On dark matter

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Summary

My big picture is, that our universe is just curved spacetime, and “matter” built up by extreme manifolds, the black holes. Through their encapsulation, they are the only manifolds that build up something we call objects. So, the words “masses curve spacetime” are modified to “*curved spacetime provides the illusion of masses*”. The document is part of my project «The universe is just curved spacetime», which agenda is documented in [(PDF) Our universe is just curved spacetime Our universe is just curved spacetime (researchgate.net)](https://www.researchgate.net) .

How did essential parameters of our universe evolve to produce our view on it?

I will present a simple identity of radius r and evolution time ct yielding a value of radial acceleration $\frac{\partial^2 r}{\partial^2 t}$ equal to the value of MOND theory at our time *NOW* – if the solution is interpreted in a special way of slicing the evolution of our universe in spheres of “equal time” and our views being views from points on these spheres, given by coordinate transformations made of elements of the Poincaré group, affinity transformations and transformations with reciprocal radii, scaling the Minkowski metric. A world line leading to a special point in spacetime is provided by a succession of transformations of the above type. Because the transformations build a group, the so-called G_{15}, this succession of transformations can be replaced by just one transformation. Let us call this transformation the unified transformation. Now, a lot of world lines may meet at the point, originating in different starting points. Their unified transformations build up the view on the universe at this point. So, the view is part of an illusion, the illusion to know the world lines. In fact, we only see “short-cuts”. This way, evolution of the universe and the views on it must be seen

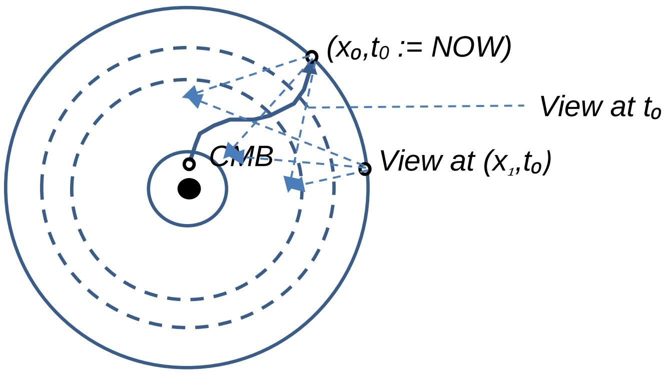
together. The views would not exist without the evolution of the universe. But on the other hand, all the views together are just the universe.

Moreover this paper constitutes a duality in the force, we call gravitation. The radial expansion – not constant over time! - induces an additional component in rotational force that is Newtonian gravitation.

Well, that is the big picture. Now let us go into details.

Dark matter

Our universe seems to be a dual construction of evolution and our view on this evolution. For the calculations to come we use the following picture:



Where *CMB* denotes the phase of recombination, and *NOW* is our time, the point in spacetime of our view on the universe. The curved line visualizes the journey of a collection of black holes in a Minkowski universe. How black holes arise in a Minkowski universe without matter (just as extreme curved spacetime manifolds) shall be part of another section in this document. In fact, only such encapsulated structures can build up something that we call object.

Now, what is creating evolution and views on this evolution, if one assumes that there is only curved spacetime and matter built up by extreme manifolds, black holes? To me it seems natural, that this must be transformations of the kind that they are scaling the Minkowski metric, written as:

(M) $\partial x'^2 + \partial y'^2 + \partial z'^2 - \partial(ct')^2 = \lambda(\partial x^2 + \partial y^2 + \partial z^2 - \partial(ct)^2)$, with c speed of light and time t, and (x',y',z',ct') being a transformation of (x,y,z,ct) in $\mathbf{R}^4$.

If we change to spherical coordinates (M) can be written as:

$$\partial r'^2 - \partial(ct')^2 + r'^2\left(\partial\theta'^2 + sin^2\theta'\partial\varphi'^2\right) = \lambda(\partial r^2 - \partial(ct)^2 + r^2(\partial\theta^2 + sin^2\theta\partial\varphi^2))$$

With radius r, polar angle θ and azimuthal angle φ.

