the general science journal

# NOTIONS OF METROLOGY FOR SPACE AND TIME AT DISCONTINUOUS DIMENSIONS

Author: Giordano Serafin
giordasera@tin.it

**ABSTRACT**
An innovative type of metrology originates in a pair of measurement units termed MIN-S and MIN-T, inherent respectively to space and time, which are hypothesized as being ultra-microscopic and minimal in the absolute sense, that is they are without submultiples, despite being of finite extension.

The description of physic phenomena mediated by such a metrological expedient allows us to obtain, in a completely autonomous manner, the mathematical expressions of the following physical situations, tightly linkable to the theory of the relativity by Einstein:
- Additive and subtractive kinetic composition which establish a maximum speed level equal to the velocity of the light
- Perfect equivalence between mass and energy.
- Minimal threshold of kinetic energy, equal to $10^{-19}$ Joule, which compels the microscopic masses to a continuous and inevitable motions.
- Mass and energy which give a result tending to infinity at the velocity of the light.

## References

| | |
|---|---|
| M. Born | Einstein' s Theory of Relativity |
| J. Andreade e Silva | Les Quanta |
| E. Parzen | Modern Probability Theory |
| R. Feynman | QED – The strange theory of light and matter |
| R. Feynman | Six not so easy pieces |

**0 – Introduction** - All physical phenomena can be identified by space and time. Namely, they take on an intelligible representation through precisely these dimensions to be understood as fundamental: spatiality that extends across three isotropic magnitudes (length, breadth and height) and temporality, an anisotropic magnitude, that develops in a single direction.

A function, that is a diagram which mathematically connects space and time, actually becomes a geometry and this can represent the portrayal of a physical phenomenon. If, for example, we consider the linear function $s = \mathbf{z}\, t$ , where $s$ stands for space, $t$ for time and $\mathbf{z}$ for a numerical constant, it means that equal spaces are gained in equal time; in other words a constant velocity is carried out, and for this reason it can be interpreted by a straight line which represents its evolutionary diagram.

However, not all functions stand for a physical phenomenon: on the contrary, there are many more possible representations than experimental correlations. Nevertheless, once the trend of a physical manifestation is known, it is important to research what its mathematical representation could be, and thus establish its diagram.

When the diagram is identified precisely it simplifies research work enormously since it is able to simulate the past present and future of the physical events gathered under the observation, transferring them from the empirical to the more economic field of geometry.

However, it is important to note that at the basis of every diagram, or rather of every function representing phenomena, there is the need to pass to numbers for the variables involved. Thus for the equation given above it is necessary to transform space and time into numbers in order to verify beyond doubt that, in the version $\mathbf{z} = s / t$ the value of the quotient $s / t$ really is a numerical constant, as $\mathbf{z}$ itself demands. Thus the passage into numbers for space and time becomes an essential condition to retrace the laws of physics, that is to verify the correspondence between the suppositions successively advanced and real behaviour observable in different phenomenological sectors.

It is easy to understand that as the precision in translating space and time into numbers becomes greater, the relations between the body of the hypotheses formulated and the physical reality under investigation can be more detailed. Nevertheless, the passage into numbers involves carrying out appropriate measurements and therefore being able to use suitable measurement units for the magnitudes involved, working in the most accurate way possible.

Accuracy of use is only a matter of technology, but the choice of measurement sample necessarily implies a concept which precedes all other actions. In other words it requires a “philosophy” and therefore a cognitive condition under which, in the field of scientific developments, it is necessary to designate special identification processes to the measurement samples and in particular to those inherent to space and time.
It is a historical fact that, in the development of its logic, geometry resorts to postulates. These postulates have the difficult task of taking the first step towards the speculative direction which they feature. Postulates are chosen, antecedent, necessary to the identification and demonstration of theorems upon which the type of development of logic depends, their contribution is so essential that different postulates correspond to different hypothetical-deductive structures.

## 1 – Two discordant postulates

The best known postulate is that of Euclid ($3^{rd}$ Century BC) according to which a point external to a straight line can be intersected by only one parallel to the given straight line. This condition is apparently evident if it were not for the fact that it is overcome by riemannian geometry. Therefore a postulate is a non-demonstrable proposition even though it sometimes appears evident. It is accepted exclusively as a foundation of a certain theoretical process, that is as a presupposition of a reasoning.

