The absolute zero vector.

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Abstract

Set theory [1] and theory of vector spaces [2] are considered as mature theories where it is safe to build on. However, they still contain a contradiction that make's set theory an inconsistent system. We will give a series of simple examples in different domains of mathematics and physics to demonstrate this. We will pinpoint the contradiction and show that applying some elementary logic removes the contradiction that is the cause of the inconsistency. On top of that is shown that introducing the concept of the absolute zero vector removes this inconsistency and offers the opportunity to extend set theory so that it becomes a more powerful theory.
In the next article (Universes) is explained that the absolute zero vector is not just a mathematical correction, but it is probably one of the most important insights to explain and get a thorough understanding of our complete reality.

Introduction

The essence of the article can be demonstrated by a simple example from reality to show where it goes wrong.

Example 1. Consider an ordered basis B with basis vectors: { $\overrightarrow{1_{\mathrm{Fx}}}$, $\overrightarrow{1_{\mathrm{Fy}}}$, $\overrightarrow{1_{\mathrm{Fz}}}$ } so that force vectors can be represented [3]. Consider also a point A where maximum 1 force act on so that the force can be described by formula $\vec{f}(t)$. Suppose that at time t = t_0 no force act on point A. Then "***the set of forces that act on point A when t = t_0***" is {} or Ø. When someone uses the formula to calculate "***the set of forces that act on point A when t = t_0***" the answer for $\vec{f}(t_0)$ will now be { (0, 0, 0) } = {$\vec{0}$}. Both answers for the question "***the set of forces that act on point A when t = t_0***" are considered correct. {$\vec{0}$} is the answer when a formula is used, while Ø is the answer when no formula is used. It is obvious that 2 different answers (element and no element) that represent exactly the same situation presented in the same basis is not possible. With such system one can prove whatever one wants. (E.g. Equal and different at the same time, 1 = 0 etc.)

The contradiction

The contradiction that is shown in example 1 is easy to explain. For most vectors that are used in reality (force, electric field, magnetic field, ...) one can consider a situation without this vectorial quantity. And for these vectors it is the habit (although not required) to choose the origin of the basis so that $\vec{0}$ correspond with the situation without this vector (presented as Ø, or no force in example 1).
So, if there are 2 mutual excluding ways to represent the same situation (no force from example 1):

- $\vec{0}$ that is an element
- Ø that is no element

then one gets an inconsistent system.

Example 2. A similar inconsequence as in example 1 is seen for continuous sets versus discrete elements.
Consider a basis to represent a force with one basis vector: { $\overrightarrow{1_{\mathrm{Fx}}}$ }
Then A = {q . $\overrightarrow{1_{\mathrm{Fx}}}$ | q ∈ [-10, 10]} will be considered as a continuous interval, and no one will doubt that 0 . $\overrightarrow{1_{\mathrm{Fx}}}$ = $\vec{0}$ is an element of set A. When we consider just the situation without forces (= $\vec{0}$ ∈ A), then this situation is usually

described as Ø. Because $\vec{0}$ correspond with Ø one can as well write A = {q . $\overrightarrow{1_{Fx}}$ | q ∈ {[-10, 0 [U] 0, 10]}} which is no continuous interval.

Example 3. Consider the concept of the empty set.

Choose a basis where $\vec{0}$ correspond with Ø.

$\vec{0}$ correspond with Ø (1)

It is obvious that following expression is correct.

$\vec{0} \in \{ \vec{0} \}$ (2)

Substitute (1) in (2) => $\vec{0} \in \{Ø\}$ => $\vec{0} \in Ø$

This is a contradiction because the empty set cannot contain elements.

The list of examples and problems is too long to elaborate on it. It are internal contradictions, conflicts with all possible domains of mathematics (logic, vector spaces, continuity, …), conflicts with the daily reality, physics, etc. No matter how one looks at it, the conclusion is always that the demonstrated contradiction leads to an inconsistent system. And such a system has of course no probative force and may not be used to build on it.

The absolute zero vector

The solution for the inconsistency that is shown, is accept that when $\vec{0}$ correspond with Ø, one should not consider $\vec{0}$ as an element.

Definition

We will call from now on $\vec{0}$ that correspond with Ø the "absolute zero vector" (noted as $\overrightarrow{0'}$).

