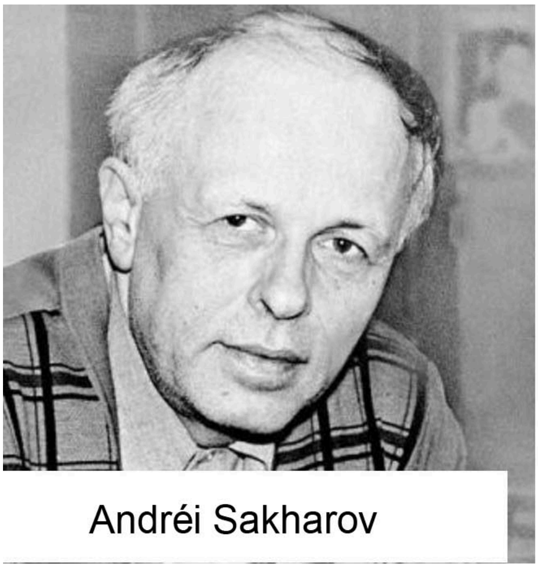
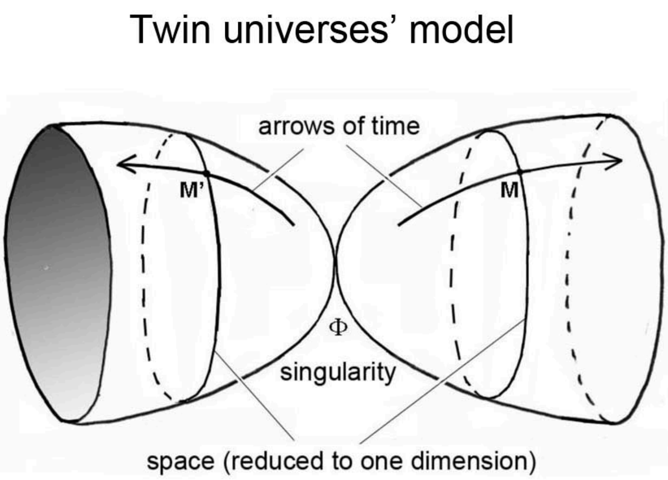
The nineteen observational confirmations of the Janus Cosmological Model (JCM)

Jean-Pierre Petit[1], Gilles d'Agostini, Nathalie Debergh

I - **Basics of the model**

The theme of a cosmological model with opposite arrows of time, which is beginning to gain some resonance in scientific circles, was in fact introduced in 1967 by the Russian Andrei Sakharov ([1], [2], [3]). He then proposed a model where two twin universes are linked by this singularity called the Big Bang.





It indicates that the arrows of time, in these two universes, are opposed but without really giving a reason for this. Its guiding idea is to propose an explanation for the non-observation of primeval antimatter.

Classically baryonic matter is created from three quarks, while antimatter is composed of three antiquarks. Sakharov then suggests that the production of matter from quarks would have been lightly faster than the production of antimatter from antiquarks. Thus, after the annihilation of the antimatter pairs there would remain a residue of one baryon in a billion, plus the equivalent in antiquarks, in a ratio of three to one.

For the sake of symmetry, Sakharov suggests the existence of a twin universe where we would have the opposite situation, i.e. an excess of antimatter and an excess of quarks.

He gives no justification for the idea of opposite arrows of time.

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[1] Member of the American Physical Society : jp.petit@mailaps.org

The inversion of the time arrow is called T-symmetry. This is discussed in the Quantum Theory of Field [4]. The time inversion operator can then take two forms:

- Linear and unitary

- Antilinear and anti-unitary.

The Nobel Prize winner S.Weinberg notes that by opting for a unitary operator this avoid negative energy states. As those seem to him a priori excluded by nature, he says that one must then opt for a choice of anti-linear and anti-unitary temporal inversion operator, simply to avoid having to manage such objects. He indicates that there is no physical situation to justify the existence of such states.

In 2011 a Nobel Prize ([26], [27], [28]) was awarded for the discovery of the acceleration of cosmic expansion, attributed to a mysterious dark energy. This is synonymous with negative pressure. But pressure is also a volume density of energy. This phenomenon thus militates for the existence of negative energy states, which contradicts Weinberg's assertion.

In addition, a recent work on Quantum mechanics [5] has shown that its formalism is perfectly adapted to the existence of objects of energy, and beyond negative mass.

In 1970 the mathematician Jean-Marie Souriau [6] developing his theory of dynamical systems, showed that the classical attributes of physics, energy, mass, spin, have a purely geometrical nature and origin, deriving from the considered dynamic group, in this case the Minkowski isometry group.

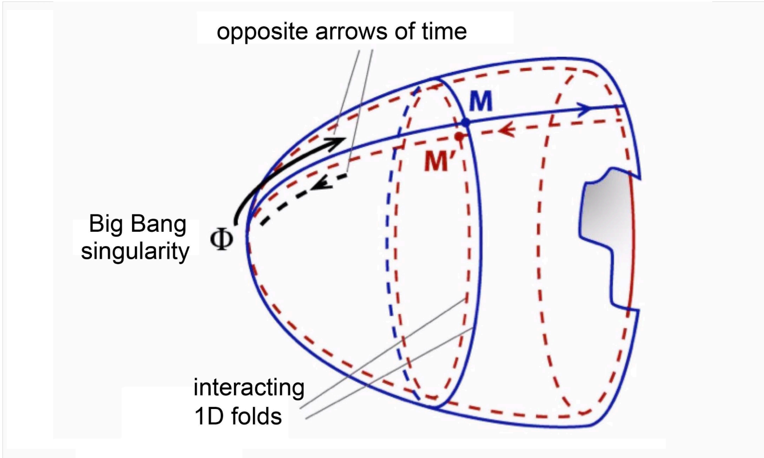
This group has four components. Two form the orthochronous subgroup (whose elements do not invert time) and the other two form the antichronous subgroup, whose elements invert time.

Classically physicists neglect these two other components, considered as non-physical, by limiting themselves to the orthochronous components, forming the *restricted* Poincaré group.

But if we consider taking in charge the whole group [12], we then demonstrate that the inversion of time is synonymous with the inversion of energy, and beyond the inversion of the mass.

This then gives a geometrical meaning to Sakharov's model. His second universe, twin to ours, would be composed of negative masses and photons of negative energy.

In the Janus cosmological model we "fold" these two sheets of universe and we then obtain a model where positive and negative masses interact.



If this corresponds to the physical reality negative mass particles, emitting photons of negative energy would be unobservable to our eyes and measuring instruments.

Taking up Sakharov's idea, with these different production rates, this "twin matter" would be made of negative mass antimatter and its nature would be known. It would be

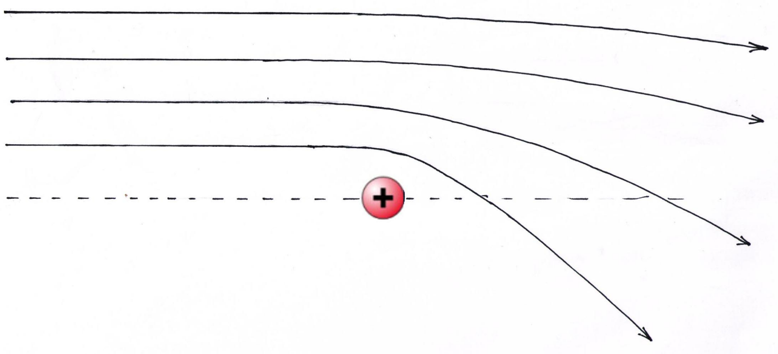
- Negative mass antiprotons
- Negative mass antineutrons
- Negative mass anti-electrons

Bathed in a sea of negative energy photons from the annihilations.

II - The problem of negative masses

We can then consider that the universe could contain positive and negative masses. If we consider including these masses in the energy-matter tensor of Einstein's equation we see a paradox called runaway that contradicts one of the fundamental principles of physics: the principle of action-reaction.

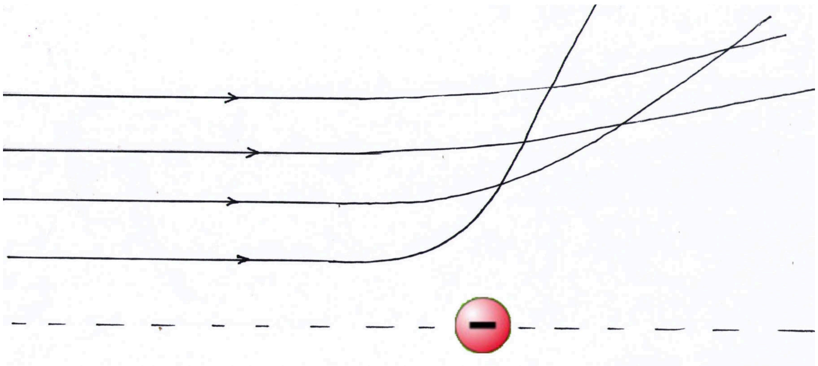
Indeed if the gravitational field is created, locally by the presence of positive masses, Einstein's equation provides a geodesic set that evokes an attraction.



Test masses, whether positive or negative, can only follow this single family of geodesics. It is deduced that

- Positive masses attract everything, whether positive masses or negative masses.

If we now assume that the energy-matter tensor is constructed from a negative mass distribution, we obtain geodesics evoking repulsion.

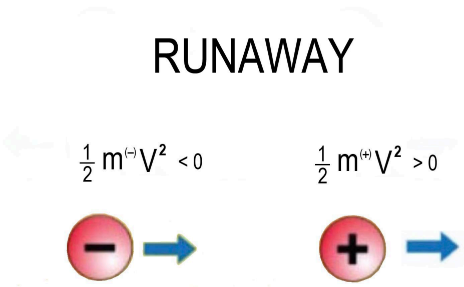


Here again, test masses, whether positive or negative, can only follow this single family of geodesics. We deduce that

- Negative masses repel everything, whether positive or negative masses. They repel themselves and repel positive mass particles.

III - **The Runaway Effect**

Let us now consider a couple of masses + m and - m :



The positive mass escapes, followed by the negative mass. These masses undergo uniform acceleration, but their overall kinetic energy remains constant since the energy of the negative mass is negative.

This phenomenon has been given the name *runaway*, which violates the action-reaction principle.

Some researchers (Farnes [8], Chardin & Benoit-Lévy [9]) are considering to accommodate this phenomenon.

If we consider reconstructing the action-reaction principle, the positive and negative test particles must follow different geodesics, derived from metrics $g_{\mu\nu}^{(+)}$ and $g_{\mu\nu}^{(-)}$. So that, placed in a given gravitational field, they would react differently. To these metrics will be associated Ricci tensors $R_{\mu\nu}^{(+)}$ and $R_{\mu\nu}^{(-)}$.