In truth, the title of this chapter 1 is not quite correct. In fact, the characteristic of every postulate is that it can be equally true and false, and therefore not in discord with any other, but here we wish to emphasise the way in which reasoning can greatly diverge if they spring from different presuppositions. The two postulates examined in these pages refer in the first case to the continuity of space and time, and in the second case to the discontinuity that can theoretically be attributed to them.

### 1A – Postulate of continuity of space and time

Although the continuity of space and time cannot be demonstrated, it is universally accepted both in classical and contemporary physics. It is normally taken as true that these two dimensions can be infinitely split by ever reducing intervals of length, that is tending to zero, in an endless process towards the null value, which however can never be reached. Let us consider, for example, a straight segment of any small length. Defining its extension means identifying it quantitatively using a measurement method, i.e. a function which establishes a distance for each pair of points belonging to the segment. In this way the segment is considered a continuous magnitude if, according to mathematical concepts, it also contains at least one other smaller segment.

Mathematicians define this property very accurately, specifying that the segments must be open, that is without extremity points. In practice the segment (**a**, **b**) is understood to be open when it is made up of the set of points (x) satisfying the following relation:

$$\mathbf{a} < x < \mathbf{b} \qquad \text{1A - 1}$$

where the points **a** and **b** are excluded, since they are extraneous elements without dimension and therefore cannot be evaluated in a divisibility sense. Of a similar nature to the concept of continuity of space and time, physical entities such as velocity, acceleration and force also become continuous magnitudes.

### 1B – Postulate of discontinuity of space and time

A simple example of discontinuous magnitude is illustrated by the weight of a load of bricks. The weight is given as a certain number of kilograms and this number can vary up or down by adding or removing bricks.
If every brick weighs 2 kg, the total weight of the load can only vary by multiples of 2 kg and under no circumstances can it vary by a lower quantity. For this reason we can say that the weight of a load of bricks is a discontinuous quantity and the smallest variation it can undergo independently of its global value is called the *weight quantum.* Likewise, in the case of space and time we can hypothesise that these dimensions could be sets of spatial and temporal *quanta* respectively. In practice the postulate of discontinuity is used as a presupposition of one of their particular compositions, since it is neither true nor false and completely impossible to demonstrate,.

From this point of view, space and time are considered as dimensions that are not infinitely divisible and which allow, each in its own sphere of action, an "atom" of their extension. If we call the minimum spatial interval MIN-S and the minimum time interval MIN-T, then space and time appear as quantized sets which can in no way vary by quantities lower than the said minimal extensions.

Obviously MIN-S and MIN-T must be considered of such minute entity that they cannot be assessed even by the most sophisticated research instruments. Furthermore, following the explanation above, they cannot feature submultiples, that is they must not contain an open segmentation smaller than themselves.

**2- Consequences of discontinuity of space and time**

For the two postulates quoted above to be un-demonstratable in the scope of infinitesimal extensions, would not seem to be of great conceptual impact. But on the contrary, as we will later see, they give rise to great interpretative diversities. For this purpose, let us hypothesise that if MIN-S and MIN-T intervals were physically available, the first as a linear segment and the second as the duration measurable by a chronograph; they could be expressed by the following graphs:

———————— ————————

MIN-S MIN-T 2.1

both without extremity points. The quotient of these magnitudes, that is MIN-S / MIN-T, identifies a velocity which, as will soon be explained, is unique and represents a universal constant able to exclude any other velocity. In fact, if a lower velocity were to exist, it would carry out a space shorter than MIN-S in the time MIN-T, which as we have already seen, cannot theoretically exist. Similarly, a greater velocity carried out in a MIN-S space would require a time lower than MIN-T, which is just as conceptually unacceptable. Therefore the velocity MIN-S / MIN-T, known as dyadic velocity or **Vd**, reveals itself as comparable to the velocity of light in its relativistic meaning: an unvarying magnitude when examined under any reference system.

