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Erratum to "Four-Dimensional Mathematics Creates the Super Universe" [World Journal of Mechanics, 2023, 13, 135-148]

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The original version of this article (Rahikainen, A. (2023) Four-Dimensional Mathematics Creates the Super Universe. World Journal of Mechanics, 13, 135-148. https://doi.org/10.4236/wjm.2023.137008) was published as some content reported mistakenly. The author wishes to correct the errors.

2. The Universe in Four Distance Dimensions

The basic calculation of the surface volume of the four-dimensional sphere in publication "Four-Dimensional Mathematics Creates the Super Universe" was right but one important thing went astray. Here is the corrected calculation of the surface volume of the four-dimensional sphere:

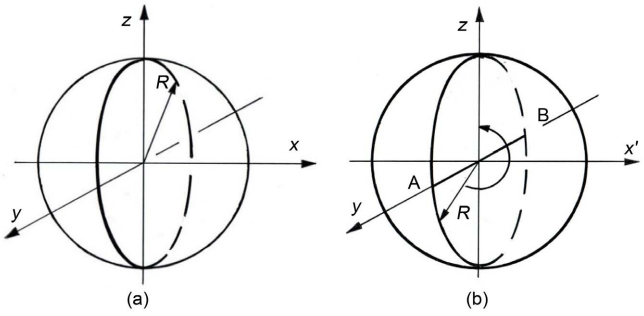

Figure 5. On **Figure 5(a)** is an ordinary three-dimensional sphere and on **Figure 5(b)** is a four-dimensional sphere. The coordinate axes on the left side are x, y, z and on the right side are y, z, $x'$and the whole x coordinate axis is located on **Figure 5(b)** in the zero point of coordinate axes. The y, z cross-sections of both spheres are the same. The four-dimensional sphere is formed by rotating the y, z cross-section around A-B axis, and it is the same manner than the ordinary three-dimensional sphere can be formed. In **Figure 5(b)**, the formation of the four-dimensional surface volume is formed by the rotation of the x'axis' direction.

1) **Figure 4** presented the principle of the four-dimensional cube. In the same manner as in **Figure 4**, the section of the four-dimensional *x*, *y*, *z*, *x'* cube has eight surface side volumes, the four-dimensional sphere has a similar surface volume.

2) The *y*-*z* cross-sections are the same in Figure 5(a) and Figure 6(b).

3) The whole surface area of the three-dimensional sphere in Figure 5(a) is located at the circumference of the *y*-*z* cross-section of the four-dimensional sphere in Figure 6(b). This is using the coordination system of two angles and the distance from the center *R*, and the technique of **Figure 3**. The thick circumference line indicated area.

4) The area within the length of the circumference line $R\mathrm{d}\varphi$, Figure 6(b)

$$\mathrm{d}A = 2\pi R\cos\varphi \cdot R\mathrm{d}\varphi = 2\pi R^2\cos\varphi\mathrm{d}\varphi \tag{1}$$

5) Rotation of the infinitesimal area $\mathrm{d}A$ round about the axis A-B is the increment of the volume, Figure 6(b)

$$\mathrm{d}V = 2\pi R\sin\varphi \cdot 2\pi R\cos\varphi \cdot R\mathrm{d}\varphi = 4\pi^2 R^3\sin\varphi\cos\varphi\mathrm{d}\varphi \tag{2}$$

6) Integration of the infinitesimal area $\mathrm{d}A$ within angles 0 - π/2 is the total surface volume of the four-dimensional sphere, Figure 6(b)

$$\int \mathrm{d}V = \int_0^{\pi/2} 4\pi^2 R^3\sin\varphi\cos\varphi\mathrm{d}\varphi = 4\pi^2 R^3\frac{1}{2}\left(\sin^2(\pi/2) - \sin^2(0)\right) = 2\pi^2 R^3 \tag{3}$$

7) The total surface volume of the four-dimensional sphere is equal to the volume of the Universe

$$V = 2\pi^2 R^3 \tag{4}$$

The surface volume of the four-dimensional sphere $2\pi^2 R^3$ divided by the center sphere of the four-dimensional sphere $4/3\pi R^3$ is 4.71. This result can be compared with the corresponding value of the four-dimensional cube. In Table 1 corresponding values of Circle-Sphere and Square-Cube divisions are compared.

Table 1. Comparison of Circle-Sphere and Square-Cube divisions.

