Mogens True Wegener

# NON-STANDARD COSMOLOGY

## ABSTRACT

After a trenchant examination of the special theory of relativity, with a short presentation of the first attempt to use that theory as basis for a cosmology developed in order to challenge models based on the general relativity theory, the latter is exposed to criticism with arguments taken from one of the theory's most prominent expositors. Having pinpointed the many flaws of the standard Λ-FLRW model, it is claimed that physics must be founded on time-invariant laws. This stance motivates my search for a new Steady State Model.

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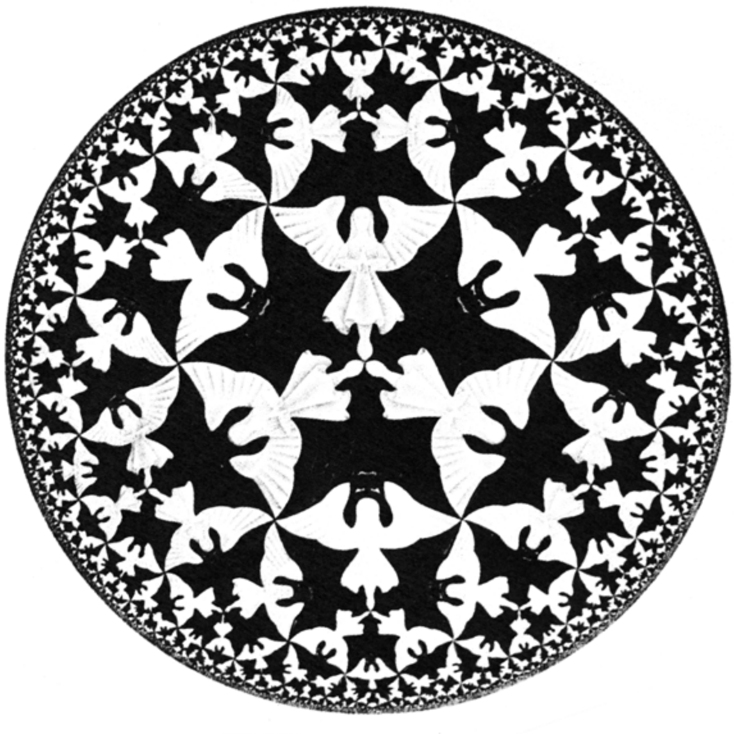
***M.C. Escher: 'Circle Limit 4'***
***a most wonderful illustration of the***
***shrinking of galaxies with distance***
***in a flat space of finite radius***



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Mogens True Wegener

**Keywords**

Relativity, Gravitation, Standard Model,
Creation, Non-Locality, Horizons, Multiverse

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## Introduction

Modern Cosmology is burdened with a heavy load of orthodoxy, hence in acute need of heretics daring to challenge the scientific establishment. Such endeavours are doomed to failure if starting from scratch, without a due consideration of earlier attempts and long neglected scientific tradition. For the daring ones, however, there is a rich historical heritage to draw upon. Among the French origins we may count Henri Poincaré and André Mercier: Poincaré for his invention of *relativité restrainte*, published some three weeks ahead of the special theory of Einstein, and Mercier for his re-interpretation of *space-time* as *time-space* as well as for his bold statement: *gravitation* ***is*** *time.*

Regarding the British sources it is even possible to point to an explicit tradition of relativity theory and relativistic cosmology developed in flat opposition to a scientific establishment intoxicated by the authority of Einstein. Among the representatives of this British tradition we may count the names of E.A. Milne, A.G. Walker, and G.J. Whitrow: Milne for his invention of the theory of *kinematic relativity*, Walker for his generalization of that theory along with his independent formulation of the cosmological *Robertson-Walker metric*, introducing *cosmic time* as a cosmic parameter, and Whitrow for his idea that the universe is ruled by a *cosmic rhytm* akin to the *cosmic harmony* of Leibniz.

That it is, in fact, possible to vindicate the classical concept of *absolute time* in plain opposition to Einstein, and thereby to expunge his scientific programme of reducing everything in physics to space-like concepts, is furthermore held by the British physicist P. Rowlands who claims that this absolute time can be identified with what he defines as: *the unique birth-ordering of non-local quantum events*. In agreement with this position, he even insists that physics should be reconstructed on the basis of time-invariant laws. Sharing his conviction, I venture to submit a brand new kind of "steady state" theory.

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## 1. Special Relativity

Let us ponder a universe containing particles which are able to observe each other, as well as the rest of the world, by exchanging signals ("photons"). A primary condition for rational communication between such observer-particles (akin to Leibnizian *monads*) is that they can be considered *equivalent* in some specified sense or, in the least, that it is possible to assess their *deviation* from equivalence. As we shall see, this start may lead us directly to the theory of *relativité restreinte* or, if you wish, that of *special relativity*.

So let us consider two equivalent observers, $P\,\&\,Q$, provided with similar clocks. Suppose an unbroken series of radar signals to be exchanged in zig-zag between $P\,\&\,Q$. We postulate the average or two way signal speed $c_o$ to be constant and equal to *unity*. If a "photon" $\phi$ is emitted from $P$ at $\tau_1^p$, reflected by $Q$ at $\tau_2^q$ and received by $P$ at $\tau_3^p$, then $\tau_3^p$ must be the same function of $\tau_2^q$ as $\tau_2^q$ is of $\tau_1^p$, whence: $\tau_3^p = \theta(\tau_2^q) = \theta\theta(\tau_1^p)$. We start by investigating the signal-function $\theta(\tau) = e^\sigma \tau + \lambda$, $\sigma\,\&\,\lambda$ being constants.

If $\sigma = \lambda = 0$, we shall say that $P\,\&\,Q$ are *identical* by permanent coincidence. If only $\sigma = 0$, we will say that the particles $P\,\&\,Q$ are *different*, but relatively *stationary*. If merely $\lambda = 0$, we will say that $P\,\&\,Q$ are in relative *inertial motion* in the *same line*. If finally $\sigma \neq 0 \neq \lambda$, but still constant, we can eliminate $\lambda$ by adjusting their time zeros. Putting $\tau = \tau_2$, and writing the signal velocity out: $c_\rightarrow$ and the signal velocity home: $c_\leftarrow$, then, using standard coordinates $t\,\&\,x$ for $P$, priming those for $Q$ as $t'\,\&\,x'$, we get:

