

A note on anisotropic quantum gravity

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Abstract

In Newton's theory, all mass gravitates in an *isotropic* (spherical) manner. In this paper, we will consider aspherical – *anisotropic* – gravitating processes, which leads to a unique view of dark matter: dark matter is a graviton condensate. We also discuss dark energy, and the possibility of a final, 5th interaction.

1 Introduction

This paper is based on one main assumption: the gravitational field is *quantized* into *gravitons*. Unfortunately, we have no empirical evidence that gravitons actually exist, although superstring theory [1] does predict such a particle. We try to make the best of the situation, as we lay out 7 sections on what quantum gravity would actually be like. In these sections we interpret the following topics using the paranoiac critical method:

- Time dilation at a high level
- Anti-gravity and time contraction
- The holographic principle and the gravitational keystone
- Information loss
- Gravitational time dilation at a mid level
- Dark matter, and fractional dimensions that follow a power law
- Dark energy, and the accelerating expansion of the Universe

Finally, we present a review of the discussion.

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2 On the interruption of a process by time dilation

A *process* is a system of mass-energy, including its internal interactions, over time.

Time dilation is the *interruption* of said process, whether it be kinematic and/or gravitational – both are the result of external interactions. In the case of the gravitational interaction, the process is interrupted by spacetime itself (e.g. gravitons). In the case of the non-gravitational interaction, the process is interrupted by the other particles (e.g. photons, etc).

This gravitational time dilation [2] is encoded in the first term on the right-hand side of the Schwarzschild line element in Einstein's general relativity

$$ds^2 = - \left(1 - \frac{R_s}{r}\right) c^2 dt^2 + \frac{dr^2}{\left(1 - \frac{R_s}{r}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (1)$$

where R_s is the Schwarzschild radius

$$R_s = \frac{2GM}{c^2}, \quad (2)$$

and M is the mass of the gravitating process. Note that the Schwarzschild line element is irrotational – it is used here as a rough model, useful for where rotation speed is practically zero (when compared to the speed of light).

Simplified, the gravitational time dilation equation is based on distance r :

$$dt' = dt \sqrt{1 - \frac{R_s}{r}}, \quad (3)$$

and the kinematic time dilation equation is based on speed v :

$$dt' = dt \sqrt{1 - \frac{v^2}{c^2}}. \quad (4)$$

The closer you are to a gravitating process, the slower your rate of time. Likewise, the faster you go, the slower your rate of time. In conjunction, this gravitational and kinematic time dilation produces an experimentally verified relativistic perihelion shift in the planets, for example.

In essence, a process *blossoms* as time dilation increases, opening up like a flower in the sunlight as internal interaction is overcome by external interaction. As a process falls toward a black hole's event horizon, the process is interrupted to the point where it becomes fully *assimilated* – it becomes one process with the black hole.

If all of physics is about processes, then it is therefore all about *computation* [3,4] – here we have even adopted the concept of process interruption, which is surely familiar to all x86 assembly programmers [5].

3 On anti-gravity and time contraction

There is the *overclocking* and *optimization* of processes to consider – literally making a process run faster than its natural rate by reducing redundant and slow interactions [6–8]. That is, there is the possibility of time *contraction*, and *anti-gravity*.

4 On taking the holographic principle literally

In simple terms, the holographic principle states that a black hole process is the *densest* process for any given mass M – contemporary digital or quantum processors are nowhere close to this limit.

It takes n Boolean degrees of freedom (e.g. a measurement of binary entropy, also known as information) to describe the gravitational field [9–11] generated by a Schwarzschild black hole process of mass M . Where $M_p^2 = \hbar c/G$ is the Planck mass squared, this number of gravitational degrees of freedom is

$$n = \frac{4\pi M^2}{\log(2)M_p^2}. \quad (5)$$

Note that where the mass is less than the Planck scale, the process is a normal particle. Otherwise, where the mass is equal to or greater than the Planck scale, the process is a black hole.

In effect, the black hole event horizon is quantized – the event horizon is made up of an ensemble of n Planck-scale oscillators. All of the non-gravitational degrees of freedom have been stripped away as gravitational waves, leaving only the gravitational degrees of freedom. In other words: a black hole is raw spacetime.

