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NEW PHYSICS OF AN ETERNAL INFINITE MULTIVERSE INSTEAD OF TODAY'S SINGULAR BIG-BANG COSMOLOGY

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ABSTRACT

The objective of this paper is to propose a new understanding of relativity theory (RT) keeping all its measurable results in a one and only non-expanding multiverse (many evolutionary cosmoses in the 'stationary universe'). In general today's ΛCDM Cosmological Concordance Model (CCM) suffers from various problems which after a paradigm shift might be resolved at one blow. Above all, the baryon asymmetry – unexplainable in its historical context – is a natural fact without need for justification. As can be seen just from Melia & Shevchuk's repeatedly discussed 2012 '$R_h = ct$' approach, the Friedman(n)-Lemaître-Robertson-Walker (FLRW) line element seems misunderstood until today. The underlying concepts of special relativistic proper length and proper time do apply only locally. These concepts are inappropriate to describe the entire universe on sufficiently large scales. Therefore 'new physics' has to discard the present reception of the FLRW form in relativistic cosmology, though special relativity (SR) remains valid in all infinitesimal tangent spaces to spacetime. Yet in the multiverse local bangs might cause 'primordial' nucleosynthesis again and again. Based on Einstein's original equations, with no need for 'dark energy', the stationary universe model (SUM) explains the Supernovae-Ia (SNe-Ia) data on universal scales $z > 0.1$ straightforwardly. Taking into account two reported 9%-contrasting Hubble 'constants', here understood to stand for H_{local} and $H_{universal}$ ('Hubble trouble'), it even provides agreement over the full redshift range. All kinds of dark matter – macroscopically lensing inhomogeneous dark matter of first kind (iDM) or homogeneous non-lensing dark matter of second kind (hDM) – appear rid of the initially assumed lack of non-gravitational interaction. There is a Planck 2015 model prediction mismatch suggesting a mathematical solution for a perfect black-body background composed of redshifted microwave radiation emitted from hDM, this solution involves a falsifiable Sunyaev-Zel'dovich alternative. It is no longer possible to take the sheer existence of the CMB as a certain proof for one singular big-bang origin of the entire universe.

Keywords: galaxies: distances and redshifts; cosmology: cosmic background radiation, dark matter, dark energy, observations.

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1. INTRODUCTION

A fundamental problem of any big-bang cosmology may be that all ‘proper’ quantities like in particular that of ‘proper distance’ are concepts of *special* relativity and thus applicable always locally only. These concepts are not legitimate to describe the infinite multiverse on sufficiently large scales.

The final analysis will show that according to constant mean redshifts of SUM (Ostermann 2014) there might be no universal expansion and therefore neither the need for one singular ‘big bang’ nor for ‘dark energy’, both supposedly causing the most puzzling problems of today’s physics at all.

O In particular SUM predicts two 9% different values for the local and the universal Hubble constant due to an observed density contrast, the latter threatening the whole ΛCDM big-bang concept.

O Furthermore it not only suggests the WIMPS of dark matter to be neutrinos, but also a homogeneously distributed part (‘thermalized’ in the end due to universal deceleration) to emit the CMB within the non-expandig multiverse. At the same time ‘dark’ matter gets also rid of its mysterious lack of non-gravitational interaction.

O In addition to local ‘proper’ lengths $\delta l_{\rm SR}$, any universal (‘comoving’) quantity l^* is a real physical distance measure by time-independent mean values of z.

O Cosmological redshift is no Doppler effect and thus no proof for any universal expansion.

O The existence of the eternal Tao multiverse is given before the creation of our local evolutionary cosmos.

O The baryon asymmetry reflecting the preponderance of matter over antimatter is a natural fact like the existence of the universe itself without need for justification.

In line with the numerically utmost successful Cosmological Concordance Model (CCM), even the repeatedly discussed concept of a ‘$R_h = ct$’ universe, Melia & Shevchuk (2012), still adheres to the mere hypothesis of a big-bang creation of everything concluded from Lemaître’s speculation of expanding space. Now avoiding this unnecessary assumption, the simplest conceivable cosmological ansatz based on Einstein’s original equations (without cosmological constant) has lead to the new model, hereafter also quoted as SUM14 (Ostermann 2014), whose secondary FLRW line element in case of flat space is mathematically identical to that of a special version of Kolb’s ‘coasting cosmology’ (Kolb 1989). This feature has been explicitly discussed by author Ostermann (2003a). As stated by Lewis (2013), Melia’s subsequent notion of a $'Rh = ct'$ universe has grown in a series of papers over recent years.

Though with SUM’s line element, in FLRW coordinates the same like that one independently found later again (Melia 2008), both cosmologies are representing completely different approaches to physical reality. This means Melia’s model stands for a big-bang creation of the entire universe, while SUM stands for a stationary multiverse.

In addition to Lewis however, who assumed that one of the earliest comments on the underlying coincidence was provided by Lima (2007), this seems to have been done for the first time in an arXiv e-print by Ostermann (2003a). In contrast to Melia & Shevchuk’s notion $R_h = ct$, in the SUM framework the mathematically equivalent coincidence reads $R_H \equiv c/H$ what means anything but the same cosmology. While the former value is assumed to be increasing with time, the latter is a natural constant due to SUM’s non-expanding space.

Primarily Melia – together with various colleagues – have continued to review essential features of ΛCDM cosmology, thereby showing that many of these would rather favor the $R_h = ct$ approach against the CCM. From this committed argument it seems only a logical step to arrive at SUM.

While actually all ultralarge scale features of the universe seem to be fundamentally determined in the ΛCDM framework, its physical origin is completely unclear [not least as a result of speculations based on the geometrical interpretation of general relativity (GR) and its ‘spacetime’ which is unnecessarily misunderstood to be physical (Einstein) instead of mathematical (Newton)].

In their initial work Melia & Shevchuk (2012) wrote: “This equality [$R_h = ct$] is very peculiar because it need not have occurred at all and, if it did, should only have happened once (right now) in the context of ΛCDM."

In case of SUM the FLRW coordinate time cannot be understood to provide a valid cosmic ‘proper’ time without intrinsic limitations (as will be shown in Sections 2.4, 2.7 below). In Melia’s (Melia 2015) ‘On Recent Claims Concerning the $R_h = ct$ Universe’ it reads: “The $Rh = ct$ Universe is a Friedmann-Robertson-Walker (FRW) cosmology which, like ΛCDM, assumes the presence of dark energy in addition to (baryonic and nonluminous) matter and radiation." Therefore it is clear that in view of SUM the various big-bang aspects of this approach will fail.

Nevertheless he found (Melia 2012a) concerning the luminosity-distance relationship using the Union2.1 distance moduli together with his ‘$R_h = ct$’ model: “... though quite promising, the match is not perfect" (s.

however in particular his Fig. 3 in comparison with Fig.s 6, 7 of the paper on hand).

Furthermore carrying out “A Comparative Analysis ..." the authors (Wei et al. 2016) conclude “since $R_h = ct$ has only one free parameter (the Hubble constant), it follows from a standard model selection technique that it is to be preferred over ΛCDM, the minimalist version of which has three . . . ". The latter argument is even much more convincing in the SUM framework, where in contrast to the ‘$R_h = ct$’ model again the quoted ‘Hubble constant’ is a true natural constant of a non-expanding multiverse (Ostermann 2013a). In this context a Hubble diagram using QSOs in the redshift range $0 < z < 6.5$ has been discussed (Lopez-Corredoira et al. 2016), or even the use of gamma-ray bursts (GRBs) as standard candles (Wei et al. 2013).

In view of SUM a special kind of ‘primordial’ nucleosynthesis would take place in re-creation processes as suggested by the *local application* of its spatially limited FLRW forms. This again stands in clear contrast to the misleading concept of nucleosynthesis in Melia & Shevchuk’s big-bang cosmology, where Lewis, Barnes, & Kaushik have been “Pouring cold water on the Simmering [$R_h = ct$] Universe" (Lewis et al. 2016). They rightly stated: “Without the addition of substantial new physics [...], it is difficult to see how the $R_h = ct$ universe can be considered a viable cosmological model". It has been correspondingly concluded by Bilicki & Seikel: “... this model has a simple mathematical form. However, it is arguably not more plausible from the astrophysical point of view than the standard ΛCDM" (Bilicki & Seikel 2012). To show that this conclusion actually applies, it needs an unbiased investigation of SUM. In any case Melia & McClintock (Melia & McClintock 2015) are clearly right to “emphasize again the need for truly model-independent observations to be used in cosmological tests".

The strange coincidence of the $R_h = ct$ approach is addressed by Melia (2016a) once more: “In the context of ΛCDM, the condition $p/\rho = -1/3$ can be achieved only once in the entire (presumably infinite) history of the Universe, making it astonishingly unlikely." This corresponds to statements of Melia & Abdelqader (2009) and is also related to the unneeded phase of inflation, as has been addressed elsewhere (Melia 2013) “We show that the horizon problem is nonexistent for the recently introduced $R_h = ct$ universe, obviating the principal motivation for the inclusion of inflation." Accordingly he commented: “... a careful re-examination [...] suggests that we may be missing the point. The observations actually reveal a simpler and more elegant Universe than anyone could have imagined. [...] the inflationary model of cosmology was invented to resolve this possible discrepancy [...] But after three decades of struggling [...] it is now clear that inflation may not be the solution after all. The idea of inflation is itself fraught with many apparently insurmountable problems" (Melia 2012b).

But regarding SUM, now the ‘new physics’ lies in the no more expected stationarity without one singular origin of the entire universe and the insight that SR concepts do categorically apply always locally, in particular that of proper length. Therefore the ‘$R_h = ct$’ approach itself as well as also e.g. the criticism of Bilicki & Seikel (Bilicki & Seikel 2012), both suffer incurably from the same dilemma in adhering to a physically inexplicable ‘big bang’ as suggested by Lemaître’s ‘miraculous’ fiction of universal expansion.

At last a strong criterion has been emphasized: “we show that an unambiguous prediction of the $R_h = ct$ cosmology is zero drift at all redshifts, contrasting sharply with all other models in which the expansion rate is variable. For example, multi-year monitoring of sources at redshift $z = 5$ with the ELT-HIRES is expected to show a velocity shift $\Delta\nu = -15cm/s/yr$ due to the redshift drift in Planck ΛCDM, while $\Delta\nu = 0cm/s/yr$ in $R_h = ct$." (Melia 2016b)

Though being the case, yet this cannot be a *"Definitive Test of [Melia’s] $R_h = ct$ Universe Using Redshift Drift"*, since the predicted constancy of universal redshift (except due to peculiar motions) has been already stated as a central feature of SUM long time ago (Ostermann 2003a,b, 2010).

Now using universal coordinates instead of the misleading FLRW form, SUM’s line element is mathematically deducible as a formal generalization of special relativity. With values of redshift statistically independent of time, a significant Hubble constant is proved in contrast to the conventional parameter. The model requires a negative gravitational dark pressure of $-1/3$ the critical density. With no need for ‘dark energy’, it explains the SNe-Ia data straightforwardly on universal scales $z > 0.1$. Taking into account two 9%-contrasting Hubble ‘constants’ H_{local} and $H_{universal}$ it provides agreement over the full redshift range.

Therefore it seems a premature statement to read from Riess et al. *"The measured H_0 is also highly inconsistent with the simplest inhomogeneous matter models invoked to explain the apparent acceleration of the universe without dark energy"* (Riess et al. 2011), s. however Fig.s 4, 6 below. This erroneous assessment evokes reminiscence to another famous discovery (while correspondingly nobody thinks of criticizing Columbus for the fact that his new continent was not India).

A homogeneous part of macroscopically non-lensing dark matter would fill the gap to critical density. At the same time this suggests a mathematical solution for a perfect black-body background composed of redshifted microwave radiation emitted within a non-expanding multiverse. Given the law of entropy restricted to evolutionary processes, SUM may be understood to describe a local-bang 'multiverse'. While the ΛCDM cosmology is theoretically founded on an unprovable single-bang origin of the entire universe, several high precision measurements of the Cosmic Microwave Background (CMB) raise increasing doubts (among others: a giant cold spot, low-multipole alignments, a reported 'dark flow', two different values for the Hubble 'constant' H_0, recently a Sunyaev-Zel'dovich cluster count prediction mismatch in the Planck 2015 data). Now with a mathematically consistent CMB alternative on hand, it seems necessary to reconsider Lemaître's expanding space conception at all, this time however in comparison with SUM as an unexpected reference model of unique mathematical simplicity. As strongly suggested, a realistic chance appears in the possibility of providing evidence for a CMB origin essentially from $z \ll 1000$ to disprove the the ΛCDM concept now. Considering 'new physics', it seems rational to discard expanding space as well as a singular 'big bang'.

That the redshift of galaxies does not at all mean a spatial expansion, corresponds to the impossibility to conclude from the effect of ordinary gravitational redshift – directly measured by Pound and Rebka – that the top of the Jefferson tower was receding from its base. Today's ΛCDM cosmology has been developed to a numerically outstanding model as correspondingly once has been that of Ptolemy, too. Since those times it must not be forgotten, that even a mathematically consistent concept can be wrong.

In contrast to its mathematical apparatus, Einstein's geometric conception of GR (quasi-dogmatic after 1921) implies a contradiction to its own presuppositions because: Any direct conclusion that real space and time might be curved, would need rigid unit sticks and non-affectable clocks to make it a physically testable statement. In fact, however, just his own SR proves the impossibility of rigid bodies and non-affectable clocks, as can be most convincingly seen from Ehrenfest's famous paradox (Ehrenfest 1909), and Kaluza's pioneering mathematical solution (Kaluza 1910), where non-Euclidean geometry has been introduced into relativity theory (RT) for the very first time (s. also Ostermann (2013b)). Either GR proves a curvature of space and time under the unrealistic presupposition of fictive 'ideal' rods and fictive 'ideal' clocks which are not available in nature, or in accordance with Poincaré (1902) and misjudged realistic ideas of FitzGerald and Lorentz the non-Euclidean geometry of GR proves real unit sticks and real clocks to be systematically affected by gravitation and universal motion without need for any material curvature of mathematical space and time themselves.

A 'multiverse' is just another word for only one universe with the possibility for multiple cosmoses from 'local bangs'. Any 'parallel-universes', however, if never causally connected, would physically not exist. The actual entirety will be the one and only universe again. To distinguish our cosmos from a pre-existing background allowing for other local 'cosmoses' as well, only this all-embracing background will be named universe. Unlike the word cosmos, here the word multiverse means – synonymously rather in sense of Laotse's Tao te king – all of all worlds. The uncomplicated SUM approach will allow an unbiased systematic classification of observational data.