In the beginning of the last century, scientists like Poincaré and Einstein [1] evaluated these transformations and found it to be the 15-parameter group G_{15} of conformal transformations with reciprocal radii [1]. The 10-parameter Poincaré group (containing the 6-parameter Lorentz-group) is contained as a subgroup. Cunningham [1] showed, that the transformations of G_{15} can be split into three parts:

⊖ $\lambda = 1$: The Poincaré group (Lorentz-group + translations)

◎ $\lambda \neq 1$: Affinity transformations

◉ $\lambda = \frac{k^4}{(x^2+y^2+z^2-(ct)^2)^2}$: Transformations with reciprocal radii

In [1] there is a remark on ◎ : If λ is set definite, then ◎ forms a group only if $\lambda = 1$. This is clear, since if we apply (M) twice we get:

$\partial x''^2 + \partial y''^2 + \partial z''^2 - \partial(ct'')^2 = \lambda^2(\partial x^2 + \partial y^2 + \partial z^2 - \partial(ct)^2)$. With $l \coloneqq \sqrt{\lambda}$ Poincaré showed, that transformations of this type can be written as

◎ $x' = \gamma l(x - \frac{v}{c}ct)$, $y' = ly$, $z' = lz$, $ct' = \gamma l(ct - \frac{v}{c}x)$, with v<c is in direction of x.

When v is a radial velocity field (associated tzo the expansion of our universe) the transformation in spherical coordinates can be written as:

$r' = \gamma l(r - \frac{v}{c}ct)$, $ct' = \gamma l(ct - \frac{v}{c}r)$, θ' = θ, φ' = φ

We assume, that evolution of the universe and its views is based on transformations of that type and an identity combining radius r and evolution ct. The creation of the objects, the black holes, is described in another paper

Short excursion into dynamic velocity

If we assume velocity v not to be constant but in x-direction, then a transformation of type ◎ in Poincare notation would generalize the Minkowski metric to:

$$\partial x'^2 + \partial y'^2 + \partial z'^2 - \partial(ct')^2 = l^2[\left(\partial x - \gamma^2 \frac{ct}{c}\partial v\right)^2 - \left(\partial(ct) - \gamma^2 \frac{x}{c}\partial v\right)^2 + \partial y^2 + \partial z^2]$$

Now, in an expanding universe a radial velocity field is of interest. Therefore, we have to change to spherical coordinates. And then the Minkowski metric will be written as:

$\partial r'^2 - \partial(ct')^2 + r'^2(\partial\theta'^2 + sin^2\theta'\partial\varphi'^2)$, and the transformation: $r' = \gamma l(r - \frac{v}{c}ct)$, $ct' = \gamma l(ct - \frac{v}{c}r)$, θ' = θ, φ' = φ, with v in direction of r and of type, say ◎* (not constant) will change the metric to:

$$\partial r'^2 - \partial(ct')^2 + r'^2(\partial\theta'^2 + sin^2\theta'\partial\varphi'^2) =$$
$$l^2[\left(\partial r - \gamma^2 \frac{ct}{c}\partial v\right)^2 - \left(\partial(ct) - \gamma^2 \frac{r}{c}\partial v\right)^2 + \gamma^2(r - \frac{v}{c}ct)^2\left(\partial\theta^2 + sin^2\theta\partial\varphi^2\right)] \quad \textbf{(M*)}$$

Since transformations of type ◎* form a group, the resulting generalized metric M* will be preserved up to scaling by transformations of that group. This will be handled in more detail in the document «*On with the Big Bang*».

So, the universe expands in nested spheres due to transformations of type ◎. Objects are built up by black holes (separate document) These objects cross the spheres by means of transformations of type ⊖ and result in views on the universe, i.e. the objects in it. Only a collection of black holes may be an observer to another black hole.

We assume that the journey is due to an identity combining radius r and time as ct. The identity shall be preserved by transformations of type ◎.

Notation: In the calculations to come we denote for a variable x the term x_0 as its value at our point of view *NOW*. So, for instance $r_\circ$ = r(*NOW*), $t_\circ$ = t(*NOW*), $\gamma_0 = \gamma(NOW) = \frac{1}{\sqrt{1-\frac{v_0{}^2}{c^2}}}$, $\beta_0 = \frac{v_0}{c}$, where $v_\circ$ = v(*NOW*). So, let us start with a simple identity:

(I) $a_0{}^2(r-\beta_0 ct)^2 - b_0{}^2(ct-\beta_0 r)^2 = 0$, with a_0, b_0 real constants (constant with respect to *NOW*). The identity being exactly valid for (r,t)=(r_0,t_0), and approximately near by. Calculation yields equivalence to

$$(a_0{}^2 - b_0{}^2)(r-\beta_0 ct)^2 = \frac{b_0{}^2}{\gamma_0{}^2}((ct)^2 - r^2)$$

Since this identity is exactly valid for (r,t)=(r_0,t_0), we may modify the identity to:

$(\frac{a_0{}^2}{b_0{}^2} - 1)\gamma_0{}^2(r-\beta_0 ct)^2 - (ct)^2 = -r_0{}^2$. So, setting $(\frac{a_0{}^2}{b_0{}^2} - 1)\gamma_0{}^2 = \pi^4$ (the reason for this will be seen later) we end up with the identity:

(D)	$(r-\beta_0 ct)^2\pi^4 - (ct)^2 = -k_0{}^2$	$\beta_0 = \frac{v_0}{c}$ [-], $k_0 = const$ [m], c speed of light, r radius, t time.