The fact that **Vd** excludes every other velocity would seem in contrast with the evidence of most common practice, but the explanation for this paradox can be found in a possible execution of kinetic intermittences, that is of advancements carried out in multiples of MIN-S interspersed with arrests of multiple durations of MIN-T. In other words, every velocity lower than **Vd** must be considered as the result of a composition of limited tracts of movement carried out at dyadic velocity, separated by moments of immobility. Thus the trend gives rise to an average which is always lower than **Vd**. In this way all velocities lower than the dyadic, when in ratio to it, are obtained by intermittences expressed by the following formula:

$$[\,L\ \text{MIN-S}\ /\ (L + R)\ \text{MIN-T}\,] = \boldsymbol{v} \qquad 2.2$$

where L and R are whole numbers.

In addition it is important to note that intermittent velocities greater than **Vd** cannot exist since they would bring about the inequality $L > (L + R)$ which is clearly a contradiction.

Recognising the affinity between **Vd** and the velocity of light, we can maintain that the quotient MIN-S / MIN-T brings about an approximately valid value for both, and if we hypothesise the extension of MIN-S equal to $10^{-30}$ metres and MIN-T equal to $10^{-38} / 3$ minute seconds, we obtain the following result:

$$\text{MIN-S} / \text{MIN-T} = 10^{-30} / (10^{-38} / 3) = 3\,.10^{8}\ \text{metres/sec} \qquad 2.3$$

close to the two given velocities..

**3 - Absence of inertial forces in velocities lower than Vd**

In the passage from a MIN-T arrest to a MIN-S tract or vice versa, the intermittent velocities cause an instantaneous variation which passes from a state of immobility to a motion at **Vd** velocity, or vice versa.

On a macroscopic level, for both of the above cases a similar kinetic condition would lead to an infinitely strong acceleration, causing a similarly infinite force. However, if we observe the same passage from the point of view of the minimal dyad ( 1 MIN-S, 1 MIN-T ), the quantification would require measurement units for space and time with lower extension than the same MIN units, that is such a measurement would require their submultiples which, as has already been noted, are inadmissible. Thus, because of this dimensional exclusion, any possibility of evaluating the acceleration mentioned above is impossible, that is, it is devoid of meaning, including that of giving value to inertial forces in velocities lower than **Vd**

## 4 – Concatenation of units of measurement for space and time

As is shown above, during each movement, only two velocities can take place: the dyadic and the null, i.e. immobility. All this means with extreme clarity that once a certain unit of measurement has been established for space, only one unit of measurement for time correlated to it can exist. In fact, if this were not the case, we could obtain velocities with non-intermittent features different from **Vd** itself, in contradiction with the hypotheses set forth so far. Inversely, the same kinetic condition also stands; that is for every time measurement unit there is only one, unique, space measurement unit. In conclusion, the measurement samples which permit us to respect the quantization of space and time belong to the following set of pairs:

$$\mathbf{Dn} = (\mathbf{n}\ \text{MIN-S},\ \mathbf{n}\ \text{MIN-T}) \qquad 4.1$$

with $\mathbf{n} \in N$ ; where N is the set of cardinals without zero.

All the pairs obtainable from formula 4.1 are known as dyads, and as such they are considered the only pairs of spatial-temporal measurement units able to describe physical phenomena which respond to the above-given constancy of **Vd** and to the intermittence of lower velocities. For instance, with $\mathbf{n} = 1$, $\mathbf{n} = 10^{30}$ and $\mathbf{n} = 3.10^{38}$ we have, as linked pairs of measurement units, the followings three dyads: [1 MIN-S; 1MIN-T], [$10^{30}$ MIN-S = 1 meter; $10^{30}$ MIN-T = $10^{-38}$ / 3 second] and [$3.10^{38}$ MIN-S = $3.10^{5}$ Km; $3.10^{38}$ MIN-T = 1 second]
Each dyad expresses different quantitative values for a single physical entity and therefore the world of reality takes on a variety of aspects, all perfectly valid in spite of their quantitative diversity

## 5 – Varying and unvarying physical entities of the dyadic scale

The moment has come to identify what happens to certain physical entities when they are quantified at different positions on the dyadic scale, or rather which numeric magnitude they take on relating to dyads and therefore the jointly linked measurement units of the scale itself. It is necessary to state in advance that physical entities are divided into two categories. The first contains those that are unvarying and the second the varying which tend to change their own quantitative value numerically.