$$t \equiv \tfrac{1}{2}(\tau_3 + \tau_1) \ . \ x \equiv x/c_o \equiv \tfrac{1}{2}(\tau_3 - \tau_1)$$
$$\tau_3 \ \equiv \ \tau + \tfrac{x}{c_\leftarrow} = e^\sigma \tau \ . \ \tau_1 \ \equiv \ \tau - \tfrac{x}{c_\rightarrow} = e^{-\sigma}\tau$$
$$\Downarrow$$
$$t = \tau + \tfrac{1}{2}\left(\tfrac{x}{c_\rightarrow} - \tfrac{x}{c_\leftarrow}\right) = \tfrac{1}{2}(e^\sigma \tau + e^{-\sigma}\tau) = \tau\, cosh\sigma$$
$$r \equiv x/c_o = \tfrac{1}{2}\left(\tfrac{x}{c_\rightarrow} + \tfrac{x}{c_\leftarrow}\right) = \tfrac{1}{2}(e^\sigma \tau - e^{-\sigma}\tau) = \tau\, sinh\sigma$$
$$v_x \ \equiv \ x/c_o\, t = [-x'/c_o\, t'] = \tfrac{\tau_3 - \tau_1}{\tau_3 + \tau_1} = \tfrac{e^\sigma - e^{-\sigma}}{e^\sigma + e^{-\sigma}} = tanh\sigma$$
$$\Downarrow$$
$$\gamma_\sigma \ \equiv \ cosh\sigma = 1/\sqrt{1 - v_x^2} = 1/\sqrt{1 - v_x'^2}$$
$$\tau = t\sqrt{1 - v_x^2} = t/\gamma_\sigma = x/v_x \gamma_\sigma$$

Now, if observers $P\,\&\,Q$ are in fact *equivalent*, then their common proper time $\tau$, as distinct from their two coordinate times, must be *invariant* and their clocks *congruent*. Thus, if we introduce a third observer *R*, equivalent to $P\,\&\,Q$ and coinciding with $P\,\&\,Q$ at the same event: $\tau_o = 0$, then *R* must keep the signalfunctions $e^{|\rho|}$ to *P* & $e^{|\eta|}$ to *Q*, say, whence $\tau$ must be *invariant* between $P\,\&\,Q\,\&$ *R*, and all three clocks must be *congruent*. $P, Q,$ *R*, thus being *pairwise collinear*, form a *3-Spray* in the sense of Schutz [1973], who was inspired by Milne [1948/51] and, notably, by Milne's collegue Walker [1948]. The idea of a 3-Spray was anticipated by Weyl's Principle, cf. North [1965].

So $\tau$ is the common proper time read off the comoving *master clocks* associated with $P, Q$, *R* which constitute the *origos* of their respective comoving coordinate frames; $t$, $t'$, $t''$, by contrast, are the time coordinates read off the many *slave clocks* constituting the fix-points of the abstract coordinate frames supposed to surround $P\,\&\,Q\,\&$ *R*, resp. Schutz, in contrast to, e.g., Gill & Lindesay [1993], did not study this common time $\tau$.

Now, in case of $\sigma = \rho = \eta$, we shall say that $P, Q$, *R* form *an equilateral triangle.* Assuming the signal-functions between four different particles: $P, Q$, *R*, *S*, to be identical, we will further say that these form *a regular tetrahedron*. Finally, if we are unable to add a fifth observer *T* without *T* coinciding permanently with one of the other four observers, then $P, Q$, *R*, *S* is a set of *maximal symmetry,* and their space is 3-dimensional.

It is the case of three or more equivalent observers in inertial collinear motion which is covered by the *Lorentz transformations* of *relativité restreinte*/*special relativity*. The coordinates are not solely assumed to describe the motion of $Q$ or *R* relative to $P$, e.g., but may refer to an event taking place at some object *O*, as observed by $P, Q$, *R*.

Suppose that the 3-Spray defined by $P, Q$, *R* is dense. Now let an arbitrary object *O* be observed by $P\,\&\,Q$ at the instant when *O* coincides with *R*. Let the signal-function between $P\,\&\,Q$ be described by the constant $e^{\sigma}$, and let further that between *P* & *R* and that between *Q* & *R* be denoted by $e^{\rho}$ & $e^{\eta}$, resp. Supposing $P\,\&\,Q$ to observe the freely moving object *O* at various instants, *O* will in general coincide with different members: $R, R', R''$ .. etc., of the same 3-Spray. Clocks at $R, R', R''$ .. etc. then show the same time $\tau$ as do those of $P\,\&\,Q$. This result makes the use of standard frame times redundant.

That an invariant proper time $\tau$ is in fa ct presupposed by the standard expression for the Lorentz Transformations can be shown by the following argument, making use of the hyperbolic formulae for, e.g., the subtraction of socalled *rapidities,* $\alpha' \equiv \alpha{-}\omega$:

$$cosh\alpha' = cosh\alpha\, cosh\omega - sinh\alpha\, sinh\omega$$
$$sinh\alpha' = sinh\alpha\, cosh\omega - cosh\alpha\, sinh\omega$$

Now, for $c_o = 1$, the Lorentz Formulae are derivable from these if, and only if, $\tau \equiv \tau'$ in:

$$t'/\tau' \equiv cosh\alpha' \; . \; t/\tau \equiv cosh\alpha \;\Downarrow\; x'/\tau' \equiv sinh\alpha' \; . \; x/\tau \equiv sinh\alpha$$
$$t' = t\, cosh\omega - x\, sinh\omega = (t{-}x/v_x)\,\gamma_\omega \;\; [y' = y]$$
$$x' = x\, cosh\omega - t\, sinh\omega = (x{-}v_x\, t)\,\gamma_\omega \;\; [z' = z]$$

If observations are referred to the *midway particle*, the *Lorentz Formulae* reduce to the *Galileo Formulae*. Inserting $t \equiv \tau + x\, tanh\frac{\omega}{2}$, and using $tanh\frac{\omega}{2} = \frac{cosh\omega - 1}{sinh\omega}$, we get:

$$x' = x - \tau\, sinh\omega = x - \tau\, v_x/\sqrt{1{-}v_x^2} \;\; [y' = y \;.\; z' = z]$$

For inertial frames, *position space* is flat, *velocity space* is hyperbolic, cf. Ungar [2008].

A full analysis of 3-space would draw us deeply into *analytic hyperbolic algebra*. Just in passing, we present a hyperbolic formula for *triangularity* within a 3-Spray:

$$cosh\alpha' = cosh\alpha\, cosh\omega - sinh\alpha\, sinh\omega\, cos\varphi$$

## 2. The Milne Universe

As long as a set of observers belong to the same 3-Spray, coinciding at the same event, there is no obstacle to claiming that the set is subject to a common invariant time. However, if observers belong to sprays coinciding at different epochs we have a problem which is due to the fact that *different sprays* constitute *different equivalence classes.*

This seems to preclude the possibility of an invariant cosmic time; but the problem can be overcome by assuming that the universe is structured as a single privileged spray. This was *Milne's solution*: he postulated the universe to be governed by a *substratum* of *fundamental observers,* covered by layers of what might be called *accidental particles.* All fundamental observers are mutually equivalent while accidental particles are not.