In this paper we take the holographic principle literally, and so even for non-black hole processes, the number of gravitational degrees of freedom is still n – the process is just not as small as a black hole would be. Of course, the non-black hole also contains non-gravitational degrees of freedom, something that the black hole process does not.

It's a matter of minimum size – there is no *singularity* in this model of the black hole process. In effect, each of the n oscillators act as a *keystone*, stopping one another from falling further toward the centre of the black hole process.

5 On the retention of information

As for information loss (e.g. $dn/dt < 0$), there must be none, due to the 2nd law of thermodynamics. The Hawking black body radiation that escapes the gravitation of the black hole process must carry away information, where the corresponding Schwarzschild radius is

$$R_s = \frac{4\pi\ell_p^2 f}{c}, \quad (6)$$

and f is the photon frequency. The maximum frequency is the Planck frequency

$$f_p = \frac{1}{2\pi} \sqrt{\frac{c^5}{\hbar G}}. \quad (7)$$

The number of gravitational degrees of freedom is

$$n = \frac{4\pi f^2}{\log(2)f_p^2}. \quad (8)$$

All but Planck-scale photons have less than 1 gravitational degree of freedom, and so it must take an entire electromagnetic field to encode many gravitational degrees of freedom at once.

6 On the mechanism behind gravitational time dilation

It's important to note that there is no such thing as a gravitational *shadow*. This means that all mass *relays* (e.g. *repeats*) all gravitons, which allows a gravitating process to *indirectly* influence even more than n receivers. It also means that a process is interrupted by the act of relaying itself – the relaying of gravitons is the source of gravitational time dilation.

In effect, gravity is *viral* – it hijacks a process, and steals cycles in order to propagate, precisely like a digital computer virus. The closer you are, the more infected you become. This is not to say that gravitons are alive. Here we define life as anything that does not always follow a spacetime geodesic: birds fly, trees rise tall, and biological viruses swim. Gravitons are taken to always follow a spacetime geodesic, and so the gravitons are not alive by our definition of the word.

With regard to a thought experiment, consider a set of jugglers. Each juggler can only juggle so many balls per second (internal interaction). Once the jugglers start passing balls to each other (external interaction), the number of balls juggled among their own selves (internal interaction) will reduce. At some point the passing of balls (external interaction) could completely overcome any balls juggled among their own selves (internal interaction), where $dt'/dt = 0$. Jugglers can only act so fast. In other words, the processing speed of matter is finite, and it is interruptible.

7 On dark matter and the fractional dimension of gravitationally bound processes

Here we use a rough model, which assumes that the gravitation is Newtonian – irrotational like with the Schwarzschild line element, but where the gradient of time dilation has a length of practically zero (e.g. where $r \gg R_s$), and so only space is curved.

With regard to the flat rotation curve found in galactic dynamics [12]: if n is at least conserved as a gravitationally bound process (e.g. a galaxy) goes from sphere to disk as distance from the process centre increases, then the gravitation becomes anisotropic, strengthening along the orbit plane, weakening elsewhere. This includes galaxies, clusters, walls, and filaments.

For a perfect sphere, the interaction strength is like 1 with a long-range falloff proportional to $1/r^x$ where $x = 2$. For a perfect disk, the interaction strength increases by a factor of c with a long-range falloff proportional to $1/r^x$ where $x = 1$. For a perfect filament it increases by a factor of c^2 with a long-range falloff proportional to $1/r^x$ where $x = 0$ (e.g. no falloff). For these perfect shapes, the spatial dimension of the gravitational field goes from being $D = 3$ down to $D = 2$ or $D = 1$.

As for a practical application, we shall discuss a toy model of the Galaxy where the disk mass is simply taken to be zero. It is found that at a distance of roughly 10 kiloparsecs from the centre of the Milky Way, the spatial dimension of the gravitational field is roughly at least $D = 2.98$. The equations used to obtain this measure are likely familiar to researchers

of the fractal geometry of nature [13]:

$$v_n = \sqrt{\frac{GM}{r}}, \quad (9)$$

$$D = 3 - \frac{\log\left(\frac{v}{v_n}\right)}{\log(c)} \quad (10)$$

$$v = v_n c^{3-D}, \quad (11)$$

where $M = 1 \times 10^{41}$ is the mass of the Milky Way's core, $v = 220000$ is the desired circular orbit speed, and the orbit radius is $r = 3 \times 10^{20}$ metres (e.g. roughly 10 kiloparsecs). In general, where $2 < D < 3$, the value of the dimension will actually be a little bit greater than that given by Eq. 10, since the falloff exponent is $1 < x < 2$. As such, D is the minimum required value (e.g. the lower bound).