IV - **Bimetric models**

Bimetric models have been considered by T.Damour & I. Kogan [10], S.Hossenfelfder [11] and Petit & d'Agostini ([12], [16]) based on systems of coupled field equations.
The system of reference [10] is : (1)

$$R_{\mu\nu}(g^L) - \frac{1}{2} g^L_{\mu\nu} R(g^L) + \Lambda_L g^L_{\mu\nu} = t^L_{\mu\nu} + T^L_{\mu\nu}$$

$$R_{\mu\nu}(g^R) - \frac{1}{2} g^R_{\mu\nu} R(g^R) + \Lambda_R g^R_{\mu\nu} = t^R_{\mu\nu} + T^R_{\mu\nu}$$

The one in reference [11] is written
(2)

$$^{(g)}R_{\kappa\nu} - \frac{1}{2} g_{\kappa\nu} {}^{(g)}R \;=\; T_{\kappa\nu} - \underline{V}\sqrt{\frac{h}{g}}\, a_{\nu}^{\;\underline{\nu}} a_{\kappa}^{\;\underline{\kappa}} \underline{T}_{\underline{\nu\kappa}}$$

$$^{(\underline{h})}R_{\underline{\nu\kappa}} - \frac{1}{2} h_{\underline{\nu\kappa}} {}^{(\underline{h})}R \;=\; \underline{T}_{\underline{\nu\kappa}} - W\sqrt{\frac{g}{\underline{h}}}\, a^{\kappa}_{\;\underline{\kappa}} a^{\nu}_{\;\underline{\nu}} T_{\kappa\nu} \quad ,$$

The one in reference [15] is written
(3)

$$R^{(+)}_{\mu\nu} - \frac{1}{2} R^{(+)} g^{(+)}_{\mu\nu} = \chi \left[T^{(+)}_{\mu\nu} + \sqrt{\frac{g^{(-)}}{g^{(+)}}}\ \hat{T}^{(-)}_{\mu\nu} \right]$$

(4)

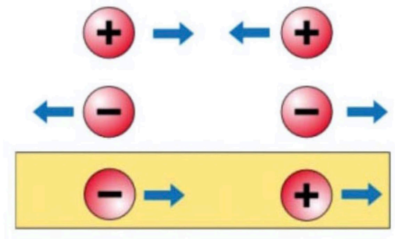
$$R^{(-)}_{\mu\nu} - \frac{1}{2} R^{(-)} g^{(-)}_{\mu\nu} = -\chi \left[\sqrt{\frac{g^{(+)}}{g^{(-)}}}\ \hat{T}^{(+)}_{\mu\nu} + T^{(-)}_{\mu\nu} \right]$$

The three systems have exactly the same first members, because they derive from similar actions, also inspired by the one producing Einstein's equation.

The reference system [10] uses gravitons with a mass spectrum and does not lead to a model allowing a comparison with observations. On the other hand, this use generates a ghost instability, typical of this "massive gravity" approach. The reference system [11] avoids the pitfall of violating the action-reaction principle, but limits the production of a solution to a symmetrical situation where the negative mass population is a copy of the positive mass population. It mentions the phenomenon of gravitational lensing, already presented in 1995 in reference [13].

V - **The Janus Cosmological Model** (JCM)

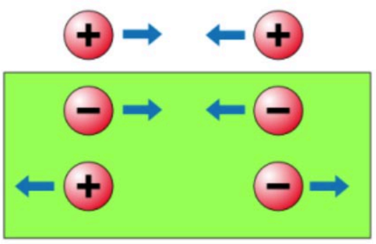
When we try to introduce negative masses into the formalism of General Relativity, i.e. into Einstein's equation, we obtain the following interaction scheme



RUNAWAY EFFECT

Negative masses repel each other while the behaviour of pairs of masses of opposite signs violates the action-reaction principle.

On the other hand, formulations [11] and [12] lead, in the Newtonian approximation, to the following interaction sc heme



JANUS COSMOLOGICAL MODEL

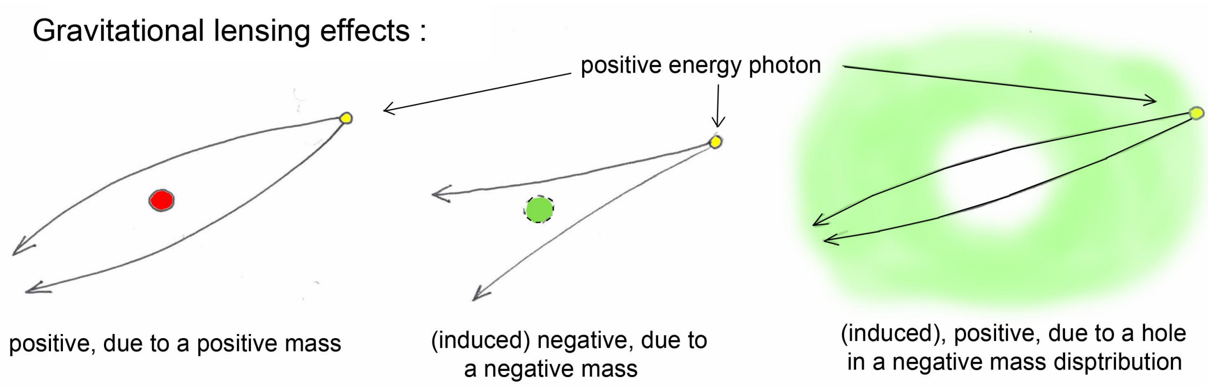
The action-reaction principle is saved.

1 - **JCM and gravitational lensing effects.**

The fact that masses of opposite signs repel each other means that, as a result of joint gravitational instabilities, both positive and negative mass concentrations will be found in this model. These are accompanied by a gravitational lensing effect. Considering the trajectory of a photon of positive energy, this radiation will undergo the classical gravitational (positive) lensing effect in the vicinity of a positive mass. This will have the effect of reinforcing the luminosity of the sources, by concentration of the rays.

But a negative mass concentration (invisible but acting on the positive masses and photons of positive energy by antigravitation) will be the source of a negative gravitational lensing effect with attenuation of the luminosity of the source by dispersion of the rays.

Finally, if the light beam passes through a gap in the negative mass, this gap is equivalent to a positive mass concentration and will create a positive gravitational lens effect.



2 - JCM: **Cosmic dynamics**

The system of reference (3) + (4) when considering the phase where the matter is dominant [15] allowed to build an unsteady solution with homogeneity and isotropy showing an excellent agreement with the observation [18].

Hereafter a figure extracted from reference [18]: Comparison between the Janus and ΛCDM models.

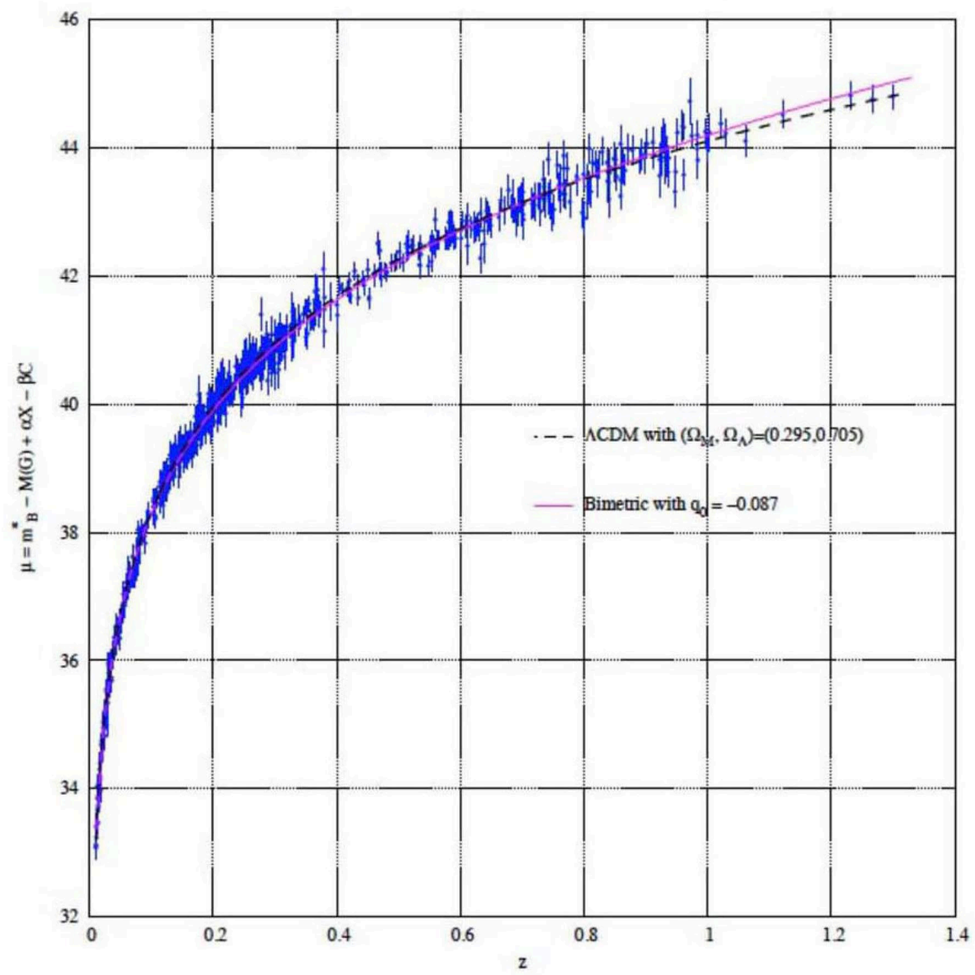
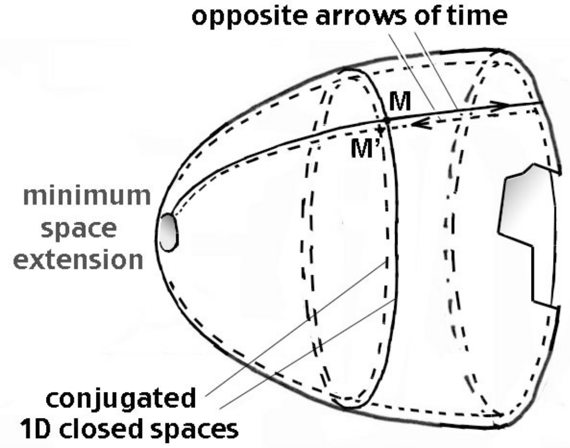


FIG. 5. Hubble diagram compared with the 2 models (linear redshift scale)

JCM Versus Lambda CDM

3 - **A first answer to the question « what about before the Big Bang ?»**

In the Janus model we can consider that the geodesics « over the Big Bang » through some « space bridge », with minimum space extension, change their time-orientation from « past to future » to « future to past ».



Under these conditions the question of before the Big Bang loses its meaning .

4 - **Comparison of** JCM **with local relativistic observations**.

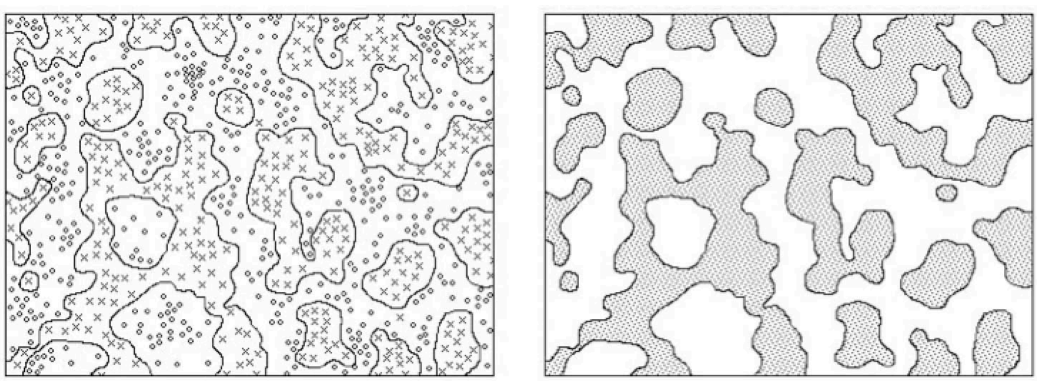
This pattern causes that where there is a positive mass concentration, the negative mass is almost absent (and vice versa). Under these conditions the tensor taling in charge the action of negative masses on positive masses is locally negligible and equation (3) becomes :

(5) $$R^{(+)}_{\mu\nu} - \frac{1}{2} R^{(+)} g^{(+)}_{\mu\nu} = \chi \, T^{(+)}_{\mu\nu}$$

That is nothing but Einstein's equation without cosmological constant. Thus the model fits with the observations that are classically used to locally justify the validity of the General Relativity model (Mercury's perihelion advance, gravitational lens effect created by the sun, etc.).