Definition: $\overrightarrow{\mathbf{0'}}$ **= Ø**

Remarks

- $\overrightarrow{0'}$ is no element because it corresponds with Ø.
- Although $\overrightarrow{0'}$ is no element, it is a vector because it has all vector properties of the zero vector.
- $\overrightarrow{0'}$ is the identity "element" of addition. ("identity element" is in fact not a good name, because $\overrightarrow{0'}$ is no element) It is obvious that if "nothing" is "added" to a vector that this vector does not change.
- Although one can use Ø instead of $\overrightarrow{0'}$ there are some reasons why the $\overrightarrow{0'}$ notation is useful:
  - The $\overrightarrow{0'}$ notation gives information about a vector space. It expresses that the zero vector of a vector space correspond with Ø. If the zero vector of a vector space does not correspond with Ø, one should use $\vec{0}$.
  - The notation $\overrightarrow{0'}$ expresses the property of Ø that it can be used as vector.
- $\overrightarrow{0'}$ is unique because Ø is unique [4].

Notes

- $\overrightarrow{0'}$ is unique while $\vec{0}$ is only unique per vector space. When a vector space is considered with $\overrightarrow{0'}$ as zero vector, then of course only components (of $\overrightarrow{0'}$) are considered that are required to define elements of the vector space.
- One can put the origin of a vector space wherever one chooses. So, when $\vec{0}$ does not correspond with Ø, then $\vec{0}$ is just the "classic" zero vector of the corresponding vector space. For some vectors that are used in reality like speed and position in space it is difficult or even impossible to know what the absolute zero vector is. But this practical difficulty does not change anything to the theoretical importance of the concept. For vectors like force,

electric field, magnetic field, where $\vec{0}$ almost always correspond with Ø (although not required), one should use $\overrightarrow{0'}$ instead of $\vec{0}$.

Examples:

- Choose a basis for a vector space V_1 where $\vec{0}$ correspond with Ø. => we should use $\overrightarrow{0'}$ instead of $\vec{0}$.
  $\vec{v} \in V_1$
  $\vec{v}$ - $\vec{v}$ = $\overrightarrow{0'}$ = Ø
  Typical examples: force, electric field, magnetic field. For those vectors one can consider a situation with no force, no electric field, no magnetic field.
- Choose a basis for a vector space V_2 where $\vec{0}$ does not correspond with Ø.
  $\vec{v} \in V_2$
  $\vec{v}$ - $\vec{v}$ = $\vec{0}$ (≠ Ø)
  Typical examples: position in space, speed. For those vectors it is not possible/practical to use an absolute zero position in space or an absolute zero speed. (earth moves in space)

When you read the text again and use the absolute zero vector where it is applicable, you will notice that there are no inconsistencies anymore.

Solution example 1.

$\vec{f}(t_0)$ = $\overrightarrow{0'}$ = Ø

Solution example 2.

A = {q . $\overrightarrow{1_{Fx}}$ | q ∈ [-10, 10]} = {q . $\overrightarrow{1_{Fx}}$ | q ∈ {[-10, 0 [U $\overrightarrow{0'}$ U] 0, 10]} } continuous set of vectors
{q . $\overrightarrow{1_{Fx}}$ | q ∈ {[-10, 0 [U Ø U] 0, 10]} }
{q . $\overrightarrow{1_{Fx}}$ | q ∈ {[-10, 0 [U] 0, 10]}}

Because $\overrightarrow{0'}$ is considered as vector, set A can be considered as a continuous set of vectors, although it is no continuous set of elements.

Solution example 3.

Choose a basis where the zero vector correspond with Ø. => we should use $\overrightarrow{0'}$ instead of $\vec{0}$.

$\vec{0} \in \{ \vec{0} \}$ (2)

Expression 2 is no longer applicable, because the zero vector is in fact $\overrightarrow{0'}$ and that is no element.

Similarity between set theory and theory of vector spaces

Set's and vectors are both ways to describe quantities. Therefore, it is not surprisingly that sets and vectors are interchangeable under certain circumstances. Without the concept of the absolute zero vector this is impossible because then one bumps on inconsistencies like will be shown. The absolute zero vector offers however the opportunity to make this interchangeability possible and extend set theory (for sets that apply to 3 additional criteria) with typical vector operations that makes it a powerful theory that can be used in daily life by almost everyone.
E.g. consider a common action with groups like the merging of two fruit baskets. To know the result of this action, one cannot use set theory.

- Summing sets makes the inconsistency very visible and is therefore not accepted (e.g. $\{\vec{v}\} + \{-\vec{v}\} = \emptyset$ is not accepted because $\vec{v} + (-\vec{v}) = \vec{0}$ what, without the concept of $\overrightarrow{0'}$, conflicts with $\emptyset$).
- Merging fruit baskets is also not a union of sets. {apple, 2 pears} U {apple, 3 pears} = {apple, 2 pears, 3 pears} while {2 apples, 5 pears} would be the answer that one expects when the fruit baskets are merged. Note that this are all valid sets and that the concept of multisets is completely irrelevant in the context of this text. (*See addendum for more info.)*

Also, other common actions like the multiplication of a set with a scalar are impossible with the current set theory (e.g. $0\ \{\vec{v}\} = \emptyset$ is not accepted because $0 \,.\, \vec{v} = \vec{0}$ what, without the concept of $\overrightarrow{0'}$, conflicts with $\emptyset$).
The insight that $\overrightarrow{0'} = \emptyset$ offers the opportunity to extend set theory so that it allows those actions.

