Adventures in universes of the Multiverse applying the theory of exploded numbers

In memory of Giordano Bruno (1568 – 1660)

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ABSTRACT.: *Using exploded numbers we consider the exploded three-dimensional space as a mathematical model of the Multiverse. Our universe is only one among the three-dimensional individual universes of the Multiverse. We use the concept of box – phenomenon of objects outside our universe. Applying a shift coordinate transformation we investigate the shifted box – phenomena of a given super-passage selected from different individual universes of Multiverse. We show that the same part of a given super-passage looks differently s depending on the individual universes*

Introduction

We visualise our universe as the familiar three-dimensional Euclidean space

$$\mathbb{R}^3 = \left\{P = (x, y, z) \middle| \begin{Bmatrix} -\infty < x < \infty \\ -\infty < y < \infty \\ -\infty < z < \infty \end{Bmatrix}\right\},$$

with its well-known apparatus, with the ordered field $(\mathbb{R}, \le, +, \cdot)$ of real numbers, where the set of real numbers is denoted by $\mathbb{R}$.. The set of exploded numbers is denoted by $\breve{\mathbb{R}}$. The genesis of exploded numbers is described in [1]. (See, Chapter 2.) The important definitions a theorems are collected in the Introduction of [2]. Here we mention the main points. For any $x \in \mathbb{R}$ its exploded is denoted by $\breve{x}$.. The set $\mathbb{R}$ is a proper subset of $\breve{\mathbb{R}}$. In this paper for any $x \in]-1,1[$ its exploded is defined by

(0.1) $$\breve{x} = \tanh^{-1} x \left(= \frac{1}{2}\ln\frac{1+x}{1-x}\right).$$

If $x \in \mathbb{R} \setminus]-1,1[$ the $\breve{x}$ is called invisible exploded number, temporarily.

The set $\breve{\mathbb{R}}$ has an algebraic structure with the super – operations

(0.2) $$\breve{x} \overline{\oplus} \breve{y} = \widetilde{x + y} \quad ; x, y \in \mathbb{R}$$

(0.3) $$\breve{x} \overline{\odot} \breve{y} = \widetilde{x \cdot y} \quad ; x, y \in \mathbb{R}$$

are called super – addition and super – multiplication, respectively.

For any pair $\breve{x}, \breve{y} \in \breve{\mathbb{R}}$ we say that $\breve{x} = \breve{y}$ if and only if $x = y$ and $\breve{x} < \breve{y}$ if and only if $x < y$. Hence, we have that $\left(\breve{R}, \le, \overline{\oplus}, \overline{\odot}\right)$ is an ordered field which is isomorphic with $(\mathbb{R}, \le, +, \cdot)$. The unit element of super-addition is $\breve{0} = 0$ and of super- multiplication is $\breve{1}$ an invisible exploded number. For any $x \in \mathbb{R}$ then (0.2) with (0.1) yield that $\breve{x}\overline{\oplus}\widetilde{(-x)} = 0$. Moreover, if $x \in]-1,1[$ then we have the identity $\widetilde{(-x)} = -\breve{x}$. So, we may denote the super – additive inverse by $-\breve{x}$ for any $x \in \breve{\mathbb{R}}$. (If $x \in]-1,1[$ then the additive inverse and super – additive inverse of $\breve{x}$ are equal.) If $x \neq 0$, then $\breve{x}\overline{\odot}\widetilde{\left(\frac{1}{x}\right)} = \breve{1}$, so $\widetilde{\left(\frac{1}{x}\right)}$ is called as super-multiplicative inverse of $\breve{x}$. If $x \in]-1,1[$ then its super-multiplicative inverse is invisible exploded number. For any $u \in \breve{\mathbb{R}}$ the real number $\underline{u}$ is called the compressed of u defined by the (first) inversion formula

(0.4) $$\widetilde{(\underline{u})} = u \quad , u \in \breve{\mathbb{R}}.$$

Hence, for any $u \in \mathbb{R}$ we have

(0.5) $$\underline{u} = \tanh u \left(= \frac{e^u - e^{-u}}{e^u + e^{-u}}\right) \quad , u \in \mathbb{R}.$$

Using the inversion formula (0.4) we give another form of the super – operations

(0.6) $$u \overline{\oplus} v = \widetilde{\underline{u} + \underline{v}} \quad ; u, v \in \breve{\mathbb{R}}, \text{(see (0.2))}$$