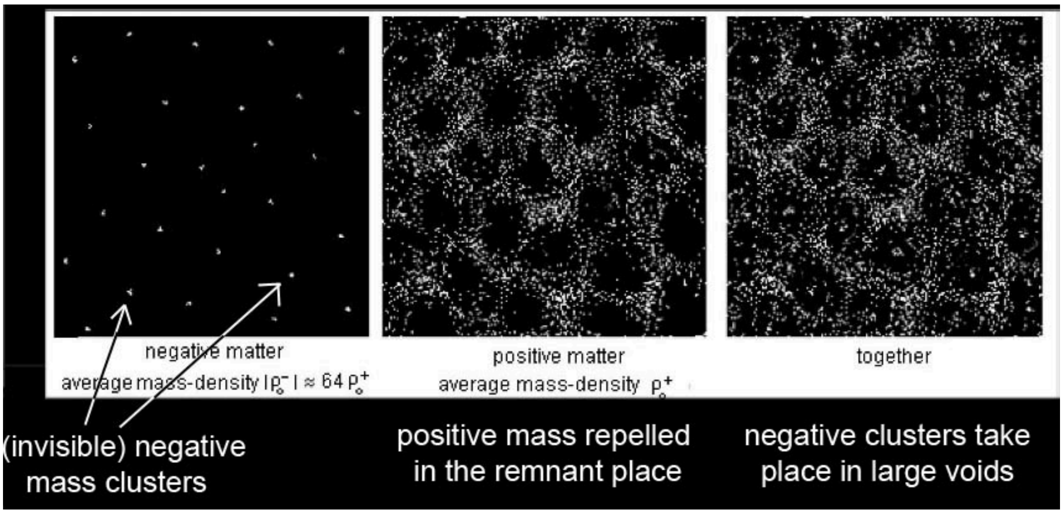
5 - JCM **and the large-scale structure**

In a series of articles published since 1995, the full range of predictions from the model and subsequent conformations to the observational confirmations have been explored. From the subsequent (Newtonian) laws of interaction it has been possible to carry out numerical simulations since the mid-nineties. The first idea was to start from a symmetrical system where the densities of the two media are equal and opposite. A percolation phenomenon was then observed:



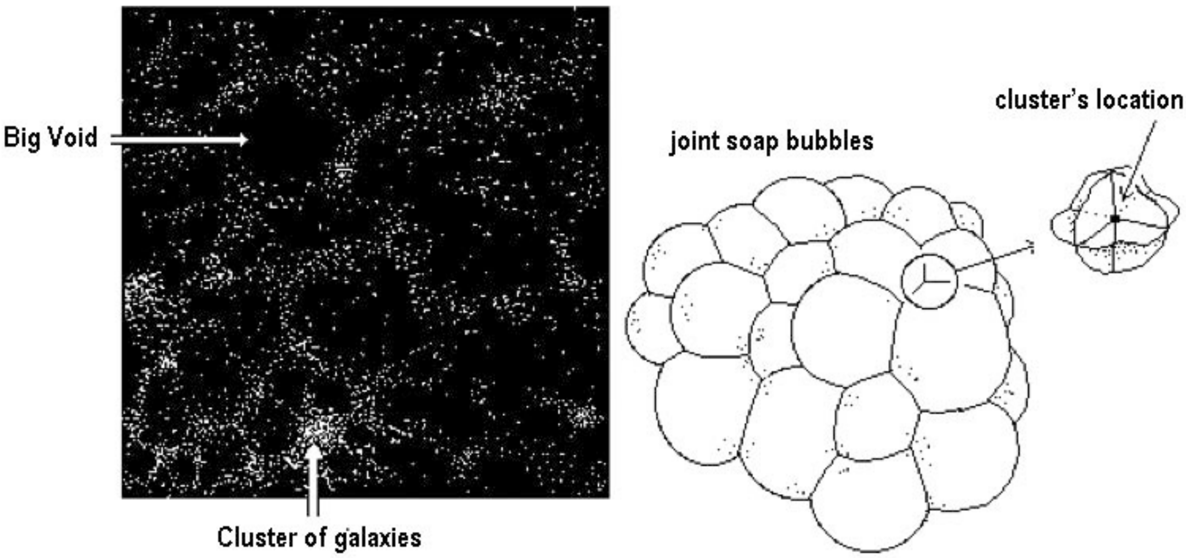
Evolution of the system from fully symmetrical conditions $\left|\rho^{(-)}\right| = \rho^{(+)}$

The two populations tend to separate, but this does not resemble the large-scale structure of the universe. As early as 1995, the idea emerged to find out how a system such as $\left|\rho^{(-)}\right| >> \rho^{(+)}$. Knowing that the accretion times (Jeans times) vary as $\frac{1}{\sqrt{\rho}}$ we have observed that the negative masses, self-attracting in the Janus model, are the first to form a series of regularly spaced spheroidal conglomerates, pushing the positive mass into the residual space, thus giving it a lacunar structure, in "joined bubbles". Here are the results of the first simulations of 1995 [13].



After [13] schematic formation of the very large structure of the universe

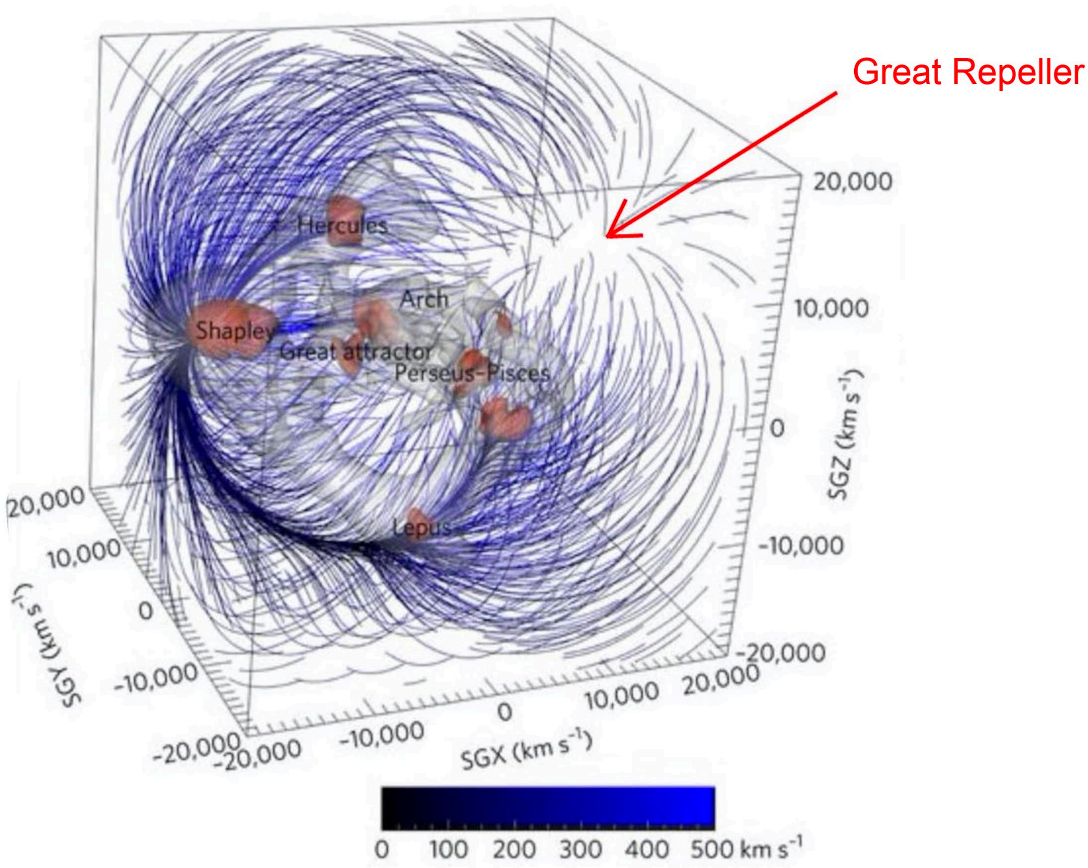
These simulations argue for a positive mass arranged in contiguous bubbles:



Under these conditions, matter tends first to gather along the junction lines of three bubbles forming filaments, then at the junction points of four empty bubbles forming clusters of galaxies. At the centre of each of these large voids, about 100 million light years in diameter, lies a negative mass cluster, pushing matter away.

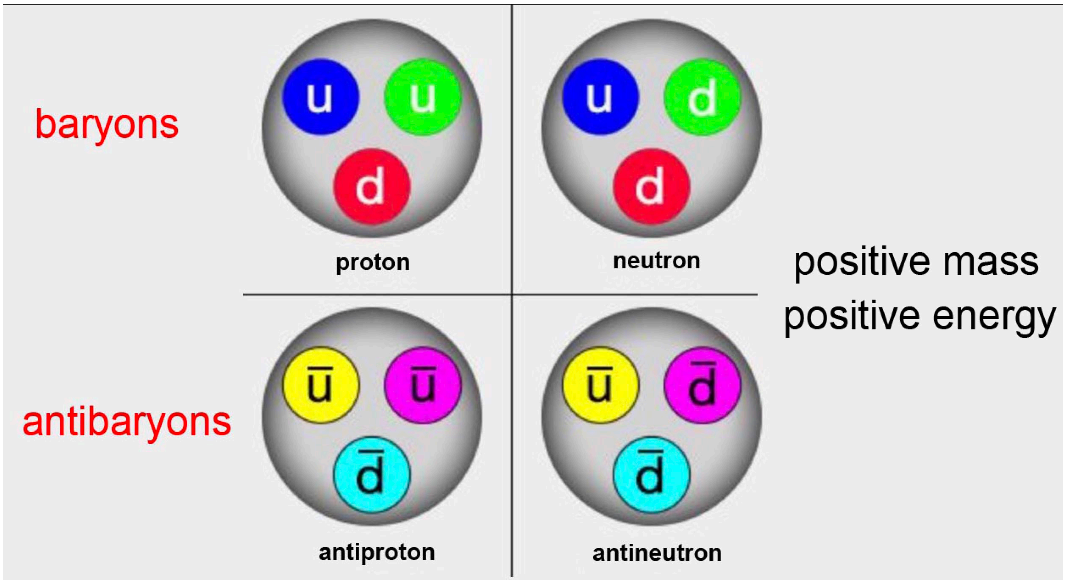
The discovery in 2017 of the Great Repeller [20] betrays the presence of this negative mass cluster, pushing away the surrounding galaxies.

These negative mass cluster act on the light coming from distant galaxies with high redshift ($z > 7$) by attenuating their luminosity. Thus these distant galaxies will appear as dwarves while their masses are much higher. Assuming that their intrinsic luminosities are equivalent to those of nearby galaxies, this could be a first source of information to specify the parameters, density, extension, temperature, of these negative mass conglomerates. In the same way the discovery of a significant boundary of attenuation of the luminosity of distant galaxies would provide the spatial extension of the Great Repeller.