Undoubtedly there has been an origin of our 'local' evolutionary cosmos billions of years ago. It is obvious, however, that a theory which once has arisen from the axiomatic presupposition of no preferred frame cannot arrive with one universal CMB rest frame without a hidden logical break. Since such a break is not in Einstein's equations, a problem may be in their historic interpretation usually simply referred to as 'relativity theory'. If RT had failed however to provide a solution for a stationary multiverse, this failure may have been caused by the same misunderstanding. Throughout this paper 'stationarity' means rather an ongoing process than a 'steady state'. The term 'single-bang' stands for the widely assumed 'big-bang' with its initially singular origin of space and time.

In the framework of SUM, the critical energy density $\varepsilon_c \equiv 3H^2/(\kappa_{\mathrm{E}}c^2)$ is a real constant (where $\kappa_{\mathrm{E}} \equiv 8\pi G/c^4$). Using the Landau & Lifschitz (1992) notation, the signature of the GR fundamental tensor g_{ik} is always assigned according to $\eta_{ik} = (+1, -1, -1, -1)$ of SR. Latin indices $i, k, l \ldots = 0, 1, 2, 3$ represent four-dimensional quantities (Greek indices $\alpha, \beta \ldots = 1, 2, 3$ spatial quantities only). As usual, all symbols are explained at first occurrence. If not otherwise stated, a bar indicates averaging over space. The various spellings of '$R_h = ct$' in literature is standardised here.

2. MATHEMATICAL DEDUCTION OF A STATIONARY COSMOLOGY BASED ON EINSTEIN'S EQUATIONS

Given there has been something where a big-bang origin of our cosmos took place: What is the line element describing the energy density and pressure of such a preexisting universal background ('tohu va bohu')?

Since evolution affects our own cosmos from a joint beginning, it is necessary to distinguish it from the multiverse. If stationary the last, it is including all that is, was, and will be. On the other hand, our cosmos may stand for the largest structure of conjoint local origin including at least the solar system. Considering the difference between cosmos and multiverse and regarding horizon problems or coincidences unacceptable for the latter, one will find the solution for a stationary relativistic cosmology without unnecessary ultralarge scale peculiarities. While no physical theory of the multiverse can be based as of ultimate certainty, the intention of this paper is at first to formulate the basics of the stationary universe model.

2.1. *The SUM line element from two postulates*

Two postulates are used here to deduce a cosmological solution of general relativity (Ostermann 2003a, 2008a, 2012a,b). Its redshift parameters z will turn out to be independent of time. – The postulates are:

Postulate I: The universe is stationary, homogeneous, and isotropic on sufficiently large scales.

Postulate II: Neglecting deviations caused by local inhomogeneities, the universal coordinate speed of light c^* would equal the natural constant c.

Obviously, the first postulate is equivalent to what has been called the perfect cosmological principle in the framework of the Steady-state Theory (SST), while the second postulate is implying spatial flatness. Together both postulates determine the line element of the stationary universe model with respect to ultralarge, i.e. universal scales $z > 0.1$,

$$\mathrm{d}\sigma^{*2}_{\mathrm{SUM}} = \zeta^{*2}_{\mathrm{SUM}}\{c^2\mathrm{d}t^{*2} - \mathrm{d}l^{*2}\}\ , \tag{1}$$

where the Euclidean $\mathrm{d}l^{*2}$ stands for $\mathrm{d}x^{*2} + \mathrm{d}y^{*2} + \mathrm{d}z^{*2}$ (or equivalent forms), and an asterisk '*' always means universal quantities. These are 'conformal' time t^* – where $t^* = t^*_{\mathrm{R}} = 0$ may stand for today – and 'comoving' distance l^* (or 'comoving' space $\vec{r}^{\,*}$). It is of importance that all system coordinates of general relativity can be understood as representatives of a quasi-Newtonian mathematical space and time (Ostermann 2002, 2003b), which may be found by arbitrary coordinate transformations from the universal frame, the latter respectively used and spatially determined according to the SUM line element.

A fundamental clearance based on Poincaré's considerations – accepted in *'Geometrie und Erfahrung'* by Einstein (1921) himself – has shown non-Euclidean geometry as a mathematical tool to handle affectable 'proper' rods and clocks. This approach seems to offer a solution in principle of two main problems of 20th century physics [explicitly addressed in Section 2.10].

Therefore, 'curvature', 'flatness', or 'line element' do not necessarily mean real properties of any physical space and time, but rather catchwords for effects of gravitation and universal motion on measuring rods, clocks and on all other tangible objects of physical reality. Now that the legitimacy has been explicitly shown (Ostermann 2013b), to understand spatial 'curvature' a gravitational effect on measuring rods instead on mathematical space, the latter therefore can be taken Euclidean at all events. Accordingly, in SUM the universal coordinates are understood to be a special representation of what is called 'system coordinates' in GR.

On the other hand, to understand the concepts of 'proper' length and 'proper' time as cool as possible – in fact without any loss of physical content – it is sufficient to accept the existence of a 'preferred' universal frame (s. Section 2.10). This is not only possible, but in view of various well-known observations physically realistic.

Evidently (1) is the simplest conceivable extension leading from special to general relativity theory, which is accounting for a non-empty homogeneous and isotropic multiverse. The constant universal coordinate speed of light

$$c^* \equiv \frac{\mathrm{d}l^*}{\mathrm{d}t^*} = c\,, \tag{2}$$

resulting from $\mathrm{d}\sigma^*_{\mathrm{SUM}} = 0$, would not be given in any form other than (1), which in contrast to the overstrained FLRW form turns out to be of unexpected physical relevance. In addition, dealing with universal distances, the assignment $c^* = c$ is most convenient for a complete mathematical treatment. With the stationary time scalar

$$\zeta^*_{\mathrm{SUM}} = \mathrm{e}^{Ht*} \tag{3}$$

the SUM line element is fixed now where H a macroscopic constant. In comparison to other 'conformal' line elements, the difference is made in that the assignment above excludes any 'horizon' of the background multiverse. Although this mean time scalar (3) is formally equal to the well-known SST scale factor $a_{\mathrm{SST}}(t') = \mathrm{e}^{Ht'}$, it means completely different physics. This is clear from a simple transformation since the conformal SST time scalar would be $\zeta'_{\mathrm{SST}} = 1/(1 \pm Ht')$ instead of (3).

Finally the stationary universal line element (1), (3) may be written as

$$\mathrm{d}\sigma^*_{\mathrm{SUM}} = \mathrm{e}^{Ht^*}\mathrm{d}\sigma^*_{\mathrm{SR}} \;. \tag{4}$$

Here, however, the expression $\mathrm{d}\sigma^*_{\mathrm{SR}}$ is different from the usual line element $\mathrm{d}\sigma_{\mathrm{SR}}$ of special relativity in that the elements of local proper time and local proper length ($\mathrm{d}t_{\mathrm{SR}}$, $\mathrm{d}l_{\mathrm{SR}}$) have to be replaced by elements of universal coordinates ($\mathrm{d}t^*$, $\mathrm{d}l^*$). In contrast to the first, the latter ones are not directly displayed by atomic clocks or spectral rods except within limited local regions of space and time. In particular the line element (4) shows the obvious transition from SR to SUM as a key to the new cosmological model.

Because of the exponential mean time scalar (3), all corresponding relative temporal changes depend on differences $\Delta t^* = t^* - t^*_R$ solely, where t^*_R is a respective reference point of universal time. Therefore no special fixation of that time scale is preferred. This fundamental feature allows to set $t^*_R = 0$ for arbitrary complexes of observation.

If one had started without explicitly using the above postulates but axiomatically placing (4) as evidently the most natural ansatz for a cosmological line element of GR with a non vanishing Einstein tensor, one would have directly presupposed SR as respective temporary approximation in the neighborhood of any arbitrarily chosen reference point of universal time.

As an extension of relation (4), there might apply an embedded line element

$$\mathrm{d}\tilde{\sigma}^*_{\mathrm{SUM}} = \mathrm{e}^{\tilde{H}(t^*,\vec{r}^*)t^*}\mathrm{d}\sigma^*_{\mathrm{GR}} \,, \tag{5}$$

where in general $\mathrm{d}\sigma^*_{\mathrm{GR}}$ is determined outside of matter by Einstein's original equations, thus approximating or even equaling $\mathrm{d}\sigma^*_{\mathrm{SR}}$ far from local inhomogeneities again. With the mean value $H^2 \equiv \overline{H^2(t^*,\vec{r}^*)}$, relation (5) averaged over universal scales of space and time yields (4) again. Where not otherwise explicitly stated there will be used the mean Hubble constant H throughout this paper except for particularly Section 3.3.

2.2. *Motion and free particles at rest in the background multiverse*

It is necessary to verify the basic assumption that the stationary line element (4) is compatible with a constant average distribution of matter and energy. Therefore, the relativistic equations of motion will be solved here for free particles (with coordinates X^{*i} and velocities U^{*i}) in the gravitational background field. The result confirms an ultralarge scale multiverse statistically at rest. The solution is deduced from

$$\delta \int \mathrm{d}\sigma^*_{\mathrm{SUM}} = 0 \,, \tag{6}$$

which action principle is called Einstein's 'geodesic' law. The equations of gravitational motion resulting from (6) are directly associated to Einstein's equivalence principle. In addition, as is well-known, the derivation from the phenomenological kinetic energy-momentum tensor

$$\mathbf{K}^{*k}_{Ni} = \boldsymbol{\mu}^*_N c^2 U^*_i U^{*k} \,, \tag{7}$$

where the individual index 'N' may refer to a corresponding number density n, applies to the motion of any particle in the gravitational field given by all others. Bold non-italic symbols like $\mathbf{K}^{*k}_{Ni} \equiv \sqrt{g^*}K^{*k}_{Ni}$ or $\boldsymbol{\mu}^*_N \equiv \sqrt{g^*}\mu^*_N$ always include the square root of the negative determinant of the fundamental tensor as a prefixed factor, where $\sqrt{g^*_{\mathrm{SUM}}} = \mathrm{e}^{4Ht^*}$. From $E^k_i = \kappa_{\mathrm{E}} K^k_i$, the contracted Bianchi identities $E^{*k}_{i;k} \equiv 0$ yield

$$\partial^*_k \mathbf{K}^{*k}_{Ni} = \frac{1}{2}\mathbf{K}^{*kl}_N \partial^*_i g^{*\mathrm{SUM}}_{kl} \,, \tag{8}$$

where ∂^*_i stands for $\partial/\partial X^{*i}$. This equation obviously results in the explicit form

$$\frac{\mathrm{d}U^*_i}{\mathrm{d}\sigma^*_{\mathrm{SUM}}} = \frac{1}{2}U^{*k}U^{*l}\partial^*_i g^{*\mathrm{SUM}}_{kl} \,, \tag{9}$$

if a conservation of rest mass according to the continuity equation

$$\partial^*_k \left(\boldsymbol{\mu}^*_N c^2 U^{*k}\right) = 0 \,, \tag{10}$$

is fulfilled. Except for collision processes, this applies to the motion of test particles in any external field.

Actually, the variation of (6) with respect to the stationary universal line element (4) yields as solutions of (9) the temporal component of the universal four-velocity

$$U^{*0} \equiv \frac{c\mathrm{d}t^*}{\mathrm{d}\sigma^*_{\mathrm{SUM}}} = \mathrm{e}^{-Ht^*}\sqrt{1 + U^{*2}_{(0)}\mathbf{e}^{-2Ht^*}} \,, \tag{11}$$

and the spatial components

$$U^{*\alpha} \equiv \frac{\mathrm{d}X^{*\alpha}}{\mathrm{d}\sigma^*_{\mathrm{SUM}}} = U^{*\alpha}_{(0)}\mathrm{e}^{-2Ht^*} \,, \tag{12}$$

where $U^{*2}_{(0)} \equiv \Sigma\left[U^{*\alpha}_{(0)}\right]^2$ (here $\alpha = 1,2,3$). Obviously the integration constants $U^{*\alpha}_{(0)}$ are the initial values of the spatial components at time $t^* = 0$. From this simple calculation the components of the ordinary spatial velocity referring to universal coordinates are $V^{*\alpha} \equiv \mathrm{d}X^{*\alpha}/\mathrm{d}t^*$. Corresponding velocities of free objects, given by

$$\frac{V^{*\alpha}}{c} \equiv \frac{U^{*\alpha}}{U^{*0}} = \frac{U^{*\alpha}_{(0)}\mathrm{e}^{-Ht^*}}{\sqrt{1+U^{*2}_{(0)}\mathrm{e}^{-2Ht^*}}}\,, \tag{13}$$

which in case of massive particles may be regarded as deviations from the state of statistical rest, will obviously decrease with time.

It has to be pointed out that the 4-velocities $U^{*i} = U^{*i}(X^{*i})$ are related to discrete cosmic objects like galaxies or clusters in contrast to $u^{*i} = u^{*i}(x^{*i})$ of an idealized medium like a perfect fluid. The transition should occur by spatial integration of the respective densities, which would apply as δ-functions where necessary.

Only for zero-rest-mass particles like photons where because of $\mathrm{d}\sigma^*_{\mathrm{SUM}} \to 0$ relation (12) implies $U^{*\alpha}_{(0)} \to \infty$, a constant velocity $|V^{*\alpha}| = c$ results for the universal speed of light directly. On the other hand, for all particles of non-vanishing rest masses like in particular neutrinos this apparently means a deceleration with respect to universal coordinates. Therefore even in intergalactic space also a freely falling inertial frame would not keep on moving uniformly with respect to these coordinates. This again implies that there is no physical situation where SR can be valid otherwise than locally, and thus approximately only.

In any case the result (13) supports the feature of galaxies statistically at rest in universal Euclidean space. This even applies to long-term averages of peculiar motions like that of objects bound in clusters. The special solution describing this situation is

$$\bar{V}^{*\alpha} = 0\,, \tag{14}$$

where – as an exception – here a bar means averaging over time. Accordingly, in the SUM framework there is no need for the usually established concept of universal 'expansion', unnecessarily presupposing the universal coordinate frame to be 'comoving'.

The results (11), (14) then also show one non-vanishing component of the mean four-velocity $\bar{U}^{*i} = (\bar{U}^{*0}, 0, 0, 0)$, which is

$$\bar{U}^{*0} = \mathrm{e}^{-Ht^*} = \frac{1}{\bar{U}^*_0}\,, \tag{15}$$

implying a universal accelerating time rate of atomic clocks at rest which in particular is causing the universal redshift without universal expansion other than locally.

How an object leaving a Schwarzschild region may turn continuously to the universal motion as derived here is discussed in SUM14 (section 2.11) together with a corresponding modification of Galileo's law of inertia.