(0.7) $$u \overline{\odot} v = \widetilde{\underline{u} \cdot \underline{v}} \quad ; u, v \in \breve{\mathbb{R}}, \text{(see (0.3))}.$$

Moreover, we have

(0.8) $$\underline{(-u)} = -\underline{u} \qquad , u \in \breve{\mathbb{R}}.$$

The inversion formula (0.4) yields the (second) inversion formula

(0.9) $$\underline{(\breve{x})} = x \qquad , \ x \in \mathbb{R}.$$

The exploded numbers $\breve{(-1)}$ and $\breve{1}$ are not real numbers. $\breve{(-1)}$ the greatest exploded number which is smaller than each number and $\breve{1}$ is the smallest exploded number which is greater than each number. $\breve{(-1)}$, $\breve{1}$ are called negative and positive discriminators, respectively. Clearly, the exploded number $u(\in \breve{\mathbb{R}})$ is a real number that is $-\infty < u < \infty$ if and only if $-1 < \underline{u} < 1$. We may say that the real numbers are visible exploded numbers.

Definition 0.10. Considering a set of points of our universe

$$\mathbb{S} = \{P = (x, y, z) | x, y, z \in \mathbb{R}\},$$

set

$$\breve{\mathbb{S}} = \{\breve{P} = (\breve{x}, \breve{y}, \breve{z}) | x, y, z \in \mathbb{R}\}$$

called the exploded of $\mathbb{S}$.■

Definition 0.11. In this paper the model of the Multiverse is the exploded set of our universe $\mathbb{R}^3$. The Multiverse is denoted by $\breve{\mathbb{R}^3}$.■

Definition 0.12. Considering a set of points of the Multiverse

$$\mathfrak{M} = \{\mathcal{P} = (u, v, w) | u, v, w \in \breve{\mathbb{R}}\}$$

set

$$\underline{\mathfrak{M}} = \{\underline{\mathcal{P}} = (\underline{u}, \underline{v}, \underline{w}) | u, v, w \in \breve{\mathbb{R}}\}$$

is called the compressed of $\mathfrak{M}$.■ Clearly, the compressed of our universe is the open cube

$$\underline{\mathbb{R}^3} = \left\{ P = (x, y, z) | \begin{Bmatrix} -1 < x < 1 \\ -1 < y < 1 \\ -1 < z < 1 \end{Bmatrix} \right\}.$$

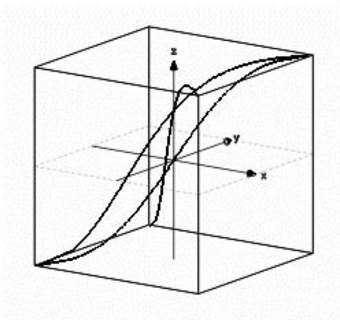


Fig. 0.13

(The Fig.0.13 shows some compressed lines in the compressed universe.)

1.
The box – phenomenon

If we explode the compressed universe $\underline{\mathbb{R}^3}$ we have our universe

(1.1) $$\mathbb{R}^3 = \left\{ \mathcal{P} = (u, v, w) | \begin{Bmatrix} \breve{-1} < u < \breve{1} \\ \breve{-1} < v < \breve{1} \\ \breve{-1} < w < \breve{1} \end{Bmatrix} \right\}.$$

Of course, $\mathbb{R}^3$ is a subset of the Multiverse $\breve{\mathbb{R}^3}$. We can consider it as an open „big" box inside the Multiverse. If one of the coordinates of point $\mathcal{P}(\in \breve{\mathbb{R}^3})$ is greater than or equal to $\breve{1}$ or less than or equal to $\breve{-1}$ then $\mathcal{P}$ is outside our universe. So, there are a lot of sets in the Multiverse which – partly or in full - are not seen in our universe. For example the borders of our universe are such subsets of the

Multiverse. The compressed borders are seen in Fig. 0.13. Namely, they are the six border – surfaces (squares) of the open cube. Taking a subset $\mathfrak{M}$ of the Multiverse the section

$$\mathfrak{M}_{box} = \mathfrak{M} \cap \mathbb{R}^3$$

is called as the box – phenomenon of $\mathfrak{M}$. For example $\widetilde{\mathbb{R}^3}_{box} = \mathbb{R}^3 = \mathbb{R}^3{}_{box}$ is obtained. In [2] we gave more examples for other box – phenomena. (See [2], Figures 2,4 and 6.)