The Milne Universe is based on the Lorentz Transformations for inertial motion and, at first, Milne saw no way of avoiding their consequence that the proper times of receding fundamental observers, as judged by an observer situated in the apparent centre, are subject to the standard retardation assumed to follow from Einstein's special relativity. But he later realized that this is not true and, in a joint paper anticipating our standpoint, showed that *'the restriction of equivalence to a triply infinite system of fundamental observers is essential if paradoxes are to be excluded'* - Milne & Whitrow [1949].

Originating from a transcendent *point event*, a sort of silent *big bang* or, in modern terms, a *singularity*, his universe is conceived as an expanding *hyperbolic pseudo-sphere* of finite radius $r_H = c_o t$. Containing an infinite number of observer-particles, whether fundamental or accidental, all particles will shrink outwards with their radial velocities due to the standard relativistic contraction; but only the fundamental ones strictly obey Hubble's law: *velocity* $\propto$ *distance*, as judged from the apparent center of the universe. So all fundamental particles coincided at the singularity $t = 0 \Leftrightarrow r_H = 0$, thus forming an equivalence class, i.e., a 3-Spray, and since dissipated with constant velocities.

In order to preclude an imminent misunderstanding, it should be noticed that the Milne Universe as presented in his *Kinematic Relativity* (KR), albeit Newtonian in a way, is very different from the Newtonian World Model set forth in papers by Milne & McCrea as well as by Milne himself, and discussed by many authors, including Kerzberg [1987]. The difference is that his Newtonian World Model *assumes* the existence of Newtonian potentials, ending up with a classical analogy to the general relativistic Friedmann metric, whereas his Kinematic Relativity *derives* gravity in an exceedingly ingenious way.

Milne, who did not know the CMBR (cosmic microwave background radiation), identified his fundamental observers with galactic nuclei, but today we shall prefer to define a *fundamental* observer as one who is *at rest* with respect to CMBR and, similarly, to define an *accidental* particle as one that is in arbitrary *motion* with respect to CMBR. Assuming that the universe expands (or that its contents of particles dissipate) uniformly according to Hubble's law, it is intuitively obvious that its set of fundamental observers constitutes *a statistically defined equivalence class* forming a sort of *cosmic grid*.

Utilizing this grid as *an unique and privileged expanding reference frame*, instead of appealing to a swarm of frozen coordinate frames, each surrounding its own observer as *origo*, we obtain an immense simplification. The point is, that the motional behaviour of an accidental object *O* can be described from instant to instant of a common cosmic time by answering only these two questions: 1) With what fundamental observer *F1* does *O* instantaneously coincide? and 2) With respect to which fundamental observer *F2* is *O* instantaneously at rest? Thus *O*'s state of motion is fully described by two simple vectors: one giving its instantaneous velocity, the other giving its instantaneous position.

According to the *principle of energy conservation*, all fundamental observers, due to their equivalence, will ascribe the same energy to an accidental particle in an arbitrary state of motion. Now let *F1* & *F2* observe the common object *O* which, as intimated, momentarily coincides with *F1* and is momentarily at rest relative to *F2*. Supposing that the distance from *F1* to *F2* is $\boldsymbol{r}$ and that the velocity of *F2* relative to *F1* is $\boldsymbol{v}$, it is obvious why Milne took the difference $\boldsymbol{r}-\boldsymbol{v}/t$ to be of pivotal significance for *O*'s state of motion. His conclusion was that what *F1* takes to be a *kinetic energy* of *O*, due to its velocity $\boldsymbol{v}$, *F2* must describe as a potential or *dynamic energy*, depending on its distance $\boldsymbol{r}$.

What follows is a re-interpretation of Milne's KR in the light of a cosmic time $\mathcal{T}$, not his own presentation of the theory which applies a bulky algebra leaning heavily upon standard special relativity applied to a universe in uniform expansion, as just described; however, I am convinced that my re-interpretation is conceived in the true spirit of Milne. The argument, amounting to *a qualitative proof that gravitation is local*, runs thus:

As all fundamental observers possess congruent clocks counting cosmic time $\mathcal{T}$, what makes the difference to the proper times read off the clocks of accidental particles is the fact that such clocks are retarded relative to $\mathcal{T}$. Taking *F1* & *F2* to be the origo each of its own *locally privileged frame*, and assuming *O* to partake in the *cosmic now* of $\mathcal{T}$, we claim the relations between *F1* and *O* to be given by the Tangherlini Transformations, derided by Arzelies [1966], but defended by Selleri [2009], and shown by Øhrstrøm (§5) in Duffy & Wegener [2000], to be experimentally equivalent to the Lorentz Formulae:

$$\tau' \;=\; \tau/\gamma_x \;\;.\;\; x' \;=\; \gamma_x(x - v_x\tau) \;\;.\;\; y' = y \;\;.\;\; z' = z \;\;.\;\; 1/\gamma_x = \sqrt{1{-}v_x^2}$$

What is decisive is the first formula, showing the clock of *O* to be delayed relative to the master-clock of *F1:* $\tau'_O/\tau_{F1} = 1/\gamma_v$. Due to *F1* $\equiv$ *F2*, *O*-time must be delayed by exactly the same factor relative to the master-clock of *F2*, but *O* being momentarily at rest with respect to *F2*, the delay must be "caused" by a potential $\varphi$, whence: $\tau'_O/\tau_{F2} = 1/\gamma_\varphi$. We tentatively put: $\varphi = -GM/r = -\frac{1}{2}v_\infty^2$, where $v_\infty$ is the classical velocity of escape. This purely Newtonian concept also plays a key rôle in Einsteinian standard cosmology by arbitrarily entering the definition of $\boldsymbol{\Omega} \equiv \rho_{obs}/\rho_{crit}$ where $\rho_{obs}$ is the observed average density of matter in 3-space and $\rho_{crit}$ is the socalled "critical density" corresponding to an universal expansion of (or in) flat space with precisely the velocity $v_\infty$. Thus we get:

$$\sqrt{1{-}v_\infty^2} = \tau'_O/\tau_{F1} = \tau'_O/\tau_{F2} = \sqrt{1{+}2\boldsymbol{\varphi}}$$

### 3. The Λ-FLRW Universe

It is commonly claimed that modern cosmology originated with the general theory of relativity and gravitation (GRG) published by Einstein in 1915. The idea of an infinite Newtonian universe seemed to run into numerous inconsistencies if supposed to be static. This was the background for Einstein's proposal (1917) of a finite world model based on the Riemannian GRG geometry for a closed spherical 3-space. In order to ensure that his model remained static instead of collapsing, Einstein introduced a constant named $\lambda$.