Now, given the stationary line element (4), relation (10) yields in case of free particles at rest

$$\mu^*_{\mathrm{N}} = \mu^{const}_{\mathrm{N}}\mathrm{e}^{-3Ht^*}\,, \tag{16}$$

where evidently

$$\mu^{const}_{\mathrm{N}} = \frac{\mathrm{d}m_N}{\mathrm{d}V^*} \tag{17}$$

Accordingly the rest mass δm_N of such a 'particle' is constant, whether taking it from the universal volume δV^* or from the local proper volume $\delta V = \delta V^* \mathrm{e}^{3Ht^*}$ due to

$$\delta m^{const}_{\mathrm{N}} = \mu^{const}_{\mathrm{N}}\delta V^* = \mu^*_{\mathrm{N}}\delta V\,, \tag{18}$$

This result of constant mean rest masses is in accordance with the stationarity of the universal matter-energy distribution. Though with regard to an energy exchange by radiation or collision processes, individual universal objects would not obey a rest mass conservation law, there seems to be an overall statistical equilibrium (s. Section 5.3 in addition).

In any case, since the statistically averaged number density of 'particles' is presupposed to be independent of time with respect to universal (allegedly 'comoving') coordinates, now together with the constant rest masses stated here, also the mean SUM matter density turns out to be independent of time.

2.3. *Stationary energy density and a negative gravitational pressure*

The exact contravariant Einstein tensor density resulting from the stationary universal line element is

$$\mathbf{E}^{*ik} = \frac{3H^2}{c^2}\mathrm{diag}\left(1, -\frac{1}{3}, -\frac{1}{3} - \frac{1}{3}\right)\,, \tag{19}$$

which in spite of the time scalar e^{Ht^*} in (4) is independent of time. Thus Einstein's equations may be written in an obviously consistent local SR form

$$E^*_{ik} = \begin{pmatrix} \frac{2H^2}{c^2} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} - \kappa_{\mathrm{E}}\, p^* \eta^*_{ik} = \kappa_{\mathrm{E}} T^*_{ik}\,. \tag{20}$$

This equals the original covariant Einstein tensor without cosmological constant Λ, and thus the corresponding stationary energy-stress tensor T^*_{ik} too. Both are completely independent of time, what also applies to their contravariant tensor densities $\mathbf{E}^{*ik}$ and $\mathbf{T}^{*ik}$ straightforwardly. In addition it may be mentioned in this context that Einstein's 'geodesic' law of motion does not only result as usual from the mixed form $T^k_{i;k} = 0$ but from the contracted Bianchi identities $T^{ik}_{;k} = 0$, too, where the last would include the constant tensor density $\mathbf{T}^{*ik}$ twice.

According to (20) the stationary model is demanding a negative gravitational 'dark' pressure $p^* = -\varepsilon_c/3$ of matter statistically at rest, where $\varepsilon_c = 3H^2/(\kappa_E c^2)$ equals the critical energy density (obviously, in this view $p*$ corresponds temporarily to something like a cosmological 'constant'). To state it explicitly, this stationary gravitational pressure $p*$ *must* be negative (Ostermann 2003b) because:

Let a subvolume of a large hall, which is filled with ordinary dust, be separated in a box. Since the situation in the box will stay the same after all matter outside the box is removed, this implies a positive pressure of the dust because the walls of the box are exerting a force inwards to bar the dust from diffusion. Now in contrast, consider a separate subvolume of a stationary multiverse including a plenty of galaxy clusters without peculiar velocities. *Then there must be a negative pressure equivalent to hypothetical walls which in this case had to pull* outwards, *to prevent the homogenous distribution of clusters inside from massing together due to their mutual attraction, after those outside had been fictively removed.*

To apply Einstein's equations according to the conventional perfect fluid treatment, one may define two other scalars

$$\mu^*_F c^2 = \frac{2}{3}\varepsilon_c e^{-2Ht^*}\,, \tag{21}$$

$$p^*_F = -\frac{1}{3}\varepsilon_c e^{-2Ht^*} \tag{22}$$

in addition to the particle quantity μ^*_N given by (16) and the constant pressure $p* = -\varepsilon_c/3$ above. Then the usual form of T^*_{ik} in (20) looks like the well-known phenomenological energy-momentum-stress (EMS) tensor

$$P^*_{ik} \equiv \mu^*_F c^2 u^*_i u^*_k - p^*_F g_{ik}\,. \tag{23}$$

Note that inserting $p^*_F = 0$ into (23), however, the corresponding mixed tensor ${P_i^{*k}}_{(p^*_F=0)}$ is not the same as K^{*k}_{Ni} of (7), because the first one is that of an idealized 'perfect-fluid', whereas the second one is that of a universal distribution of 'particles' in their mutual gravitational field. That the latter is the appropriate representation reflecting stationarity has been already shown in the previous section. Now both, the covariant EMS tensor T_{ik} of matter as well as its contravariant density $\mathbf{T}^{ik}$, are constant, what – taken together with galaxies statistically at rest – coincides with the conservation of universal mass-energy.

Even using $P^{*ik} = g^{il}g^{km}P^*_{lm}$ according to (23) it is possible to verify once more the equilibrium of the universal matter-energy distribution derived from Einstein's 'geodesic' equations above. Though, in case of a fluid with non-vanishing variable pressure p^*_F, the 'geodesic' equations of motion corresponding to (9) can only apply to each of its elements for a special kind of 'free fall' where – writing $\partial^i \equiv g^{ik}\partial_k$ – it is

$$c^2 u^i \partial_k \left(\boldsymbol{\mu}_F u^k\right) = \sqrt{g}\partial^i p_F\,. \tag{24}$$

A conclusion from μ^*_F instead of μ^*_N on rest masses of 'particles', however, is impossible since (24) shows that no continuity equation of matter is valid there. Thus, though galaxies or clusters may be regarded as 'particles' in the universal gravitational field, this does not apply to arbitrary parts of the ultralarge scale matter-energy distribution described by a perfect fluid tensor P^*_{ik}. Nevertheless, evaluating (24) in case of SUM, this relation is fulfilled taking into account (21), (22) and $u^{*0} = e^{-Ht^*} = 1/u^*_0$ corresponding to (15) directly.

Independent of questions caused by the traditional assignment (23), now in particular with the constant number density of universal objects given in 'comoving' coordinates, the rest mass conservation stated in the previous section does not only apply to microscopic particles but also to gravitationally bound systems up to galaxies or even clusters. Therefore – regarding those structures statistically at rest – this means a conservation of universal mass-energy, too, thus corresponding to the evidently stationary covariant energy-stress tensor (20) or its contravariant density immediately. The conventional perfect-fluid interpretation based on the time-dependent mixed tensor T^k_i, however, might together with Rosen's bi-tensor ${}_{(\mathrm{bi})}t^k_i$ of the gravitational field (Rosen 1940, 1963) account for 'local' processes of emergence and disappearance instead.

2.4. *The inapplicability of universal proper length and the non-existence of universal proper time*

Natural atomic clocks do not continuously tick intervals of universal time dt^* but intervals of local 'proper' time again and again. Correspondingly, natural rods do not always and everywhere show constant intervals of universal length dl^*. In contrast, their local realizations have approximately to fulfill

$$d\sigma^{*2}_{SR} \stackrel{!}{\approx} e^{2Ht^*}\left\{c^2 dt^{*2} - dl^{*2}\right\}\,. \tag{25}$$

Using atomic clocks and spectral rods, the intervals of proper time and length are directly measurable only within sufficiently small regions, which are local with respect to universal space and to universal time. Thus these intervals are defined always together according to the line element of SR

$$\mathrm{d}\sigma_{\mathrm{SR}}^2 = c^2\mathrm{d}t_{\mathrm{SR}}^2 - \mathrm{d}l_{\mathrm{SR}}^2 \tag{26}$$

in local inertial frames. There, to avoid unnecessary assumptions, it is always sufficient to understand 'proper time' as a display of atomic clocks, and 'proper length' as a number of spectral unit sticks, both correspondingly affected by gravitational potential and universal motion.

Now, comparing the SR approximation (25) of the universal line element (1) on the one hand with that of local SR within freely falling inertial frames (26) on the other hand, this immediately leads to fundamental relations between elements of universal coordinates ($\mathrm{d}t^*$, $\mathrm{d}l^*$) and local 'proper' coordinates ($\mathrm{d}t_{\mathrm{SR}}$, $\mathrm{d}l_{\mathrm{SR}}$). Thus according to (4), atomic clocks at rest (always with respect to the universal coordinate frame) show increasing intervals of local proper time $\mathrm{d}t_{\mathrm{SR}}$ and local proper length $\mathrm{d}l_{\mathrm{SR}}$, both displayed as

$$\mathrm{d}t_{\mathrm{SR}} \approx \mathbf{e}^{Ht^*}\mathrm{d}t^* \,, \tag{27}$$

$$\mathrm{d}l_{\mathrm{SR}} \approx \mathbf{e}^{Ht^*}\mathrm{d}l^* \,. \tag{28}$$

Here relation (27) corresponds exactly to (15) above. Where furthermore according to relation (5) deviations from the mean Hubble constant H have to be taken into account, its value will be respectively replaced by $\tilde{H} \equiv \tilde{H}(t^*, \vec{r}^*)$.

In any case relations (27), (28) imply a crucial non-integrability of proper length and time which is obvious from the fact that it is simply impossible to write down a line element for a non-empty multiverse only using *both* 'proper' coordinate elements ($\mathrm{d}t_{\mathrm{SR}}$, $\mathrm{d}l_{\mathrm{SR}}$) exactly. Therefore the approximate symbol '$\approx$' (and not an equal sign '$=$') has to be used here due to limited SR applicability (s. also Section 2.7).

In view of the non-existence of any fixed zero point t_R^* of the universal time t^*, though, there must be a self-restoring validity of SR within local inertial frames. This is in accordance with processes which – in e.g. freely falling space labs with varying relative velocities – cannot continuously stay strictly compatible to SR. In contrast, deviations from an idealized SR behavior actually increase with time. To give the impression of an uninterrupted macroscopic validity, it seems sufficient that SR is strictly valid for each process connecting two *local* quantum leaps – in particular e.g. between emission and absorption of photons underway in a Michelson interferometer – while a comparison of photons emitted and absorbed in different galaxies need a description by *universal* GR. Any quantum leaps may imply an appropriate adaption of involved proper quantities to restore local SR again and again.[1]

According to the equivalence principle there exists an approximate realization of the SR line element (26) within local inertial frames. From (27), (28) the system S' of *integrated* coordinates ($r', T' \equiv 1/H + t'$), implicitly given by

$$t^* \equiv \frac{\ln(HT')}{H}, \; r^* \equiv \frac{r'}{HT'} \,, \tag{29}$$

transform the stationary line element (4) approximately into that of SR

$$\mathrm{d}\sigma'^2 = \left[1 - \left(\frac{r*}{R_{\mathrm{H}}}\right)^2\right] c^2\mathrm{d}T'^2 + 2\left(\frac{r*}{R_{\mathrm{H}}}\right) c\mathrm{d}T'\mathrm{d}r' - \mathrm{d}l'^2 \,, \tag{30}$$

where $\mathrm{d}l'2 = \mathrm{d}r'^2 + r'^2\mathrm{d}\Sigma'^2$ with $\mathrm{d}\Sigma'$ the element of a Euclidean spherical surface. It is of decisive importance to see from (30) that in comparison to (26) the obvious condition

$$r^* \overset{!}{<} R_H \,, \tag{31}$$

with $R_H \equiv c/H$ the Hubble radius, is setting an uppermost limit for the validity of any approximate SR concepts and processes transferred to cosmology. It seems even probable that more realistic limitations should be set by $r^* \ll R_H$, thus possibly indicating the extensions of galaxies, clusters, or Lyman-α blobs as those of local 'cosmoses', if appropriate.

Therefore the integrated time $T' \equiv T_H + t'$ with $T_H \equiv 1/H$ as a quasi-Minkowskian coordinate approximation to a *local* proper-time integral t_{SR} is not suitable to hold at and beyond coherent universal distances $r^* \approx R_H$. In particular, the coordinate time T' of any FLRW-form cannot be a uniform proper time all over the multiverse. Proper time is always given within *local* cosmic areas only, limited to extensions described by relation (31) above.

On the other hand, since no universal coordinate origin is preferred there will be many 'locally' coherent re-

[1] Such a feature does not at all seem impossible. Apparently related to the well-known phenomenon called 'reduction of wave packets', GR may apply that way to the multiverse in processes where QM is essentially involved. While in quantum leaps various physical possibilities are reduced to one single respective reality, there is an analogy in the self-restoring aspects of SR. Therefore the description of physical reality by both RT and QM might be effectively 'quantized' itself, thus corresponding to a sequence of single snapshots making a movie.

gions where the special-relativistic concepts of proper length and proper time approximately apply. This is the mathematical reason why SUM is describing an 'eternal multiverse of suggested local bangs', a concept in striking contrast to the historically accepted singular big-bang event so far.

The condition $T' \overset{!}{>} 0$, obvious from (29), means that no local structures should be older than $T_H \equiv 1/H$ with respect to their local pseudo-proper time t'. Thus by no means the quantity T_H has to be the age of the entire universe.

Particularly the overinterpreted SR-based 'big bang' concept seems limited to local regions of gravitational creation. Such regions may be spread all over a stationary multiverse, where the material components are determined by the requirement that they are recreated in extreme gravitational centers – grown to hot 'local-bang' events – according to the laws of quantum physics at the same rates as they have disappeared before. This means that, even restricted to such local events, the material components of a stationary multiverse would exist at rates approximately calculated from the 'big bang' model so far.

2.5. *Constant values of redshift without universal expansion*

Only as long as the redshift of galaxies is understood to originate from an increase of real distances, this seems to imply a peculiar history of the entire universe. An alleged Doppler effect underlying this hypothesis, however, is questionable as already considered by Hubble (1929) himself. Above all, the concept of universal expansion (particularly where superluminal) inevitably would mean a 'schism of consistent physics' because of two different velocities between same physical objects and the respective particles. The historical concept needs explanations to answer the simple question of one actual physical velocity of e.g. the Andromeda galaxy mass center, because there had to be *two* summands (one due to 'peculiar' motion plus one due to the unnecessarily assumed 'Hubble flow'). The mathematical assertion that expanding 'space' gives the impression of relative motion is physically an unnecessary fiction.

Ordinary gravitational redshift in local fields, found by Einstein as another previously unknown effect before, has certainly nothing to do with any mysterious expansion. Correspondingly the redshift of starlight from extragalactic objects can be interpreted as a particular extension of ordinary redshift to the gravitational 'potential' e^{Ht^*} of the *stationary* universe. The argumentation is exactly the same which has led to (27), (28) above. Keeping this in perspective, there is no need for a universal expansion, though a quasi-Doppler interpretation has been suggestive because time is involved. In fact, all cosmological solutions since Friedman(n)'s work are not static of course. Nevertheless one of them seems to be stationary after all.