2.
Universes different from our universe

Considering a fixed point $\mathcal{O}_0 = (u_0, v_0, w_0)$ of the Multiverse $\widetilde{\mathbb{R}^3}$ the super – shift transformation was introduced in [3] as follows:

$$\begin{cases} \xi = u \,\overline{\ominus}\, u_0 \\ \eta = v \,\overline{\ominus}\, v_0 \\ \zeta = w \,\overline{\ominus}\, w_0 \end{cases} \qquad (u, v, w) \in \widetilde{\mathbb{R}^3}.$$

The super – shift transformation instead of the exploded Descartes - coordinate system „$u\ v\ w$" gives another system „$\xi\ \eta\ \zeta$ which has the centre $\mathcal{O}_0$. The original centre (origo) $\mathcal{O} = (0,0,0)$) which is the origo of our universe, has new coordinates, namely

$$\mathcal{O} = (u = 0, v = 0, w = 0) = (\xi = -u_0\,, \eta = -v_0, \zeta = -w_0).$$

(Here we remind the Reader, that the super – additive inverse was mentioned in the Introduction.) To prevent the misunderstanding regarding the fixed point of the Multiverse we will give the coordinates in both systems. For example,

$$\mathcal{O}_0 = (u = u_0, v = v_0, w = w_0) = (\xi = 0, \eta = 0, \zeta = 0).$$

We choose the following subset of the Multiverse:

(2.1) $$\mathbb{W}_{\mathcal{O}_0} = \left\{ (u, v, w) \in \widetilde{\mathbb{R}^3} \,\middle|\, \begin{pmatrix} \widetilde{-1} \overline{\oplus} u_0 < u < \breve{1} \overline{\oplus} u_0 \\ \widetilde{-1} \overline{\oplus} v_0 < v < \breve{1} \overline{\oplus} v_0 \\ \widetilde{-1} \overline{\oplus} w_0 < w < \breve{1} \overline{\oplus} w_0 \end{pmatrix} \right\}, \mathcal{O}_0 = (u_0, v_0, w_0) \in \widetilde{\mathbb{R}^3}.$$

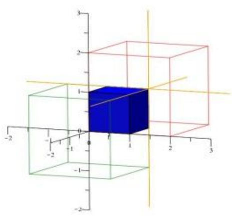
If $\mathcal{O}_0 = \mathcal{O}$ then $\mathbb{W}_{\mathcal{O}_0}$ is just our universe, given by (1.1). Otherwise our universe differs from $\mathbb{W}_{\mathcal{O}_0}$. Using the new coordinates given by the super - shift transformation

$$\mathbb{W}_{\mathcal{O}_0} = \left\{ (\xi, \eta, \zeta) \in \widetilde{\mathbb{R}^3} \,\middle|\, \begin{pmatrix} \widetilde{-1} < \xi < \breve{1} \\ \widetilde{-1} < \eta < \breve{1} \\ \widetilde{-1} < \zeta < \breve{1} \end{pmatrix} \right\}$$

obtained, which shows that $\mathbb{W}_{\mathcal{O}_0}$ is a three – dimensional universe of the Multiverse. We can say that universe $\mathbb{W}_{\mathcal{O}_0}$ is an individual universe parallel to our universe. The reason for using the term of "parallel" is the super – shift transformation introduced in (2.1) because

$$\underline{\mathbb{W}_{\mathcal{O}_0}} = \left\{ (\underline{u}, \underline{v}, \underline{w}) \in \mathbb{R}^3 \,\middle|\, \begin{pmatrix} -1 + \underline{u_0} < \underline{u} < 1 + \underline{u_0} \\ -1 + \underline{v_0} < \underline{v} < 1 + \underline{v_0} \\ -1 + \underline{w_0} < \underline{w} < 1 + \underline{w_0} \end{pmatrix} \right\}, \underline{\mathcal{O}_0} = \left(\underline{u_0}, \underline{v_0}, \underline{w_0}\right) \in \mathbb{R}^3.$$

and $\underline{\mathbb{W}_{\mathcal{O}_0}}$ is an open cube having the parallel borders with respect to $\underline{\mathbb{R}^3}$. (See Fig. 0.13.)