We must remember that every entity is quantified using its "part", known as the unitary sample, in function to the number of times it is contained in the entity itself. The term "part" is in inverted commas since it can be algebraically greater than the magnitude to be measured. For example, a segment takes on the quantitative value of **Q** according to the times the length sample covers it completely, as shown in the following relation

$$\mathbf{Q} = \text{segment / sample} \qquad 5.1$$

It is clear that 5.1 expresses arithmetically inverse behaviour between the measurement sample extension and the magnitude **Q**. The greater the sample, the lower the value given by the measurement.

Spatial and temporal intervals are a typical example of entities which are quantified in inverse proportion to their measurement units. Therefore it is easy to understand that they are quantified by greater numbers towards minor dyads, and by lower numbers towards greater dyads. From this fact one can deduce that velocity, given by the quotient of space over time, is a dyadically unvarying magnitude. In fact, in accordance with 4.1, these two dimensions mutate in unison to the numerator and the denominator of the same quotient respectively, leaving it unchanged.

Force is also a dyadic invariant because, as in the case of a weighing scale upon which all types of force can work, it depends on a ratio between two lever arms, which does not vary as the measurement unit used to quantify both their lengths changes.

Energy varies in close analogy with space. In fact, its formula $e = \boldsymbol{F} s$ depends exclusively on space itself, since force is invariant. Thus every energy form is an entity which takes on greater quantification at minor dyads and lower quantification at greater dyads. On the other hand, acceleration and frequency of a periodic phenomenon follow an inverse trend. They grow with greater dyads and diminish at lower dyads since they come respectively from the formulae $s / t^2$ (where $s / t^2$ is numerically equal to $1 / t$ for formula 4.1) and $1 / t$ both with invariant numerators, while the denominators, being variant, confirm the cited inverse results (see the meanings of the symbols in the table 1 below)

Algebraically equal behaviour to that above is shown by angular velocity and centripetal acceleration. Their respective formulae $v / \mathrm{r}$ and $v^2 / \mathrm{r}$ use the denominator to show the unit of space measurement instead of that of time, whose variance is such that it brings about the same result given above. ( r = curvature radius)
Mass, identified by the formula $m = \boldsymbol{F} / a$, is clearly a physical entity with quantitative trend contrary to that of acceleration, since the second is given as the denominator. Therefore, in the scale of dyads, mass changes

in the same manner as space and time. The following table 1 summarises the dyadic features explained above.

**TABLE 1 OF DYADIC FEATURES**

| Entity | Symbol | Formula | Quantification at minor dyads | Quantification at greater dyads |
|---|---|---|---|---|
| Space | $s$ | | + | _ |
| Time | $t$ | | + | _ |
| Mass | $m$ | $\boldsymbol{F} / a$ | + | _ |
| Energy | $e$ | $\boldsymbol{F} s$ | + | _ |
| | | | | |
| Force | $\boldsymbol{F}$ | $m\, a$ | = | = |
| Velocity. | $\boldsymbol{v}$ | $s / t$ | = | = |
| | | | | |
| Acceleration | $a$ | $s / t^2$ | _ | + |
| Angular V | $\boldsymbol{v}_a$ | $\boldsymbol{v}$ / r | _ | + |
| Centripetal ac | $a_c$ | $\boldsymbol{v}^2$ / r | _ | + |
| Frequency | $f$ | $1 / t$ | _ | + |

The symbol + shows an increase, the symbol _ a decrease and the symbol = no variation in the passage from one dyad to another. ( r = curvature radius)

**6 - Composition of velocities.**

The term which exhaustively distinguishes every intermittent velocity is the quotient L / R, the mathematical division between the entire L sequence of the MIN-S motions, named “steps” and the entire R sequence of the MIN-T immobility durations, named “stops” in compliance with the following relation for formula 2.2:

$$L / R = \mathbf{v} / ( 1 - \mathbf{v} ) \qquad 6.1$$

Where $\boldsymbol{v}$ stands for a speed in ratio to dyadic velocity, to which the unitary value is attributed.
By summing two of the said quotients, respectively valid for any two velocities $\boldsymbol{v}_1$ and $\boldsymbol{v}_2$ acting in the same direction, we obtain the expression below:

$$\boldsymbol{v}_1 / (1 - \boldsymbol{v}_1) + \boldsymbol{v}_2 / (1 - \boldsymbol{v}_2) = [\boldsymbol{v}_1 (1 - \boldsymbol{v}_2) + \boldsymbol{v}_2 (1 - \boldsymbol{v}_1)] / [(1 - \boldsymbol{v}_1) (1 - \boldsymbol{v}_2)] \qquad 6.2$$