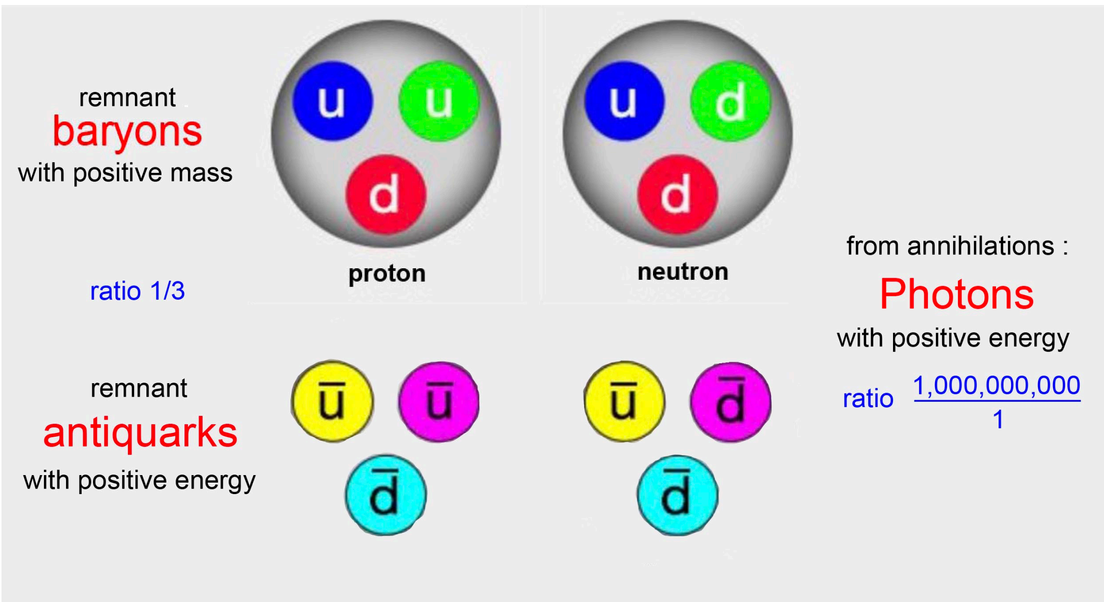


6 - JCM **and the Invisible Components of the Universe**

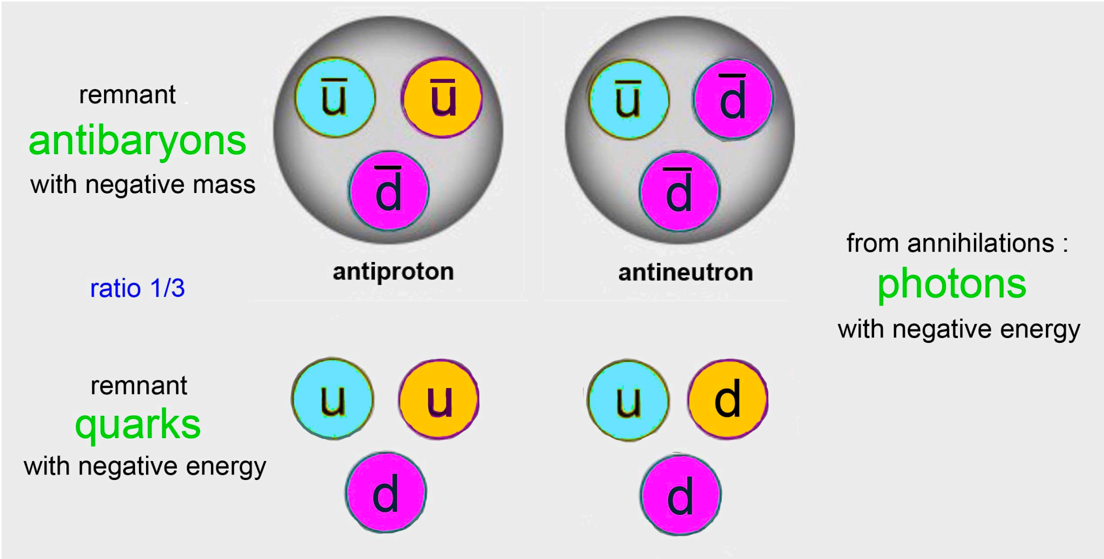
Classically matter and antimatter are created from quarks:



The Janus model brings a coherent geometric support to Andrei Sakharov's idea. If, like him, we suppose that the production rate of baryons (positive mass) can be very slightly higher than that of antibaryons (positive mass), we would have the following residue in the world of positive masses and energies:



In the negative world:

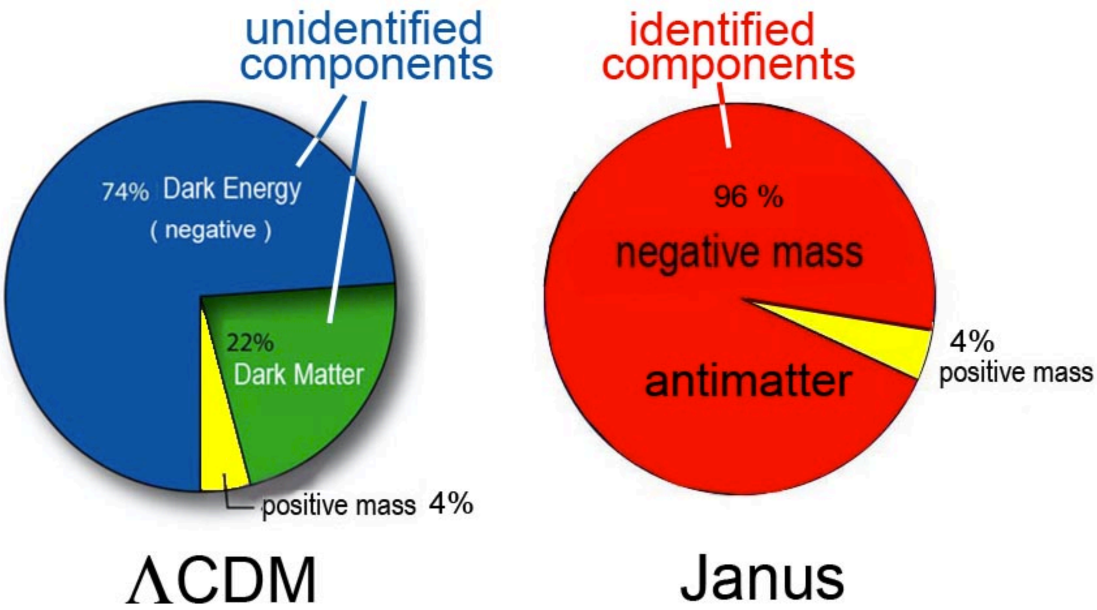


The elements of negative mass and energy only interact with our own world of positive mass and energy through (anti)gravitational forces, creating a negative gravitational lens effect. If we consider that negative mass particles emit negative energy photons, they are invisible to our eyes and measuring instruments.

But we can also justify this invisibility on geometrical grounds by saying that negative energy photons follow null geodesics, of zero length, derived from metrics $g_{\mu\nu}^{(-)}$ have nothing in common with the geodesics on which positive mass particles, derived from metrics $g_{\mu\nu}^{(+)}$, take place.

And vice-versa: for an observer made of negative mass (in fact negative mass antimatter) our galaxies, stars and planets would be invisible.

Negative mass plays the double role of dark matter and dark energy, since its presence accounts for the acceleration of cosmic expansion. We can therefore replace the diagram accompanying the ΛCDM model with one where 96% of the cosmic content is negative-mass antimatter.



7 - JCM: **antimatter in the Earth's gravitational field.**

Experiments are under way at CERN with the aim of demonstrating the behaviour of laboratory antimatter, created in the Large Collider, under the effect of the Earth's gravitational field. Some believe (and hope) [9] that it could 'fall downwards'.

According to the Janus model there are two types of antimatter.

- An antimatter of positive mass, corresponding to a C-symmetric, which could be called "Dirac antimatter".

- An antimatter of negative mass, PT-symmetrical, which could be called "antimatter in the sense of Feynman". Its negative mass comes from T-symmetry.

It is this second antimatter that constitutes the invisible component of the universe (at 96%). Laboratory antimatter, on the other hand, belongs to the first category. The Janus model therefore predicts that this antimatter will behave like ordinary matter when subjected to the Earth's gravitational field.

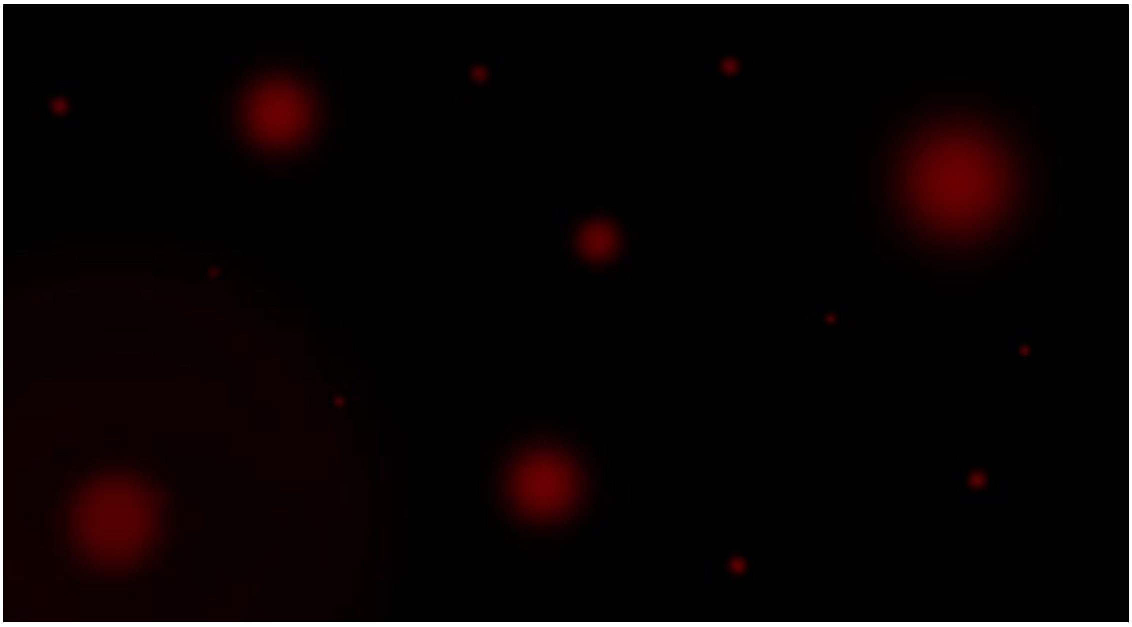
8 - JCM a**nd the** "CPT **theorem**".

This theorem asserts that the CPT-symmetric of a particle is identical to that same particle. This assertion is based on the fact that T-symmetry does not invert energy, which is an a priori of the Quantum Field Theory, based on the arbitrary choice of an anti-unit and antilinear time inversion operator.

With the choice of a linear and unitary T operator, the whole Quantum Field Theory must be put back on the job.

9 - JCM: **Structures of negative mass concentrations.**

It can be conjectured that a primordial nucleosynthesis gives rise to antihelium of negative mass, or even traces of anti-lithium of negative mass. This would indicate what negative mass conglomerates would be made of. These would behave like giant protostars, radiating in the red and infrared, emitting negative energy photons (which would escape our measuring instruments). Like protostars, these formations would have a cooling time, but of a duration greater than the age of the universe. Thus these objects would have hardly evolved since their formation. The corollary is that this negative world gives birth neither to galaxies, nor to stars, nor to atomic elements heavier than hydrogen and helium, nor to planets.