The dark part is

$$\underline{\mathbb{R}^3} \cap \underline{\mathbb{W}_{\mathcal{O}_0}} = \left\{ P = (x,y,z) \middle| \begin{Bmatrix} 0 < x < 1 \\ 0 < y < 1 \\ 0 < z < 1 \end{Bmatrix} \right\}.$$

So, the two universes $\mathbb{R}^3$and $\mathbb{W}_{\mathcal{O}_0}$have a common part

$$\mathbb{R}^3 \cap \mathbb{W}_{\mathcal{O}_0} = \left\{ \mathcal{P} = (u,v,w) \in \breve{\mathbb{R}^3} \middle| \begin{Bmatrix} 0 < u < \infty \\ 0 < v < \infty \\ 0 < w < \infty \end{Bmatrix} \right\}.$$

Having a subset $\mathfrak{M}$ of the Multiverse the section

$$\mathfrak{M}_{shifted-box} = \mathfrak{M} \cap \mathbb{W}_{\mathcal{O}_0}$$

is called the shifted box-phenomenon of $\mathfrak{M}$, concerning the universe $\mathbb{W}_{\mathcal{O}_0}$.(Introduced in [3]). Clearly,

$$\breve{\mathbb{R}^3}_{shifted-box} = \mathbb{W}_{\mathcal{O}_0} \text{ and } \bigcup_{\forall \mathcal{O}_0 \in \breve{\mathbb{R}^3}} \mathbb{W}_{\mathcal{O}_0} = \breve{\mathbb{R}^3}.$$

The latter formula shows that by the shifted box – phenomena, like a moving three –dimensional infinite– wide camera, we are able to discover the Multiverse in part.

3.
Itinerary

Let us consider an (Euclidean) line of three – dimensional space $\mathbb{R}^3$, described by the set

(3.1) $$\mathbb{S} = \left\{ (x,y,z) \in \mathbb{R}^3 \middle| \begin{Bmatrix} x = \frac{2}{\sqrt{29}} t \\ y = \frac{3}{\sqrt{29}} t \\ z = \frac{4}{\sqrt{29}} t \end{Bmatrix} \right. \quad , -\infty < t < \infty.$$

The exploded of line $\mathbb{S}$ is called super-line denoted by $\breve{\mathbb{S}}$. Denoting

$$\breve{x} = u\,, \breve{y} = v\,, \breve{z} = w\,, \breve{t} = \tau$$

by (0.3) we get

(3.2) $$\breve{\mathbb{S}} = \left\{ (u,v,w) \in \breve{\mathbb{R}^3} \middle| \begin{Bmatrix} u = \breve{\left(\frac{2}{\sqrt{29}}\right)} \breve{\odot} \tau \\ v = \breve{\left(\frac{3}{\sqrt{29}}\right)} \breve{\odot} \tau \\ w = \breve{\left(\frac{4}{\sqrt{29}}\right)} \breve{\odot} \tau \end{Bmatrix} \right. \quad , \quad \tau \in \breve{\mathbb{R}}.$$

Of course, we are not able to see the full graph of the super-line $\breve{\mathbb{S}}$, but we may investigate it in the shifted boxes $\mathbb{W}_{(u_0,v_0,w_0)}$ of the Multiverse $\breve{\mathbb{R}^3}$. (See (2.1).) Our planned way is an open super-passage of $\breve{\mathbb{S}}$. Let us indicate the following points as milestones of the journey.

$$\breve{L_l} = \left(\breve{\left(-\frac{1}{2}\right)}, \breve{\left(-\frac{3}{4}\right)}, \breve{-1} \right), \tau = \breve{\left(-\frac{\sqrt{29}}{4}\right)}; \breve{O} = (0,0,0) = O, \tau = 0;\ \breve{B} = \left(\breve{\left(\frac{1}{2}\right)}, \breve{\left(\frac{3}{4}\right)}, \breve{1} \right), \tau = \breve{\left(\frac{\sqrt{29}}{4}\right)};$$

$$\breve{R} = \left(\breve{\left(\frac{2}{3}\right)}, \breve{1}, \breve{\left(\frac{4}{3}\right)} \right), \tau = \breve{\left(\frac{\sqrt{29}}{3}\right)}; \breve{G} = \left(\breve{1}, \breve{\left(\frac{3}{2}\right)}, \breve{2} \right) = O, \tau = \breve{\left(\frac{\sqrt{29}}{2}\right)};\ \breve{A} = \left(\breve{\left(\frac{4}{3}\right)}, \breve{2}, \breve{\left(\frac{8}{3}\right)} \right), \tau = \breve{\left(\frac{2\sqrt{29}}{3}\right)};$$

$$\breve{T} = \left(\breve{\left(\frac{3}{2}\right)}, \breve{\left(\frac{9}{4}\right)}, \breve{3} \right), \tau = \breve{\left(\frac{3\sqrt{29}}{4}\right)} \textit{ and final milestone } \breve{O_s} = (\breve{2}, \breve{3}, \breve{4}), \tau = \breve{\sqrt{29}}.$$

