Energy and the tessellated 3-sphere

S. Halayka *

March 3, 2020

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 an energy associated with the 3-sphere.

1 Curvature and energy

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 psuedorandomly placed vertices, rather than the vertices placed by Marching Cubes and Marching Hypercubes. 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

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

Unexpectedly, this is in line with the measure Ω_m used in the wCDM model [2] – it is unknown if this is just a numerology. Where curvature is proportional to energy,

$$K \propto E, \tag{3}$$

there is an energy because of this non-vanishing curvature. See Fig. 1 for a 3-sphere edge length histogram, where vertex count $N = 1,000,000$. 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 [3]. The code requires the qhull executables for mesh generation, the OpenCV library for plotting histograms, and the OpenGL library for visualizing the vertices.

*sjhalayka@gmail.com

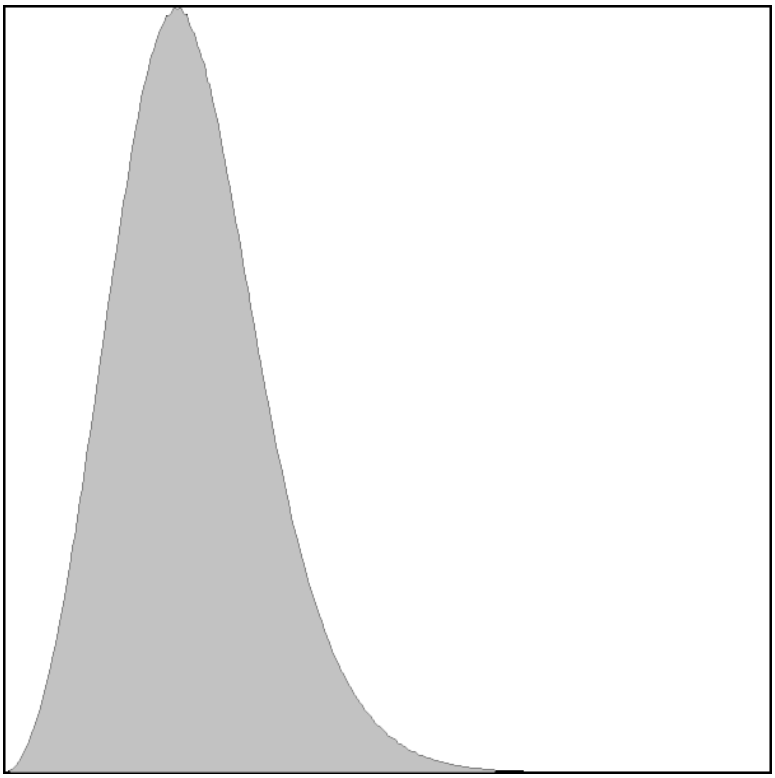

Figure 1: 3-sphere edge length histogram, where vertex count $N = 1,000,000$. Max = 0.0565194, mode = 0.012455. curvature K = 0.28452.

Vertex count 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 is variable.

References

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

[2] Abbott TMC (2018) "Dark Energy Survey year 1 results: Cosmological constraints from galaxy clustering and weak lensing" Phys. Rev. D 98, 043526 `https://journals.aps.org/prd/abstract/10.1103/PhysRevD.98.043526`

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