Vector sets
Sets that apply to the further mentioned criteria, allow following operations:
(+) Addition of sets. E.g. A + B with A and B sets
(.) Multiplication of a set with a scalar. E.g. 5 . A with A a set.
We call sets that allow these operations vector sets.
The 3 criteria so that the addition and scalar multiplication with sets are possible are:

1. It must be possible to consider each element of the set as a vector wherefore the addition and the scalar multiplication are defined.
2. When considering a one-dimensional basis [3] for each individual element of the set, then the zero vector should always correspond with $\emptyset$. => we use $\overrightarrow{0'}$ instead of $\vec{0}$.
3. No element of the set should be linear combination of the other elements of the set.
   Examples:
   - $\{5\ \vec{a}, 2\ \vec{a}\}$ does not apply to this criterion. To be a vector set it should be converted to $\{7\ \vec{a}\}$
   - $\{5\ \vec{a}, 2\ \vec{b}, 3\ \vec{a} + 4\ \vec{b}\}$ does not apply to this criterion. To be a vector set it should be converted to $\{8\ \vec{a}, 6\ \vec{b}\}$

Notes

- Daily life objects (e.g. apples) can be treated as vectors. With $\overrightarrow{0'}$ as zero vector you can check that all axioms of vector spaces are satisfied [2]. On first sight we don't know a physical inverse element for most physical objects. But nowhere in the axioms is specified that the inverse element should be a physical element that you can find in daily life. Inverse elements can as well be virtual, like the removing of an object etc. So, it is up to mathematic users to verify that objects apply to all axioms of a vector space in the way and range they will use it. Mathematicians on the other hand should offer a theoretical framework that is consistent and powerful enough to solve problems so that conclusions are correct in the domain the user has defined, whatever the nature of the elements is.
- It is possible that the result of an addition of two vector sets does no longer apply to the third criterium (not linear independent) for vector sets. In that case the result can be converted so that it is again a vector set.
  E.g. $\{5\ \vec{a}, 2\ \vec{b}\} + \{3\ \vec{a} + 4\ \vec{b}\} = \{5\ \vec{a}, 2\ \vec{b}, 3\ \vec{a} + 4\ \vec{b}\}$
  $\{5\ \vec{a}, 2\ \vec{b}, 3\ \vec{a} + 4\ \vec{b}\}$ can be converted to $\{8\ \vec{a}, 6\ \vec{b}\}$ that is again a vector set.

Example 4.

We merge two vector sets and multiply the result with 0. Without the concept of $\overrightarrow{0'}$ we can do this with vectors, but then we get a wrong result (element $\vec{0}$, when it should be Ø), and with set's it is even not possible.
With the new insights there is no problem to calculate this correctly with vector sets and with vectors.

<table>
<tr><th>Example with vector sets.</th><th>Equivalent example with vectors.</th></tr>
<tr><td>Vector set A = { 5 . $\overrightarrow{1_{Fx}}$, 2 apples, 500 g sand }
Vector set B = {-5 . $\overrightarrow{1_{Fx}}$, 4 apples, 2 kg sand, 15 Euro}

0 . (A + B) = 0 . ({ 5 . $\overrightarrow{1_{Fx}}$, 2 apples, 500 g sand } +
{-5 . $\overrightarrow{1_{Fx}}$, 4 apples, 2 kg sand, 15 Euro})
= 0 . { 0 . $\overrightarrow{1_{Fx}}$, 6 apples, 2.5 kg sand, 15 Euro }
= 0 . { $\overrightarrow{0'}$ = Ø, 6 apples, 2.5 kg sand, 15 Euro }
= 0 . { 6 apples, 2.5 kg sand, 15 Euro }
= { 0 apples, 0 kg sand, 0 Euro }
= { Ø, Ø, Ø}
= Ø</td><td>Choose a basis with following basis vectors:
{ $\overrightarrow{1_{Fx}}$, 1 apple, 1 kg sand, 1 Euro }

$\vec{a}$ = (5, 2, 0.5, 0)
$\vec{b}$ = (-5, 4, 2, 15)

0 . ($\vec{a}+\vec{b}$) = 0 . ((5, 2, 0.5, 0) + (-5, 4, 2, 15))
= 0 . (0, 6, 2.5, 15)
= (0, 0, 0, 0)
= $\overrightarrow{0'}$
= Ø</td></tr>
</table>

Notice the similarity between vector sets and vectors with $\overrightarrow{0'}$ as zero vector.

