Cosmic dark matter density and the tessellated 3-sphere

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Abstract

The tessellation of space is considered for both the 2-sphere and the 3-sphere. As hypothesized in an earlier work, it is found that there is a dark matter density $\Omega_{DM} = 0.284$ associated with the curvature of the 3-sphere.

1 Curvature and dark matter density

For a method of calculating the curvature of triangle meshes and tetrahedron meshes, please see [1]. Unlike in [1], the tessellations in this paper will rely on pseudorandomly placed vertices, rather than the vertices placed by Marching Cubes and Marching Hypercubes. Also unlike in [1], we will not be compensating for the variation in simplex extent (e.g. do nothing special even where there are sliver simplices). In effect, the calculation of the curvature is as simple as possible. The vertex count is N.

On one hand, it is found that for a tessellated 2-sphere, the local curvature vanishes when the tessellation is made up of finer and finer triangles. That is, the more vertices N used in the tessellation, the less the local curvature is:

$$\lim_{N\to\infty} K(N) = 0.0. \tag{1}$$

On the other hand, it is found that for a tessellated 3-sphere, the local curvature does *not* vanish when the tessellation is made up of finer and finer tetrahedra. The curvature settles around

$$\lim_{N\to\infty} K(N) = 0.284. \tag{2}$$

This is in line with the dark matter density measure Ω_{DM} used in the various xCDM models [2, 3]. If this is not merely a coincidence, then this is direct evidence of the discrete nature of space, based on a few simple, first principles.

See Fig. 1 for a 3-sphere edge length histogram, where vertex count $N = 1,000,000$. Also see Table 1 for a list of properties of the histograms where the vertex count N is variable. A C++ code for generating the tessellated 3-sphere can be found at [4]. The code requires the qhull executables for mesh generation, the OpenCV library for plotting histograms, and the OpenGL / GLUT library for visualizing the vertices.

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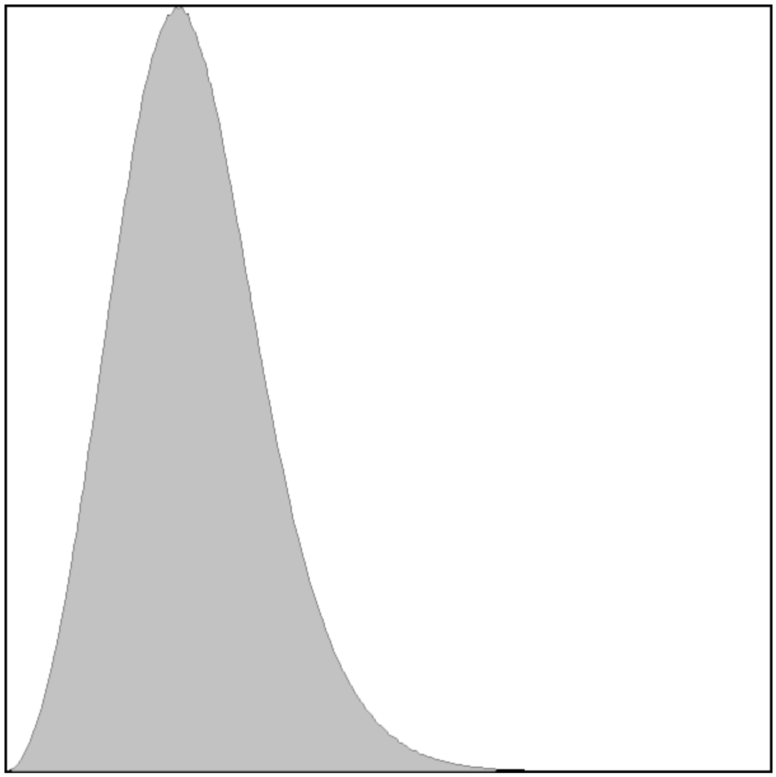

Figure 1: 3-sphere edge length histogram, where vertex count $N = 1,000,000$. Max = 0.0565194, mode = 0.012455. curvature K = 0.28452.

N	K	Max	Mode	Max / Mode
1,000	0.29473	0.405105	0.132555	3.05612
10,000	0.28821	0.215664	0.0619268	3.48256
100,000	0.28413	0.113452	0.0268951	4.21831
1,000,000	0.28452	0.0565194	0.012455	4.53788

Table 1: Properties of the histograms where vertex count N is variable.

References

[1] Halayka S. (2020) "The curvature and dimension of a closed surface"
`https://vixra.org/abs/1812.0423`

[2] Abbott TMC., et al. (2018) "Dark Energy Survey year 1 results: Cosmological constraints from galaxy clustering and weak lensing" Phys. Rev. D 98, 043526
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[3] Capozziello S., et al. (2006) "A fluid of strings as a viable candidate to the dark side of the universe" arXiv:astro-ph/0601266
`https://arxiv.org/abs/astro-ph/0601266`

[4] Halayka S. (2020) "3-sphere Universe C++ code"
`https://github.com/sjhalayka/4d_universe`