By inserting $\lambda$ into his field equations, Einstein "clearly believed that they had no possible solution for empty space", North [1965]. However, de Sitter soon suggested a static universe, based on the hyperbolic geometry of Lobachevsky, that had to be empty, the point being that a free particle, when inserted, would receive an outward acceleration. The example of a particle possessing inertia without being exposed to gravitation seems to break the intimate coupling between inertia and gravitation assumed by Einstein.

This has grave consequences for cosmological models based on the Einstein-Mach principle which claims that inertial forces are caused by the presence of distant matter. De Sitter had made use of the cosmological constant $\lambda$, but Taub pointed out that the field equations of GRG, even without $\lambda$, under certain conditions might yield curved space in the absence of matter. This made North conclude that: "there is no longer any excuse ... for this parlance: 'the curvature of space-time is the cause of gravitation'" [ibid.].

Modern cosmology saw a sort of renaissance after the discovery of Hubble, who at first adhered to Einstein's static universe, that light from galaxies is shifted increasingly towards the red end of the spectrum with their distance from the observer (Hubble's law). This prompted Eddington (1930) to draw attention to an earlier paper of Lemaître who had proposed an expanding world model based on GRG starting from "a primeval atom". It was later realized that this model was anticipated in a still earlier paper by Friedmann. Interest in expanding world models obeying Hubble's law henceforth burst rapidly.

The equations of Friedmann and Lemaître were refined by Tolman and Robertson. The latter (1929) proposed a line-element for expanding world models; cf. North [ibid.]:

$$ds^2 = dt^2 - e^{2f(t)} h_{\mu\nu} dx^\mu dx^\nu$$

This line-element, by separating relativistic space-time into a separate parameter of time orthogonal to a (possibly curved) 3-space subject to homogeneity and isotropy, and by introducing an expansion-factor with a function $f$ of $t$, where $h_{\mu\nu}$ are spatial coefficients, marked a step away from the space-time amalgam of Minkowsky and Einstein.

Now (1935), first Walker, with inspiration from early papers of Milne, and shortly afterwards Robertson, independently analysed this line-element and proved it to be the most general one satisfying what North [ibid.] baptized: *Milne's cosmological principle*: a principle being satisfied by "any system of equivalent (fundamental) particle-observers who offer (formally) identical descriptions of the system as a whole". This is the reason why the above line-element is called the Friedmann-Lemaître-Robertson-Walker metric, and models obeying the metric are called FLRW models. Milne is mostly forgotten.

The prefix $\Lambda$, of course, is Einstein's long neglected cosmological constant, derided by Einstein himself as "my biggest blunder". However, after the discovery of evidence from super-novae of type $1a$ that the universal expansion is not decelerating, as expected, but seems to be accelerating, the $\lambda$-term in the field equations of GRG was re-introduced in the attempt to find an explanation of the observations based on "dark energy".

Today "dark energy" is seen, on a par with "dark matter", as the darkest mystery of modern cosmology. But Einstein inserted $\lambda$ into his field equations in order to balance the effects of gravitational forces, explained away by a supposed curvature of space-time. However, it is not realized that there is no need for $\lambda$ to explain an accelerated expansion if gravity is not universal. The whole mystery is hidden in a needless assumption.

The following discussion is greatly indebted to Mercier, Treder, Yourgrau [1979]. In the first chapter of their book, Mercier, its main author - having participated personally in the growth of GRG since its renaissance after the 50-year jubilee of special relativity - honestly lists a true parade of problems and difficulties connected with general relativity. In the concluding chapter, when outlining the future prospects for the theory, he restates his provisos, opining that new revolutionary changes are "pretty sure to happen".

GRG rests upon *two assumptions*, passing unquestioned by Mercier: A) gravitation is universal: B) gravitation cannot be described within the framework of special relativity. GRG is further based upon *two principles*: 1) the principle of *equivalence*: inertial mass is experimentally indistinguishable from gravitational mass; 2) the principle of *covariance*: it is always possible to devise a system of coordinates in which all apparent forces are eliminated, at least locally and momentarily, so that the motion observed is unaccelerated. As a consequence of these principles gravitation, i.e., acceleration, is reducible to inertia. The physics of GRG is not a dynamics: all effects of gravity are purely kinematic.

It should be noticed that 'equivalence' in the context of GRG, meaning: equivalence of inertial and gravitational mass, is altogether different from 'equivalence' in the context of the cosmological principle of Milne where it means: equivalence of observer-particles. The cosmological argument of §1, using equivalence of observer-particles to demonstrate that the kinetic energy of an object *O*, relative to an observer *F1*, appears to be dynamic, or potential, as judged by another observer *F2*, should suffice to prove that the principle of equivalence, so characteristic of GRG, is not an issue of disagreement, or controversy. What is at stake is the principle of covariance. Considering Hubble's law and the CMBR, it is hard to believe that there are no privileged observer-particles in the universe!

However, the focus of Mercier & al. is to be found in a rather different direction. The first very weak point referred to is that GRG, pretending to be universal in scope, seems unable to integrate electromagnetism, which is treated so well by special relativity. The point is that, whereas gravitation is basically symmetric and polar, electromagnetism is fundamentally anti-symmetric and bipolar. As a consequence, Riemannian geometry has to be dropped if electromagnetism shall be included otherwise than by admitting an independent Maxwellian theory to be, so to say, "glued onto GRG".

Further, whereas the Maxwellian field equations are linear, the Einsteinian field equations are non-linear. This implies that the superposition principle of electrodynamics, which is one of the conditions of quantization, is inapplicable to GRG, in all generality; quantization of the Einsteinian field of gravitation is therefore "an obscure undertaking". Moreover, just as energy in an electromagnetic field is exchanged by means of photons, so energy in gravitational fields may be exchanged by means of particles called gravitons. The problem here is that gravitons may exchange energy in the form of new gravitons, which is indeed a weird consequence, unkown for photons, mesons, leptons, etc.

Of further difficulties connected with GRG, Mercier & al. also count the following: 1) GRG claims to be universal, but it is not; so it must be subject to further unifications and generalizations, which never come to an end; 2) it is deterministic in a particularly sinister sense and irreducible to the quantum interpretation of probabilistic determinism; 3) it is experimentally verifiable only by means of very weak effects which are "wrongly called crucial"; 4) it is incompatible with the conservation of energy when this is taken in the usual sense; 5) it is unable to accept a privileged coordinate system; 6) it does not lend itself to a separation of space and time that is natural to observation or measurement; 7) it is foreign to the standard concept of material rigidity; etc., etc., etc.

