ON THE CONNECTION BETWEEN MASS AND SPACE

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Abstract

We show that an elegant relation $R = c^2 / G$ arises describing the size of the universe R in terms of the speed of light c and the gravitational constant G when we treat mass as being made of space instead of in, but separate from, space.

Main

General relativity is a theory describing the relation between spacetime, matter and radiation. It assumes that matter is something separate from space. What if this picture is wrong? What if matter is not separate from space but is made of space itself? What if mass <u>is</u> space?

Why would we postulate that mass is space instead of mass being in space? There is a simple reason. If we want to unify we have to take apparently different things and bring them together, discover them as fundamentally being the same thing[3]. The approach to this will be top down. Start with only one thing, and derive everything else from it[4]. This process has the advantage of implicit unification. We will use space as our fundamental starting point and then explore how we can derive[5] mass from space. The result of a certain choice in the top down process has to connect with the real world, otherwise the choice is not correct. This is how we can gauge our choices.

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[1] I thank H. Morsch for his infinite support
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[3] Newton brought an apple and the moon together. Einstein brought acceleration and gravitation together. Here we bring mass and space together
[4] Properties like mass, time, charge, spin have to be expressions of space. E.g. time is space changing
[5] How we choose what mass is in terms of space so that it resembles mass as we know from the real world

To start we postulate

1. There is only space[6]

In this paper we focus on deriving mass from space. The only thing we can postulate at this point is

2. Mass is a specific configuration of space[7][8]

We have to express mass in terms of space. The question becomes, what configuration does space have when it is denoted as mass? We might be able to take inspiration from general relativity and the predicted existence of black holes.

We start with a neutron star. A neutron star is made of neutrons[9] and has a certain mass. Postulate 1 states that we have to view everything as being made of space. Thus a neutron star is made of space. It is space configured in a 'neutron star way'[10] with the individual neutrons being space configured in a 'neutron way'[11]. At least part of the space configuration of a neutron star has to account for its mass. We will denote this part as mspace, with all other configurations of space denoted as zspace. We do this to identify what mass is. A neutron star therefore is a superposition of mspace and zspace. When adding[12] mass to the neutron star it will reach a limit where the 'neutron star' space configuration breaks down to something smaller called a black hole[13]. The black hole has the same[14] mass as the neutron star just before it collapsed. The mass has not disappeared, yet the volume of space has decreased, in other words mspace has been retained while zspace has decreased. Now let's assume[15] that a black hole only consists of mspace, all zspace has been ejected, then we can postulate

3. A black hole is pure mass

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[6] It implies that everything else has to be derived from space
[7] Mass refers to 'a region of space having a specific configuration'
[8] It implies that the unit kilogram cannot be fundamental. Kilogram is a reference to 'something space'
[9] Mostly neutrons. There are other particles present
[10] A certain layered packing of neutrons (and other particles)
[11] Every particle, e.g. a neutron or a proton, has its own specific configuration of space
[12] E.g. by infalling matter
[13] There might be stadia between a neutron star and a black hole, e.g. a 'quark star'
[14] A simplification to streamline the argument
[15] We will gauge later if the result of this assumption 'connects' with the real world

Pure mass is a region of space where all space is mspace. A region of space has a volume. A volume has a surface. This surface encloses the volume and it defines the volume[16]. Therefore in the case of a black hole the surface, which defines a volume of mspace, should also define the mass. We postulate

4. The surface area of a black hole defines its mass

A black hole has an associated radius called the Schwarzschild radius[17]. This radius is denoted as r_s and depends on mass m of the black hole as follows

$$r_s = 2\,G\,m\,/\,c^2$$

The surface area of a black hole is equal to $4\,\pi\,r_s^2$

We are looking for a way to express mass in terms of space. Here we arrive at that point. We associate the mass of the black hole with its surface area[18] as follows

$$m = 4\,\pi\,r_s^2$$

Inserting this into the Schwarschild equation we get

$$r_s = 2\,G\,4\,\pi\,r_s^2\,/\,c^2$$

We find the following relation

$$r_s = c^2\,/\,8\,\pi\,G$$

With $c = 3 \times 10^8$ and $G = 6.7 \times 10^{-11}$ we find

$$r_s = 5.4 \times 10^{25} \text{ meter}$$

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[16] Not the other way around
[17] From within this radius no light can escape, hence ‘black hole’
[18] The magic of equating mass and space

This is a surprising number. Instead of being very small, it is very big. It has the same order as the size of our observable universe R[19]. The result seems to 'connect' to the real world[20]. It is not easy to explain why the local Schwarzschild equation 'flipped' to a universal scale. But we see that by expressing mass in terms of space the Schwarzschild equation, when using R in place of r_s, reveals something about the universe as a whole, pointing to a universal relation between G, R and c. If we leave out numerical factors like 2, 4, π, etc we get the following elegant relation

$$R = c^2 / G$$

It suggests that we can directly calculate the size of the universe by simply measuring G and c. This relation is static. Would it be dynamic, as in e.g. a 'big bang' scenario where R is variable, then it would imply that G and/or[21] c also vary over time[22].

Another observation arises when we write the relation as follows

$$G = c^2 / R$$

Here the relation is indicating the universe having an inherent 'rotational' aspect, as it has the same form as the centrifugal force. In a closed universe a photon, flying through the universe, eventually would end up at its starting position, and thus would have flown a circle. The last relation expresses this feature. It suggests G being an inherent universal centrifugal force felt by all photons.

Furthermore when there is a rotating system, there is not only a centrifugal force but also a coriolis force. The coriolis force, inherent to the universe, scales with c/R. This inherent universal coriolis force might be the reason why galaxies like Andromeda and the Milky Way have spiral arms. It is no coincidence that hurricanes and galaxies look the same because both result from a coriolis force.

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[19] Which is currently estimated at 4.4x10^26 meter

[20] The postulates follow a logic. The resulting relation R=c^2/G does seem to 'connect' to the real world, albeit perhaps not fully understood. This strengthens the validity of the postulates

[21] It could be that G or c is constant over time, but not both

[22] It should be noted that time itself is an expression of space as per postulate 1