Vector sets	Vector spaces with ordered basis where $\vec{0}$ correspond with $\overrightarrow{0'}$ (= Ø).
Elements have a name and can be scaled. E.g. $7\vec{v}$, apple, 2 Euro	Basis elements have a position, and only scale factors are used to represent an element.
Empty set: Ø	Absolute zero vector: $\overrightarrow{0'}$
Some operations: #, U, ∩, +, -, .	Some operations: +, -, .
All Axioms of a vector space are applicable.	All Axioms of a vector space are applicable.

Conclusion

"The element $\vec{0}$ corresponding with Ø (= no element)" is a contradiction, and such an element can therefore not exist. Contradictory elements lead to inconsistent systems, and never correspond with the reality that is always possible (= never a contradiction). The described contradiction is removed by introducing the absolute zero vector $\overrightarrow{0'}$. On top of that if offers the opportunity to extend set theory with vector sets that allow common actions like the addition and scalar multiplication of sets.

References

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Universes

Abstract

The concept of the absolute zero vector ($\overrightarrow{0'}$) has consequences on multiple domains of mathematics, physics and daily life. The most important consequence is however that there will be proved that the existence of the absolute zero vector directly (and logically) leads to the conclusion that there exist an infinite number of sets that have the following characteristics:

- **Vectors of the set actually exist.**
  The elements of the set represent vectors (forces, accelerations, electric fields etc.) that have as property that they actually exist. In a similar way as objects exist that we can observe in our universe.
- **Vectors of the set obey to strict rules.**
  Vectors that not obey to these rules are a contradiction, and can therefore of course not exist. There are an infinite number of sets for which these rules are completely equivalent with the laws of physics that we know from our universe.
- **Sets are completely independent of other sets.**
  We limit the element of a set to vectors that are dependent of other vectors in the set. So, vectors in this set are completely independent of elements that do not belong to the set.

Because such sets have the full potential to explain all aspects of our universe, it makes sense that sets that obey to those criteria are called universes. With a worked-out example we will describe in detail a complete mini universe so that the explained principles become clear.

The absolute zero vector ($\overrightarrow{0'}$) exists.

The short and simple reasoning starts with the fact that the absolute zero vector exists. One can consider this trivial, because Ø = $\overrightarrow{0'}$ and Ø of course exists, but there are many ways to prove this. Who likes can see a few of them in Appendix A. So, we can summarize some properties of $\overrightarrow{0'}$:

- It is a vector
- It is unique
- It unconditionally exists

Sets of vectors that exist.

For the absolute zero vector is proven that it exists. But then all that is equal to $\overrightarrow{0'}$ of course also exist.
(A exists, and A = B ⇒ B exists. If B would not exist, then A ≠ B, what conflicts with the initial assumption.)
Consider a set of vectors: V
At first sight we could thus write:

$$\sum_{\vec{\mathbf{v}} \in V} \vec{\mathbf{v}} = \overrightarrow{\mathbf{0}'} \Rightarrow \left(\sum_{\vec{\mathbf{v}} \in V} \vec{\mathbf{v}} \right) \text{exists} \tag{1}$$

But there is still a very important condition missing. Each of the vectors $\vec{\mathbf{v}} \in \mathrm{V}$ should of course be possible. “possible” should be interpreted in the strict logical sense as “not impossible” what is equivalent with “not contradictory”. So, these vectors should not contain or lead to contradictions. If they do, they can of course not exist, and it is nonsense to write them in the sum expression.

We know that when a set of existing vectors (physical forces, electric field etc.) are considered so that the sum equals $\overrightarrow{0'}$, that it is equivalent with (applying) the (unconditionally) existing absolute zero vector. Concluding from the existence of $\overrightarrow{0'}$ that a set of vectors for which the sum equals $\overrightarrow{0'}$ also exist is however not allowed, because we will show that only vectors that obey to strict rules are possible (= do not contain or lead to contradictions). In the next paragraph, we will explain this in detail, and show that the condition that a vector should be possible is a severe condition and the reason that rules that are equivalent with the laws of physics exist.