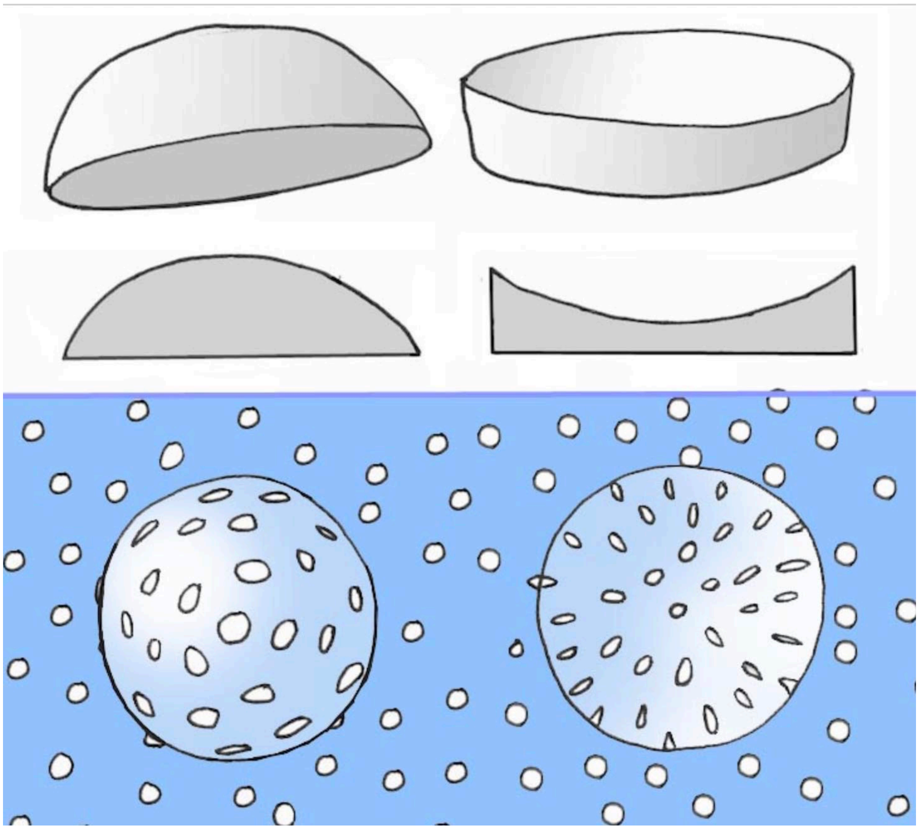
The "negative world" as perceived by an observer made up of negative mass[2]: a regular distribution of spheroidal conglomerates made up of negative-mass antimatter.

This world is therefore not conducive to the appearance of life, which would remain the prerogative of the positive world.

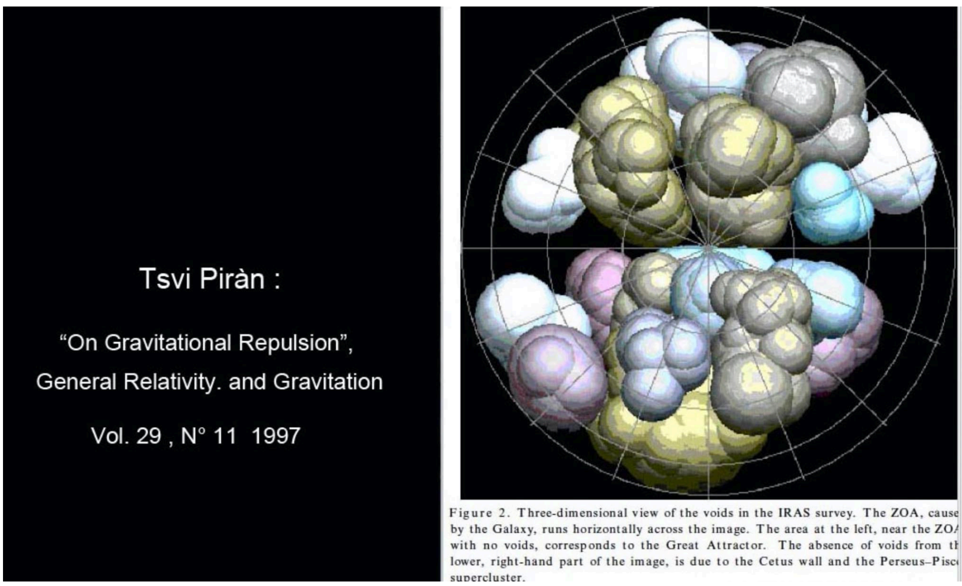
10 - JCM **and mapping by weak lensing.**

As suggested by the Japanese [21], negative mass concentrations produce an inverse distortion of the images of galaxies, in the same way as convergent and divergent lenses do. Converging optics create azimuthal distortion while diverging optics create radial distortion as shown in this figure :

[2] Or by an observer whose masse would have been inversed.

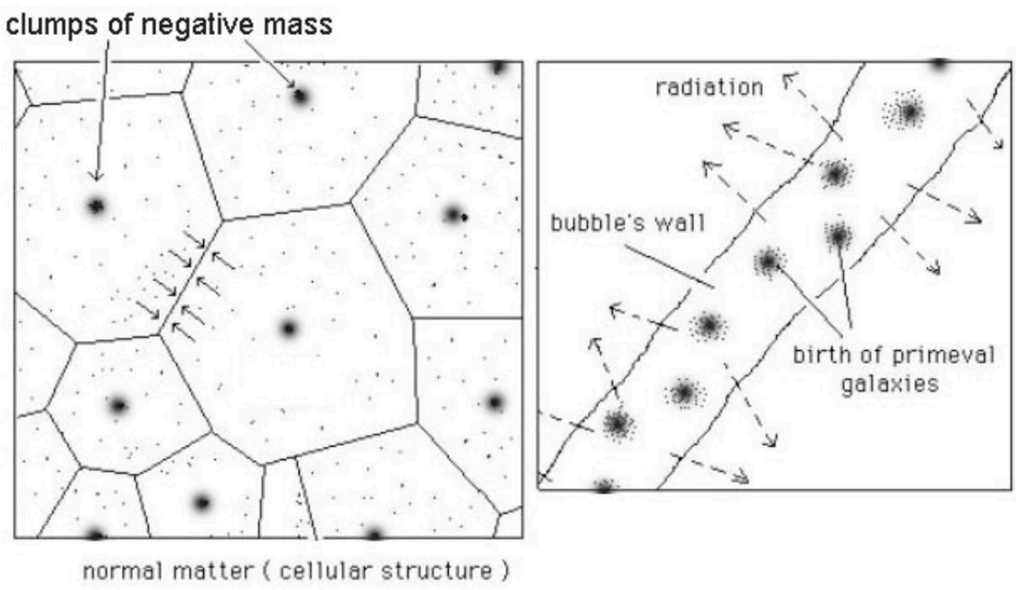


The Japanese have suggested undertaking alternative mapping through weak lensing based on the hypothesis of negative weak lensing. This would result in a different cartography which could then be compared to maps showing the arrangement of large voids such as the one presented in 1997 by the Israeli Tsvi Piràn [22]



11 – JCM **and the formation of galaxies.**

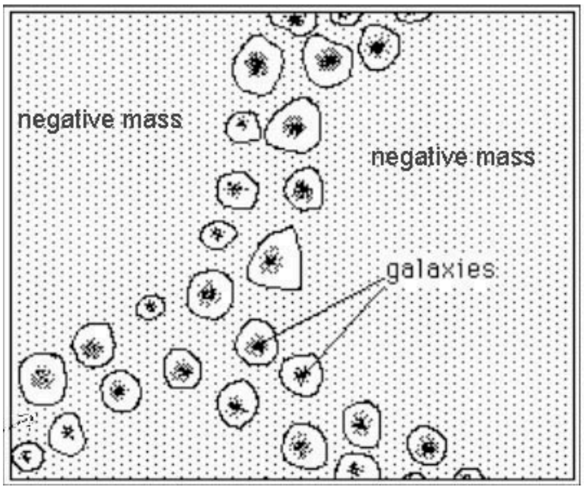
It is gravitational instability that creates objects in the universe when the large-scale structure of the universe is formed. In order for matter condensation to take place it is necessary that some of the energy collected can be dissipated by radiation. In the configuration suggested by the Janus model, matter is distributed in plates that are sandwiched between conglomerates of negative mass that exert a counter-pressure on them. The plate configuration is then optimal to ensure rapid cooling by radiation emission.

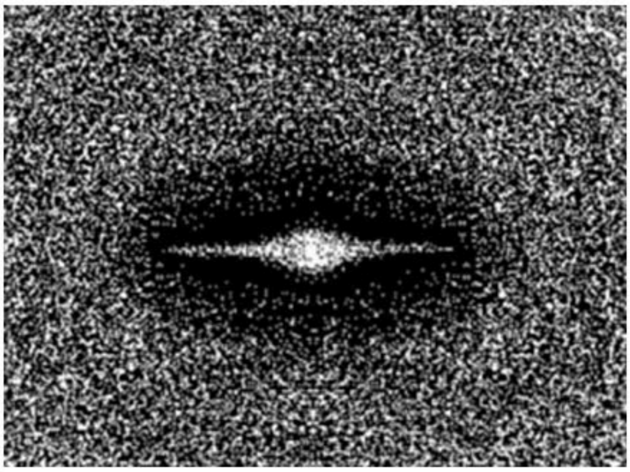


Current powerful computing resources could allow the 3D reconstruction of this galaxy formation scheme.

12 - JCM: **Galaxy confinement, rotation curves**.

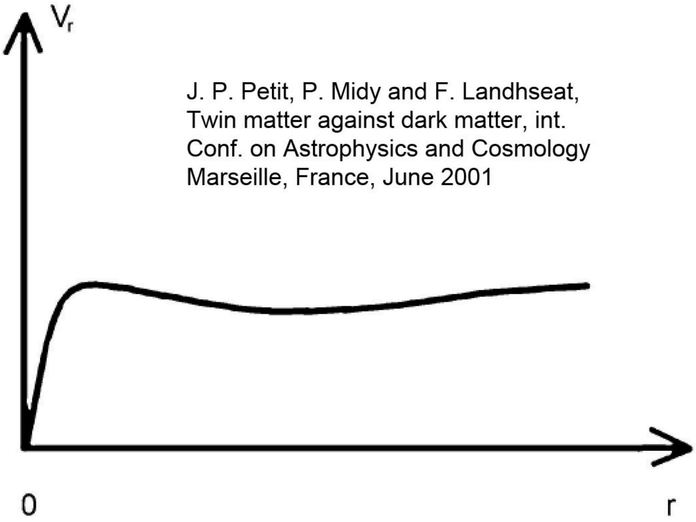
It is clear under these conditions that the negative mass will invade all the space between the galaxies and will exert on them a counter-pressure, ensuring their confinement



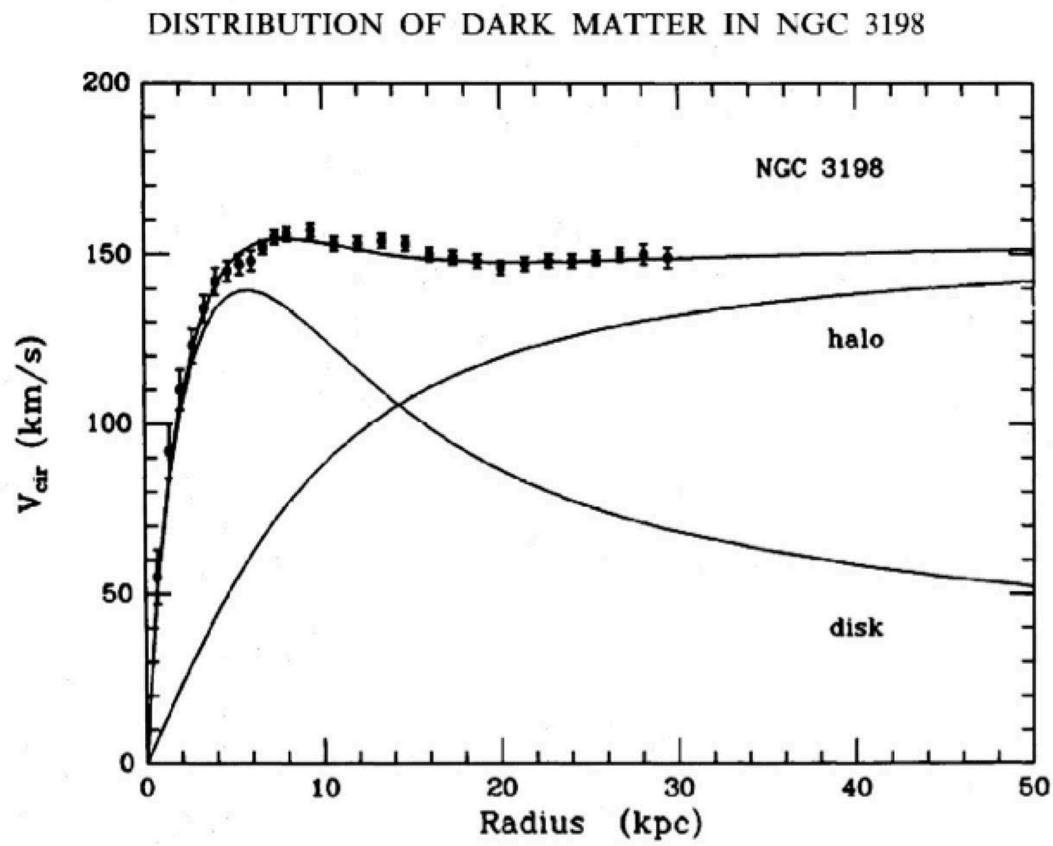


A gap in a negative mass distribution is equivalent to a positive mass concentration. The rotation curve resulting from this confinement phenomenon was therefore calculated