By taking the denominator of the above and adding its own numerator, we obtain a quotient of 2.2 type, denoting the following velocity:

$$\boldsymbol{v}_1 (+) \boldsymbol{v}_2 = [\boldsymbol{v}_1 / (1 - \boldsymbol{v}_1) + \boldsymbol{v}_2 / (1 - \boldsymbol{v}_2)] / [(1 - \boldsymbol{v}_1) (1 - \boldsymbol{v}_2)] + [\boldsymbol{v}_1 (1 - \boldsymbol{v}_2) + \boldsymbol{v}_2 (1 - \boldsymbol{v}_1)] \qquad 6.3$$

which can be simplified into the formula

$$\boldsymbol{v}_1 (+) \boldsymbol{v}_2 = (\boldsymbol{v}_1 + \boldsymbol{v}_2 - 2\boldsymbol{v}_1\boldsymbol{v}_2) / (1 - \boldsymbol{v}_1\boldsymbol{v}_2) \qquad 6.4$$

where the symbol (+) stands for the additive composition.
Formula 6.4 represents the sum of the two velocities $\boldsymbol{v}_1$ and $\boldsymbol{v}_2$ when they take on values from zero to **Vd**, these last included.

Using an algebraic procedure completely similar to the previous one, the subtractive composition of two velocities leads to the following formula:

$$\boldsymbol{v}_1 ( - ) \boldsymbol{v}_2 = ( \boldsymbol{v}_1 - \boldsymbol{v}_2 ) / ( 1 - 2\boldsymbol{v}_2 + \boldsymbol{v}_1\boldsymbol{v}_2 ) \qquad 6.5$$

where the relation $\boldsymbol{v}_1 \geq \mathbf{v}_2$ is applied, while the symbol ( – ) stands for subtractive composition.
Formulae 6.4 and 6.5 have noteworthy features, the first indicating that the additive composition never gives results greater than **Vd** and both specify that if $\boldsymbol{v}_1$ , or $\boldsymbol{v}_2$ are equal to dyadic velocity their result is equal to it, in keeping with **forecasts from relativistic mechanics**. Furthermore, in the case of $\boldsymbol{v}_1 = \boldsymbol{v}_2 =$ **Vd**, the calculation becomes indeterminate, that is zero over zero, precisely because of the impossibility of recognising whether the two velocities are to be added or subtracted. In fact only one of the velocities needs to be equal to **Vd** to determine identical and indistinguishable solutions to both the said formulae.

**7 - Extensions of L and R parameters**

Parameters L and R are composed by sequences of MIN-S motions and sequences of MIN-T durations, that is they are respectively made up of a number of "steps" and "stops" emerging from the following formulae:

$$L = h / m ( 1 - \boldsymbol{v} ) / \boldsymbol{v} \quad \text{quantity of MIN-S "steps"} \qquad 7.1$$

$$R = L ( 1 - \boldsymbol{v} ) / \boldsymbol{v} \quad \text{quantity of MIN-T "stops"} \qquad 7.2$$

where h stands for the Planck constant and *m* for mass, both calculated in MIN measurement units, and the velocity ***v*** is in ratio to the dyadic speed. (see Conversion Factors)

It is necessary to note that the formula 7.1 refers to the incontestable relation of indeterminacy by Heisenberg given by: $\Delta x \, \Delta v \geq h / m$ . The term $\Delta x$ represents an indeterminacy in the measurement of the exact position of a body in motion. Therefore the said term can be compared to the entire extension of an L sequence which is completely devoid of discernible spatial elements. ( MIN-S has neither internal nor extremity points). Where as the term $\Delta v$ corresponds to the indeterminacy in measurement of the exact value of a velocity established by formula 2.2; i.e. this term can be assumed into the quotient L / R , since every MIN-S "step" is also devoid of specific internal velocities compared to R which, on the other hand, expresses a precise velocity, that is, immobility.