It is obvious that when a sum of possible vectors equals an existing vector $\vec{\boldsymbol{a}}$, that all vectors of the sum should also exist. If one or multiple vectors of the sum does not exist, then those terms can be deleted so that the sum no longer equals the existing vector $\vec{\boldsymbol{a}}$.
So, we can write:

$$\begin{cases} \sum\limits_{\vec{\mathbf{v}} \in \mathrm{V}} \vec{\mathbf{v}} = \overrightarrow{\mathbf{0'}} \\ \forall_{\vec{\mathbf{v}} \in \mathrm{V}} \ \vec{\mathbf{v}} \text{ is possible} \end{cases} \qquad (2)$$
$$\Rightarrow$$
$$\forall\, \vec{\mathbf{v}} \in \mathrm{V} \Rightarrow \vec{\mathbf{v}} \text{ exists}$$

Laws of nature.

The last step in the reasoning is to show that there are sets of vectors that have as property that they exist (expression 2), and where vectors obey to all kind of rules comparable with the laws of nature that we know from our universe [6]. To explain this mechanism in a comprehensible way we will use examples with dimensions that we know from our universe.

Example 1. Speed

Let's consider the physical quantity "speed" (v). As we know, speed can be considered as a vector, but speed is also by definition a displacement per unit of time or mathematically formulated v = dx/dt.
This definition has several consequences:

- **All required dimensions** [7] **should exist.**
  A displacement dx when there is no space, or dt when there is no time doesn't make sense and is therefore of course impossible. For those reasons, talking about a speed vector implies a multi-dimensional vector space with at least basis vectors for speed but also for space and time.
- **Continuity** [8]**.**
  The differentials [9] dx and dt cannot exist for discontinuous elements. Those differentials thus impose conditions on the continuity of the vectors in the set that is considered.
- **Dimensions are related to each other with formulas.**
  "v" is "dx/dt". Therefore, the condition v = dx/dt should of course always be satisfied for each vector (of an object). But as long as there is no concept of (any kind of) matter or radiation, the speed is a rather theoretical concept. It does not make much sense to talk about "the speed of nothing" or "the speed of empty space". Matter will be introduced in the next example.

Example 2. Matter

To explain the concept of matter we will consider a basis that allows the existence of elements that behave exactly like charged and uncharged matter in electric fields in our universe. To avoid that everything should be written in 3 spatial dimensions, only one spatial dimension (x) will be used.

Consider an ordered basis B_0 with basis vectors: { $\overrightarrow{\mathbf{1_t}}$, $\overrightarrow{\mathbf{1_E}}$, $\overrightarrow{\mathbf{1_x}}$, $\overrightarrow{\mathbf{1_v}}$, $\overrightarrow{\mathbf{1_a}}$, $\overrightarrow{\mathbf{1_M}}$, $\overrightarrow{\mathbf{1_Q}}$ }
To have a 1 one 1 mapping with the behaviour of objects in our universe, one need to choose the units in the following way.

- $\overrightarrow{\mathbf{1_t}}$: Unit: 1 s (second)
  Comparable with time in our universe.
- $\overrightarrow{\mathbf{1_E}}$: Unit: 1 N/C (Newton / Coulomb)
  Comparable with electric field (in direction of x-axis) in our universe.
- $\overrightarrow{\mathbf{1_x}}$: Unit: 1 m (meter)
  Comparable with position on an x-axis in our universe.
- $\overrightarrow{\mathbf{1_v}}$: Unit: 1 m/s
  Comparable with speed (in direction of x-axis) of an object in our universe.
- $\overrightarrow{\mathbf{1_a}}$: Unit: 1 m/s²
  Comparable with acceleration (in direction of x-axis) of an object in our universe.
- $\overrightarrow{\mathbf{1_M}}$: Unit: 1 kg/m (in 3 spatial dimension this would be 1 kg/m³)
  Comparable with mass density in our universe.
- $\overrightarrow{\mathbf{1_Q}}$: Unit: 1 C (Coulomb) / m (in 3 spatial dimension this would be 1 C/m³)
  Comparable with charge density in our universe.

When (t, E, x, v, a, M, Q) is an element in basis B_0 then the relations that exist between the components are:

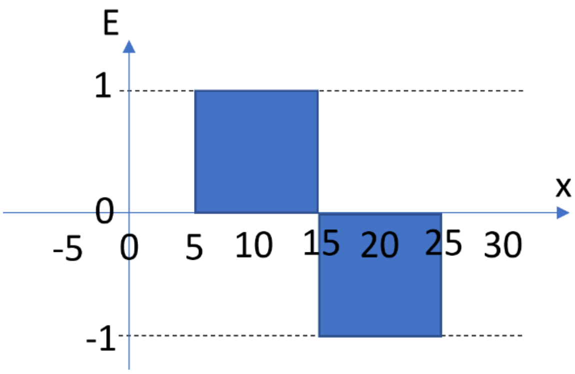
- v = dx / dt
- a = dv / dt
- E = M . a / Q

Note that these relations can be formulated in different ways, because if y = f(x) then x = f^{-1}(y).
These 3 relations link the 7 components of vectors in basis B_0 in exactly the same way as they are linked in our universe. Therefore, we can use in fact "classic" physics to come to exactly the same results as calculating it purely in the mathematical way.