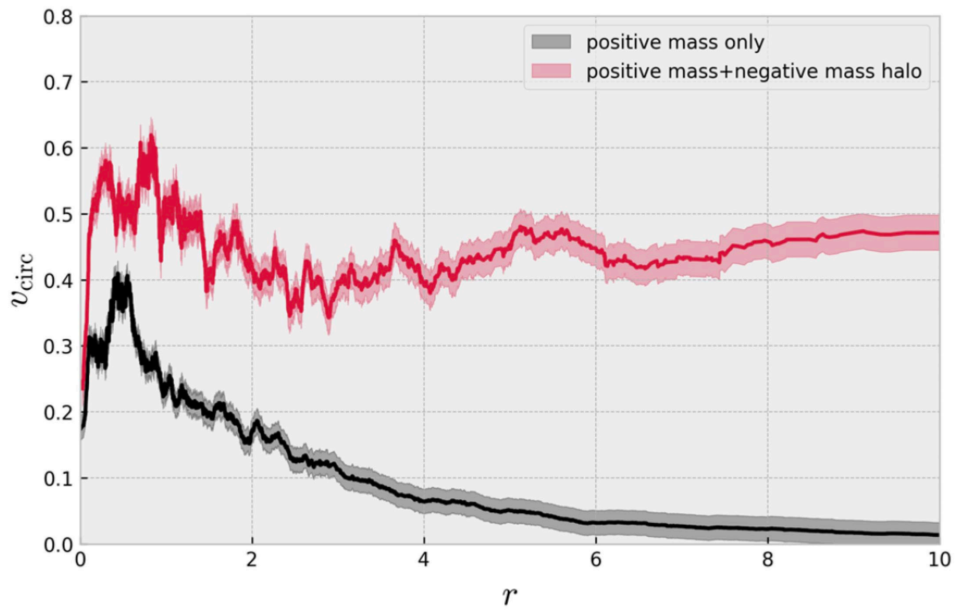
and presented in 2000 [23]:



which perfectly fits typical obsevational data.

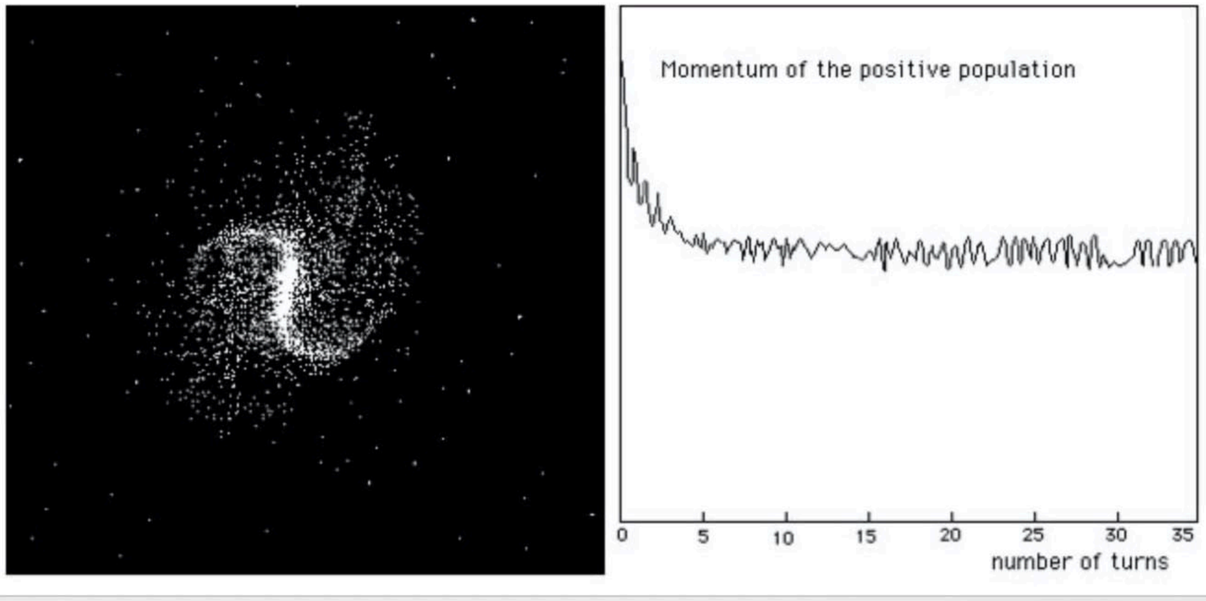


Following, 2017 Jamie Farnes'result [8] :



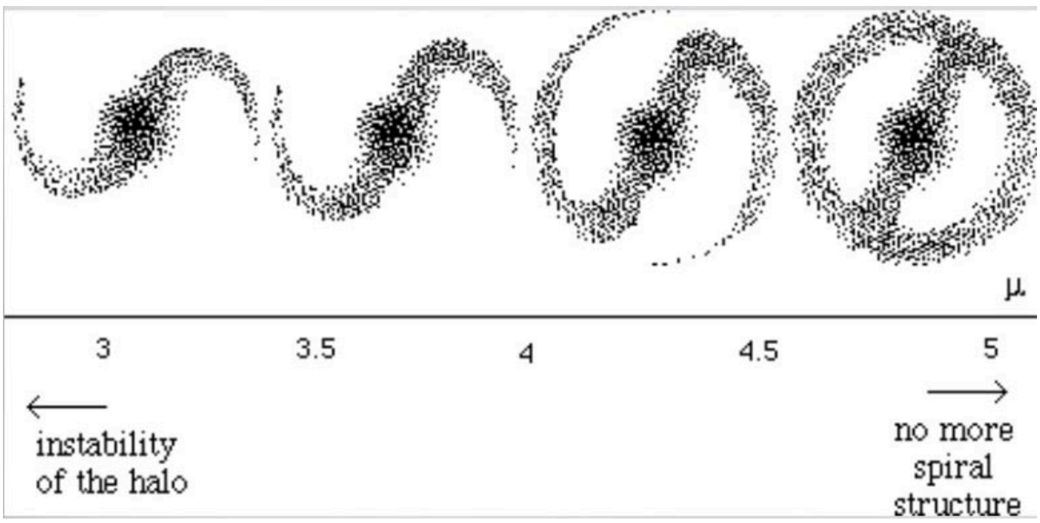
13 - JCM **and the Spiral Structure**

2D simulations carried out by placing a galaxy in a negative mass environment, the two elements being calculated on the basis of a resolution of two Vlasov equations coupled to a Poisson equation, have given rise to a few revolutions, by dynamic friction, a good looking barred spiral formation persisting for thirty revolutions. As much as this friction was accompanied by a strong decrease of the kinetic moment of the galaxy at the time of the formation of this structure, as much this decrease became insensitive thereafter.



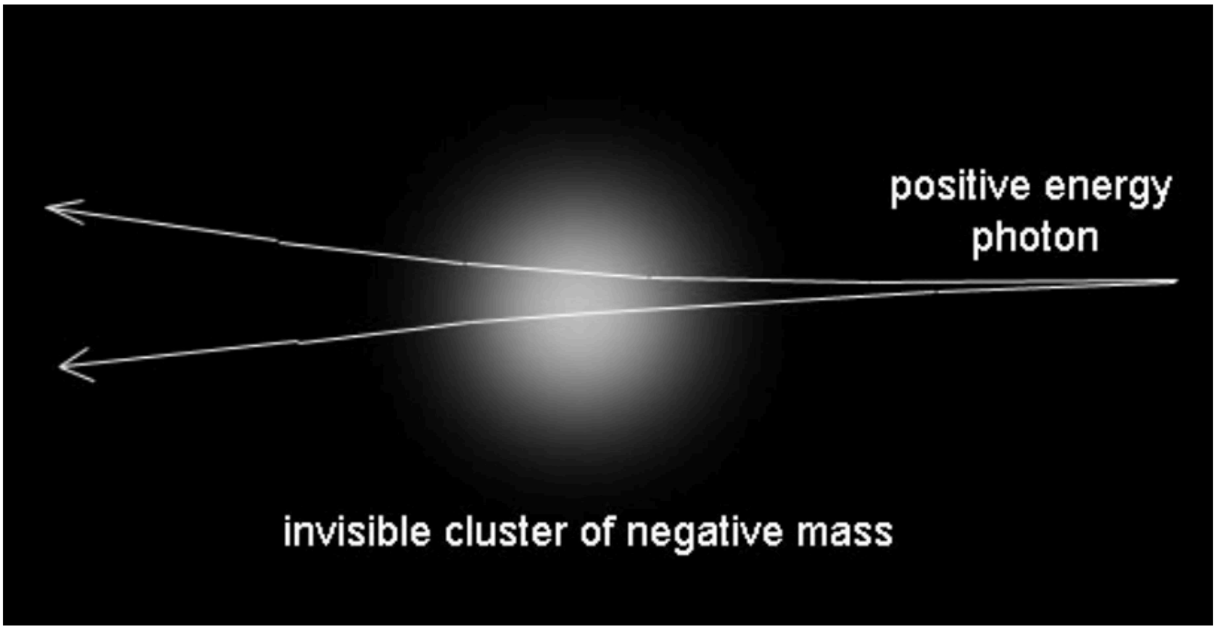
14 - JCM: **Galaxies, evolutionary scheme**

Akthough as a classification between the different forms of galaxies has been created long time ago, it is not clear why they adopt these forms. Through the simulation we could for example show that the passage of barred spiral galaxies SBb to SBa was obtained by increasing the density contrast between the surrounding negative mass and that of the galaxy.



15 - JCM : **Magnitude of the distant sources** (Z > 7)

When light passes through negative mass clusters, conglomerates it interacts with them only by antigravity, which is accompanied by a negative gravitational lens effect that reduces the magnitude of very distant sources, in this case galaxies with redshifts greater than seven.



Ces faibles magnitudes ayant été constatées les astronomes pensent que des galaxies naines se formeraient d'abord, donnant des objets plus denses par fusion. Nous pensons qu'il s'agit de galaxie standard et que cet effet trahit l'existence de ces conglomérats de masse négative.

Par ailleurs des mesures futures, plus précises, concernant le Great Repeller pourraient permettre, en mettant en évidence d'un gradient d'atténuation, d'en préciser l'extension.