By substitution into the Heisenberg relation, we obtain the following expression: $L . L / R = h/m$, where the disequality sign is disregarded, and from which we have the cited formula 7.1, holding in consideration that $L / R = \boldsymbol{v} / ( 1 - \boldsymbol{v} )$ . Moreover, formula 7.2 is the result of 7.1 combined with 2.2. We can observe that the formulae 7.1 and 7.2 seem to introduce apparently paradoxical results in the case where velocity takes on a unitary or null value. In fact, for these values they give results equal respectively to zero or infinity, contrary to the kinetic conditions to which they are applied.

In the first case, relating to unitary value velocity but with a null result, the incongruity is solved by taking into account that no mass, no matter how small, can ever reach dyadic velocity. In the second case, relating to null velocity but giving the result of infinity, the incongruity is solved if we take into account that the parameter R , revealing the condition of immobility, is forced to allow a maximum limit beyond which dyadic intermittence is unsustainable due to an excessive arrest time, and this theme will be covered as below described.

**8- Minimal velocities**

Formulae 7.1 and 7.2 indicate that if a mass is stressed to the velocity ***v***, it is forced to carry out movements made up of sequences of MIN-S "steps" of a quantity equal to L, interspersed with arrests made up of sequences of MIN-T "stops" of a quantity equal to R. This intermittent trend is repeated cyclically for the entire expression time of the velocity ***v***.

The term L does not demonstrate any extension limitations, at most it can be identified with the dyadic velocity **Vd** which corresponds to an uninterrupted sequence of MIN-S "steps"; whereas the dimensional level of the term R, can cause de-structuring in the motion's of the dyadic intermittence, as explained below. If the term R increases beyond a certain limit at low velocities, since it is inverse to the velocity itself, periods of immobility can occur of such length that they provoke the arrest of the motion. The question to be asked is the following: what is the kinetic threshold limit, known as **Vt**, below which the term R causes de-structuring of dyadic intermittence ?

It is clear that, using a completely practical and simplified view, the velocity **Vt** corresponds to an R between the duration of a single MIN-T and that of the minute second in which there is certainly an arrest. Therefore the R itself can be considered relative to an average time included between the powers of $10^0 = 1$ MIN-T and $3 \,.10^{38} = 1$ minute second, which are the respective extensions taken from the Conversion Factors. Therefore this time can plausibly be expressed by the average value of $10^{24}$ MIN-T, that is having a duration of approximately one hundredth of a billionth of a minute second, as a maximum interval of immobility acceptable in the execution of an dyadic intermittence.

For this temporal interval the formula 7.2 is transformed as follows.

$$R = h / m \; [ (1 - \boldsymbol{v}) / \boldsymbol{v} ]^2 = 10^{24} \qquad 8.1$$

from which the following reciprocal is obtained:

$$h / 2 .10^{24} = m / 2 [ \boldsymbol{v} / (1 - \boldsymbol{v}) ]^2 = m \boldsymbol{v}^2 / 2 = e \cong 10^{-19} \text{ J} \qquad 8.2$$

where $e$ represents a level of kinetic energy in SI units, which is valid for all masses stressed to velocities not close to that of light; the algebraic passages are as follows:

$h / 2 .10^{24} = ( \underline{6,63 .10^{-34}} / ( 2 .10^{24} .10^{-38} / 3 ) = 3 . \underline{6,63 .10^{-34}} / 2 .10^{-14} \cong 10^{-19}$ ; with the Planck constant underlined and where the fraction ($10^{-38}$ / 3 ) represents the relationship among 1 MIN-T and 1 minute second.

In conclusion, formula 8.2 shows that macroscopic masses can reach the energy of $10^{-19}$ Joule by almost imperceptible velocities, whereas microscopic masses require very high velocities to establish an R equal to $10^{24}$ MIN-T.

