

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:

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

the Schwarzschild radius is:

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

and the mass is:

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

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:

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

The gradient strength is:

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

The Newtonian acceleration a_{Newton} and velcocity v_{Newton} are:

$$a_{Newton} = \frac{v_{Newton}^2}{R} = \sqrt{\frac{gGc\hbar \log 2}{2Rk\pi}}, \quad (6)$$

$$v_{Newton} = \sqrt[4]{\frac{gGRc\hbar \log 2}{2k\pi}}. \quad (7)$$

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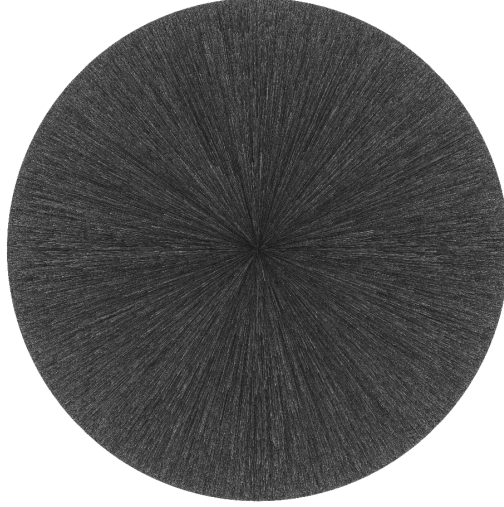


Figure 1: Where $D = 3$. The normals are isotropic.

From this we can get the Newtonian acceleration a_{flat} for a flat rotation curve of speed v_{flat} :

$$a_{flat} = \frac{v_{flat}^2}{R} = \frac{gRc\hbar \log 2}{2k\pi M}, \quad (8)$$

$$v_{flat} = \sqrt{\frac{gR^2c\hbar \log 2}{k2\pi M}}. \quad (9)$$

The ratio of the acceleration is

$$\frac{a_{flat}}{a_{Newton}} = R^d, \quad (10)$$

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

$$D = 3 - \frac{\log \frac{a_{flat}}{a_{Newton}}}{\log R}. \quad (11)$$

References

- [1] Misner et al. Gravitation. (1970)
- [2] 't Hooft. Dimensional reduction in quantum gravity. (1993)
- [3] Susskind. The World as a Hologram. (1994)

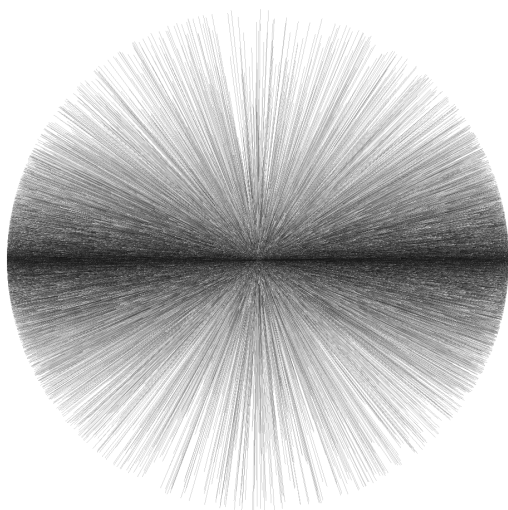


Figure 2: Where $D = 2.1$. The normals are increasingly anisotropic.

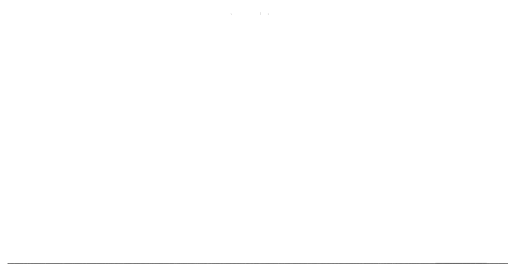


Figure 3: Where $D = 2.001$. The normals are anisotropic.



Figure 4: Where $D = 3$.