16 - JCM **and the homogeneity of the primitive universe.**

In 1988 [24], clarified in 1995 [13], an interpretation of the homogeneity of the primitive universe was presented, as an alternative to the mainstream scheme of inflation, attributed to particles of unknown nature called inflatons. According to this alternative scheme the homogeneity of the early universe is due to a secular variation of the speed of light. But unlike the other c-variable models, this one involves joint variations of all the physical quantities so as to leave the equations in which they appear invariant. Thus that phenomenon is not accompanied by the classical observational contradictions related to the variation of the fine structure constant, etc..

Are involved in these generalized gauge variations :

- The (independent) constants of physics

$$\left\{ \not c, \not h, \not G, \not e, \not m, \not \mu_o \right\}$$

Crossing out the letters means that they are varying quantities.

- Time and space gauges a and

Forming the whole

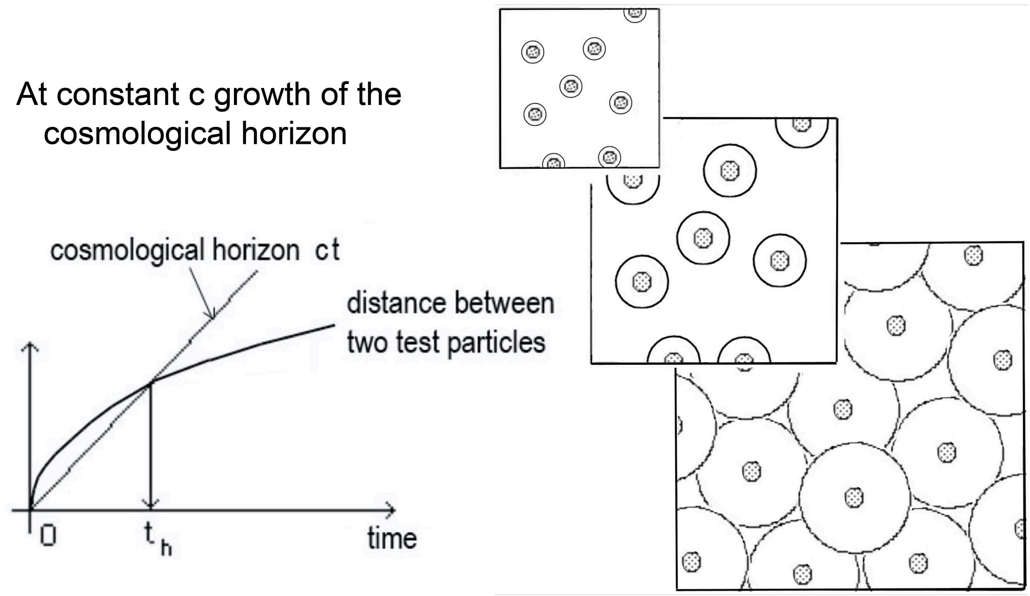
$$\left\{ \not c, \not h, \not G, \not e, \not m, \not \mu_o, a, \hat{t} \right\}$$

Based on any one of these quantities it is then possible to express all the others according to them. The most meaningful is to express these quantities with the help of the space gauge. The result is :

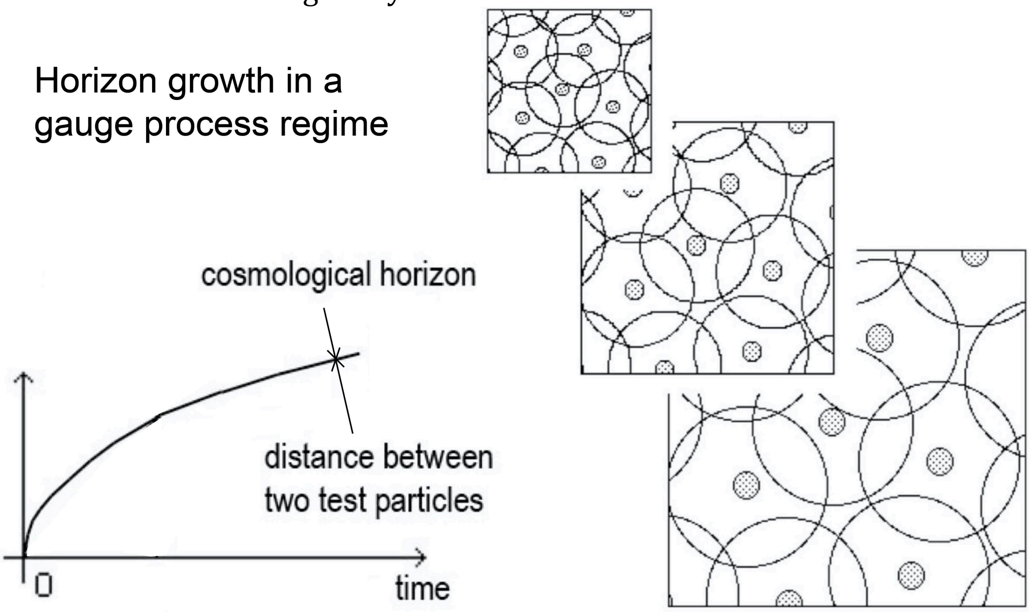
(6)

$$\not c \propto \frac{1}{\sqrt{a}} \quad \not h \propto a^{2/3} \quad \not G \propto \frac{1}{a} \quad \not e \propto \sqrt{a} \quad \not m \propto a \quad \hat{t} \propto a^{3/2} \quad \not \mu_o \propto a$$

At constant c, the evolution of the universe in its primitive phase corresponds to :



In a "variable constants" regime the evolution corresponds to a gauge process. The evolution of the cosmological horizon then follows the growth of the universe and homogeneity is thus ensured at all scales:

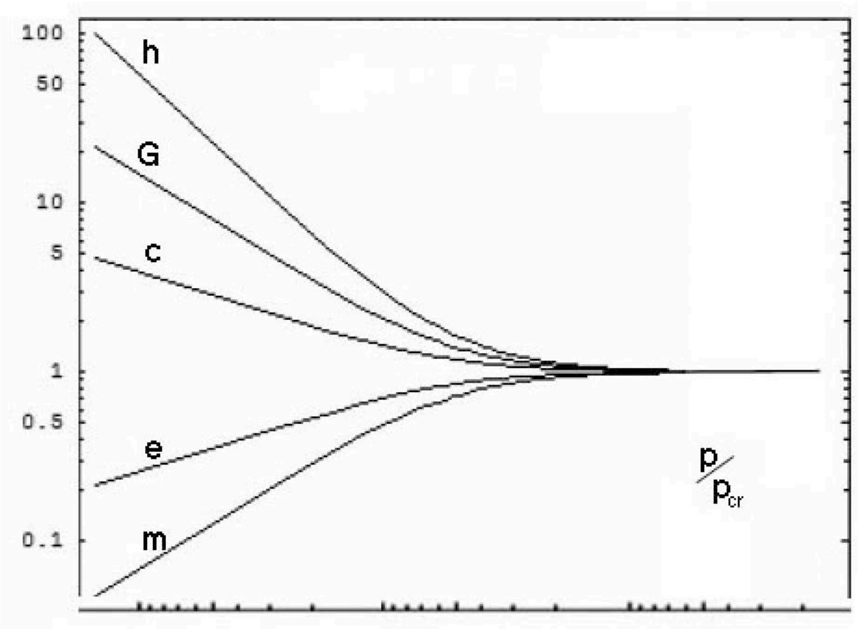


The cosmic inflation model is no longer needed.

Under these conditions all characteristic lengths vary as a and all characteristic times vary as $\hat{t}$. All energies are also conserved, which is not consistent with a redshift phenomenon and leads us to assume that this drift in constants occurs at a time before decoupling, when measurements do not reveal a redshift. We suppose that this phenomenon occurs when the energy density per unit volume (pressure) exceeds a certain threshold. We can also suppose that this gaging process starts when the distance between the baryons becomes less than their Compton length and thus these particles no longer have enough space to accommodate their wave function, which calls for a different evolutionary process. The speed of light and the gravitational constant decrease, while the other constants undergo a parabolic evolution, all these constants asymptotically tending the values we know them today.

$$\not{c} \rightarrow c \qquad \not{h} \rightarrow h \qquad \not{G} \rightarrow G \qquad \not{m} \rightarrow m \qquad \not{e} \rightarrow e \qquad \not{\mu}_o \rightarrow \mu_o$$

which corresponds to the curves :



This process affects both sets of masses, which therefore evolve with their own set of constants and scale factors. This deep break in symmetry occurs at the very beginning of the evolution, starting from a totally symmetrical situation, a phenomenon that has been modelled. The diagram above represents the global evolution of the regime in the Janus cosmological model. The instability first creates two sets of "variable constants", one for the positive masses and the other for the negative masses.

$$\left\{c, h, G, e, m, \mu_o, a, \hat{t}\right\} \begin{array}{l} \nearrow \left\{c^{(+)}, h^{(+)}, G^{(+)}, e^{(+)}, m^{(+)}, \mu_o^{(+)}, a^{(+)}, \hat{t}^{(+)}\right\} \\ \searrow \left\{c^{(-)}, h^{(-)}, G^{(-)}, e^{(-)}, m^{(-)}, \mu_o^{(-)}, a^{(-)}, \hat{t}^{(-)}\right\} \end{array}$$

These two sets then experience their own gauge process which corresponds to :

$$c^{(+)} \propto \frac{1}{\sqrt{a^{(+)}}} \qquad h^{(+)} \propto a^{(+)\,3/2} \qquad G^{(+)} \propto \frac{1}{a^{(+)}} \qquad e^{(+)} \propto \sqrt{a^{(+)}} \qquad m^{(+)} \propto a^{(+)} \qquad \hat{t}^{(+)} \propto a^{(+)\,3/2} \qquad \mu_o^{(+)} \propto a^{(+)}$$

$$c^{(-)} \propto \frac{1}{\sqrt{a^{(-)}}} \qquad h^{(-)} \propto a^{(-)\,3/2} \qquad G^{(-)} \propto \frac{1}{a^{(-)}} \qquad e^{(-)} \propto \sqrt{a^{(-)}} \qquad m^{(-)} \propto a^{(-)} \qquad \hat{t}^{(-)} \propto a^{(-)\,3/2} \qquad \mu_o^{(-)} \propto a^{(-)}$$

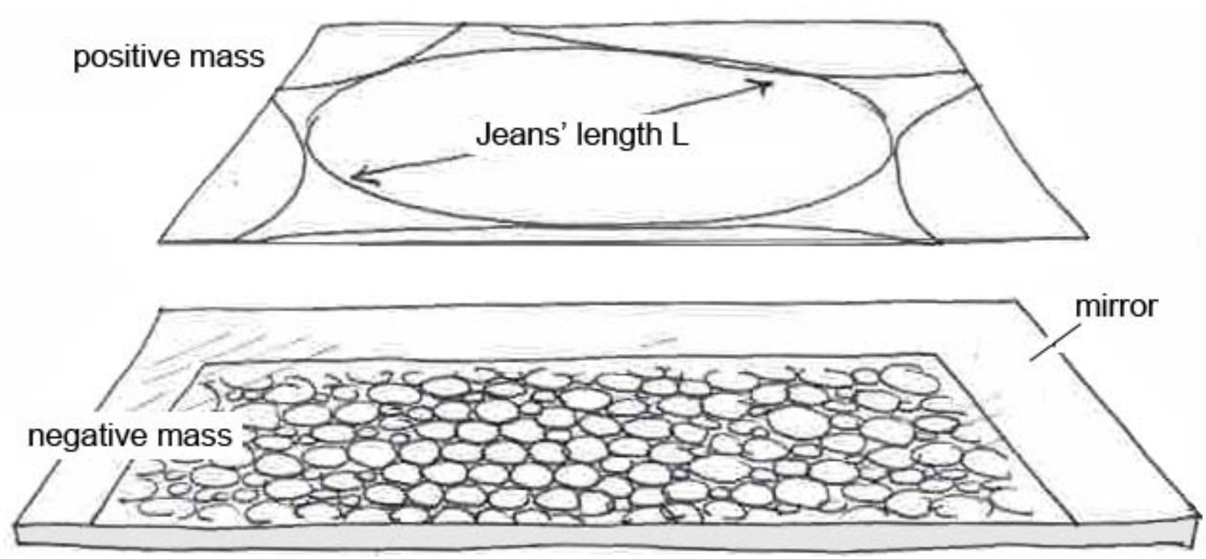
Then the situation stabilizes, the two entities evolve this time with their two sets of absolute constants.