Let us consider as examples two masses made up of the average human weight and that of the electron.
In the calculation, the quotient h / *m* uses the Planck constant as the numerator, defined in Joule per second, and uses for its denominator the mass in kilograms, transformed as in the Conversion Factors with the term $10^{22}$ / 3 in order to pass from SI to MIN measurement units. If this term is applied to formula 8.1, for an average weight of 66 kg, the **Vt** limit velocity corresponds to the motion of approximately one micron every hundred prime minutes. This value is virtually impossible to perceive, whereas the same calculation using the mass of the electron obtains a **Vt** limit velocity equal to approximately 466 km / sec.

One can observe that below these kinetic thresholds any velocity is not quantifiable and the meaning of this statement is not based on the technical difficulties in measurement but in the total lack of significance in the quotient of space over time when R exceeds the value of $10^{24}$ MIN-T.

The calculation of **Vt** is carried out using formula $[(1 - \boldsymbol{v}) / \boldsymbol{v}] = (m / h)^{1/2} .10^{12}$ , and to which the equivalence $\boldsymbol{v} = 1 / \{1 + [(1 - \boldsymbol{v}) / \boldsymbol{v}]\}$ is applied.

We must note that the said minimal threshold of kinetic energy, equal to $10^{-19}$ Joule, compels the microscopic masses to continuous and inevitable motions.

**9 - Equivalence of mass and energy**

A specific dyad such as that made up of one linear metre, as its spatial component, determines unequivocally a temporal unit, said t* , equal to $1/3 .10^{-8}$ minute second. In fact, only in this case, the quotient of the spatial unit over the temporal unit coincides with the dyadic speed itself. Every dyad is a pair composed of the same number of elements MIN-S for space and MIN-T for time, (See formula 4.1), and consequently an important condition results: both the metre and the brief time t* are entities containing equal quantities, according to type, of the elements MIN-S and MIN-T. This condition can be summarised in the following numerical equality:

$$n = s = t^* \qquad 9.1$$

where n represents a certain number of MIN-S or MIN-T elements and s stands for one metre.
Now it is not important to know the exact value of n , whereas it is interesting to examine the following algebraic developments. The dimensional formula of mass is established in the following expression:

$$m = \boldsymbol{F} / a = \boldsymbol{F} ( t . t / s ) \qquad 9.2$$

where *m* indicates the mass and ***F*** the constant force it sustains; whereas *a* stands for acceleration, *t* for time in minute second and finally s stands for space in metres.

If we substitute the unit represented by minute second with t*, as a unit of temporal measurement and therefore equal to one, 9.2 becomes the following equation:

$$m = \boldsymbol{F} ( t^* / \mathbf{c} ) ( t^* / \mathbf{c} ) ( 1 / s ) \qquad 9.3$$

where **c** indicates the number $3 .10^8$.

From 9.3 we obtain:

$$\mathbf{c}^2 \, m \; = \; \boldsymbol{F} \, ( t^* \, . \, t^* / s ) \qquad 9.4$$

and 9.1 renders the following formula:

$$( \mathbf{c}^2 \, m ) \; = \; \boldsymbol{F} \, s \; = \; e \qquad 9.5$$

where $e$ stands for energy and the term ( $\mathbf{c}^2 \, m$ ) represents the value of the mass itself through the measurement units of the metre and the time-span t* .

It is easy to demonstrate that 9.5 is valid for all dyads, independent of the extensions of their space-temporal components, whereas in the case of an unique measurement unit established by the only meter, as for the second part of 9.5 where t* misses, this formula becomes **the well-known equivalence coined by Einstein**

**10 - Quantification of kinetic energy**

When a microscopic mass, generally inferior to around $10^{-12}$ Kg, overcomes the speed pointed out by the following formula:

$$( m / \mathrm{h} )^{1/2} \; = \; (1 - \mathbf{Vs}) / \mathbf{Vs} \qquad 10.1$$

that has been drawn since 7.2 setting the parameter R to the unitary value, the following condition it is verified:

$$\mathrm{L} > 1 > \mathrm{R} \qquad 10.2$$

In such way, while the parameter L maintains its composition by “steps” MIN-S, the parameter R should be reduced to less than one “stop” MIN-T, if this were not in contrast with the note impossibility of its subdivision in sub-multiples.