To continue the example, we consider a set V_0 in basis B_0, with following elements:

V_0 = { (t, E, x, v, a, M, Q) | t ∈ ℝ, E = 0, x ∈ ℝ \ [5, 25[, v = 0, a = 0, M = 0, Q = 0} U
{ (t, E, x, v, a, M, Q) | t ∈ ℝ, E = 1, x ∈ [5, 15[, v = 0, a = 0, M = 0, Q = 0} U
{ (t, E, x, v, a, M, Q) | t ∈ ℝ, E = -1, x ∈ [15, 25[, v = 0, a = 0, M = 0, Q = 0}

Hereunder E (electric field) of set V_0 is presented as function of x (position) graphically.



Notice that the sum of the vectors in set V_0 equals the absolute zero-vector and the set does not contain any contradiction. As explained before this is the condition so that the set exists.

Suppose now that we replace element (100, 1, 10, 0, 0, 0, 0) by (100, 1, 10, 0, 0, 2, 4)
Comparable with giving this element a mass (density) and charge (density).
We see that this is not possible, because a = E . Q / M. So, a = 1 . 4 / 2 = 2
So, the correct replacement should be with element p_1(100, 1, 10, 0, 2, 2, 4)
But v (= dx / dt) and a (= dv /dt) are based on dt, so let's calculate the other elements (p_2 and p_3) in the environment (+dt and -dt) of p_1 so that all definitions are correct, and p_1 is not just nonsense. We start with calculating $p_2(t_2, E_2, x_2, v_2, a_2, M_2, Q_2)$.

	p_1	p_2	Calculation of p_2
t	100	100 + dt	
E	1	1	E is constant (= 1) in the environment of p_1. (see definition of V_0)
x	10	10	$x_2 = x_1 + dx = 10 + v_1 . dt = 10 + 0 . dt = 10$
v	0	2 dt	$v_2 = v_1 + dv = 0 + a_1 . dt = 2$ dt
a	2	2	v_2 = E . Q / M = 1 . 4 / 2 = 2 (E, Q and M are constant in the environment of p_1.)
M	2	2	v is (defined as) the displacement of an element with mass (density) and charge (density). => M and Q are constant on the path (in space and time) that is defined by the speed.
Q	4	4	see explanation of M.

So, we get element p_2 (100 + dt, 1, 10, 2 dt, 2, 2, 4)
We can of course make a similar reasoning for -dt that lead to p_3 (100 - dt, 1, 10, -2 dt, 2, 2, 4)
But p_3 and p_2 can also only exist when there are elements "before" and "after". So, in fact we get a complete path of elements in space and time. Some integrating gives us the formula for the path in the environment of p_1.
{ (t, E, x, v, a, M, Q) | t ∈ [... 100 ...], E = 1, x = $t^2 - 200t + 10010$, v = 2 t – 200, a = 2, M = 2, Q = 4}
The path will pass the x values (5, 15, 25) where the situation changes, but we will not calculate the full path, because this is always the same principle. The full path should now replace elements of V_0 so that we get a set V_1 that contains elements that are in fact equivalent with a mass (density) and charge (density) that "moves" in space and time, exactly like it would be in our universe.
So, now we created a set V_1 that contains no contradictions, but the sum of the vectors no longer equals the zero-vector. This means there is no reason why set V_1 would exist.
We will check per component to see what should happen to ensure that V_1 equals the zero-vector, so that it exists, and stays a set without contradictions.
t, E, x: was initially ok (sum = 0), and the particle (path of elements with M = 2 and Q = 4) changes nothing to this.
M, Q: here is a problem (sum > 0). This should be compensated in one way or another, so that the sum for M and Q equals zero. One of the many solutions to compensate this, is introducing a second particle that exists as long as the first particle, and wherefore M and Q are opposite (so M = -2, Q = -4). The introduction of multiple particles, with different M and Q values, that exist longer or shorter is of course also possible. The place (x and t) of the particles doesn't matter, as long as it is within the space and time formed by the vectors of set V_1. In other words, the new (compensating) particle replaces vectors from set V_1, and there are no new vectors added.
a, v: although the sum of "a" and "v" of a single particle can be 0, we still have to calculate it, and if the result is not 0 then "a" and "v" should be compensated with other particles, similar how M and Q are compensated.