Starting from the assumption that – as verified by the special solution (14) in Section 2.2 – galaxies are statistically at rest with respect to universal coordinates, the redshift, as defined by

$$z \equiv \frac{\lambda_{\mathrm{A}}}{\lambda_{\mathrm{E}}} - 1\,, \tag{32}$$

is calculated in complete analogy to the well-known gravitational redshift in local fields, where the indices 'E' and 'A' mean emission or absorption respectively.

As usual, consider the crest of a light wave emitted at universal time t^*_{E} anywhere at a distance l^* in Euclidean (allegedly 'comoving') space, and then arriving at universal time t^*_{A}. The following crest, emitted at the same place as before but at time $t^*_{\mathrm{E}}+\delta t^*$, will arrive at $t^*_{\mathrm{A}}+\delta t^*$ because of the constant universal speed $c^* = c$ of light. This means that the interval δt^* – which is nothing but the oscillation period of propagating starlight with respect to universal time t^* – has been transported and kept unchanged over an intergalactic distance $l^* = c\Delta t^*$, where $\Delta t* \equiv t^*_{\mathrm{A}} - t^*_{\mathrm{E}}$.

On the other hand, a proper time interval $\delta t_{\mathrm{SR}} \equiv \tau$ of a natural atomic clock at rest is related to the corresponding interval δt^* of universal time according to (27). Hence at the time t^*_{E} of emission and at the time t^*_{A} of arrival, the corresponding proper time intervals are

$$\tau_{\mathrm{A}} = \delta t^* \mathbf{e}^{\tilde{H}_{\mathrm{A}} t^*_{\mathrm{A}}} \tag{33}$$

$$\tau_{\mathrm{E}} = \delta t^* \mathbf{e}^{\tilde{H}_{\mathrm{E}} t^*_{\mathrm{E}}} \tag{34}$$

where

$$\tilde{H}_{\mathrm{E}} \equiv \tilde{H}\left(t^*_{\mathrm{A}} - \frac{|\vec{r}^{\,*}_{\mathrm{E}} - \vec{r}^{\,*}_{\mathrm{A}}|}{c}, \vec{r}^{\,*}_{\mathrm{E}}\right). \tag{35}$$

With regard to relation $\lambda = c\tau$ for wavelength and period of light, and setting

$$t^*_{\mathrm{A}} = 0,\ \vec{r}^{\,*}_{\mathrm{A}} = 0 \tag{36}$$

due to arbitrarily choosable coordinate origin and reference point of universal time, it follows immediately that the corresponding intervals of proper length and time will be different in a proportion

$$\frac{\lambda_{\mathrm{A}}}{\lambda_{\mathrm{E}}} = \frac{\tau_{\mathrm{A}}}{\tau_{\mathrm{E}}} = \mathbf{e}^{\tilde{H}_{\mathrm{E}} \Delta t^*} = 1 + \tilde{z}\,, \tag{37}$$

where because of the constant universal speed of light

$$\Delta t^* = l^*/c \tag{38}$$

is just the positive transit time of extragalactic light. So far, τ_{E} in (37) is only the proper time interval at the universal time t^*_{E} of emission whereas τ_{A} is a proper time interval at the universal time t^*_{A} of absorption. But the actual question is to compare the oscillation period τ_{A} with the oscillation period τ_0 of new spectral radiation of same type, when both are emitted at place and time of absorption.

It is obvious, however, that with respect to local proper time the oscillation period of one particular spectral line will be $\tau_{\mathrm{E}} = \tau_0$ again and again, which is a constant at place and time of its origin. This is a direct consequence of Einstein's equivalence principle. If using natural atomic clocks, the same statement would be a mere tautology, because the design of those clocks is just based on this constancy.

Since measuring means comparing, the common constant factor $\mathrm{e}^{Ht^*_R}$ which would explicitly appear in numerator and denominator of (37) cancels out. Displayed on clocks is respectively always only a number, i.e. the *quotient* of measured natural quantities and corresponding local natural units. These are changed at the same rate.

Now, neglecting inhomogeneities associated to local Hubble contrasts and inserting the 'infinitesimal' wavelengths $\lambda_{\mathrm{A/E}} = c\tau_{\mathrm{A/E}}$ according to (37) into (32), any mean redshift parameter z is found completely independent of time for starlight emitted from sources at rest:

$$z = \mathbf{e}^{Hl^*/c} - 1 \quad \Leftrightarrow \quad l^* = \frac{c}{H}\ln(1+z)\,, \tag{39}$$

where $l^* = c\Delta t^*$ is the covered universal distance. Obviously, this result does not depend on single absolute values t^*_{E} or t^*_{A} of universal time, but only on their positive difference Δt^* and the constant H. This is one more detailed example fulfilling the postulate of stationarity, because after having inserted $t^*_{\mathrm{A}} = t^*_{\mathrm{R}}$ and $t^*_{\mathrm{E}} = t^*_{\mathrm{R}} - \Delta t^*$ into (33), (34) the physical results (37), (38) prove the non-occurrence of the arbitrary reference time t^*_{R} directly.

Therefore, to get a simple explanation for the redshift of galaxies it is sufficient to make the difference between local proper intervals (δt_{SR}, δl_{SR}), and universal intervals (δt^*, δt^*) according to (27), (28). Not only the redshift, but also the corresponding time dilation is clearly confirmed in particular by the SNe-Ia measurements quoted in Section 3 below.

With the Hubble law (39) applying to galaxies statistically at rest, i. e. $l^* =$ constant relative to the isotropic background (or also to the CMB if in a common state everywhere), here is a contradiction to the traditional understanding of supposedly meaningless system coordinates of GR. The reason is that in addition to a local 'proper' length Δl_{SR}, any universal quantity l^* is actually a real physical distance measure by time-independent mean values of z according to (39).

The most rational conclusion is that apart from the historical view, there are neither any reproducible facts nor any testable physical reasons which make a model of receding galaxies necessary for cosmology. In particular, the universal redshift of galaxies as the fundamental observational fact of cosmology is found independent of time (except for peculiar motions). Consequently, this feature applies to all other quantities which are functions of z too, like the apparent magnitudes of Supernovae-Ia (SNe) used as standard candles. Naturally it applies also to the Hubble constant H in the SUM framework itself.

Now, from the quantum mechanical energy-frequency relation for photons – but also deducible from classical electrodynamics in GR – and with

$$\nu_{\mathrm{E}} \equiv \nu_{\mathrm{A}}(1+z) \tag{40}$$

according to (32), the extended form (39) of Hubble's originally linear law shows that the redshift also applies to photon energies as

$$\delta\varepsilon_{\mathrm{A}} = \delta\varepsilon_{\mathrm{E}}\mathbf{e}^{-Hl^*/c}\,. \tag{41}$$

Re-substituting l^* by $c\Delta t^*$ here, the cosmic redshift apparently requires the energy of free photons to decrease with universal time relative to local absorbers. Such a time-dependent energy loss of free photons might look like a violation of an overall energy conservation, but given a stationary multiverse, with respect to sufficiently large scales it is not. In this case, with statistically constant values of l^*, relation (41) may be understood a *stationary* energy loss affecting the whole of free photons respectively. Its mathematical form is exactly that of the familiar law of ordinary attenuation, what includes the hypothetical absorption once assumed by Olbers (1823) in a proposal to solve his famous paradox (thus the beginning of modern cosmology). The main objection made against Olbers' hypothesis has been taken up in the SUM framework (SUM14/2.8) and seems to be finally disproved in Section 5.3. In spite of the energy loss stated in (41) SUM is, due to the time dilation according to (27), measurably different from Zwicky's historical 'tired light' approach.

Altogether, with respect to universal coordinates now measurable by their constant redshift parameters except for peculiar motions or any processes of re-formation, galaxies as well as other universal objects statistically stay where they are. This fundamental feature is in accordance with time independence of the Hubble constant again.

2.6. *The stationary magnitude-redshift relation*

Given a universal object (U) of absolute radiation power L^*_{U} at a constant distance r^* with respect to universal coordinates, the SUM implies the apparent luminosity

$$I^*_{\mathrm{U}} = \frac{L^*_{\mathrm{U}}}{4\pi r^{*2}} \mathrm{e}^{-(2+\kappa)\frac{r^*}{R_H}} , \tag{42}$$

which is the bolometric intensity of the radiation observed per square unit, and locally measured per unit of proper time. Here from the redshift relation (39) a first factor $\mathrm{e}^{-r^*/R_H} = 1/(1+z)$ results as usual by application of the quantum mechanical energy-frequency relation of photons equivalent to (41), and a second factor e^{-r^*/R_H} from the relative dilation in comparison with the local proper time of the measuring device. Furthermore, taking into account possible effects of attenuation like extinction, absorption, scattering, or obscuring, there is a corresponding coefficient κ in (42) which is set constant here (though applying to spectral distributions it may be taken a function of frequency if necessary).

Obviously κ/R_H corresponds to the reciprocal of a mean free path of the respective radiation. Inserting

$$r^* = R_H \ln(1+z) \tag{43}$$

taken from (39) leads to

$$I^*_{\mathrm{U}}(z) = \frac{L^*_{\mathrm{U}}}{4\pi R_H^2}\Big[(1+z)^{1+\frac{\kappa}{2}} \ln(1+z)\Big]^{-2} . \tag{44}$$

To compare the result (44) with the SNe-Ia magnitude-redshift data directly, it has to be converted to the distance modulus

$$\mu \equiv m - M = 5\log\left(\frac{d^*_{\mathrm{L}}}{\mathrm{Mpc}}\right) + 25 , \tag{45}$$

where m is the apparent magnitude, M represents an appropriate value for the absolute standard brightness of e.g. SNe Ia, and d^*_L is the luminosity distance, here

$$d^*_{\mathrm{L}} \equiv \sqrt{\frac{L^*_{\mathrm{U}}}{4\pi I^*_{\mathrm{U}}}} = r^*(1+z)\mathrm{e}^{\frac{\kappa}{2}r^*/R_H} , \tag{46}$$

which then may be written as a pure function of redshift

$$d^*_{\mathrm{L}}(z) = R_H (1+z)^{1+\frac{\kappa}{2}} \ln(1+z) . \tag{47}$$

Inserting this into (45) yields the stationary magnitude-redshift relation

$$\mu_{\mathrm{SUM}} = 5\log\Big[(1+z)^{1+\frac{\kappa}{2}} \ln(1+z)\Big] + 25 + 5\log\left(\frac{c/H}{\mathrm{Mpc}}\right) \tag{48}$$

Since for sources at rest in universal coordinates the redshift parameters z are independent of time, so are the magnitudes and all other quantities, which are functions of z. It is relation (48) for the distance modulus which will be shown in Section 3 to fit the SNe-Ia magnitude-redshift observations on universal scales $z > 0.1$ with no need for any universal expansion or 'dark energy'.

For each cosmological model in question, particularly the distance modulus is of fundamental interest, since it establishes a 'clean' relation between the directly measurable values of apparent magnitudes and their redshift parameters. In contrast to today's 'dark' interpretation this relation is uncontaminated by cosmological priors of a 'big bang'. It is also remarkable, that the SNe-Ia data do not show any significant cosmic evolution, thus indicating a stationary validity of local physics again.

2.7. *The misleading FLRW form concealing the SUM solution for a lively multiverse*

The varied genesis of GR may have been the reason that Einstein's insight into the non-integrability of proper length and proper time – in a debate with Abraham (Einstein 1912a,b,c) – apparently passed into oblivion.

In contrast to Section 2.4 retaining the universal distance r^* and only transforming half-heartedly the universal time t^*, this procedure would have resulted in a misleading Friedman(n)-Lemaître-Robertson-Walker (FLRW) form. Thus, to directly compare the stationary SUM line element with today's Cosmological Concordance Model (CCM), it is particularly instructive now to rewrite (1) traceably in such a traditional FLRW form which – given spatial flatness and keeping $l^{*\alpha}$ the universal coordinates – may be written as

$$\mathrm{d}\sigma'^2_{\mathrm{FLRW}} = c^2\mathrm{d}t'^2 - a^2\mathrm{d}l^{*2} , \tag{49}$$

where $a \equiv a(t')$ is the general FLRW scale factor. Obviously t' is the FLRW coordinate time which will be referred to as the *integrated coordinate time*, since it is given by direct integration of (27) after having replaced $\mathrm{d}t_{\mathrm{SR}}$ by $\mathrm{d}t'$ and the sign '≈' by '='. The latter replacements are necessary because the local intervals of proper time $\mathrm{d}t_{\mathrm{SR}}$ and proper length $\mathrm{d}l_{\mathrm{SR}}$ are not integrable without changing their respective character (hereafter indicated by an inverted comma like in t'). The integrable FLRW time t', though, cannot be understood as a valid 'cosmic proper time', otherwise the expression $a^2 \mathrm{d}l^{*2}$ of (49) had to be identical to $\mathrm{d}l^2_{\mathrm{SR}}$. If, however, in the locally valid relation

$$\mathrm{d}l_{\mathrm{SR}} \approx a \mathrm{d}l^* \,, \tag{50}$$

an equal sign '=' was used instead of the approximate sign, the whole relation (49) would be nothing but the line element of SR itself – whose Riemann, Ricci, or Einstein tensors and therefore the entire universal mass energy density would vanish to zero.

As consequences of this necessary distinction there are intrinsic limitations of proper length and proper time. Because of the non-integrability, already stated in Section 2.4, it is

$$l' \not\equiv a l^* \tag{51}$$

contrary to a naive overstrained interpretation of (50). In particular there is no unlimited increasing universal 'proper' distance l'.

Now a determination of the stationary scale factor a_{SUM} can be done by a simple transformation of the universal time t^* to the integrated pseudo-proper time t' or $T' \equiv T_H + t'$, where $T_H \equiv 1/H$, without thereby changing any relevant physical results. Using the relation $t^* = \ln(HT')/H$ taken from (29), the corresponding coordinate transformation of (1) yields the FLRW-form (Ostermann 2003a) corresponding to the original SUM line element

$$\begin{aligned} &\mathrm{d}\sigma'^2_{\mathrm{SUM-FLRW}} = \\ &c^2 \mathrm{d}T'^2 - a^2_{\mathrm{SUM}} \left(\mathrm{d}r^{*2} + r^{*2} \mathrm{d}\Sigma^{*2} \right) \,, \end{aligned} \tag{52}$$

where r^* is the radial distance and $\mathrm{d}\Sigma^*$ the element of a Euclidean spherical surface in universal coordinates. Then the SUM scale factor

$$a_{\mathrm{SUM}} \equiv HT' \equiv 1 + Ht' \,, \tag{53}$$

equals the stationary time scalar (3) as is obvious from the first relation in (29).

In contrast, the SST scale factor $a_{\mathrm{SST}} = \mathrm{e}^{Ht'}$ would result in a horizon problem corresponding to a seemingly small, but physically essential difference in the line element, which difference in view of the SUM is regarded an unacceptable feature.