From this simple identity we will get:

$w := \frac{\partial r}{\partial t} = \frac{c^2 t}{\pi^2\sqrt{(ct)^2 - k_0{}^2}} + \beta_0 c = c * (\frac{1}{\pi^2\sqrt{1-\frac{k_0{}^2}{(ct)^2}}} + \beta_0)$ (this will show to be the amount of the radial velocity vector field describing the expansion of our universe).

And for the radial acceleration we obtain:

$$a := \frac{\partial w}{\partial t} = -\frac{c^2 k_0{}^2}{\pi^2(\sqrt{(ct)^2 - k_0{}^2})^3} .$$

This way we get $a^2 = \frac{c^4 k_0{}^4}{\pi^4((ct)^2 - k_0{}^2)^3}$, and assuming that $a \neq 0$:

$$k_0{}^6 + (\frac{c^4}{a^2\pi^4} - 3(ct)^2)\, k_0{}^4 + 3(ct)^4 k_0{}^2 \text{-} (ct)^6 = 0$$

This is a cubic equation for $k_0{}^2$. One recognizes, that this equation would yield a time dependency of $k_0{}^2$, which would be a contradiction to the assumption of $k_0{}^2$ being a constant. So, this equation can be only valid exactly, when $t = t_0 = NOW$ and $a = a_0$ being the amount of the radial acceleration at this time, our time.

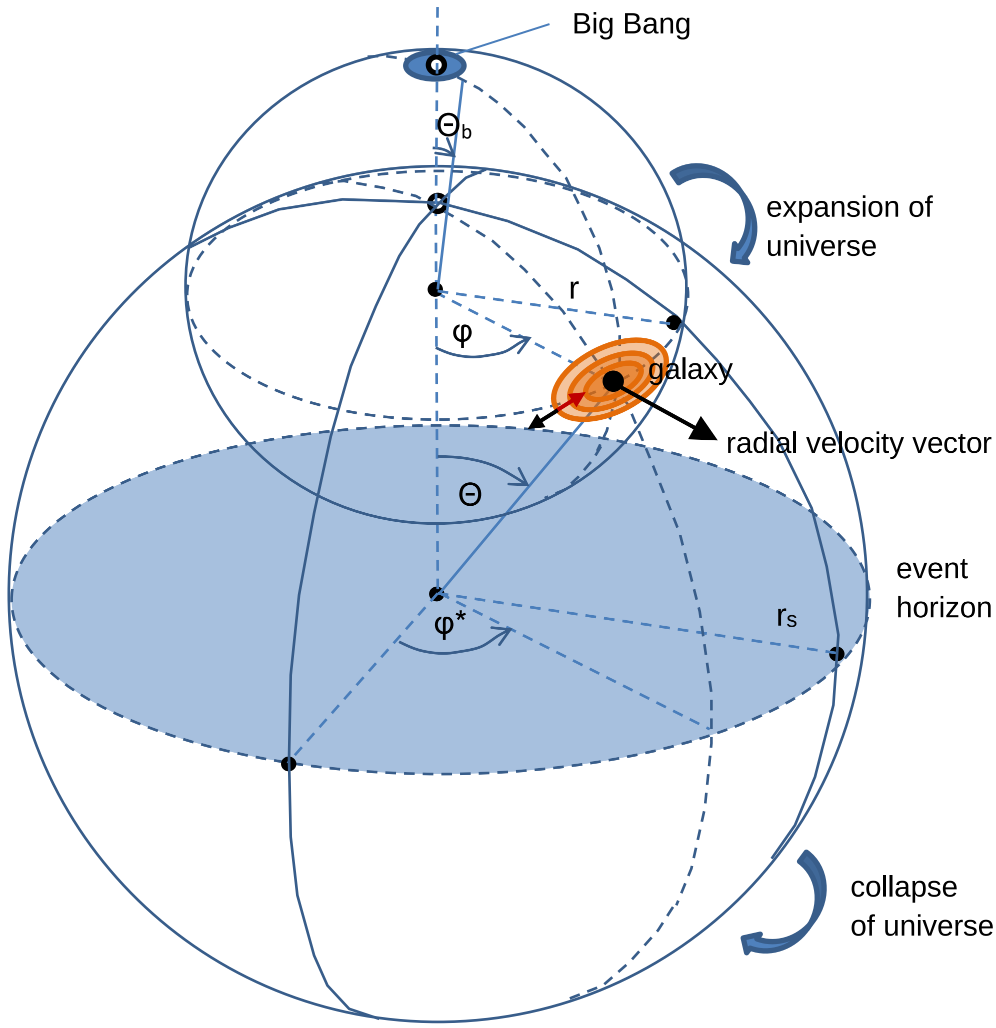
One calculates that the discriminant D of the cubic equation is