Radiation
Magnetic fields need 3 spatial dimensions. So, when basis B_0 is extended with 3 spatial dimensions, we can also add magnetic fields (Symbol B). Such a basis looks like this:
$\{ \overrightarrow{\mathbf{1}_t}, \overrightarrow{\mathbf{1}_{Ex}}, \overrightarrow{\mathbf{1}_{Ey}}, \overrightarrow{\mathbf{1}_{Ez}}, \overrightarrow{\mathbf{1}_{Bx}}, \overrightarrow{\mathbf{1}_{By}}, \overrightarrow{\mathbf{1}_{Bz}}, \overrightarrow{\mathbf{1}_x}, \overrightarrow{\mathbf{1}_y}, \overrightarrow{\mathbf{1}_z}, \overrightarrow{\mathbf{1}_{vx}}, \overrightarrow{\mathbf{1}_{vy}}, \overrightarrow{\mathbf{1}_{vz}}, \overrightarrow{\mathbf{1}_{ax}}, \overrightarrow{\mathbf{1}_{ay}}, \overrightarrow{\mathbf{1}_{az}}, \overrightarrow{\mathbf{1}_M}, \overrightarrow{\mathbf{1}_Q} \}$

This basis is all we need so that electromagnetic radiation can exist. (see Maxwell equations)

Other laws of nature

A dimension can be considered as a set of possible (= not impossible) values that can be generated by a one-dimensional basis. Those elements can have any property and can be linked with other dimensions in any way, as long that this does not lead to contradictions (= impossible).

So, there is no limitation on laws (properties of dimensions and formulas that link them) that can be defined in a basis, as long that they don't contain or lead to contradictions.

In our reality there are of course also no contradictions. This means that there is a basis that is able to explain all laws of nature in our universe. This "full explanation" includes "classic physics" as well as parts that are usually not considered by "classic physics" but that undeniable exist like feelings and sensation and that are also connected with other physical quantities. If there was no link between them, then:

- the world like described by "classic physics" can not influence "feelings and sensation". (1)
- "feelings and sensation" can not influence the world like described by "classic physics". (2)

It is not difficult to prove that expressions 1 and 2 are false, so basis vectors required for "feelings and sensation" are definitely required for a basis that describes our full reality.

Our universe

It is not a big challenge to put all "classic physics" we currently know (relativity theory, quantum mechanics, weak force, strong force, gravity, …) in a basis like proposed here. Because of proceeding insights this basis can be extended or modified so that it can finally explain all aspects of our reality.

But the set of elements that exist in this basis should of course also match with our universe, and there is still a problem with mass for which the sum is definitely not zero in our universe.

There are however multiple solutions that could explain this. One of the explanations is that our universe is a "sub-universe" of an "entire universe". The "sub-universe" and the "entire universe" exist of course in the same basis, but the sum of the vectors in a "sub-universe" does not necessary equals the absolute zero vector. This is only a requirement for the "entire universe".

Such a scenario is that the starting point of our "sub-universe" is the singularity where our "observable" universe began (see big bang theory). This point can be considered as absolute zero vector, and because the presence of the absolute zero vector is the reason that a universe exists, it should be a valid vector ($\overrightarrow{0'}$ is no element because it corresponds with Ø) in each basis for a universe. So, the absolute zero vector can be the connection between "sub-universes":

- Sub-universe 1: The time after the "big bang", that can be considered as t > 0. The total mass of this "sub-universe" is positive.
- Sub-universe 2: The time before the "big bang", that can be considered as t < 0. The total mass of this "sub-universe" is negative.

The sum of sub-universe 1 and sub-universe 2 should correspond with the absolute zero vector.

There are more explanations possible to explain that the sum of the mass in our "universe" not equals zero, but it would lead to far to discuss them.

Unique solution to explain our universe.

The proposed solution has the full potential to explain all aspects of our universe, and until now there was no other theory that even was a begin of an explanation for why there is something, why there are laws of nature, and how laws of nature work. Based on this, it would be extremely unlikely that the proposed solution is not the one and only solution that explains everything in our universe. But even when the exact match between this model and our reality

is completely clear, there is still a chance that there is an alternative explanation for our reality. To be 100% sure, one should prove that there are no alternative solutions that could explain our reality.
A possible prove could exist out of 2 parts:

1. Prove that if something exists, that it can always be written in a basis.
2. Prove that there are no other mechanisms than the one explained here (equals the existing absolute zero vector) that result in the existence of vectors.

It would lead to far to elaborate on this, but it might be a topic for further investigation.

