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.

1 Introduction

This paper is based on only one assumption – the gravitational field is *quantized* into *gravitons*. Unfortunately, we have no empirical evidence that gravitons actually exist. We try to make the best of the situation however, as we lay out a half-dozen sections on what quantized gravity would actually be like. In these sections we interpret the following topics:

- Time dilation
- Anti-gravity, or lack thereof
- The holographic principle and gravitational anti-degeneracy
- Information loss, or lack thereof
- The mechanism behind gravitational time dilation
- Dark matter, and fractional dimensions that follow a power law

Finally, we present some conclusions for further consideration.

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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, force-carrying particles (e.g. photons, etc).

This gravitational time dilation [1] is encoded in the first term on the right-hand side of the Schwarzschild line element in Einstein's general relativity

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

where R_s is the Schwarzschild radius

$$R_s = \frac{2GM}{c^2}, \tag{2}$$

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:

$$dt' = dt\sqrt{1 - \frac{R_s}{r}}, \tag{3}$$

and the kinematic time dilation equation is based on speed:

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

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* [2, 3] – here we have even adopted the concept of process interruption, which is surely familiar to all x86 assembly programmers [4].

3 On anti-gravity and time contraction

It should be noted that there is no *anti-gravity* – there is no *anti-interruption*, just simply a *lack* of interruption. That said, 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 [5–7]. That is, there is the possibility of time *contraction*.

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 [8–10] 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

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

Note that where the mass is less than the Planck scale, the process is an elementary 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 a lack of *degeneracy*, and minimum size – there is no *singularity* in this model of the black hole process.

5 On the retention of information

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

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

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

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

The number of gravitational degrees of freedom is

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

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. Thus, there is a fundamental limit to the amount of processing that can occur per unit of time, otherwise the relaying of gravitons would not cause time dilation at all.

In effect, gravity is *viral* – it highjacks 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.

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 [11]: 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. In fact, gravitation is anisotropic for all gravitationally bound processes, for there is no such thing as a perfect spherically symmetric, isotropic, homogeneous process (not even a Schwarzschild black hole is perfectly spherically symmetric, because the event horizon is quantized). This includes galaxies, clusters, walls, and filaments.

For a perfect disk, the interaction strength increases by a factor of c with a long-range falloff proportional to $1/r$, and for a perfect filament it increases by a factor of c^2 with a long-range falloff proportional to 1 (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, 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 $D = 2.97$. The equation used to obtain this measure is likely familiar to researchers of the fractal geometry of nature [12]:

$$D = \frac{\log\left(\frac{c^3 GM}{v^2 r}\right)}{\log(c)}, \tag{9}$$

where $M = 1 \times 10^{41}$ is the mass of the Milky Way's core, $v = 200000$ 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. 9, since the falloff exponent x is $1 < x < 2$. As such, D is the minimum required value.

To compare, where $v = \sqrt{GM/r} = 149108$, it is found that $D = 3$ exactly (e.g. where Newton's isotropic theory of gravitation still works great).

8 Conclusions

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*.

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 is still very great, for the relatively small AU-scale cases where dark matter practically need not be factored in.

We can only assume 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.

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