What worries Mercier & al. at most, however, seems to be the pretentions of GRG to be universal when envisaged in connection with the determinism implied by the theory. What is peculiar to GRG is the analysis of the entire universe: "GRG is cosmology itself, if you wish, or at least it means to be" .. but "with what Riemannian or other space is it identifiable? give me its metric $g_{ik}$ and all its further properties as final datum, and then everything is determined, is even super-determined in it; no freedom is left", p.134.

That vision makes them uneasy: "it is Spinoza's God, and we must be pantheists". But the medicine is close at hand: Space is a construction of the human mind, invented to separate *the same* into a *duality* made up of *time* and *matter*, and *there are many spaces*, each of them serving its own purpose: coordinate space, configuration space, phase space, Minkowsky space, Riemann space, Finsler space, Hilbert space - but no one is real space. The conclusion is simple: "***there is no such thing as real space***" (ibid., my bolds).

To the above should be added all the shortcomings and drawbacks of the theory noticed by Rowlands [2007] and restated in Wegener [2021, ch.8]. It is indeed hard to fathom how a theory using such heavy apparatus to obtain such poor results has seduced people to embrace it with such almost religious reverence and glorification! -

**NOTE:**

André Mercier (1913-1999): first *professeur ordinaire de physique théorique et de philosophie de l'Université de Berne*; as president of the *Societé Suisse de Physique*, and official delegate of his country, deeply involved in the foundation of *CERN*, the world's greatest physical laboratory; initiator of *Spec.Rel. 50 Year Jubilee*, 1955; founder, editor, later honorary editor, of the journal *General Relativity & Gravitation*, 1970f.; former secretary general of *FISP* (Fed.Int.Soc.Phil.); *etc.*

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Mogens True Wegener

## 4. Towards a Steady State

In §1, we saw how an isotropic cosmological framework consisting of an infinite equivalence class of fundamental observer-particles enables us to define a cosmic time. The absolute and universal simultaneity of a cosmic time mocks the generally accepted dogma of the dissolution of the classical concept of simultaneity by special relativity.

In §2, we saw how the members of such equivalence class would identify what an observer *F1* takes to be the delay of the proper time of an object *O* due to inertial motion with what another observer *F2* takes to be the delay of the proper time of the same object due to the influence of a classical potential $\boldsymbol{\varphi}$, so that (granted $\frac{1}{2}\boldsymbol{v}^2 = -\boldsymbol{\varphi}$) we have:

$$d\{\tau_O'/\sqrt{1-\boldsymbol{v}^2}\} = d\mathcal{T}_{F1} = d\mathcal{T}_{F2} = d\{\tau_O'/\sqrt{1+2\boldsymbol{\varphi}}\}$$

Following Milne, there is no gravitational attraction between fundamental particles. However, when *O* passes *F1* with the velocity $\boldsymbol{v}$, *O* will be attracted towards *F2* as if the total mass, $M_\omega$ of the universe were centered at *F2*, exerting the Newtonian potential $\boldsymbol{\varphi}$. The potential will increase the velocity $\boldsymbol{v}$ of *O* further towards *F2* in the direction *F1*→*F2*. According to Milne [1934], this is why cosmic rays approximate the speed of light.

This holds when a test-particle *O* is released in the presence of the substratum only. Assuming that the local symmetry of fundamental particles is distorted by an aggregation of accidental particles with mass $m_{\boldsymbol{\varphi}}$, we have to search for a way of "adding" $m_{\boldsymbol{\varphi}}$ to $M_\omega$. Now, as hinted at above, the notion of *fundamentality* (here defined by respect to CMBR) should be understood in a *statistical* sense. So we are in need of a statistical device.

Milne found this in a Boltzmann equation, used in the theory of gases to derive a distribution function when an acceleration function is given; he then inverted it, using a distribution function, specified to depict freely moving accidental objects in the same way for all fundamental observers, to the purpose of deducing their function of acceleration. To obtain that, the distribution function was defined so as to ensure Lorentz invariance. In the present context, we are not able to investigate this important issue further.

However, as we do not want to restrict ourselves to consider universes in uniform expansion, we discard strict Lorentz invariance, inertial motion being not found in nature. Moreover, there are other and more serious problems associated with the Milne universe It is thus a consequence of his world model that some presumed constants of nature are, after all, not constant, since *G* and $\hbar$ are varying secularly with the age of the universe. Models with similar properties have been suggested by other physicists, e.g., Dirac.

Rowlands [ibid.] claims that all such models must be rejected for physical reasons. His point, which I accept, *leaves us with only one option*, viz., to search for world models that ensure socalled constants of nature, and Eddingtonian numbers, to be true constants: *such models, therefore, must either be in a steady state or tend towards a steady state.* However, the old steady state model of Gold & Bondi, as well as the similar one of Hoyle, ran into difficulties and are now generally discarded, so we have to make a fresh start.

This we can do by taking $e^{2f(t)} = 1$ in the RW line-element of §3, assuming:

$$d\mathcal{T}^2 = dt^2 - dr^2 - r_o^2 sinh^2(\tfrac{r}{r_o})(d\theta^2 + sin^2\theta\, d\phi^2) = \textit{invar.}$$

We thus solve two problems at once: 1) we obtain that the model, contrary to the old one, *satisfies Lorentz invariance locally*; 2) we obtain that *position space* like *velocity space*, Ungar [2008], is *hyperbolic*. This saves Hubble's law: *velocity* $\propto$ *distance*, cf. ***** below.

We further demand that the model must at least tend to fulfil this condition:

$$d\mathcal{T} = dt/cosh(\tfrac{r}{r_o}) = dr/[c]\, sinh(\tfrac{r}{r_o}) = \textit{invar.}$$

An immediate consequence is: $v = dr/dt = tanh(\frac{r}{r_o})$, whence we derive the formulae:

$$dt = d\mathcal{T}/\sqrt{1-v^2} \quad . \quad dr = v\, d\mathcal{T}/\sqrt{1-v^2}$$

The overt similarity with formulae distinctive of Special Relativity is indeed remarkable.