Conclusion

This is a short introduction that is meant to show that sets of elements comparable with our universe should exist. It offers a new approach to look at our reality. The classic approach starts from observing the reality and make laws that are able to describe reality. In this new approach we prove that there are in infinite number of universes. Identifying the basis and the set of elements that correspond with our universe is then required to give a full explanation of everything in our universe.
Looking at complicated matters, (like our universe) from different angels is one of the most powerful techniques to understand it. The new way to look at our reality is therefore a very efficient and probably the only way to explain all facets of our reality in a thorough way.

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Appendix A. Proves that the absolute zero vector exists.

Prove 1. Based on a property of the empty set, that Ø is unique [4]**.**

Ø = $\overrightarrow{0'}$ *def. (1)*

Ø is unique (2)

Substitution of (1) in (2) => $\overrightarrow{0'}$ *is unique. In other words, there exists precisely 1 absolute zero vector. (If* $\overrightarrow{0'}$ *would not exist, then this would be equivalent with the existence of 0 absolute zero vectors.)*

Prove 2. Logic

We start with two conditional expressions that both lead to the same conclusion: Ø exists.
Logically at least one of the following two conditional expressions is true. => Ø exists (unconditionally)

- *Expression 1: "No elements" exists (1)*
  "No elements" is equivalent with Ø (2)
  Substitution of (2) in (1) => Ø exists (3)
- *Expression 2: There are elements that exist.*
  Choose an existing element a
  {a} exists (4)
  {a} = {a} U Ø (5)
  Substitution of (5) in (4) => ({a} U Ø) exists
  => Ø exists (6)
  At least one of conditional conclusions (3) and (6) is true
  => Ø exists (unconditionally) (7)
  Ø = $\overrightarrow{0'}$ *(8)*
  Substitution of (8) in (7) => $\overrightarrow{0'}$ *exist*

Prove 3. Reality (per construction)

Consider a one-dimensional basis for forces ($\vec{0}$ *correspond with Ø).*
We can now consider an ***existing situation*** *with "no forces". (1)*
"No forces" (Ø) correspond with $\overrightarrow{0'}$ *(2)*
Substitution of (2) in (1) => existing situation with $\overrightarrow{0'}$ *=>* $\overrightarrow{0'}$ *exist*
Add another basis vector to this basis wherefore $\vec{0}$ *correspond with Ø. (e.g. electric field). We can now consider an* ***existing situation*** *without electric field and without force. =>* $\overrightarrow{0'}$ *for this two-dimensional basis exists. Repeat this operation for all basis vectors where (*$\vec{0}$ *correspond with Ø). Note that the basis vectors can be added in an arbitrary order. =>* $\overrightarrow{0'}$ *exists (for all basis where* $\vec{0}$ *correspond with Ø)*

Addendum

Multisets

Some people might think that this text has one way or another something to do with multisets. E.g. that {5 apples} is no set, but a multiset. Here are just a few reasons why this idea is not to the point.

- This counter argument goes against the definitions of set and multiset.
  https://en.wikipedia.org/wiki/Multiset
  https://en.wikipedia.org/wiki/Set_(mathematics)

  - {7 Euro, 2 pears} is a set (and because a multiset is a generalization of sets, it is of course also a multiset)
    Reason: Elements of a set can be anything and the elements of the set are different.
  - {7 Euro, pear, pear} is a multiset and no set.
    Reason: It is not allowed for a set that elements appear more than once.

- This thesis goes against the generally accepted use of sets.
  {2 $\vec{v}$} is everywhere accepted as a valid set.

- This thesis conflicts in many ways with logic and common sense.
  - {2 $\vec{v}$} should be no set, and {$\vec{u}$} should be a set, but what if $\vec{u}$ = 2 $\vec{v}$?
  - What do we do with 1000 kg sand?
    This is for some people no valid set. But if we call it 1-ton sand, is it then a valid element of a set?
  - Maybe we have to consider the sand grains. How hard do we have to push the sand so that it can be considered as one block? In which axiom's is this kind of stuff written?
  - How are we going to write 1000 stones?
    {1000 stones} is not allowed as element of a set, and with the syntax of multisets we have a lot of writing work {stone, stone, …, stone}
  - …

- Also { 5 apples, 2 apples } is a valid set.
  - **Prove:**
    As shown { 5 apples } and { 2 apples } are both valid sets.
    When applying the definition of a union on both sets one get:
    { 5 apples } U { 2 apples } = { 5 apples, 2 apples }
    The union of sets is a set, and nowhere is written that it is not allowed to do a union of the sets above.
  - Or just stick to the definition of sets.
    https://en.wikipedia.org/wiki/Set_(mathematics)

- Multisets are used for a completely different purpose than what users of this argument think. It has nothing to do with the topic of this text. I will not elaborate on it, but multisets are for example indispensable to note things like results …
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