$$D = \frac{c^8(ct_0)^6}{12 a_0{}^4\pi^8} * (3(ct_0)^2 - \frac{4c^4}{9a_0{}^2\pi^4}) .$$

Of special interest are solutions for D=0. This means:

$a_0{}^2\pi^4 = \frac{4c^4}{27(ct_0)^2}$, so: $a_0 = -\frac{2c^2}{3\sqrt{3}\pi^2 ct_0}$. For $k_0{}^2$ we get: $k_0{}^2 = \frac{(ct_0)^2}{4}$ (other solutions for $k_0{}^2$ would be negative).

How to interpret this result? Let us have a look at the picture to follow.



The radial expansion with non constant velocity corresponds to a radial acceleration, say a. The expansion induces in a galaxy (see picture) a force, radial relative to the galaxy with amount - aπ, that induces a counter force a= aπ.

Now let $ct_0 = 9{,}702$ billion lightyears (this is the age of the universe for our point of view, due to the event horizon model [2], which is smaller than the age of 13,8 billion years in the standard model of cosmology, because redshift by gravity is included, leading to a smaller contribution of redshift by expansion). Then we get:

$a_o = -3{,}821213 * 10^{-11}\frac{m}{s^2}$. So,

$a_o\pi = -1{,}20047 * 10^{-10}\frac{m}{s^2}$ which amount is exactly the value of MOND theory. Now, that is the reason for the setting $(\frac{{a_0}^2}{{b_0}^2} - 1){\gamma_0}^2 = \pi^4$ above.

For any nearby rotating system, such as galaxies in distances up to some hundred million lightyears, this means, that we will have to add a radial acceleration (with direction to the center of the rotating system, because a_0 is negative) to the acceleration due to gravity of the mass inside the sphere of the object under consideration (i.e. a star rotating at higher velocity than induced by just gravitational force). This additional gravity is what we call *dark matter*. Its amount results (for non-relativistic velocities) from the equation:

a(*NOW,rotation-system*) = $\frac{G*M(r)}{r^2} + |a_0| = \frac{v^2}{r}$ with tangential velocity **v**, where *a(NOW)* denotes the radial acceleration at radius r of the rotating system with M(r) being the mass inside the radius, G gravitational constant.

$\rightarrow$ v = $\sqrt{\frac{G*(M(r)+\frac{|a_0|*r^2}{G})}{r}}$.

The term $M_v(r) := \frac{|a_0|*r^2}{G}$ yields the (additional) dark matter.

One recognizes that for large values of r v increases by $\sqrt{r}$. But objects are "outside" of billions of rotating systems in our universe, so billions of velocity vectors will have to be added, limiting the increase of v for objects outside the special rotating system.

The Slice model

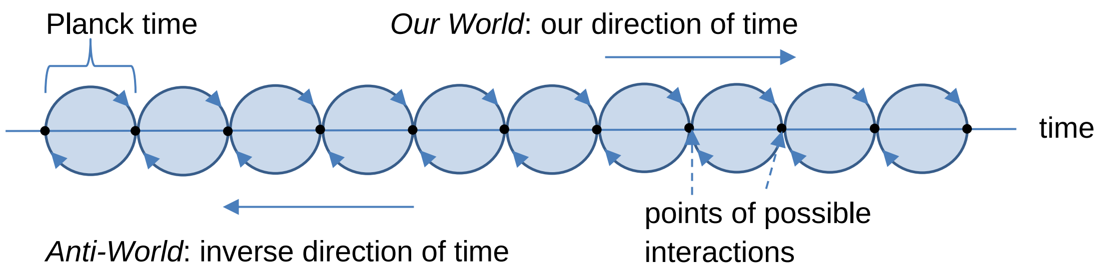
Now, back to identities (I) and (D), what is the interpretation of the above result on our view on the universe, given by ${k_0}^2$? My interpretation is the following one:

First, I suppose, that (I) is equal to (D), meaning that $(\frac{{a_0}^2}{{b_0}^2} - 1){\gamma_0}^2 = \pi^2$ is not only valid for t=NOW, but for all time steps. Identity (D) describes essential properties of the expansion of our universe, delivering a frame for the possible views on it, one of these views being our view.