In order to prevent this incongruity, it is therefore necessary for the velocities greater than **V**s to be supported by dyads of greater extension compared to the minimal (MIN-S, MIN-T); or as can easily be argued, carried out in extensions space-temporal equal to the inverse of R. The following example should be noted: for a h / $m$ = 1 and a velocity of **V**d / 2 , the parameter R is, for the formula 7.1, exactly equal to one MIN-T; while for a speed of 10 / 11 of **Vd**, R reduces to one hundredth of MIN-T. Therefore if the supporting dyad of this velocity is that made up of (100 MIN-S, 100 MIN-T) , the reduction of its temporal unit to one hundredth does not affect the integrity of the single MIN-T.

This solution might seem rather imaginative to the reader, but the exchange of dyads is a normal dimensional application for any physical phenomenon. In fact, the passage from one dyad to another is a fundamental characteristic of the dyadic system and specifically a quality that is valid for the comprehension of reality. However, in the changes of dyads it is necessary to give special attention to the quantitative variations they introduce; in particular, in the passage from a lower dyad to a greater dyad both kinetic energy and mass must be quantified as many times more as those of greater dyadic extension, strictly necessary for the maintenance of integrity in the single MIN-T.

Therefore, in the example above relating to the velocity equal to 10/11 of **V**d, the mass must necessarily be increased one hundred times, since it is underestimated by the dyad with greater extension.
More in general, its quantification in MIN units complies with the following formula:

$$m \; = \; \mathrm{m}° \, . \, 1 / \mathrm{R} \; = \; \mathrm{m}° \, . \, \{ (\mathrm{m}° / \mathrm{h}) \, . \, [\mathbf{v} / (1 - \mathbf{v})]^2 \} \qquad 10.3$$

where m° stands for the mass at rest and **v** for those velocities greater than **V**s.

The value of energy in MIN units also follows the same increase and the formula which expresses it becomes:

$$e \; = \; (\mathrm{m}° \, \mathbf{v}^2 / 2) \, . \, \{ (\mathrm{m}° / \mathrm{h}) \, . \, [\mathbf{v} / (1 - \mathbf{v})]^2 \} \qquad 10.4$$

From the two formulae 10.3 and 10.4 we obtain an increase both of mass and energy which tends to infinity with the dyadic speed, a result similar to the **relativistic** **mechanics** under the condition, however, that only velocities greater than **V**s are expounded. On observes that the macroscopic masses, which well hardly satisfy to the formulas 10.1and 10.2, seem to be excluded from the supplementary increases above mentioned

**11 -- Conversion Factors**

The conversion factors below depend directly on MIN magnitudes, hypothesised as $\mathbf{10^{-30}}$ metres for the spatial unit MIN-S and as $\mathbf{10^{-38}/\,3}$ minute seconds for the temporal unit MIN-T. Such factors are defined in the numerator by the MIN units and in the denominator by SI units (metre, minute second) each referring to the following magnitudes:

$h = 3.10^{68}/1$; $h/m = (10^{22} / 3) / 1$; $e = 10^{30}/1$; $f = 1 / 3.10^{38}$; $m = 9.10^{46}/1$; $a = 1/ 9.10^{46}$.

Let us take the example of the ratio, h / *m* which contains the Planck constant as the numerator, defined in Joule per second, and mass in kilograms as the denominator. Its literal expression becomes as follows:

$$J\, s / Kg = \mathbf{N}\, s\, t / \mathbf{N}\, ( t^2 / s ) = ( s / t ) . s$$

where **N** indicates the measurement unit of force which is simplified in the fraction, whereas *s* stands for space, *t* for time, the parenthesis $( t^2 / s )$ for the reciprocal of the acceleration.
Therefore the relation ( s / *t* ) . *s* takes on the following quantification: $(10^{30} / 3 .10^{38}) . 10^{30} = 10^{22} / 3$ , as given above.

As a second example, let us consider the mass *m* with the literal expression as follows:

$$m = \mathbf{N} / a = \mathbf{N}\, ( t^2 / s ) = [( 3 .10^{38} )^2 / 10^{30}] = 9 .10^{46}$$

where **N** stands for the unit of force, which to be an unvarying magnitude is simplified.