The seeming singularity of (52), (53) at $T' = 0$, however, cannot disprove the *universal* SUM stationarity found in the previous sections, because: According to the covariance of GR, the alternative FLRW representation of SUM must yield the same directly observable physical results as the original stationary line element (4) of the ultralarge scale background multiverse. It is easily verified, for example, that from (52), (53) the exact Hubble relation (39) holds in its time-independent form, too. Keeping the full stationarity of all corresponding results it may be emphasized here, that this stationarity is a coordinate-free statement, while any apparent singularity means an inadequacy in the mathematical treatment.

What in view of the singularity in (52), (53) is otherwise called 'age of the universe', now in view of SUM turns out to be rather the maximum age of macroscopic structures according to Section 2.4. Seemingly opposite observations of e.g. oldest galaxies cannot convince of a singular origin (in analogy to the commonplace experience that the existence of people with each member not older than one hundred years does not prove this individual maximum lifetime to be a historical age of the whole population).

Together with Section 2.4 the results above show any pseudo-proper FLRW form only to apply to limited regions of an eternal multiverse. Thus local bangs might cause 'primordial' nucleosynthesis in a universe of many cosmoses again and again.

2.8. *The ignored significant Hubble constant H*

In view of far-reaching consequences, it seems necessary to show, that independently of the respective scale factor $a(t')$, in general the significant FLRW Hubble parameter is $H_{\mathrm{s}} \equiv \dot{a}$ what, if given the stationary scale factor $a_{\mathrm{SUM}} \equiv HT' \equiv 1 + Ht'$, actually means a true Hubble constant $H_{\mathrm{s-SUM}} \equiv H$.

With regard to the general FLRW-form (49), the definition of redshift, $z \equiv \lambda_{\mathrm{A}}/\lambda_{\mathrm{E}} - 1$, can be written in the well-known form

$$z \equiv \frac{a(t'_{\mathrm{A}})}{a(t'_{\mathrm{E}})} - 1 \equiv \frac{\Delta a_{\mathrm{AE}}}{a(t'_{\mathrm{E}})} \approx \frac{\dot{a}}{a} \Delta t' \,, \tag{54}$$

where a dot means differentiation with respect to t' or T'. Since light propagates according to $\mathrm{d}\sigma_{\mathrm{FLRW}} = 0$ with FLRW coordinate velocity $c' = c/a$, and a local element of proper length is assumed to be $\Delta l' \approx a \Delta l^*$, it is

$$\Delta t' \approx \frac{a \Delta l^*}{c} \quad \Leftrightarrow \quad \Delta t' \approx \frac{\Delta l'}{c} \,, \tag{55}$$

Inserted both equivalent expressions into (54) it follows at first Hubble's linear law in its *significant* form

$$cz \approx \dot{a} \Delta l^* \equiv H_{\mathrm{s}} \Delta l^* \,, \tag{56}$$

as well as the approximate law in its *conventional* form

$$cz \approx \frac{\dot{a}}{a} \Delta l' \equiv H_{\mathrm{c}} \Delta l' \,, \tag{57}$$

where according to (55) the expression $\Delta l' \approx c\Delta t'$ is usually regarded the alleged 'proper' distance to the light source.

Even in view of traditional cosmology, however, the conventional assignment of the Hubble parameter H_c on the right hand side of (57) is misleading. By definition it is not the pseudo-proper distance l' but the universal (allegedly 'comoving') distance l^* which is *constant* for galaxies without peculiar motions. Therefore not the intervals $\Delta l'$ in (57) are presupposed to be independent of time, but the intervals of universal distance Δl^* instead. Thus clearly relation (56) is the valid approximation (for a discussion of the historical context s. Ostermann (2013a) or SUM14/A1).

Concluding this section it may be emphasized once more that in contrast to the stationary universal line element (4) itself, the FLRW-form (49) with its scale factor $a_{\mathrm{SUM}}(t') \equiv HT' \equiv 1 + Ht'$ is no longer without a mathematical singularity. But there are the intrinsic limitations of proper length and proper time revealed in Section 2.4, which have to be taken into account. Accordingly it is important to keep in mind that from (30) it has to be $r^* < R_H$ or even $r^* \ll R_H$. Thus in view of SUM any overstrained pseudo-proper FLRW form, if understood to apply to the entire universe instead of only 'local' regions, is effectively misleading.

2.9. *Large-scale distribution of universal objects*

A theoretical distribution of universal objects U will be roughly estimated here as a function of z. Considering an idealized uniform number density n^*_{U} of homogeneously distributed objects like stars, galaxies, quasars or clusters, for example, the number of them included within a spherical shell between r^* and $r^* + dr^*$ is

$$\mathrm{d}N^*_{\mathrm{U}} = n^*_{\mathrm{U}}\mathrm{d}V^* = 4\pi n^*_{\mathrm{U}} r^{*2}\mathrm{d}r^* \tag{58}$$

with

$$n^*_{\mathrm{U}} = \frac{\Omega_{\mathrm{U}}\rho_{\mathrm{c}}}{M_{\mathrm{U}}}\,, \tag{59}$$

where as usual Ω_{U} is the parameter of a mean matter density given by $\mu^*_{\mathrm{U}} \equiv \Omega_{\mathrm{U}}\rho_{\mathrm{c}}$, and M_{U} the mass of a typical object. Inserting (59), as well as r^* and dr^* taken from (43), into (58) yields

$$\frac{\mathrm{d}N^*_{\mathrm{U}}}{\mathrm{d}z} = 4\pi n^*_{\mathrm{U}} R_H^3 \frac{\ln^2(1+z)}{(1+z)} \tag{60}$$

not yet taking into account any effects of possible absorption, selection, or local evolution. The total number of respective objects is $N_{\mathrm{U}} = \infty$ of course (as easily verified by integration). This natural result corresponds directly to the concept of SUM, since the underlying stationary line element (4) does not imply any horizons of the multiverse as a whole.

The idealized distribution (60) shows a flat peak at $z_{\mathrm{SUM}} = \mathrm{e}^2 - 1 \approx 6.4$ while it is approximating zero in the limit $z \to \infty$. The value z_{SUM}, though, seems clearly above the observed maximum at $z_{\mathrm{obs}} \approx 1.9$ of quasi stellar objects (QSOs). However, the steep decrease of the quasar distribution in the interval $2 < z < 4$ to almost zero as shown again by Schneider (2010) for example, does not at all necessarily mean a steep decrease in the actual number density, too, because there is implied a selection bias due to a magnitude limit of e.g. 20.2 mag. The distribution of quasars seemed to indicate that these objects did only exist at sufficiently large universal distances outside our cosmic environment; but in the meantime the latter's dimensions are seen much wider. Taking into consideration a Malmquist bias, however, such an apparent maximum in the quasar distribution at about $z_{\mathrm{obs}} \approx 1.9$ may have been actually observed (s. SUM14/Fig.7).

Unexpected giant Lyman-α blobs – with a content of hydrogen gas apparently sufficient to build new stars or galaxies even today – are among the largest known individual objects in the universe. That selection effects can suggest an erroneous impression of particularly large distances is exemplarily shown by these objects, which preferentially are found at high redshifts $z > 2$ because the original UV photons have to be redshifted before they can propagate through the atmosphere. At any point of universal time there should be extragalactic objects in any possible stadium of formation.

2.10. *More implications in presupposing a stationary multiverse*

It is widely believed that at least on Planck scales General Relativity (GR) and Quantum Mechanics (QM) prove incompatible. Such a statement, however, seems premature as long as Einstein's detailed equations

$$R_{ik} - \frac{1}{2}Rg_{ik} = \kappa_{\mathrm{E}} T_{ik}^{\mathrm{QM-detailed}} \tag{61}$$

are not consistently solved for a corresponding quantum EMS tensor on their right hand side. Here again E_{ik} is the Einstein tensor, while R_{ik}, R are the Ricci tensor and its scalar, g_{ik} the fundamental tensor, and Einstein's constant κ_{E} means $8\pi G/c^4$ (not to be confused with the absorption coefficient κ). In Einstein's 'extended' equations there would be an additional term Λg_{ik} (with Λ his cosmological constant).

Thus far, Einstein's original equations are successfully solved in many important cases only for his phenomenological substitute $T_i^k := P_i^k$. This tensor is essentially describing a perfect fluid, whose provisional nature once let him write of 'lumber instead of marble' (Einstein 1936).

The completion of what is called 'general relativity' by the quasi-Euclidean universal rest frame, as implied in Einstein's tetrad concept (Einstein 1928) after reflected in Rosen's bi-metric approach (Rosen 1963) (s. a. SUM14), may offer a solution in principle of two main problems of 20th century physics: (a) the alleged incompatibility of GR with QM as well as (b) an assumed unphysical 'big bang' creation of space and time out of nothing. Only on the bi-metric base, the energy content of the gravitational field does no longer depend on the respectively chosen coordinate system. It is particularly this feature that would guarantee an objective reality of any energy transport within gravitational fields, above all that of gravitational waves (according to SUM gravitational waves do not represent oscillations in 'spacetime' but oscillations of gravitational potentials).

The preferred universal frame is established by the isotropy of any background radiation over sufficiently large scales and the statistically constant values of redshift for individual sources (s. Section 2.5).

In spite of the fact, that *exact* detailed quantum solutions of (61) may be found rarely if at all, a resignation in view of the assumed incompatibility of GR and QM seems unjustified. As soon as one discards the strictly geometric interpretation of GR, most of the fundamental problems rather vanish into new chances – from particle physics up to cosmology. There is simply no need for geometric properties of space and time instead of physical properties of material objects to recover the immense plenty of experimentally verified results. Accordingly any attempt to quantize a mathematical 'spacetime' itself instead of real physical matter would make no sense.

A central idea leading to SUM as the stationary cosmological solution of Einstein's equations is that no universal horizons must limit physical reality where locally, together with gravitation, quantum mechanics reveals its full creative potential. It has to be stated, though, that given a stationary background multiverse – this view strongly supported by the Supernovae Ia magnitude-redshift measurements – hot originating 'local bang' events seem to violate an unrestricted validity of the law of entropy. On the other hand, a single-bang origin of the universe as a whole would have violated *all* physical laws since *none* such laws could have existed within sheer nothing.

A violation of the second law of thermodynamics, however, would be irrefutably restricted to local regions beyond evolutionary environments, though within universal space and time. Such assumptions are particularly supported in the context of SUM, where a relationship appears between the *negative* gravitational pressure and a local reduction of entropy. On the other hand, the well-established increasing entropy of ordinary gas is always related to its *positive* pressure which is causing the well-known diffusion in closed overall thermodynamical systems.

Ultralarge scale stationarity demands small local space-time areas of decreasing entropy. No laboratory experience would ever contradict a restriction of the natural entropy increase to evolutionary scenarios only, whereas in the cores of supermassive gravitational centers (SGCs), for example, any process of ordinary diffusion is overcome by gravitation and an unrestricted law of entropy may break down there.

This possibility is also supported by the well-known – otherwise puzzling – microscopic reversibility of elementary interactions implying the principle of detailed balance as expression of universal stationarity. Together with gravitationally disabled diffusion, this balance may turn to a reversal from increasing to decreasing entropy in extreme environments, particularly where the densities of matter and energy would approximate those at a corresponding Schwarzschild radius ('black hole'). In accordance with the struggle of ultralarge scale entropic balance against local evolution (s. Section 7), there is, on the other side, the well-known struggle of all structures against decline and decay.

In view of SUM it remains the question, how far do the limits of our evolutionary cosmos actually reach out. Where and when does the realm of our physical evolution actually merge into the infinite ultralarge scale multiverse? Unnecessary speculations about varying laws of nature do make no sense, because either such pseudo-laws change systematically with time, what would be only another unchanging law. Or they change untraceably and therefore unpredictably. In both cases they would make any valid conclusion impossible for serious physics.

Since 'local bangs' may actually take place as indicated by explosion of hypernovae, GRBs, QSOs, or AGNi, the stationary multiverse might be interpreted with all due respect as 'tohu-va-bohu' or 'tao' in which our own evolutionary cosmos originated billions of years ago. Already at that time, however, eternal laws of nature must have been in this anything but senseless chaos.

According to SUM there is no ultimate fate of the universe, but an eternal interplay of local collapse and gravitational re-creation in corresponding explosions in-

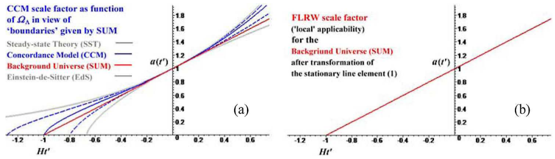

Figure 1. — *Left panel (a):* Top-down $(\Omega_{\rm M}, w_{\rm M}, \Omega_\Lambda)$ = (0, 0, 1), (0.1, 0, 0.9), (0.27, 0, 0.73), (1, −1/3, 0), (0.6, 0, 0.4), (1, 0, 0), i.e.: Steady-state Theory $a_{\rm SST}(t') = {\rm e}^{Ht'}$ [upper grey solid line, this model discussed in the past], a first alternative to $a_{\rm CCM}(t')$ with higher value of Ω_Λ [blue broken line], today's concordance model $a_{\rm CCM}(t')$ [blue solid line, see (62), (63)], stationary ultra-large scale universe $a_{\rm SUM}(t') = HT' = 1 + Ht'$ [red straight line, s. (53)], a second alternative to $a_{\rm CCM}(t')$ with lower value of Ω_Λ [lower blue broken line], Einstein-de-Sitter model $a_{\rm EdS} = (1 + \frac{3}{2}Ht')^{2/3}$ [lower grey solid line, favored before the SNe-Ia observational breakthrough].
— *Right panel (b):* SUM's stationary scale factor without unnecessary alternatives. Its unexpected local character as *pseudo-proper FLRW form* is concluded from the results of Section 2.7. In contrast to other values, the CCM best-fit parameter $\Omega_\Lambda = 0.737$ (blue solid line) seems determined by the condition that it should meet the SUM scale factor (red straight line) at its 'boundaries', i.e. at its beginning $Ht' = -1$ exactly and at $Ht' \sim 0$ approximately today.

stead. In such scenarios no physical singularities must exist.

3. THE SUPERNOVA-IA BREAKTHROUGH IN ACCORDANCE WITH SUM

In case of today's CCM it is nearly impossible to work out high precision cosmology without fundamental priors including essentially unknown physics. The exact CMB and its anisotropies, for example, are only determined after subtraction of some 'unsuitable' microwave radiation as a small part of the CIB (Kashlinsky 2005; Ade 2011). Therefore it seems appropriate to recall briefly some ΛCDM essentials for comparison.