Note that where $D = 3$ is held constant, one can calculate the upper bound of the amount of dark matter:

$$M_{total} = \frac{rv^2 c^{2D-6}}{G} = \frac{rv^2}{G}, \quad (12)$$

$$M_{dark} = \frac{rv^2}{G} - M. \quad (13)$$

That is, the condensation of the gravitons produces a measurable amount of dark matter: at the very most M_{dark} . The views that $M_{dark} > 0$ and $D < 3$ are both correct at the same time – they are complimentary ways of describing the same thing: anisotropic gravitation leads to dark matter, which leads to anisotropic gravitation, etc.

Here we have defined a unique view of dark matter, which forms due to anisotropic gravitation in gravitationally bound processes. Of greatest importance is the fact that there is a finite number of gravitational degrees of freedom n for a process of mass M , and that when aligned, these gravitational degrees of freedom form gravitational bonds that are stronger than those predicted by Newton's isotropic theory of gravitation. Dark matter is a graviton *condensate*. If dark matter is a condensate of *gravitating* gravitons, then it is like the ants and their attractive, ultimately self-reinforcing pheromone trails – that is, complex, emergent structure occurs at the Galactic scale and larger, where gravitation is practically the only binding force. It's impossible to deny: the simulated Universe looks very much like ant trails, biological neural networks, and wide area computer networks – the similarity is *not* coincidental. The rich get richer, so to speak [14], when it comes to forming a scale-free network in the cosmos, just like it does with ant colonies, brains, and the Internet. See Fig. 1.

It should be noted that for processes bound by all four known interactions (e.g. gravity, weak, electromagnetic, and strong), such as protoplanetary disks, there is practically no dark matter to be found, because the emission of gravitons is so very close to being isotropic due to the isotropic nature of the other three interactions. For the Solar system – which was once a protoplanetary disk – the overall mass distribution has become too sparse to form any appreciable amount of anisotropic gravitation in the Sun. This is to say that Newton's isotropic theory of gravitation still very closely applies, for the relatively small AU-scale cases where dark matter practically need not be factored in.

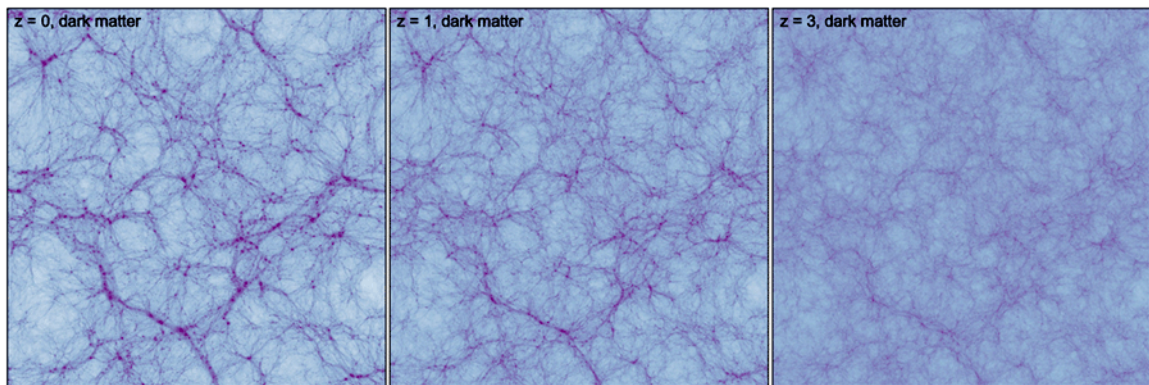


Figure 1: Image of Universe simulation by IllustrisTNG – <https://www.tng-project.org/>