We easily integrate $d\mathcal{T} = dt/cosh(\frac{r}{r_o}) = dr/[c]sinh(\frac{r}{r_o})$, the result being:

$$e^{\mathcal{T}/t_o}\rho = e^{t/t_o}\rho/cosh^2\frac{r/2}{r_o} = 2\, tanh\frac{r/2}{r_o}$$

where $\rho$ is a constant of integration; defining $\mathcal{R}(\frac{\mathcal{T}}{t_o})/r_o \equiv 2\, tanh\frac{r(t/t_o)}{2\, r_o}$, we finally obtain:

$$\mathcal{R}(\tfrac{\mathcal{T}}{t_o})/r_o = 2\, tanh\frac{r(t/t_o)}{2\, r_o} = e^{\mathcal{T}/t_o}\rho$$

We have thus constructed a brand new Steady State model, not suffering the drawbacks of the old ones devised by Gold & Bondi and by Hoyle, obeying: $\mathcal{H} \equiv \dot{\mathcal{R}}\, t_o/\mathcal{R} = 1.^*$

With the usual SR-formula for redshift we can even calibrate natural units:

$$s = 1+z = \frac{dt+dr}{d\mathcal{T}} = \frac{d\mathcal{T}}{dt-dr} = e^{r(t)/r_o} = \frac{1+tanh\{\frac{1}{2}r(t)/r_o\}}{1-tanh\{\frac{1}{2}r(t)/r_o\}} = \frac{1+\mathcal{R}(\mathcal{T})/2r_o}{1-\mathcal{R}(\mathcal{T})/2r_o}$$

$$s = 1+z = e \simeq 2.7 \;\Leftrightarrow\; r = r_o = t_o \equiv 1$$

$$s = (1+\tfrac{1}{2})/(1-\tfrac{1}{2}) = 3 \;\Leftrightarrow\; \mathcal{R} = r_o = t_o \equiv 1$$

Thus our new model is seen to obey the ***dimensional postulate*** of Milne [1948]: No dimensional constant may be allowed to enter the definition of the substratum.

Milne distinguished the universe as ***world-map*** from the universe as ***world-view***; literally, he used the word 'world-picture', and his notion is somewhat different. Perceived as appearance in the perspective of an observer, the universe shows itself as world-view. Conceived as simultaneous co-existence, the universe is reconstructed as world-map. World-Map is isotropic & homogeneous, World-View is isotropic & inhomogeneous.

***The World-Map of our new model describes the-universe-in-itself: an invisible temporal One of simultaneous presence, simulating an infinite hyperbolic 3-space:***

$$\underline{d\mathcal{T}^2 = dt^2 - ds^2[c^{-2}] = \textit{invar.}} \quad . \quad ds^2 = dr^2 + [r_o^2] sinh\, r^2(d\theta^2 + sin^2\theta d\phi^2)$$

***The World-View of our new model discloses the-universe-for-us: an observable pseudosphere of shells of outwards growing age, showing a contraction of objects with light-time-distance in a flat finite 3-space of radius*** $\mathcal{R}_u = 2$; cf. M.C. Escher [1960]:

$$\underline{[c^2]dt^2 = [c^2]d\mathcal{T}^2 + ds^2} \quad . \quad ds^2 = \{d\mathcal{R}^2 + \mathcal{R}^2(d\theta^2 + sin^2\theta\, d\phi^2)\}/(1-\frac{\mathcal{R}^2}{4[r_o^2]})^2$$

From a philosophical point of view, however, many people may feel reluctant to accept the "prospect" of a past eternity, apparently implied by the model here developed. This leads us to search for a model with a finite past tending towards a steady state.

As we shall see, it is in fact easy to construct two models with such properties. Both models preserve the same *world-map* and the same *world-view* as described above, showing their spaces to be stationary, not expanding. The differences are $(t_o \equiv r_o \equiv 1)$:

***Model M₁: "Steady State"***

$$\underline{\rho \equiv \sinh r/e^t \equiv 2\tanh\tfrac{r}{2}/e^{\mathcal{T}} \equiv \mathcal{R}/e^{\mathcal{T}}}$$
$$e^t d\rho = \cosh r\, dr - \sinh r\, dt = dr - \sinh r\, d\mathcal{T}$$
$$\underline{\mathcal{T} = \ln\{\underline{e^t}/\underline{\cosh^2\tfrac{r}{2}}\} = \ln\{\underline{e^t}(1-\tfrac{\mathcal{R}^2}{4})\} = invar.}$$
$$v \equiv dr/dt \underset{d\rho=0}{=} \tanh r \,.\Rightarrow.\, \gamma_v \equiv 1/\sqrt{1-v^2} \underset{d\rho=0}{=} \cosh r = \tfrac{dt}{d\mathcal{T}}$$
$$\mathcal{H}_1(\mathcal{T}) \equiv \dot{\mathcal{R}}(\mathcal{T})/\mathcal{R}(\mathcal{T}) \propto constant$$

***Model M₂: "Fierce Blow"***

$$\underline{\rho \equiv \sinh r/\sinh t \equiv 2\tanh\tfrac{r}{2}/\sinh \mathcal{T} \equiv \mathcal{R}/\sinh\mathcal{T}}$$
$$\sinh t\, d\rho = \cosh r\, dr - \sinh r \coth t\, dt = dr - \sinh r \coth\mathcal{T} d\mathcal{T}$$
$$\underline{\mathcal{T} = arsh\{\underline{\sinh t}/\underline{\cosh^2\tfrac{r}{2}}\} = arsh\{\underline{\sinh t}(1-\tfrac{\mathcal{R}^2}{4})\} = invar.}$$
$$v \equiv dr/dt \underset{d\rho=0}{=} \sqrt{\sinh^2 r+\rho^2}/\cosh r \,.\Rightarrow.\, \gamma_v \equiv 1/\sqrt{1-v^2} \underset{d\rho=0}{=} \cosh r/\sqrt{1-\rho^2}$$
$$\mathcal{H}_2(\mathcal{T}) \equiv \dot{\mathcal{R}}(\mathcal{T})/\mathcal{R}(\mathcal{T}) \propto \coth\mathcal{T} \underset{\mathcal{T}\to\infty}{\longrightarrow} \mathcal{H}_1$$

***Model M₃: "Gentle Flow"***

$$\underline{\rho \equiv \sinh r/\cosh t \equiv 2\tanh\tfrac{r}{2}/\cosh\mathcal{T} \equiv \mathcal{R}/\cosh\mathcal{T}}$$
$$\cosh t\, d\rho = \cosh r\, dr - \sinh r \tanh t\, dt = dr \sinh r \tanh\mathcal{T} d\mathcal{T}$$
$$\underline{\mathcal{T} = arch\{\underline{\cosh t}/\underline{\cosh^2\tfrac{r}{2}}\} = arch\{\underline{\cosh t}(1-\tfrac{\mathcal{R}^2}{4})\} = invar.}$$
$$v \equiv dr/dt \underset{d\rho=0}{=} \sqrt{\sinh^2 r-\rho^2}/\cosh r \,.\Rightarrow.\, \gamma_v \equiv 1/\sqrt{1-v^2} \underset{d\rho=0}{=} \cosh r/\sqrt{1+\rho^2}$$
$$\mathcal{H}_3(\mathcal{T}) \equiv \dot{\mathcal{R}}(\mathcal{T})/\mathcal{R}(\mathcal{T}) \propto \tanh\mathcal{T} \underset{\mathcal{T}\to\infty}{\longrightarrow} \mathcal{H}_1$$

Our definition of proper distance, $\mathcal{R} \equiv 2\,tanh\frac{r}{2}$, may be explained as the distance of two fundamental particles, $P\,\&\,P'$, described in the frame of their *midway particle*, $M$. Write $v_{pm} = \tanh r_{pm} = \tanh\frac{1}{2}r_{pp'} \underset{r\to\infty}{\longrightarrow} 1$ and $v_{mp'} = \tanh r_{mp'} = \tanh\frac{1}{2}r_{pp'} \underset{r\to\infty}{\longrightarrow} 1$; then, just as $v_{pm}+v_{mp'} \underset{r\to\infty}{\longrightarrow} 2$, we have: $\mathcal{R}_{pp'} \equiv \tanh r_{pm} + \tanh r_{mp'} \underset{r\to\infty}{\longrightarrow} 2$. Cf. p.4 above.