The CCM is governed by a spatially flat line element of FLRW form, with a matter density $\rho_{\rm M} \approx 0.3\rho_c$ inclusive of 'dark matter', and an amount of 'dark energy' $\Lambda/(8\pi G/c^4) \equiv \varepsilon_\Lambda = (\rho_0 - \rho_{\rm M})c^2 \approx 0.7\rho_c$ due to a cosmological constant Λ, first exact values concluded from WMAP (Bennett et al. 2003; Jarosik et al. 2011). Here it is $\rho_0 \equiv \rho_{\rm total} \approx \rho_c$ with $\rho_c \equiv 3H_0^2/(8\pi G)$ the critical density, G Newton's gravitational constant, and H_0 the conventional Hubble parameter $H_c(t' = 0)$ today. The present 'deceleration' parameter is q_0, and T'_0 is called 'age of the universe'. Several well-known pillars are supporting the CCM like the 'predictions' concerning the magnitude-redshift relation of SNe Ia or the primordial nucleosynthesis, s. however the lithium problem (Fields 2011). Of all pillars the CMB black-body radiation together with the almost perfect description of its anisotropies are the strongest arguments for a hot 'big bang' in the ΛCDM framework, see e. g. Durrer (2008). In particular the paradigm of inflation however – indispensable for that model – is raising serious doubts (Steinhardt 2011). Therefore it is a natural question whether instead of inflation after a 'big bang' there might be an alternative to reconcile a relativistic CCM cosmology with those observational facts which otherwise mean a fundamental dilemma each.

Using SUM's FLRW form (52), now it is easy to compare its scale factor $a_{\rm SUM}$ (53) to that of today's Cosmological Concordance Model $a_{\rm CCM}$ directly.

According to a phenomenological pressure of matter $p_{\rm M} \approx 0$ today and also setting $\Omega_R \approx 0$ (for radiation), Einstein's extended equations, using a cosmological constant Λ, yield the approximate CCM scale factor $a_{\rm CCM}(t')$ for a spatially Euclidean model

$$a_{\rm CCM}(t') = \left[\left(\frac{1}{\Omega_\Lambda} - 1\right)\sinh^2 X\right]^{1/3} \tag{62}$$

with here temporarily

$$X = \frac{1}{2}\ln\left(\frac{1-\sqrt{\Omega_\Lambda}}{1+\sqrt{\Omega_\Lambda}}\right) - \frac{3}{2}\sqrt{\Omega_\Lambda}H_0 t' \tag{63}$$

as found by direct integration. Even taking the CMB radiation density yet into account, this does not result in visible changes of the solid blue CCM-line in Fig. 1, which has been already discussed (Ostermann 2003a) after the first WMAP results (Bennett et al. 2003).

From the claim, that the FLRW singularity (otherwise 'age of the universe') should correspond to infinite past in universal time $t^* = -\infty$ it follows $T'_0 \equiv 1/H_0$ today. Then the numerical solution of (62), (63) is $\Omega_\Lambda = 0.737$, $\Omega_M = 0.263$, thus almost perfectly matching the first-year CCM density parameters for 'dark energy' ($\Omega_\Lambda = 0.73 \pm 0.04$) and matter ($\Omega_M = 1 - \Omega_\Lambda$) reported in the WMAP-paper for a spatially flat model quoted above. Later on, this aspect has been pointed out also by Melia & Shevchuk (2012). Several results claiming validity in their $R_h = ct$ cosmology may be valid as well in the SUM framework, except for fundamental features directly concerning the hypothetical big-bang origin of the entire universe, like e.g. the 'Epoch of Reionization' (Melia & Fatuzzo 2015). Though in Melia's big-bang cosmology, the universe would have no horizon problem, and therefore might have evolved without inflation, SUM's central features of stationarity and no expansion of space remained undiscovered there.

3.1. *The CCM conclusion from the Supernovae-Ia data of an alleged universal acceleration*

In 1998/99 an observational breakthrough to completely unexpected SNe-Ia data seemed to require a 'strange recipe'. Here at first the original gold-sample of the Riess et al. SNe-Ia data compilation is used containing 140 ground-discovered plus 30 HST-discovered SNe Ia (11 HST-'silver' data have been included for illustration).

Mixing about 30% of the EdS cosmology to about 70% of the old SST led to today's CCM. – From

$$\mu_{\mathrm{CCM}} = 5\log\left[(1+z)\int_0^z \frac{\mathrm{d}z'}{\sqrt{(1-\Omega_\Lambda)\,(1+z')^3+\Omega_\Lambda}}\right] + \mu_{\mathrm{offset}} \tag{64}$$

according to (62), (63) with temporarily

$$\mu_{\mathrm{offset}} \equiv 25 + 5\log\left(\frac{c/H}{\mathrm{Mpc}}\right) \tag{65}$$

the CCM cosmology is represented by the curved bold blue lines in Fig.s 2, 3, fitting the SNe-Ia data numerically well (an insignificant contribution Ω_{R} due to radiation is neglected as usual).

Besides the achievements of COBE (Mather et al. 1990), WMAP (Bennett et al. 2003), HST Key Project (Freedman et al. 2001), the HST Calibration Program (Sandage et al. 2006), and SDSS (Kessler et al. 2009; Schneider 2010), there are the decisive SNe-Ia data of the High-z Supernova Search Team (HZT) (Riess et al. 1998, 2004, 2007) on the one hand, as well as those of the Supernova Cosmology Project (SCP) (Perlmutter et al. 1999; Kowalski 2008; Amanullah et al. 2010; Suzuki et al. 2012) on the other hand. These data may represent the most valuable cosmological measurements of the last decades (because actually their immediate confrontation with competing theories is least hampered by input of even more unproven hypotheses about the universe).

Fig. 2 shows a preliminary naive SUM confrontation (red) with the SNe-Ia data (diamonds or filled circles) against the CCM 'prediction' (blue), the latter claiming this diagram to prove an accelerated expansion of the universe. With the bold blue CCM-line in the upper panel 2(a) best fitting the SNe-Ia data, one has to consider the residuals. If temporarily using the same Hubble constant, e.g. $H_{\mathrm{illu(stration)}} = 65$ km/s/Mpc for both models, this would show a global deviation from the red broken horizontal SUM-line in panel 2(b). There the

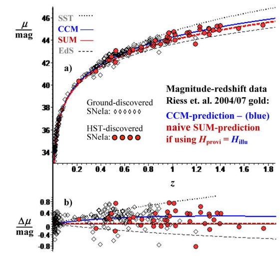

Figure 2. — *Top panel 2(a)*: The SNe-Ia data taken from Riess et al. (2004, 2007) and the distance moduli $\mu = m - M$ of various models. Temporarily using the same parameter $H_{(0)}$ for all models at first, the SUM magnitude-redshift prediction is naively compared (red broken line) to the CCM-prediction (blue line) which stands for the best fit representing a flat space model with $\Omega_\Lambda = 0.73$. In addition to the CCM there are also shown its 'parents' SST, EdS (grey broken lines above and beneath). The red, blue and grey lines represent those predictions derived from the scale factors a_{SUM}, a_{CCM}, a_{SST}, and a_{EdS} as given in Section 3 (Fig. 1). According to the quoted High-z Supernova Search Team papers, the ground-discovered SNe Ia of their 'gold ' sample are plotted as black diamonds whereas the HST discovered SNe Ia are represented by red filled circles. — *Bottom panel 2(b)*: The magnitude-redshift residuals and the CCM prediction are shown both with respect to the first provisional SUM prediction (naively assumed the CCM value of the Hubble constant $H_{\mathrm{illu(stration)}}$, neglecting any local peculiarities or dimming by grey dust). Since the blue CCM-line is best fitting the data and their Δm-residuals, it is seemingly resulting an unacceptable deviation from the red horizontal SUM-line here. This may be why such a model has not been taken seriously so far.

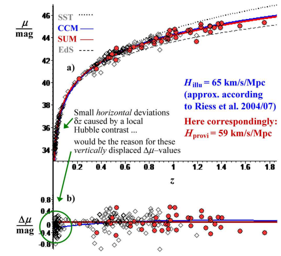

Figure 3. — *Top panel 3(a)*: A vertical shift of $\Delta m \sim 0.2$ mag is sufficient to remove all visible differences between a red provisional SUM-line and the blue CCM-line in this illustration. The predictions of both models seem to coincide almost completely now. Despite of the Δm-shift, however, there remain some *hidden* differences which come to light by plotting the residuals with respect to the H_{provi} prediction. — *Bottom panel 3(b)*: Only when analyzed in detail, a relevant difference appears primarily within the green circle of the lower panel (b). This example means nothing but a reduction of about 9% in the Hubble constant [if e.g. $H_{\mathrm{illu(stration)}} \approx 65\ km/s/Mpc$, then $H_{\mathrm{provi(sional)}} \approx 59\ km/s/Mpc$]. Though this panel still shows significant deviations between the CCM- and the SUM-residuals, the picture has changed essentially, because now the remaining problem is only a local one concerning the low redshift-range $z \le 0.10$, whereas CCM and SUM both describe the observed universal SNe-Ia-range $0.10 < z < 1.8$ comparably well (the SUM fits even slightly better than the CCM here). Both panels illustrate the SNe-Ia measurements still without taking any local Hubble contrast into account (or any dimming by grey dust).

Δm-residuals of the SNe-Ia data themselves as well as those of the CCM, SST, and EdS are displayed relative to the SUM prediction.

Today, the CCM obviously represents a mathematical combination of SST and EdS, while the seeming local SUM disagreement in 2(b) is most likely the reason why this model – developed only several years later – has not been taken seriously so far. Nevertheless, the upper panel (a) of the same Fig. 2 strongly suggests the small vertical shift to the blue CCM-line as therefore applied in Fig. 3. Correspondingly Riess et al. (2004) explicitly stated before: "The zero point, distance scale, absolute magnitude of the fiducial SN Ia, and Hubble constant [...] are independent of the aforementioned normalization parameters".

In fact, still neglecting all other 'local' cosmic peculiarities, but based on two different Hubble constants, $H_{\rm provi}$ in contrast to $H_{\rm illu}$, the top panel (a) of Fig. 3 shows the interim SUM prediction surprisingly close to that of the CCM now. Though looking different, this figure is physically equivalent to Fig. 2(a), since the absolute value of $H_{\rm illu}$ is arbitrary here. According to the new assignment of the *universal* Hubble constant, however, the SUM lines of Fig. 3 are vertically shifted by $\Delta m = 0.2$ mag, what according to (48) means a reduction in the range $z > 0.1$ of the preliminarily adopted CCM Hubble constant by about 6 km/s/Mpc [$\kappa = 0$]. More realistic values are given in Section 3.3, while only the relative difference $\Delta H/H \approx 9\%$ is relevant for such an adjustment.

Though Fig. 3(b) still shows significant deviations between the CCM- and the SUM-residuals, now the remaining problem is only a *local* one concerning the low redshift-range $z \leq 0.1$, while CCM and SUM both describe the observed universal SNe-Ia-range $0.1 < z < 2$ comparably well. This strongly suggests the local Hubble contrast as discussed in Section 3.3.

3.2. *Evidence for SUM from the magnitude-redshift data on universal scales ($z > 0.1$)*

Fig. 4(a) shows the SUM prediction (red solid line) on universal scales $z > 0.1$ together with those of the CCM and two flat space models once prominent in the history of relativistic cosmology [the Steady-state Theory (SST) at the top and the Einstein-deSitter (EdS) model at the bottom].

A vertical shift of $\Delta m \approx 0.2$ has been applied in Fig. 4 to remove all obvious differences between the red SUM-line and the blue CCM-line in this redshift range. If the presupposed value of M (in $\mu = m - M$) stays unchanged, then this vertical shift (SUM-line up) does mean nothing but a local relative increase

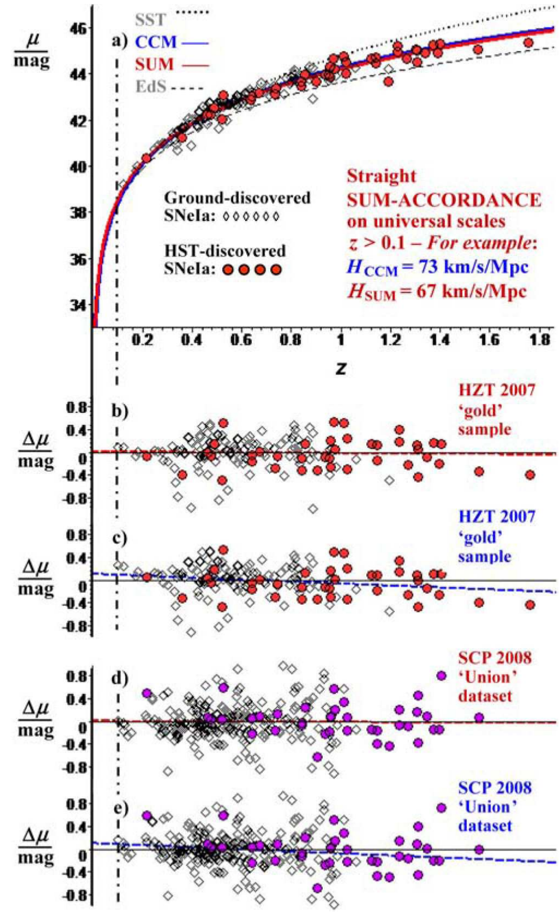

Figure 4. It seems premature to claim from a clearly local deviation limited to the data in the range $z \leq 0.1$ (omitted here) on a mysterious 'dark energy' dominating the universe.
— *Top panel (a)*: When comparing the SUM magnitude-redshift prediction (48) with the SNe-Ia data and the CCM-prediction (as usual for $\kappa = 0$), there is a straightforward SUM agreement on universal scales $z > 0.1$ where the universe may be rightly regarded homogeneous and isotropic. The red SUM-line coincides almost completely with the blue CCM-line (the latter with a locally 9 % higher Hubble 'constant' $H_{\rm local} = H_{\rm CCM} = 73$ km/s/Mpc).
— *Lower panels (b) - (e)*: These figures are of high importance, since here in the high-redshift range $z > 0.1$ again, the pure model predictions are compared without any local corrections (the red broken lines as well as the blue broken lines do not represent the predictions but the mean residuals with respect to the z-axes, i. e. deviations from the data). Taking a look in particular at the panels (b), (d) – which strictly plot the pure 'gold' data of Riess et al. without any local Hubble contrast – it seems nearly impossible to ignore the obvious feature, that relevant deviations from the direct SUM-prediction can be only in the local range $z \leq 0.1$.

$H_{\rm local}/H_{\rm universal} - 1$ of about 9% in the Hubble constant (if for example $H_{\rm SUM} = H_{\rm universal} = 67$ km/s/Mpc then $H_{\rm local} = H_{\rm CCM} = 73$ km/s/Mpc).