By (3.2) parameter τ proves that the milestone is situated on the super-line $\breve{\mathbb{R}}$. Our aim is to investigate the open super-passage having the last $\breve{L_l}$ and $\breve{O_s}$. By (1.1) we can see that except for milestone $\breve{O} = (0,0,0)$ are outside our universe $\mathbb{R}^3$.

In the case of parameter-domain

$$\breve{\left(-\frac{\sqrt{29}}{4}\right)} < \tau < \breve{\left(-\frac{\sqrt{29}}{4}\right)}$$

the points of the super-line $\breve{\mathbb{S}}$ are situated in our universe. Denoting $t = \underline{\tau}$ and using (0.1) and (0.5) by the definition of box-phenomenon

$$(3.3) \qquad \breve{\mathbb{S}}_{box} = \widetilde{\mathbb{S}_{L_l,B}} = \left\{ (u,v,w) \in \mathbb{R}^3 \middle| \begin{cases} u = \tanh^{-1}\left(\frac{2}{\sqrt{29}} \cdot t\right) \\ v = \tanh^{-1}\left(\frac{3}{\sqrt{29}} \cdot t\right) \\ w = \tanh^{-1}\left(\frac{4}{\sqrt{29}} \cdot t\right) \end{cases}, -\frac{\sqrt{29}}{4} < t < \frac{\sqrt{29}}{4} \right\}$$

where $\mathbb{S}_{L_l,B}$ is an open passage of the line $\mathbb{S}$ with the endpoints

$$L_l = \left(-\frac{1}{2}, -\frac{3}{4}, -1\right) \text{ and } B = \left(\frac{1}{2}, \frac{3}{4}, 1\right)$$

generated by the parameters $t = -\frac{\sqrt{29}}{4}$ and $t = \frac{\sqrt{29}}{4}$, respectively. (See (3.1).) $\breve{\mathbb{S}}_{box}$ is the first part of our road and it is seen in our universe $\mathbb{R}^3$. By (3.3) we have that $\breve{\mathbb{S}}_{box}$ is unbounded in our universe. So, the milestone $\breve{\mathbb{B}}$ is already in another universe of Multiverse.

4. Continuation of the journey in Multiverse

Considering the super – shift transformation

$$\begin{cases} x^* = u \\ y^* = v \,\overline{\ominus}\, \breve{1} \\ z^* = w \,\overline{\ominus}\, \breve{1} \end{cases}, \quad (u,v,w) \in \widetilde{\mathbb{R}^3}$$

we get to the parallel universe

$$(4.1) \qquad \mathbb{W}_{(0,\breve{1},\breve{1})} = \left\{ (u,v,w) \in \widetilde{\mathbb{R}^3} \middle| \begin{cases} \widetilde{-1} < u < \breve{1} \\ 0 < v < \breve{2} \\ 0 < w < \breve{2} \end{cases} \right\}.$$

Let us observe that universe $\mathbb{W}_{(0,\breve{1},\breve{1})}$ contains the points $\breve{B}$ and $\breve{R}$. Moreover by (3.2) we have

$$\widetilde{\mathbb{S}_{B,R}} = \left\{ (x^*,y^*,z^*) \in |\mathbb{W}_{(0,\breve{1},\breve{1})} \begin{cases} x^* = \tanh^{-1}\left(\frac{2}{\sqrt{29}} \cdot t\right) \\ y^* = \tanh^{-1}\left(\frac{3}{\sqrt{29}} \cdot t - 1\right) \\ z^* = \tanh^{-1}\left(\frac{4}{\sqrt{29}} \cdot t - 1\right) \end{cases}, \frac{\sqrt{29}}{4} \le t \le \frac{\sqrt{29}}{3} \right\}$$

so, $\mathbb{S}_{B,R}$ is a closed passage of the line line $\mathbb{S}$ with the endpoints