Circle-Sphere radius R		Square-Cube length of the side a	
$2\pi R/2R$	3.14	$4a/a$	4
$4\pi R^2/\pi R^2$	4	$6a^2/a^2$	6
$2\pi^2 R^3/(4/3\pi R^3)$	4.71	$8a^3/a^3$	8

The value 4.71 seems to be correct in comparison with the progress of Square-Cube divisions, and the formula of the surface volume of four-dimensional sphere seems to be correct. In internet a similar formula is in publication [1].

The calculation of the four-power volume of the four-dimensional sphere is performed as follows: The three-dimensional volume of the surface area of the four-dimensional sphere is in Equation (4)

$$V = 2\pi^2 R^3$$

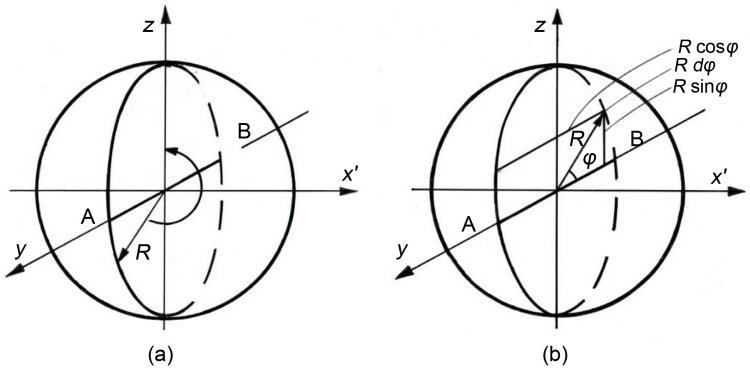

Figure 6. The figure presents the three-dimensional section *x*, *z*, *x*′of the four-dimensional *x*, *y*, *z*, *x*′sphere. The surface layer of the four-dimensional sphere is the model of the Universe. On the **Figure 6(a)** and **Figure 6(b)** the whole surface area of the sphere of **Figure 5(a)** is transformed into the thick circle line at the radius *R* on the *z*-*y* plane. On the **Figure 6(b)** the surface volume of the sphere is calculated by rotating the minimal area d*A*, Equation (1), round about the A-B axis, the rotation in the direction of *x*′axis.

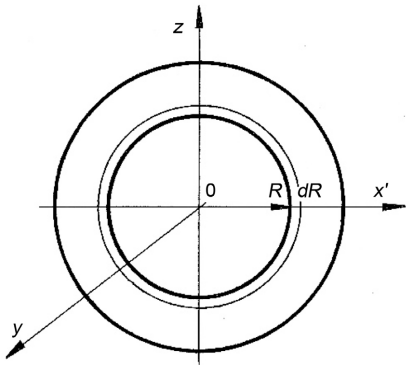

Figure 7. The calculation of the four-power volume of the four-dimensional sphere is presented in the cross-section of the sphere. The thick circle line indicates the surface volume of the four-dimensional sphere $V = 2\pi^2 R^3$.

The increment of the four-power volume of the four-dimensional sphere is

$$\mathrm{d}W = 2\pi^2 R^3 \mathrm{d}R \tag{5}$$

and the whole four-power volume is the integral

$$W = \int_0^R 2\pi^2 R^3 \mathrm{d}R = \frac{1}{2}\pi^2 R^4 \tag{6}$$

3. Red Shift Calculations

The radius of the Universe *R* in **Figure 7** of the publication "Four-Dimensional Mathematics Creates the Super Universe" can be calculated based on **Figure 8**. The angle φ between points A and B in **Figure 7** is in **Figure 8** the angle φ beneath the horizontal axis. The maximum distance of measurement 13.8×10^9 ly corresponds to the angle $\varphi = 62.7^\circ$ in **Figure 8**, and in **Figure 7** the angle $\varphi = 360^\circ$ corresponds to the distance $(360^\circ/62.7^\circ) \times 13.8 \times 10^9$ ly $= 79.2 \times 10^9$ ly which is the circumference of the four-dimensional sphere, and the radius of the Universe

is $R = 79.2 \times 10^9$ ly/$2\pi = 12.6 \times 10^9$ ly. Calculation of the surface area of the Universe using Equation (4)

$$V = 2\pi^2 R^3 = 2\pi^2 \times 12.6^3 \times 10^{27}\ \text{ly}^3 = 39.5 \times 10^{30}\ \text{ly}^3$$

The volume of the center sphere of the Universe is

$$\frac{4}{3}\pi R^3 = \frac{4}{3}\pi \times 12.6^3 \times 10^{27}\ \text{ly}^3 = 8.38 \times 10^{30}\ \text{ly}^3$$

References

[1] Weisstein, E.W. Four-Dimensional Geometry. *MathWorld—A Wolfram Web Resource*. https://mathworld.wolfram.com/Four-DimensionalGeometry.html