Thus the new stationary universe model turns out to represent the SNe-Ia data (Riess et al. 2004, 2007) in

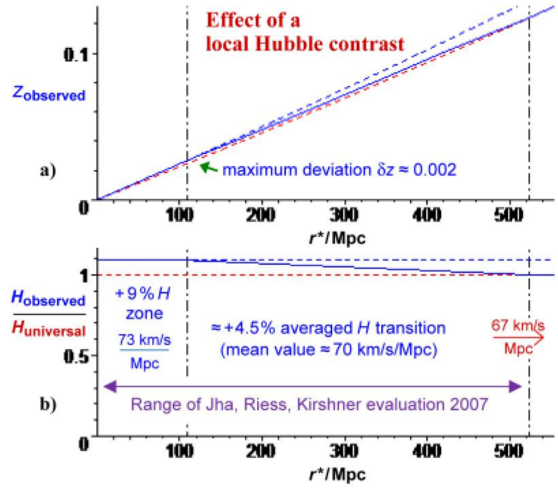

Figure 5. 'Hubble trouble': Two different values for the Hubble 'constants' $H_{\text{local}} = H_{\text{CCM}}$ and $H_{\text{universal}} = H_{\text{SUM}}$.
– *Top panel (a)*: The blue solid line represents the real values z_{observed} of the SNe-Ia measurements, the red broken straight SUM line is neglecting possible peculiar flows or local inhomogeneities. The maximum deviation $\partial z \approx 0.002$ ($\approx$ 600 km/s/c) within $z < 0.027$ corresponds to a maximum contrast $H_{\text{local}}/H_{\text{universal}} - 1$ of about 9 % at this point where $H_{\text{universal}} \approx$ 67 km/s/Mpc.
– *Bottom panel (b)*: Within $r^* < 110$ Mpc the blue line corresponds to $H_{\text{local}} \approx 73$ km/s/Mpc, while the mean value in the transition zone (up to $z \approx 0.13$) is about $H_{\text{trans}} \approx 70$ km/s/Mpc. The difference leads to $H_{\text{local}}/H_{\text{trans}} - 1 \approx 4.7\%$ up to $H_{\text{local}}/H_{\text{universal}} - 1 \approx 8.9\%$ thus approximately corresponding to the range of the local Hubble contrast reported by Jha et al. (2007) to be $6.5\% \pm 1.8\%$.

the high redshift range $z > 0.1$ straightforwardly well. Only in the low range $0.01 < z \leq 0.1$ its luminosity predictions differ from those of today's CCM significantly. It has been shown, however, that instead of an accelerated expansion, a local Hubble contrast may result in full agreement with the low redshift data, too.

3.3. *SUM prediction of two different values for the local and the universal Hubble constant ('Hubble trouble')*

The completely unexpected feature is not, however that the data may be fitted within the big-bang framework alternatively by ad hoc adjusting another hypothetical ΛCDM parameter again. Instead there is a chance for a multiverse without unnecessary coincidences, horizon problems or other peculiarities (Ostermann 2003b,a, 2008a). Even straight away ($\delta H = 0$, $\kappa = 0$), the SUM-prediction (48) would fit the data much better than EdS or SST.

To take into account a local Hubble contrast now and using $\tilde{H}_{\text{E}} \equiv f_H H$ with regard to (5) it is

$$\tilde{\mu}_{\text{SUM}} = 5 \log \left[(1+z)\ln(1+z)\right] + \tilde{\mu}_{\text{offset}} \qquad (66)$$

where

$$\tilde{\mu}_{\text{offset}} \equiv 25 + 5 \log \left(\frac{c/H}{\text{Mpc}}\right) - 5 \log f_H \qquad (67)$$

instead of (48). In both panels of Fig. 5 the solid blue lines may represent the real SNe-Ia observations, the broken red lines (respectively below) do represent straight SUM. A maximum deviation $\partial z \approx 0.002$ corresponds to a maximum Hubble contrast of $\approx +9\%$.

With $H_{\text{universal}} \approx 67$ km/s/Mpc e.g. this would mean $H_{\text{local}} \approx 73$ km/s/Mpc within $r^* < 110$ Mpc ($z < 0.027$), while the mean value in the transition zone is about $H_{\text{trans}} \approx 70$ km/s/Mpc. Regarding the limited range of the 2007 Jha-Riess-Kirshner evaluation this leads to $H_{\text{local}}/H_{\text{trans}} - 1 \approx 4.7\%$ or otherwise with respect to the full universal range $H_{\text{local}}/H_{\text{universal}} - 1 \approx 8.9\%$, thus just approximately corresponding to the local Hubble contrast $6.5\% \pm 1.8\%$ as found by Jha, Riess, & Kirshner (2007).

Now recently, by the second of these authors (Riess et al. 2016), there has been reported another "local value" $H_0 = 73.2$ km/s/Mpc, with an uncertainty of only 2.4 % as well as 71.9 km/s/Mpc ±3.8% (approximately corresponding to 72.8 km/s/Mpc ±3.3% (Bonvin et al. 2017) on base of $\Omega_m = 0.32$).

Close to 72 km/s/Mpc by Freedman et al. (2001), but in clear contrast to 67 km/s/Mpc predicted by ΛCDM cosmology from the new Planck high-redshift measurements (Aghanim et al. 2016) – or approximately also the 68 km/s/Mpc of Cheng & Huang (2015) – this remarkably means a Hubble contrast of about +9% again, the latter almost perfectly matching the original SUM prediction (Ostermann 2007) (s. also "Indication from the Supernovae Ia Data of a Stationary Background Universe" (Ostermann 2012a)) or the bottom panel of Fig. 5. Apparently the authors of the new report presuppose the 'curved' shape of a ΛCDM Hubble diagram (without explicit justification) and therefore, of course, cannot find any difference between the local and global value of the Hubble constant.

This seems to mean a wrong conclusion by a wrong presupposition and may be also the reason that the Hubble contrast previously reported by Jha, Riess, & Kirshner (2007) is no more discussed. Therein, however, it convincingly read: *"... the feature is present in the Hubble flow SN sample, and this has important implications for using SN Ia as tools for precision cosmology."*

Now the occurrence of two different values for the Hubble constant is another unexpected coincidence between the contradictory ΛCDM framework and a consistent SUM concept. The other way round, with the clear SUM relations (48) and (66), (67) on hand it seems even possible to determine the peculiar mass-energy distribution in our anisotropic 'local' cosmic environment $z < 0.1$ with help of high precision measurements of apparent SNeIa luminosities.

Taking an unbiased look at the panels (b), (d) of particularly Fig. 4 above - which strictly plot the pure data of both Nobel-Prize awarded SNeIa teams - it appears nearly impossible to ignore the obvious feature, that relevant deviations from the direct SUM-prediction can be only in the local range $z \leq 0.1$. It seems unfortunately only a presumptuous claim to conclude from a clearly local deviation on the fiction of 'dark energy' dominating the universe.

In line with the Riess-et-al. quotation above it may be emphasized that the local Hubble contrast $H_{\rm local}/H_{\rm universal} - 1$ found here of approximately $+9\%$ is determined by the relative difference $H_{\rm local} - H_{\rm universal}$, ≈ 6 km/s/Mpc.

3.4. *Full scale SUM compatibility of the SNe-Ia data without the need for 'dark energy'*

The panels (a), (b), (d) of Fig. 6 show that after taking into account the local Hubble contrast of Figur 5 now according to (66) the SUM-residuals result in reasonable agreement with the low redshift data, too (whereas the other way round the CCM might face a serious problem in the low redshift range $z < 0.1$ now). If necessary, there might be also an additional adaptability from effects like dimming by grey dust [$\kappa = 0.24$ in combination with $\partial H/H_{\rm universal} = 4.7\%$ in the green panels (a), (d) of Fig. 7].

Independent of any local peculiarities, however, actually the decisive feature is the straightforward agreement on universal scales $z > 0.1$ according to panels (a), (b), (d) of Fig. 4 or to the panels (a), (b), (d) of Fig. 6 (the latter respectively on the right hand side of the vertical dashed lines), where the model predictions are compared without any local corrections. These panels prove a straight SUM accordance on scales $z > 0.1$ with the 'gold' sample of Riess et al. (2004, 2007) as well as with 'The World's Supernova Distance-Redshift Data' (Kowalski 2008).

Now the question remains, how the same data could be understood to have proved the existence of a 'dark energy' in ΛCDM single-bang cosmology, though completely incomprehensible so far. In contrast to the hypothetical CCM conclusion from the SNe-Ia data of a corresponding universal acceleration, however, here is the traceable chance for a paradigm shift to the stationary background universe model (multiverse) as described by SUM.

Regarding the full redshift range, either these SNe-Ia data are explained taking into account a local Hubble contrast ($H_{\rm local} > H_{\rm universal}$ as actually observed), or they are explained by the CCM requiring a mysterious 'dark energy' due to an unnecessarily assumed 'accelerated expansion of the universe from a cosmological constant', which seems to be fine-tuned to the strange level of one part in $\sim 10^{120}$ (thus unexpected by impossible orders of magnitude).

4. DARK MATTER AND 'DARK ENERGY'

A vast isothermal main part of homogeneously distributed dark matter of second kind (hDM) might exist instead of the 'dark energy' assumed today. Until now, only the smaller known inhomogeneous part (iDM) is commonly accepted in form of dark matter halos, whether or not bound to galaxies or clusters. An additional macroscopically non-lensing hDM would fill the gap between observable matter and critical density, the latter required by any flat space solutions of Einstein's gravitational equations.

Thus the universal 'dark' matter distribution may be similar to that of a viscous vitreous medium filling universal space with local inclusions. This seems to be realized with overdensities in form of bulges, halos or clusters gathering stars and galaxies, while in huge 'voids' between them the density is low but yet high enough to make the dominant fraction of matter and energy. There may be different sorts of that 'dark' matter, one of them consisting of non-baryonic particles like e.g. thermalized neutrinos (it has not necessarily to consist of only one fraction of particles, various components may even include unseen macroscopic objects). Together with local inhomogeneities these could make up a universal non-lensing background. Even a possible contribution of gravitons cannot be safely excluded from considerations today.

While the ΛCDM model seems to depend on two pieces of undiscovered physics (Shanks 2004), now 'dark' matter may get rid of its mysterious lack of non-gravitational interaction. Both forms might possibly even absorb some intensity of gravitational waves in various frequency ranges (though in case of e.g. the binary pulsar PSR 1913+16 (Hulse & Taylor 1975) a corresponding loss of potential energy obviously exists,

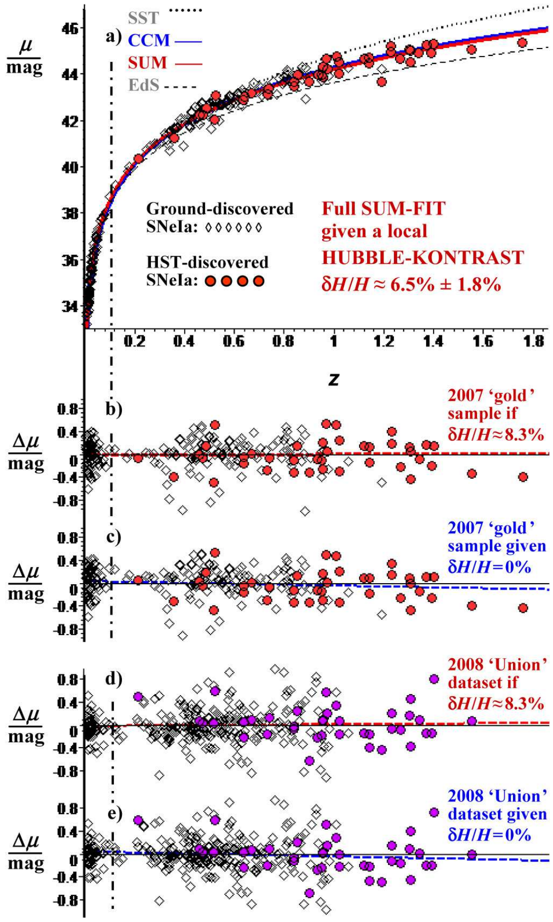

Figure 6. — *Top panel 6(a)*: Taking into account a local Hubble contrast as shown in Fig. 5, there is a full scale SUM compatibility according to (66) with not only the SNe-Ia data of the HZT (Riess et al. 2004, 2007) but also with those of the SCP's 2008 Union 'world' compilation (Kowalski 2008). Obviously the corresponding corrections of at most $\partial z \approx 0.002$ within $z_{\mathrm{observed}} < 0.027$ are sufficient to cause a reasonable accordance between the SUM and the data in both low redshift ranges, too.
— *Lower panels 6(b),(d)*: Full scale compatibility with the Riess et al. 'gold' data given a local Hubble contrast.
— *Lower panels 6(c),(e)*: Also in these panels again, the blue broken straight lines are determined by the method of least quadratic deviations and should ideally prove congruent with the respective z-axis.

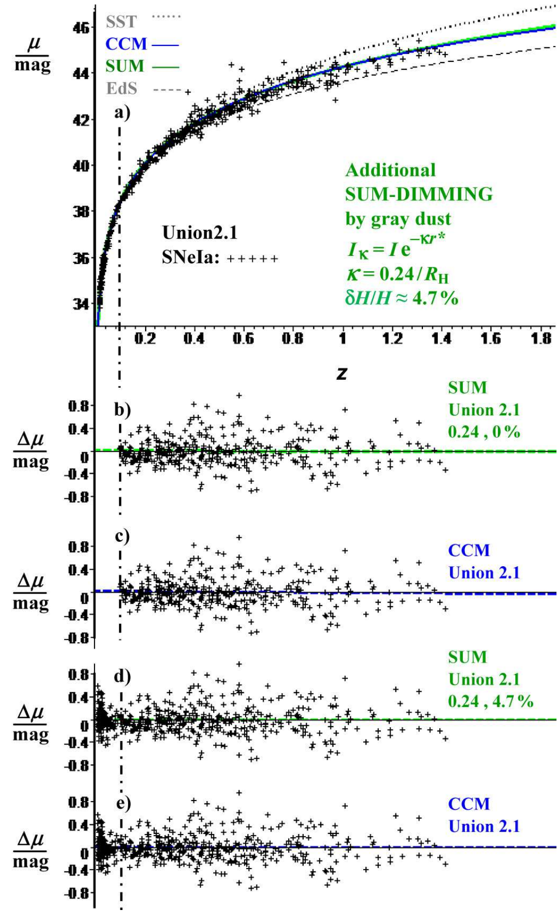

Figure 7. — *Top panel 7(a):* All panels of this figure show corresponding illustrations for the Union 2.1 results (Suzuki et al. 2012; Amanullah et al. 2010) where now a value $\kappa = 0.24$ is exemplarily tested (while in the mm-microwave frequency range a different value of $\kappa \approx 2$ might apply for absorption, s. Section 5.1).
— *Intermediate panels 7(b),(c)*: These panels show corresponding illustrations of the Union 2.1 results on universal scales $z > 0.1$ for dimming by gray dust according to tentatively $\kappa = 0.24$.
— *Bottom panels 7(d),(e)*: The respective results as above over the full redshift range when additionally a local Hubble contrast $\delta H/H$ of only $\sim 4.7\%$ ist taken into account.

its emission is not yet directly observed so far, s. also Shannon et al. (2015)].