$$B = \left(\frac{1}{2}, \frac{3}{4}, 1\right) \; and \; R = \left(\frac{2}{3}, 1, \frac{4}{3}\right)$$

generated by the parameters $t = \frac{\sqrt{29}}{4}$ and $t = \frac{\sqrt{29}}{3}$, respectively. (See (3.1).) $\widetilde{\mathbb{S}_{B,R}}$ is the second part of our road and it is seen in universe $\mathbb{W}_{(0,\breve{1},\breve{1})}$ and bounded in it. Although our universe $\mathbb{R}^3$ and universe $\mathbb{W}_{(0,\breve{1},\breve{1})}$ are extremely close universes (see [2], point V.), $\widetilde{\mathbb{S}_{B,R}}$ is invisible in our universe.

Considering the super – shift transformation

$$\begin{cases} x^* = u \,\overline{\ominus}\, \breve{1} \\ y^* = v \,\overline{\ominus}\, \widetilde{\left(\frac{3}{2}\right)} \\ z^* = w \,\overline{\ominus}\, \breve{2} \end{cases}, \quad (u,v,w) \in \widetilde{\mathbb{R}^3}$$

we get to the parallel universe

$$(4.2) \qquad \mathbb{W}_{\left(\breve{1},\widetilde{\left(\frac{3}{2}\right)},\breve{2}\right)} = \left\{ (u,v,w) \in \widetilde{\mathbb{R}^3} \middle| \begin{cases} 0 < u < \breve{2} \\ \widetilde{\left(\frac{1}{2}\right)} < v < \widetilde{\left(\frac{5}{2}\right)} \\ \breve{1} < w < \breve{3} \end{cases} \right\}.$$

Let us observe that universe $\mathbb{W}_{\left(\breve{1},\widetilde{\left(\frac{3}{2}\right)},\breve{2}\right)}$ contains the points $\breve{R}$, $\breve{G}$ and $\breve{A}$. Moreover by (3.2) we have

$$\widetilde{\mathbb{S}_{R,A}} = \left\{ (x^*,y^*,z^*) \in \mathbb{W}_{\left(\breve{1},\left(\breve{\frac{3}{2}}\right),\breve{2}\right)} \middle| \begin{cases} x^* = \tanh^{-1}\left(\frac{2}{\sqrt{29}}\cdot t - 1\right) \\ y^* = \tanh^{-1}\left(\frac{3}{\sqrt{29}}\cdot t - \frac{3}{2}\right) \\ z^* = \tanh^{-1}\left(\frac{4}{\sqrt{29}}\cdot t - 2\right) \end{cases} , \frac{\sqrt{29}}{3} \le t \le \frac{2\sqrt{29}}{3} \right\}$$

so, $\mathbb{S}_{R,A}$ is a closed passage of the line line $\mathbb{S}$ with the endpoints

$$R = \left(\frac{2}{3}, 1, \frac{4}{3}\right) \, and \, A = \left(\frac{4}{3}, 2, \frac{8}{3}\right)$$

generated by the parameters $t = \frac{\sqrt{29}}{3}$ and $t = \frac{2\sqrt{29}}{3}$, respectively. (See (3.1).) $\widetilde{\mathbb{S}_{R,A}}$ is the third part of our road and it is seen in universe $\mathbb{W}_{\left(\breve{1},\left(\breve{\frac{3}{2}}\right),\breve{2}\right)}$ and bounded in it. We may observe that $\breve{G}$ is the origo of the coordinate system in the universe $\mathbb{W}_{\left(\breve{1},\left(\breve{\frac{3}{2}}\right),\breve{2}\right)}$. Of course, $\widetilde{\mathbb{S}_{R,A}}$ is invisible in our universe $\mathbb{R}^3$.