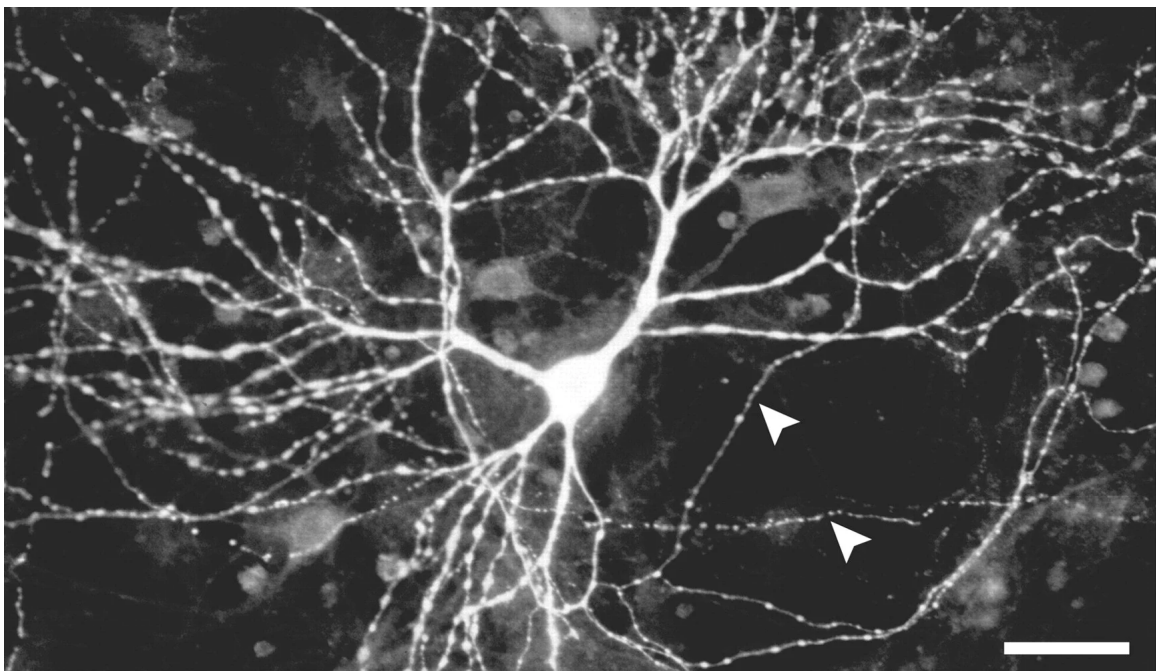


Figure 2: Image of a biological neural network by B. Zemelman et al – <https://doi.org/10.1073/pnas.242738899>

8 On dark energy and the computational efficiency of the Universe

We can only contemplate that, for the sake of symmetry in the interactions, there is a final, 5th interaction that is even stronger than the strong interaction. If this symmetry exists, then this 5th interaction would be opposite of 3-dimensional gravity. In other words: where the strong interaction is 2-dimensional (e.g. a triangle of quarks), the 5th interaction would be 3-dimensional (e.g. a tetrahedron of constituents). Where the strong interaction relies on 1-dimensional strings to communicate, the 5th interaction would rely on 2-dimensional membranes. Where the strong coupling constant is like 1, the coupling constant for this 5th interaction would be like c .

Perhaps this 5th interaction is the force behind the accelerating cosmic expansion. If so, then time contraction is the high-level mechanism behind this 5th interaction. It seems that the computational efficiency of the Universe is increasing over time in general, because of the 2nd law of thermodynamics, thus causing this time contraction; this antithesis of gravity.

9 Review

Evidently, time dilation exists, and so should time contraction. We have taken the holographic principle literally, and so a mass always contains all of its gravitational degrees of freedom: $n \propto M^2$. There was no information loss found: $dn/dt \geq 0$. We then discussed how gravitational time dilation is caused by the relaying of gravitons. Next we discussed dark matter, and how the gravitational interaction increases in strength when the gravitational degrees of freedom align to become oblate (e.g. 2-dimensional) or prolate (e.g. 1-dimensional). To finish, we discussed dark energy, and a final, 5th interaction.

The following is a table of interactions, according to this model:

Type	Inherent spatial dimension	Communication spatial dimension
Gravitation (isotropic)	3	4
Gravitation (oblate)	2	3
Gravitation (prolate)	1	2
Weak	0	1
Electromagnetism	1	0
Strong	2	1
5th interaction	3	2

If this model is correct, then it goes to retrodict the entire dark sector.

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