Whereas it appears impossible to ascribe a definite first instant to the model ***M3***, the model ***M2*** originates as a hot singularity at the instant $\mathcal{T} = 0$ of cosmic time and, after a short phase of inflation with nearly constant speed, it accelerates towards a steady state. *M2 in this way seems to combine the best of two worlds: 'big bang' and 'steady state'.*

Please, notice that according to the kinematic argument of Milne, reaffirmed in §2, gravitation is not universal, but local, which means that instead of functioning as a brake on universal expansion (in our context: universal dissipation) it must be understood as an immediate, i.e., instantaneous, mathematical consequence of the universal dissipation.

So there is no need of "dark energy", and not of "dark matter" either, Ungar [2008]. Further, *the crowding of objects with distance* in the World View of all our SS-models turns the crucial number-distance count, used by Ned Wright to reject the old SS-model, against the standard BB-model; cf. *www.astro.ucla.edu/~wright/stdystat/htm*,fig.$2_{(1\text{-}3)}$.

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## 5. A Boiling Multiverse

The idea of a *multiverse* is partly inspired by the search for a "background free" version of GRG. So its background is a blatant disregard for the two most conspicuous cosmological discoveries of the 20th century: Hubble's law, and the CMBR at 3 Kelvin. Both discoveries seem to indicate the existence of a privileged cosmological framework which can serve as the physical foundation for an all-encompassing cosmic time.

One might believe that the orthodoxy of the old "big bang" theory had already been sufficiently shaken by the recent sprouting of the most diverse types of *inflation theories*. In fact, most of these developments are motivated by the sustained attempt to absolve a number of intriguing problems that has bedevilled the old theory for quite a long time. However, only very few cosmologists consider questioning its basic assumptions.

Instead, an increasing number of scientists appear seriously engaged in the joyful pastime of imagining "realities" altogether different from our own observable universe, "realities" taken to be manifest "in other regions of space", or "in wholly separate spaces". What it means to be "real" is seldom explained, but mostly left to exuberant imagination. Something similar holds for space: the mind-boggling vastness of infinite space supposed to stretch endlessly beyond our tiny observable part is a thrill to the vivid phantasy.

Tegmark, one of those very bright people bent on boosting the idea of a multiverse, knows that the best defence is an attack; led by him, "the multiverse strikes back" [2019]. Defining *our own universe* as that part of everything in existence which is observable to us as human beings, and distinguishing four different levels of the concept of *multiverse*, he describes *level 1* as that part of "being" which is *in fact unobservable* to us, but ruled by *the same laws* of nature, and *level 2* as that part of "being" which is *in principle unobservable* to us and which may thus be ruled by wholly *different laws* of nature.

In both cases it is the idea of *cosmic horizons* that is in play, in fact or in principle; obviously, the non-existence of cosmic horizons would make the multiverse indefensible. But concerning *level 3* something very different is at stake since, with this term, he refers to the idea of *parallel universes*, introduced by Evereth and embraced by Wheeler, as a plausible solution to the problem of *wave function collapse* annoying quantum theorists. Since this solution presupposes quantum theory to be *unitary* in the sense of providing an over-arching wave function $\Psi$, at least $\Psi$ must be a "law" common to all such universes, having the same form in all the "parallel" universes, including that we call "our own".

What characterizes the *many worlds interpretation* of quantum theory, making it affine to the idea of a *mathematical universe* designated as *level 4* in the classification proposed by Tegmark [2007], is that it invests the notion of "reality" in a purely formal abstraction, viz., the mathematics of the wave function represented by the symbol $\Psi$. This is a move that brings him in opposition to the classical *Copenhagen Interpretation*, which he summarily dismisses. According to Bohr & al., what is real is much rather the collapse of the wave function into an observable and causally effective *quantum event*. Here it is *the collapse of our mathematics* that *brings us into contact with reality*.

This, of course, is intolerable for brilliant mathematicians like Tegmark & his allies. For him *the observer's perspective* is only "the frog's view", contemptuously contrasted to *the mathematician's perspective* which he calls "the bird's view", thereby tacitly implying that such elevated perspective is the privilege of genuine "spiritual eagles" like himself. Presupposing "reality" to be mathematical, he finally identifies physics with mathematics, thus professing an extreme type of "Platonic" idealism; nevertheless, he insists on talking of *structural realism*, thereby turning the usual meaning of "realism" on its head.

As if this is not enough, he goes as far as he can in stripping mathematical physics of all traces that might remind his followers of anything with a taste of traditional realism. At the end of that track we find only *mathematical structures* consisting of formal entities and their relations, but totally devoid of irrelevant "human baggage" composed of notions such as "particles", "forces", "fields", &c. &c.; whence one would guess that even his own concepts of "entity", "relation", and "structure", belonged to this sort of baggage or waste. Having led us that far astray he claims, with Vilenkin, that all this is "solid science".

How solid then? On what rock-solid foundation does this pretended science rest? Answering some objections from Ellis, Tegmark [2019] mentions seven open questions, one of them added by himself, namely, whether quantum theory is unitary or maybe false. Since quantum mechanics is one of the best confirmed theories we know, let us accept it; this leaves us with one question, viz., whether the many-worlds interpretation is correct. So let us start discussing his ideas by going back from level 3, over level 2, to level 1.

Concerning level 3, I prefer the Copenhagen interpretation, not "parallel worlds". As regards level 2, it makes use of the idea of minima in a "string theoretical landscape". However, the solidity of string theory is a far cry from that of standard quantum theory; so far indeed, that it is questionable whether string theory can be counted as a science: seldom has the devastating criticism: "- it is not even wrong", been more appropriate! With respect to level 1, it rests wholly on the idea of *inflation*, already mentioned above, and invented *ad hoc* in order to solve some problems of the old "big bang" theory.