Considering the super – shift transformation

$$\begin{cases} x^* = u \,\breve{\ominus}\, \breve{1} \\ y^* = v \,\breve{\ominus}\, \breve{2} \\ z^* = w \,\breve{\ominus}\, \breve{3} \end{cases} , \quad (u,v,w) \in \widetilde{\mathbb{R}^3}$$

we get to the parallel universe

$$\mathbb{W}_{(\breve{1},\breve{2},\breve{3})} = \left\{ (u,v,w) \in \widetilde{\mathbb{R}^3} \middle| \begin{cases} 0 < u < \breve{2} \\ \breve{1} < v < \breve{3} \\ \breve{2} < w < \breve{4} \end{cases} \right\}. \tag{4.3}$$

Let us observe that universe $\mathbb{W}_{(\breve{1},\breve{2},\breve{3})}$ contains the points $\breve{A}$ and $\breve{T}$. Moreover by (3.2) we have

$$\widetilde{\mathbb{S}_{A,T}} = \left\{ (x^*,y^*,z^*) \in \mathbb{W}_{(\breve{1},\breve{2},\breve{3})} \middle| \begin{cases} x^* = \tanh^{-1}\left(\frac{2}{\sqrt{29}}\cdot t - 1\right) \\ y^* = \tanh^{-1}\left(\frac{3}{\sqrt{29}}\cdot t - 2\right) \\ z^* = \tanh^{-1}\left(\frac{4}{\sqrt{29}}\cdot t - 3\right) \end{cases} , \frac{2\sqrt{29}}{3} \le t \le \frac{3\sqrt{29}}{4} \right\}$$

so, $\mathbb{S}_{A,T}$ is a closed passage of the line line $\mathbb{S}$ with the endpoints

$$A = \left(\frac{4}{3}, 2, \frac{8}{3}\right) \, and \, T = \left(\frac{3}{2}, \frac{9}{4}, 3\right)$$

generated by the parameters $t = \frac{2\sqrt{29}}{3}$ and $t = \frac{3\sqrt{29}}{4}$, respectively. (See (3.1).) $\widetilde{\mathbb{S}_{R,A}}$ is the fourth part of our road and it is seen in universe $\mathbb{W}_{(\breve{1},\breve{2},\breve{3})}$ and bounded in it. Of course, $\widetilde{\mathbb{S}_{A,T}}$ is invisible in our universe $\mathbb{R}^3$.

The last milestone point $\widetilde{O_s} = (\breve{2},\breve{3},\breve{4})$, given by $\tau = \sqrt{29}$ is already invisible in the universe $\mathbb{W}_{(\breve{1},\breve{2},\breve{3})}$, so the last part of our road is half – open super-passage

$$\widetilde{\mathbb{S}_{T,O_s}} = \left\{ (x^*,y^*,z^*) \in \mathbb{W}_{(\breve{1},\breve{2},\breve{3})} \middle| \begin{cases} x^* = \tanh^{-1}\left(\frac{2}{\sqrt{29}}\cdot t - 1\right) \\ y^* = \tanh^{-1}\left(\frac{3}{\sqrt{29}}\cdot t - 2\right) \\ z^* = \tanh^{-1}\left(\frac{4}{\sqrt{29}}\cdot t - 3\right) \end{cases} , \frac{3\sqrt{29}}{4} \le t < \sqrt{29} \right\}$$

and $\mathbb{S}_{T,O_s}$ is a half – open passage of the line line $\mathbb{S}$ with the endpoints

$$T = \left(\frac{3}{2}, \frac{9}{4}, 3\right) \, and \, O_s = (2,3,4)$$

generated by the parameters $t = \frac{3\sqrt{29}}{4}$ and $t = \sqrt{29}$, respectively. (See (3.1).)

The road $\widetilde{\mathbb{S}_{L_l,B}} \cup \widetilde{\mathbb{S}_{B,R}} \cup \widetilde{\mathbb{S}_{R,A}} \cup \widetilde{\mathbb{S}_{A,T}} \cup \widetilde{\mathbb{S}_{T,O_s}}$, over the milestones $\widetilde{L_l}, O, \breve{B}, \breve{R}, \breve{G}, \breve{A}, \breve{T} \, and \, \widetilde{O_s}$ passes through four universes $\mathbb{R}^3$(see (1,1)) and parallel universes $\mathbb{W}_{(0,\breve{1},\breve{1})}$, $\mathbb{W}_{\left(\breve{1},\left(\breve{\frac{3}{2}}\right),\breve{2}\right)}$ and $\mathbb{W}_{(\breve{1},\breve{2},\breve{3})}$. (See

(4.1), (4.2) and (4.3), respectively.) The lattest parallel universe is extremely far from our universe because $d_{\widetilde{\mathbb{R}^3}}\left(\mathbb{R}^3, \mathbb{W}_{(\breve{1},\breve{2},\breve{3})}\right) = \breve{\sqrt{2}}$. (See [2], point V.)

References

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