multiplying this by the velocity.

$$\dot{\rho} = -v \frac{x}{2\pi} e^{-\frac{1}{2}x^2}$$

But this is only for a single instance in time, since the inertial gradient could change with time. But recall that at constant velocity $\dot{m_x} = \dot{m_t}$. Firstly let's find the value of these.

7 Dimensional Homogeneity

In this section I want to talk about something a little bit different. I want to speak about the nature of physical dimensions. This is mainly the work of my professor who did his thesis and various articles on it. His work focuses mainly on the many alternative physical dimensions we could use and the nature of dimensionless physical constants. He also speaks of the idea of fractal physical dimensions and Hausdorff dimensions. But another idea, he favors be far the most is a fully homogeneous system of units he calls dimensionless units. [Voda]

What's revolutionary about his ideas isn't so much about how it changes physics, but more so how it changes our way of thinking about it. "Dimensions are arbitrary conventions", He says, " and it's interesting to see what happens when you break them, specifically what remains invariant under a transformation of units".

He starts with a very simple idea. You can think of time as the length of a light beam. How long it took for an event to occur is how long the light beam has become since it started traveling at the beginning of an event to the end. The main idea here is that you can think of time as a length and give it units of length $x_t = ct$. But fans of classical physics recognize an immediate paradox, it would now seem that time is dependent on velocity, on how fast I am travelling. For example, if I am travelling at the same speed as that of light, it would appear that time has come to a complete stop. But fans of relativity have no problem with this, this is exactly what relativity predicts. Classical mechanics advocates may instead want to define time as $x_t = ct + vt$. With this, time is invariant, but only so in an absolute frame of reference. [Pau]

My Professor argues, why not define time as proper time, then we can still call time an invariant quantity, after all it's just a definition. But the response to this is clearly time is what my clock measures, my clock doesn't measure proper time. But his response to this was brilliant, he said "Why not build a device that measures proper time instead of 'time', and call this the clock, then we can all agree on time.". But how could we build a device that measures proper time? [Vodb] [Ein] [Bar]

But, I have strayed a bit off topic, my point wasn't to argue about what time is, but to show that it can reasonably be defined as a length, and thus given the units of length. It would be an arbitrary convention, bit our system of units is also an arbitrary convention. I went of topic for good reasons, to allow you to rethink the nature of time.

The first interesting thing that happens if one chooses to measure time as a length $x = ct$ is that velocity becomes a dimensionless quantity. Since it's the ratio of distance travelled to the distance light traveled. The essence of a dimensionless quantity is that it doesn't change no matter how much we scale our units. For example the refractive index of water is 1.3 and there is no units attached to it. That means it doesn't matter whether you chose feet's, yards, or centimeters, the refractive index of light is still 1.3. We call these unchanging constants dimensionless physical constants. The same thing happens with velocity when we choose units such that velocity is dimensionless. In this case though we get the velocity of light as the uninteresting value of 1.

Another slightly less obvious consequence of this arbitrary choice is that power becomes just a form of force, in the sense that it has the same units of force. Momentum, mass and energy would all have the sane units in such a system.

Another thing one could consider and my Professor did, is what if we kept time as a fundamental unit and created another arbitrary fundamental unit.

Let's assume for some arbitrary reason we chose length and distance to be fundamentally distinct. The choice is arbitrary, and maybe sound useless, maybe it is, but what would happen if we did? Well, we would create new units like distance/length and length/distance, which we would consider non homogeneous. For most purposes these are clearly useless, but it is just as arbitrary as our choice of units.

But he had another idea, what of we chose quantities we knew were dimensionless and gave them units. Let's make angle a fundamental quantity and remove length, for one minute. Not surprisingly, his new system of units could not recreate the concept of length or velocity. He had to create the concept of perspective length and perspective velocity in this system of units. He showed that by changing the system of units you can change what the laws of physics look like mathematically. But almost certainly you can't change them.

But he wasn't finished there. He asked what would happen if we made area and length and length the same unit. Now this might sound impossible, but he argued that if you define the area of a 5×5 square as 5 rather than 25 then such a measure would indeed be possible. Now, like everything else so far, this is arbitrary, but our choice of measuring area as a square was somewhat arbitrary. It has become so built into our mathematical language that we can hardly question it.

8 How this theory can be proven

This theory makes some bold predictions about density as a differentiable field, but how can we demonstrate this. One of the ways I can show that such a theory is at least plausible is by showing how much of what it can explain. In this I try to find particle distributions from which I can derive the laws of quantum mechanics. I did a little of this in my thesis and will elaborate on that in a later page. But the more prominent way is in designing machines that can detect the predicted results of my theory.

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