One of these, the *flatness* problem, emanates from the field equations of Einstein. Following GRG, the classical velocity of escape marks the flat limit between *spherical* world-models, ending in collapse, and *hyperbolic* world-models, continuing to expand. Thus, if $\boldsymbol{\Omega} > 1$ - meaning: the quotient $\rho_{obs}/\rho_{crit}$ is greater than unity - the expansion of space will come to a full stop followed by an implosion that ends up with a "big crunch", and, if $\boldsymbol{\Omega} < 1$, the expansion will never stop, but the density will be steadily diminished. In both cases, the slightest deviation of $\boldsymbol{\Omega}$ from unity will increase very rapidly.

The limiting flat case being that unstable, why is space as flat as it appears to be? Here the inflation hypothesis comes to the rescue: assuming that cosmic space is blown up enormously in a tiny fraction of a second (is inflation subject to a cosmic time, then?) it follows that the local curvature of space is reduced to a minimum very close to zero. However, the hypothesis of inflation accentuates the problem of cosmic horizons.

The ghost of the multiverse lives, and dies, with the existence of cosmic horizons!

## 6. Creation from Nil

Whereas adherents of the inflationary multiverse seem to endorse the odd maxim: *Entia ad libitum sunt multiplicanda*, serious scientists, in their efforts to purify physics of superfluous speculation (Newton: *Hypotheseis non fingo*), have for centuries appealed to the socalled Ockham's razor: *Entia non sunt multiplicanda praeter necessitatem*.

Tegmark in his [2007] submits two hypotheses: 1) the External Reality Hypothesis and 2) the Mathematical Universe Hypothesis. According to the ERH, "there exists an external physical reality completely independent of us humans". According to the MUH, "our external physical reality is a mathematical structure". ERH entails MUH, he says.

With some few (!important!) provisos, I can immediately subscribe to them both. What I have termed *World Map*, in section 4, is precisely such a mathematical structure, although it describes an element of 1+3 dimensional *time-space*, and so does not provide the indigestible meal of a 3+1 dimensional "space-time spagetti" served by Tegmark.

Further, *World Map*, if compared to what I call *World View*, presents exactly that *outside* "bird's view" which Tegmark so strikingly contrasts with the *inside* "frog's view". Whereas *World Map* is an infinite hyperbolic time-space having *no center*, *World View* is a finite flat space-time *centered* at the observer, and its flatness is given for free.

Moreover, *World View* can be understood in two ways, as representing either the incoming or the outgoing *light-cone*, both centered at an SAS ("self-aware substructure"), who can therefore be interpreted either as *spectator* or as *contributor*, reflected in the *complementarity* between *passive observation* and *active intervention*, cf. Bohr.

In this way the detested "frog's view" suddenly assumes an exceptional importance. One can ask whether the socalled "bird's view" makes any sense at all if separated from it. The point is that the centered *World View* displays some really extraordinary properties. With a critical mass that allows nothing to escape, it similates *a perfect black hole*.

No observer-particle, or galaxy-cluster, will ever, due to its shrinking with distance cross the pseudosphere's surface at distance $\mathcal{R}_{u_r = \overline{\overline{ct}} = \infty}$ 2 from the observer. This shows the "surface" to be a simple fiction. In other words: our three models possess no horizons! That no-horizon models are possible flouts the hope for an inflationary multiverse.

The shrinking is an immediate consequence of translating the hyperbolic geometry of our *World Map* into the flat Euclidean geometry of our *World View* and is equivalent to a reduction with distance of the speed of light, cf. Escher [1960]. This reduction makes the speed $\dot{\mathcal{R}}$ of a distant receding object fade out, like the classical velocity of escape.

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## Conclusion

It is natural to think that the contents of any universe will dissipate, Milne [1934]. Accepting the position of Rowlands [2007] that the fundamental laws of nature must be time invariant, it is reasonable to assume that the dissipation must stabilize at the value:

$$d\mathcal{T} = dt/cosh(\tfrac{r}{r_o}) = dr/[c]\, sinh(\tfrac{r}{r_o}) = \textit{invar.}$$

Granted this, we are ensured that special relativity, at least, holds good locally:

$$v \equiv dr/[c]dt \equiv tanh(\tfrac{r}{r_o}) \;\Rightarrow\; :\; dt = d\mathcal{T}/\sqrt{1{-}v^2}\;\;.\;\; dr = v\, d\mathcal{T}/\sqrt{1{-}v^2}$$

Local deviations from global symmetry/isotropy will then produce gravitational effects. If this bold conjecture is true, one of our three steady state models seems unavoidable.

Now, choosing the simplest possible RW line-element with hyperbolic geometry:

$$d\mathcal{T}^2 = dt^2{-}dr^2[c^{-2}]{-}[t_o^2]sinh^2(\tfrac{r}{[r_o]})(d\theta^2{+}sin^2\theta\, d\phi^2) = \textit{invar.}$$

we obtain that *position space* is hyperbolic, on a par with *velocity space*; cf. Ungar (ibid.). That this is so accords very well with the stance of Varićak [1924] and of Barrett [1994]. For $\mathcal{R} \equiv 2[r_o]tanh(\frac{r/2}{[r_o]})$ we get $\mathcal{H} \equiv \dot{\mathcal{R}}\,[t_o]/\mathcal{R} = \frac{dr/[c]d\mathcal{T}}{sinh(r/[r_o])} = 1$, implying a steady state.

Passing from *World Map* $d\mathcal{T}^2 = dt^2{-}ds^2$ to *World View* $dt^2 = d\mathcal{T}^2{+}ds^2$, we go from an instantaneous snapshot of our preferred model in hyperbolic space to the same model depicted as a pseudo-sphere surrounding a single fundamental observer, for which all other particles seem to be shrinking outwards with their distance from the center.

No observer-particle or galaxy-cluster can ever, due to its shrinking with distance, cross the pseudo-sphere's surface at distance $\mathcal{R}_{u\,r\,=\,ct\,\simeq\,\infty} = 2$ from the observer, showing that the surface is fictitious; in other words: all our three models are devoid of horizons!

Assuming further that the reduction is 3-dimensional and is reflected in a reduction of the gravitational attraction exerted between distant masses, we have a perfect reason for ascribing a finite universal mass $\mathcal{M}_u$ to the *apparent black hole* of our *World View*.

It is natural to claim that the universal mass must be, or at least tend to be, constant. It is likewise natural to claim that there must be, or at least tend to be, a balance between the average mass density in the universe and its average pressure, so that: $\varrho = -p$.

Granted that the sum total of motional and gravitational energy in our "black hole" can be put equal to zero, it follows that the loss of energy at the periphery is compensated by a corresponding gain at the center, implying a *creatio continua* of matter *ex nihilo*. This is just a direct consequence of the classical principle of conservation of energy!

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Mogens True Wegener