$$\left\{c^{(+)}, h^{(+)}, G^{(+)}, e^{(+)}, m^{(+)}, \mu_o^{(+)}, a^{(+)}, \hat{t}^{(+)}\right\} \longrightarrow \left\{c^{(+)}, h^{(+)}, G^{(+)}, e^{(+)}, m^{(+)}, \mu_o^{(+)}, a^{(+)}, \hat{t}^{(+)}\right\}$$

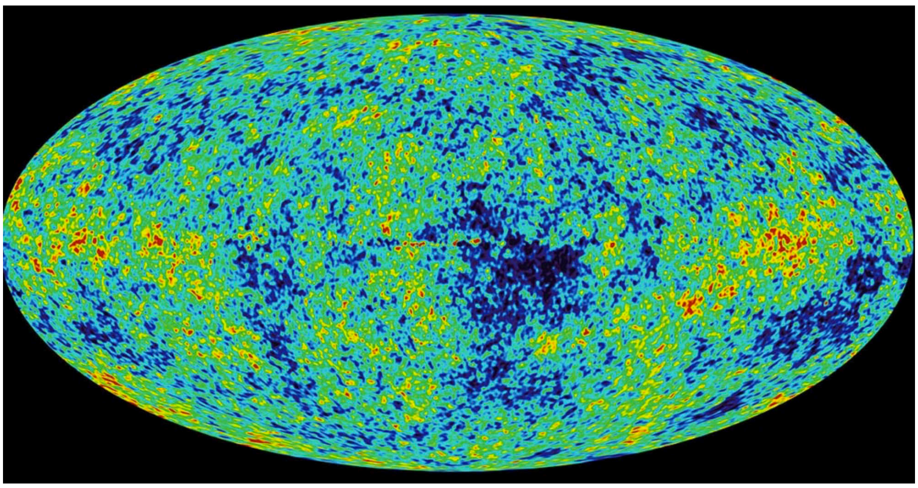
$$\left\{c^{(-)}, h^{(-)}, G^{(-)}, e^{(-)}, m^{(-)}, \mu_o^{(-)}, a^{(-)}, \hat{t}^{(-)}\right\} \longrightarrow \left\{c^{(-)}, h^{(-)}, G^{(-)}, e^{(-)}, m^{(-)}, \mu_o^{(-)}, a^{(-)}, \hat{t}^{(-)}\right\}$$

17 - JCM **and fluctuations in the** CMB.

Both entities are subject to the phenomenon of gravitational instability at all scales, including when both are radiation dominated. The gravitational instability that develops there is then associated with a Jeans length that happens to be of the order of the cosmological horizon, which is of the order of the scale factor in both populations in these "constant variable" evolutions.



Fluctuations that affect a population are thus not detectable by an observer made of the same type of material. On the other hand, as the system is very asymmetrical, the density fluctuations affecting the negative world leave their imprint in the positive world and this constitutes an alternative interpretation to the CMB fluctuations [25].



In this model, fluctuations in the CMB are attributed to the footprint of gravitational fluctuations in the world of negative masses. The characteristic wavelength being of the order of one degree, the ratio between the Jeans lengths and the scale factors is of the order of one hundred.

(7) $$\frac{L_J^{(+)}}{L_J^{(-)}} \propto \frac{a^{(+)}}{a^{(-)}} \propto 100$$

If, as is conjectured, the different speeds of light derive from the gauge relationships [13], we have :

(8) $$\frac{c^{(-)}}{c^{(+)}} \propto \sqrt{\frac{a^{(+)}}{a^{(-)}}} \propto 10$$

This causes the speed of light to be ten times higher on the negative side.

The combination of the two potentially allows interstellar travel times to be reduced by a factor 1000, provided that the mass of a vehicle and its occupants could be reversed.

18 - JCM **and the "bubbles of the universe"** (« **baby universes** »).

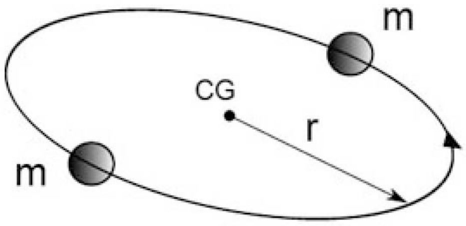
-In these joined "bubbles of universes" the sets of constants differ from one to the other, which gives support to an image of baby universes. But if these constants differ, the equations in which they appear are similar, from one bubble to another, so the stories that accompany each of these bubbles would keep a complete similarity. In each of these bubbles the same objects are constituted, from the nucleosynthesis giving birth to the Mendeleiev table to the creation of galaxies, stars, planets, biomolecules etc..

19 – JCM **and cosmological time**.

When people speculate on what might have happened by going back in time to the supposed Big Bang they simply rely on "a time variable" designated by the letter t . But does this time make sense? Would it be measurable? And using what instruments?

When we go back in the distant past of the universe several problems appear. Once the Nobel Prize winner Steven Weinberg in his famous book "The First Three Minutes" considered that it was problematic to describe the cosmic content before the first hundredth of a second. Beside that the temperature of a medium made of particles is nothing but the measurement of the average (kinetic) energy of its components.

Thus, when we go back up the thread of events, these same components are inexorably endowed with relativistic velocities, tending as fast as light. However, Lorentz's contraction causes "mercury to freeze in chronographs", so that the measurement of time loses its meaning. One can obviously envisage an elementary clock, purely conceptual, composed of two masses orbiting around their common centre of gravity.



In a diagram where the masses, the gravity constant and the distance joining these two objects are constants, the period of rotation is also a constant. For us, a measure of time is primarily a measure of angle. It is the turn of the second hand of our watches that moves the minute, the turn of the small hand that marks the hours; the turn of the Earth around itself that marks the days and the turn of the Earth around the sun that corresponds to the year.

With such a description we reach the so-called Big Bang when our clock has completed a finite number of revolutions.

Things are different when we opt for the "Janus" model, with "variable constants". The period of our elementary clock depends on several things. The distance between the masses decreases and tends towards zero as we go back in time. The masses and the gravity constant also vary. The calculation then shows that the period of rotation also tends towards zero and that therefore, in trying to go back to "an origin", our elementary clock will have to make an infinite number of revolutions!

Earlier we had already suggested that the Janus model calls into question the validity of the adverb "before", near the origin, since what is called the Big Bang is, according to Sakharov initially, an inversion of the arrow of time. But, "with variable constants" it even becomes problematic to reach, even conceptually, the origin of time. A grain to grind for philosophers.

We can propose two images to illustrate this idea. In the first, the universe is comparable to a book. Instant zero would be comparable to its first page, where the author of the book would have, in a preface, recorded his intentions. When we try to access this preface, the pages of the book become thinner and thinner. Their thickness tending towards zero it becomes impossible to do so. If we assimilate the characters on the pages to microphysical events when we flip through the book backwards the chapters, then the sentences, then the words themselves disappear. The pages are only filled with a random distribution of characters, devoid of any meaning. The conceptual meaning of the model would be that reaching a supposed "moment zero" would imply an infinite sequence of elementary events[3].

[3] See Janus 18 https://www.youtube.com/watch?v=jlwD0r0IHEc&feature=youtu.be

We know the so-called Achilles and the turtle' paradox where Achilles fails to catch the animal. We can imagine this time the same character tending to approach the zero instant.

and is aging more and more rapidly as he approaches:

The drawing below summarizes all of the above:

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Appendix 1 :

Form of tensors reflecting the induced geometry effect.

Let us write the system (3) + (4) in mixed form :

(A1-1)

$$R^{(+)\,\nu}_{\;\;\mu} - \frac{1}{2}\delta_\mu^\nu R^{(+)} = \quad \chi\left[T^{(+)\,\nu}_{\;\;\mu} + \sqrt{\frac{g^{(-)}}{g^{(+)}}}\;\widehat{T}^{(+)\,\nu}_{\;\;\mu} \right]$$

(A1-2)

$$R^{(-)\,\nu}_{\;\;\mu} - \frac{1}{2}\delta_\mu^\nu R^{(-)} = -\chi\left[\sqrt{\frac{g^{(+)}}{g^{(-)}}}\;\widehat{T}^{(+)\,\nu}_{\;\;\mu} + T^{(-)\,\nu}_{\;\;\mu} \right]$$

This system must satisfy the Bianchi conditions, which derive from the form of the first members. This determines the shape of the two tensors reflecting the effects of induced geometry:

With : $\rho^{(+)} > 0 \qquad p^{(+)} > 0 \qquad \rho^{(-)} > 0 \qquad p^{(-)} > 0$

(A1-3)

$$T^{(+)\,\nu}_{\;\;\mu} = \begin{pmatrix} \rho^{(+)} & 0 & 0 & 0 \\ 0 & -\dfrac{p^{(+)}}{c^{(+)2}} & 0 & 0 \\ 0 & 0 & -\dfrac{p^{(+)}}{c^{(+)2}} & 0 \\ 0 & 0 & 0 & -\dfrac{p^{(+)}}{c^{(+)2}} \end{pmatrix}$$

(A1-4)

$$\widehat{T}^{(+)\,\nu}_{\mu} = \begin{pmatrix} \rho^{(+)} & 0 & 0 & 0 \\ 0 & \dfrac{p^{(+)}}{c^{(+)2}} & 0 & 0 \\ 0 & 0 & \dfrac{p^{(+)}}{c^{(+)2}} & 0 \\ 0 & 0 & 0 & \dfrac{p^{(+)}}{c^{(+)2}} \end{pmatrix}$$

(A1-5)

$$T^{(-)\,\nu}_{\mu} = \begin{pmatrix} \rho^{(-)} & 0 & 0 & 0 \\ 0 & -\dfrac{p^{(-)}}{c^{(-)2}} & 0 & 0 \\ 0 & 0 & -\dfrac{p^{(-)}}{c^{(-)2}} & 0 \\ 0 & 0 & 0 & -\dfrac{p^{(-)}}{c^{(-)2}} \end{pmatrix} .$$

(A1-6)

$$\widehat{T}^{(-)\,\nu}_{\mu} = \begin{pmatrix} \rho^{(-)} & 0 & 0 & 0 \\ 0 & \dfrac{p^{(-)}}{c^{(-)2}} & 0 & 0 \\ 0 & 0 & \dfrac{p^{(-)}}{c^{(-)2}} & 0 \\ 0 & 0 & 0 & \dfrac{p^{(-)}}{c^{(-)2}} \end{pmatrix}$$

If we consider an empty region, these four tensors are obviously zero. The metric solutions are then two "outer" Schwarzschild metrics corresponding to positive and negative values of the parameter m depending on whether this empty space surrounds a positive or negative mass :

(A1-7)

$$ds^2 = \left(1 - \frac{2m}{r}\right) dt^2 - \frac{dr^2}{1 - \dfrac{2m}{r}} - r^2\left(d\theta^2 + \sin^2\theta\, d\varphi^2\right)$$

The geometry inside the considered mass then corresponds to an "inner metric" of Schwarzschild [19] and Bianchi's condition simply expresses that inside this mass the pressure is balanced by the force of gravity.