The evolution of our universe is then given by spheres of isolated solutions for ${k_0}^2 = \frac{(ct_0)^2}{4}$. In Planck units the dimension is ${l_\mathrm{p}}^2$ using Planck length l_p , the dimension of a spin. Since this is the smallest unit, observable for us, the spheres will differ from another by a radius increment of multiples of $\hbar$. So our universe may be described with respect to its expansion by the following union U of identities:

U := $\{(r-\beta_n ct)^2\pi^2 - (ct)^2 = -\frac{1}{4}(ct_n)^2\colon (ct_n)^2 = nl_p^2,\ n\ \epsilon\ \mathbf{N},\ \beta_n\ \epsilon\ \mathbf{R}$ free parameter for a view on the universe by observer for every solution at $t = t_n\}$.

Now, we get solutions only at discrete points in time. Of course, one could complete the discrete solution to a smooth total solution, but what would be the use? We would never be able to look into the intervals of limiting Planck time units. So, the time axis has properties of "timelike" black holes, lined up like a pearl necklace – in fact a pearl tree with respect to space dimensions.



So, if this picture is true, again we notice, that there would not be any object called time, without black holes. In a continuous world no objects would exist, since every boundary would be arbitrary. It is the Planck quantum $\hbar$ and the black holes, which makes this world a world of objects. Note, that curved spacetime does not mean “curved because of gravity”, it means just “curved”. Parts of curvature should for instance result from electro-magnetism. So, which parts of curvature result in phenomena like electromagnetism is part of ongoing work.

Note also, that since there is a free parameter β_n for the view of arbitrary observers at sphere of time t_n, there is no determinism. One may argue, that if one knows initial values of all points on a sphere one would be able to calculate the future. But this is just nonsense, since we can never compare such different views from a sphere to the universe, since any other point on a sphere is out of reach due to the limitation of the speed of light. There is a large variety of different views on our universe. Only the identity (D) would have to be fulfilled *with respect to essential parameters of our universe corresponding to its expansion*. So, identity (D) is useful in evaluating some dynamical parameters, but it does not describe our universe.

On past and future

The Slice Model shows that the expansion of the universe is determined. But that is not true for the evolution of the views. At a certain point on a sphere, a lot of world lines meet there. Neither their past nor their future is determined.

Applications

The **Bullet cluster** consists of two clusters of galaxies that penetrated each other leaving behind a cloud of merged gas between the now separating clusters. Although the mass concentrates in the cloud of gas the Bullet-cluster shows lensing effects primarily in the separating clusters. This is noted to be a counterexample to MOND theory and an indicator for the dark matter hypothesis. The above model states that the virtual masses add only to rotational systems but not to the cloud of gas. So the observed lensing effect may be explained without using the concept of dark matter.

Within the **Milky way** we could check tangential velocity of outer stars to be greater than the minimum tangential velocity given by a lower limit for M(r) and the virtual mass $M_V := \frac{|a_0|*r^2}{G}$. If for instance we take r = 27000 light years from the center (estimated distance of the solar system) and M(r) = 80 billion solar masses $M_\odot$ *(≈1.59*10*^{41} *kg)*, we get:

$M_V(r)$ [billion $M_\odot$]	57
v(r) [km/s]	267

v(r) is an actual measured value for tangential velocity of the solar system. For stars 50000 light years from the center Sagittarius A*, we would get $M_V \approx 195$ billion solar masses. Given a good estimate of baryon mass M(r=50000ly) we should be able to compare calculated tangential velocity to measured one.

Falsification

- The amount of “dark matter” in distant galaxies should increase with the distance of comparable galaxies. *Comparable* means, that it does not make sense to compare diffuse galaxy types (like dust clouds with beginning rotation) with ones similar to the milky way.

- The amount of “dark matter” in our solar system within the earth radius should be $\sim 4{,}0246 \cdot 10^{22}$ kg (this is comparable with the mass of the moon: $\sim 7{,}346 \cdot 10^{22}$ kg)

References

[1] Kugelwelltransformationen, WIKIPEDIA, Mai 2020, Link: https://de.wikipedia.org/wiki/Kugelwellentransformation

[2] Event-Horizon-Model, Harald Kunde, February 2021, Link: http://harald-kunde.de/pdf/OnCosmology01.pdf