Real dimension in the Newtonian simulation of disk-like pressure-free systems

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Abstract

This paper contains a short introduction to Newtonian gravitation. The main focus is on some C++ code.

1 Brute force: field line intersection density gradient

Regarding the holographic principle, where n is the gravitational field line count, and A_s is the Schwarzschild black hole event horizon area:

$$n = \frac{A_s k c^3}{4G\hbar \log 2}, \tag{1}$$

the Schwarzschild radius is:

$$r_s = \sqrt{\frac{A_s}{4\pi}} = \sqrt{\frac{nG\hbar \log 2}{kc^3\pi}}, \tag{2}$$

and the mass is:

$$M = \frac{c^2 r_s}{2G} = \sqrt{\frac{nc\hbar \log 2}{4Gk\pi}}. \tag{3}$$

Where R is some far distance from the centre of the gravitating body (e.g, $R \gg r_s$), β is the get intersecting line length function, and ϵ is some small value (e.g 10^{-5}), the gradient is:

$$\gamma = \frac{\beta(R+\epsilon) - \beta(R)}{\epsilon}. \tag{4}$$

The gradient strength is:

$$g = -\gamma\pi = \frac{n}{2R^3}. \tag{5}$$

From this we can get the Newtonian acceleration a for a flat rotation curve of speed v:

$$a = \frac{v^2}{R} = \frac{gRc\hbar \log 2}{k2\pi M}, \tag{6}$$

$$v = \sqrt{\frac{gR^2 c\hbar \log 2}{k2\pi M}}. \tag{7}$$

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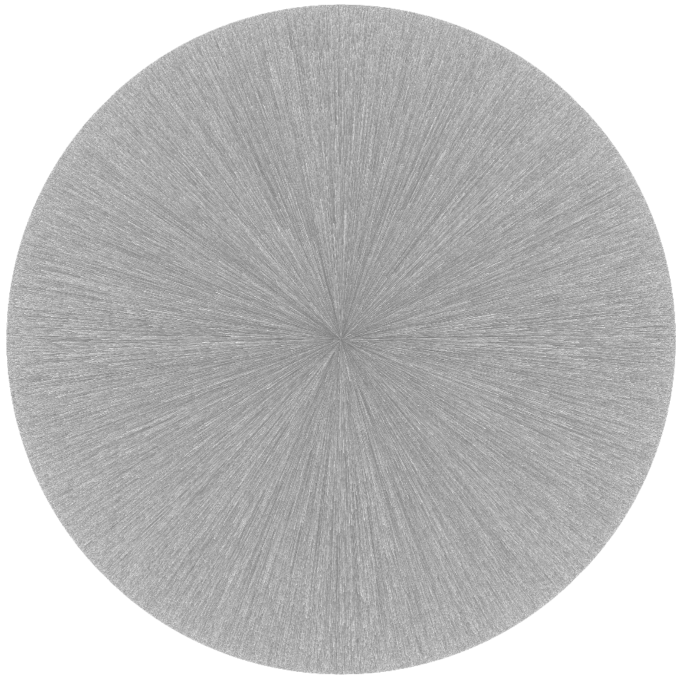

Figure 1: Where $D = 3$.

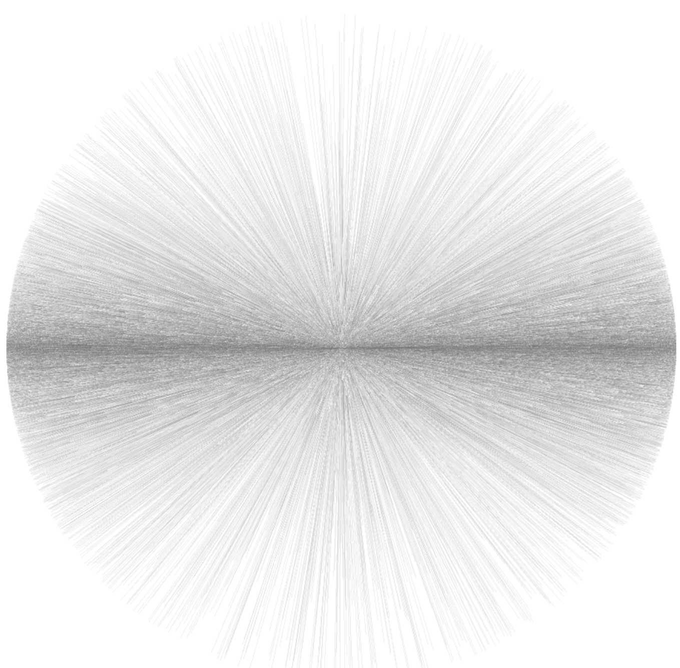

Figure 2: Where $D = 2.1$.

2 Heuristic: field line intersection density gradient

For example, where $D = 2.001$, the ratio of the acceleration is

$$\frac{a_D}{a_3} = R^d, \tag{8}$$

where $d = 3 - D = 0.999$. Here d stands for disk-like.

The code for this section can be downloaded from:
`https://github.com/sjhalayka/ellipsoid_emitter`

References

[1] Misner et al. Gravitation. (1970)

[2] ‘t Hooft. Dimensional reduction in quantum gravity. (1993)

[3] Susskind. The World as a Hologram. (1994)