Furthermore, dark matter of weakly interacting particles (WIMPs) could be at least partially responsible for the observed cosmic microwave background radiation.

In the context of ΛCDM particle physics there remains also the question how there should have been a primordial excess of baryons over antibaryons necessary to explain why a single-bang universe has allegedly survived an origin out of nothing. Given a stationary universe such a question does not even arise, while concerning one particular cosmos in a Tao multiverse this might need an answer again.

4.1. *Inhomogeneous lensing dark matter of first kind (iDM)*

Dark matter seems necessary to explain the otherwise unexpected rotation curves in galaxies (Rubin & Ford 1970; Rubin 1998), or the puzzling peculiar velocities in clusters (Zwicky 1933), as well as gravitational lensing far from visible objects.

A physical question is: What is the temperature of that macroscopically lensing dark matter of first kind (iDM), which is observable by its inhomogeneous distribution (whether baryonic or not)? A simple calculation like in particular that of a pure Emden sphere (singular isothermal) suggests the essential feature of approximately constant velocities. On the assumption that pressure, volume, and temperature of simplified hypothetical iDM distributions are related in the same way as in regular gases, there appear rotation curves similar to those actually observed if only in each galaxy the temperature of this dark matter took a respective (nearly) constant value.

In view of the ΛCDM cosmology, any ideas that dark matter might consist of massive 'thermal' neutrinos seem disproved. But according to SUM, from non-zero rest masses it follows that neutrinos – despite propagating after release at almost the speed of light – will be slowed down by deceleration of free particles in the gravitational field of the infinite multiverse (s. Section 2.2). At thermal velocities they may show unexpected features. Also a possible mean mass of iDM particles might be estimated in order of magnitude. From the simplifying assumption of an isothermal distribution leading to the observed rotation curves in our galaxy could follow ∼1/1000 the mass of the electron. Such an order of magnitude might indicate a context of thermal neutrinos indeed. In this view a search for candidates of iDM particles in the high energy range of e.g. the LHC appears not promising, while in contrast a search of weakly interacting particles slowed down to low energies by universal deceleration instead might be not in vain.

4.2. *Homogeneous non-lensing dark matter of second kind (hDM)*

In addition to the currently assumed inhomogeneous parts, a macroscopically non-lensing hDM distribution (dark matter of second kind in form of an approximately homogeneous isothermal background) as an alternative to 'dark energy' could fill the gap to critical density. The same hDM then may be the main source of a universal microwave radiation, where what is called CMB would be only the dominating 'black body' part in contrast to the mm-range of the 'additional' cosmic infrared background.

The nature of possible hDM particles raises the question of non-baryonic dark neutrino matter again. If spin-$\frac{1}{2}$ particles are primarily involved, then in spite of all 'big bang' counterarguments these particles might yet be neutrinos. A reason is that on basis of the following consideration other such candidates are possibly not available. The number of 24 elementary spin-$\frac{1}{2}$ particles seems to be related to the 24 components of a real torsion tensor as explicitly addressed in the next section. This occurence is numerically in full accordance with the standard model of particle physics.

In contrast to candidates in the high energy range for dark matter particles, which are not part of the standard model of particle physics (otherwise extremely successful in describing all observed matter phenomena (Kroupa et al. 2012)) low-energy neutrinos are notoriously difficult to detect. If a homogeneous distribution of neutrinos was responsible for the CMB, however, as briefly addressed in Sections 5.1, 5.4, then actually the only observable effect to detect it might be a local emission within cavities of the hDM radiation corresponding to the broken red line of Fig. 8.

4.3. *Numerical hints to 24 elementary spin-$\frac{1}{2}$ torsion particles*

There is a strange hint that the inflationary ΛCDM big-bang model might fail, namely because of an apparent materialization of an antisymmetric torsion tensor

$$T_{ikl}\,. \tag{68}$$

The multiverse seems constituted of 24 elementary spin-$\frac{1}{2}$ particles which are 6 leptons + 3 colors · 6 quarks. These curling structures, behaving as 'whirl' particles, may represent exactly the 24 components of a real torsion tensor which are 6 'temporal' + 3 · 6 'spatial' constituents

$$T^i_{kl} = T^0_{\alpha\beta} + T^\gamma_{\alpha\beta}\,, \tag{69}$$

what seems to be more than a mere coincidence [in this section Latin indices $i, (k \neq l) = 0, 1, 2, 3$ in contrast to Greek spatial indices, here $\gamma, (\alpha \neq \beta) = 1, 2, 3$ only].

In addition, of the 6 'lepton'-components in $T^0_{\alpha\beta}$ there may be 3 'electric' + 3 'magnetic' (according to the assignment in the electromagnetic field strength tensor), thus reflecting three e, μ, τ particles plus three respective ν_e, ν_μ, ν_τ neutrinos

$$T^0_{\alpha\beta} = T^0_{0\alpha} + \left(T^0_{32} + T^0_{13} + T^0_{21}\right)\,. \tag{70}$$

As has been shown by Landau & Lifschitz (1992) long time ago, however, the physical existence of a non vanishing torsion tensor would contradict Einstein's equivalence principle. This principle is underlying the literally geometric interpretation of his gravitational equations, while in view of SUM the geometric approach fails in reducing physics to exclusively Riemannian properties of non-Euclidean space and time (this failure is also indicated by the existence of tetrads (Ostermann 2014, 2013b)). Therefore a microscopic violation of the fundamental equivalence principle would contradict the space-time concept where today's Concordance (Consensus) Model of cosmology is relying on.

In view of extended elementary spin-$\frac{1}{2}$ torsion structures (in most situations identifiable and acting as wholes) also Heisenberg's uncertainty principle can be essentially understood in contrast to the strange behavior of 'point' particles otherwise unrealistically presupposed so far.

In any case, contrary to its historical reception, quantum mechanics may be understood as theory of extended whirl structures of variable shape. A first deductive attempt to extended structures, outlined by Ostermann (2008a,b), seems to explain Bohr's energy-frequency formula and to imply Heisenberg's uncertainty relations in accordance with approved principles of relativistic physics. Thus this feature is shown to be anything but an incomprehensible surprise after all.

Particles like electrons and protons as well as their constituents are neither real mass points without any extensions nor one-dimensional 'strings', nor two or higher-dimensional 'branes', but they are three-dimensional deformable structures with particle parameters in form of several characteristic constant integrals pertaining to rest mass, charge, and spin among others. Also the quantum mechanical result that particles do not have an unambiguous momentum is only a natural statement in view of interacting extended structures, where a possibly varying momentum *density* is self-evident. On the other hand, in spite of unavoidable uncertainties due to relative inner motions, the total momentum of a free particle can be exactly determined. While the details may prove strange, the natural laws behind should be clear.

In contrast to solid bodies, remarkable characteristics of torsion structures are a completely different steadiness and their temporally dissolved identities. It is obvious that a theory of elementary whirl particles subdivides kinematics and dynamics of existing structures from a theory of production and transformation ('Erzeugung und Verwandlung' in Einstein's words). Contrary to naive point-particle models, the new concept allows a fundamentally simple understanding of transformations. While concerning free motion of whole objects only kinematics may be of interest, in particle physics inner forces play the decisive role. Even the indistinguishability of elementary particles of same kind – otherwise a complete mystery – is no longer unintelligible as well as interference and diffraction phenomena.

The torsion model is independent of the question whether such particles may exist as material objects in vacuum or in form of whirl structures in a continuously extended medium. Nature may show both aspects (like spiral nebulae in a background of dark matter). It seems an evident chance that:

– *Elementary particles are whirl structures (torsion particles).*

– *Whirl structures can stay consistent over astronomical periods of time*
due to the conservation of their angular momentum.

– *Like macroscopic whirl structures also microscopic torsion particles are*
subject to processes of production and transformation.

– *During transitional phases, whirl structures lose their identity.*

– *On the one hand, torsion structures are best described*
in some situations as particles.

– *On the other hand, torsion structures are best described*
in some situations as waves.

– *In whirl structures, detailed velocities of their components together with the averaged velocities of their mass centers are realized simultaneously, what quite naturally implies 'uncertainty relations' and indeterminism of a presupposed particle behavior.*

Thus the elementary particles, which are assumed to constitute the entire multiverse, are essentially different from those eternal solid 'atoms' of the pioneering antique philosophers Leucippus and Democritus. Since it is clear that only at the price of unavoidable uncertainties torsion structures can be dealt with as extensionless point particles, a complete relativistic mechanics has to contain a future consistent formulation of quantum theory. As already addressed in SUM14, an appropriate basis will be the bi-metric relativity (Rosen 1940, 1963) after fixation to the (preferred) universal frame.

5. MICROWAVE BACKGROUND OF REDSHIFTED RADIATION FROM DARK MATTER WITHIN A NON-EXPANDING UNIVERSE

If the universe is spatially flat and thus infinite, and if there cannot exist any physical substance without non-gravitational interaction, then SUM – overcoming the ΛCDM concepts of dark matter and 'dark energy' – opens the chance for a CMB origin within a stationary multiverse.

There, all radiation must be emitted *and* absorbed internally. Except for the unrealistic case of complete opaqueness, however, any omnipresent black-body radiation seems impossible because of universal redshift. Several considerations, however, do suggest an origin of the microwave background from everywhere and the existence of such a DM black-body background as predominant radiation emitted stationarily. A tentative CMB approach assumes that this microwave radiation originates essentially from an approximately homogeneous fraction of 'dark'-matter distributed in voids. As well there will be much smaller contributions from the inhomogeneous iDM fraction in halos like those of galaxies or clusters.

The feature that the CMB might be emitted from a macroscopically non-lensing hDM background, should be falsifiable by observations of the SZ effect (SZE) (Sunyaev & Zeldovich 1970, 1980). Unexpectedly in the ΛCDM framework, the Planck 2015 data show a model prediction mismatch between observed and predicted SZ cluster counts (Ade 2015). Previously Lieu, Mittaz, & Zhang (2006) pointed out a puzzling WMAP discrepancy between predicted and detected SZE profiles, reflecting how a cosmological CMB origin could be reconciled with their results. In another context, it has been stated that "Early expectations that measurements of the tSZ effect [...] could be used for precision cosmology now seem naive" (Efstathiou & Migliaccio 2012). Taken together with the Planck 2015 data and other CCM peculiarities it makes sense to reconsider the CMB and in particular its origin again.

5.1. *Mathematical composition*

Apparently the only chance for a mathematical composition of the CMB from unknown universal hDM contributions seems to work as follows.

In a non-expanding stationary multiverse the spectral density of a gravitationally redshifted black body (BB) radiation – where (39) $z = \mathrm{e}^{Hl^*/c} - 1$ – would be

$$\rho_{\nu,\Theta} \equiv \rho_{\nu,\Theta_E/(1+z)} = \frac{1}{(1+z)^{1+\kappa}}\,\rho_{\nu_E,\Theta_E} \qquad (71)$$

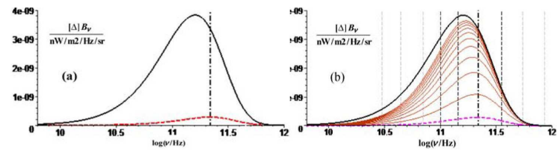

Figure 8. — *Left panel:* The bold solid black line shows the total CMB spectrum according to (75) for $\kappa = 2$ as actually observed. The bold broken red line shows the emission of the hDM radiation exemplarily in a local sphere of $\Delta r^* = 100$ Mpc as calculated from (84).
— *Right panel:* In addition, the thin red solid lines show respective parts coming from *within* $z = Z$. The upper integration limit ∞ of relation (75) is replaced and evaluated there *from bottom to top* by $Z = 0.1, 0.2, ..1.0$ respectively.

inclusive of absorption with constant κ. As usual, emitted frequencies and corresponding temperatures have to be replaced by

$$\nu_{\mathrm{E}} \equiv \nu(1+z)\ \ ,\ \ \Theta_{\mathrm{E}} \equiv \Theta(1+z)\,, \qquad (72)$$

where in accordance with (40) an index '$_{\mathrm{E}}$', indicating 'emission', means any respective quantity at place and time of its origin.

Even in a stationary universe the locally emitted radiation itself has not necessarily to be of pure black body type. Given a frequency-dependent emissivity β_{hDM} ($\nu_{\mathrm{E}} < 10^{12}$ Hz) at a constant mean temperature Θ_{hDM}, the following composition

$$\rho^*_{\mathrm{hDM}\nu} = \frac{8\pi h}{c^3}\int_0^\infty \beta_{\mathrm{hDM}}\left(\nu_{\mathrm{E}}\right)\frac{\nu_{\mathrm{E}}^3}{\mathrm{e}^{\frac{h\nu_{\mathrm{E}}}{k\Theta_{\mathrm{hDM}}}}-1}(1+z)^{-2-\kappa}\mathrm{d}z \qquad (73)$$

leads to a perfect BB spectrum as observed in total of an ideal stationary microwave radiation, where

$$\beta_{\mathrm{hDM}}\left(\nu_{\mathrm{E}}\right) = \frac{h\nu_{\mathrm{E}}}{k\Theta_{\mathrm{hDM}}}\frac{1}{1-\mathrm{e}^{-\frac{h\nu_{\mathrm{E}}}{k\Theta_{\mathrm{hDM}}}}}. \qquad (74)$$

It is easily verified that in case of $\kappa_{(\mathrm{mm})} = 2$ the integration of (73) yields exactly Planck's law.

$$\rho^*_{\mathrm{hDM}\nu} = \frac{8\pi h}{c^3}\frac{\nu^3}{\mathrm{e}^{\frac{h\nu}{k\Theta_{\mathrm{hDM}}}}-1}. \qquad (75)$$

The corresponding attenuation $1/(1+z)^2$ in the mm range would still allow measurements of quasars or radio galaxies (even from e.g. $Z = 6$ there would remain $1/49$ the luminosity).

Regarding Fig. 8 the bold broken red line shows the assumed emission of hDM radiation in a local sphere of 100 Mpc with its maximum photon energy of approximately 0.001 eV just at the SZE thermal null frequency 218

GHz. All respective local contributions taken together would constitute the CMB as statistically observed everywhere in the universe.

In comparison it may be remarked that the lowest mass difference of neutrino oscillations is assumed to correspond to $\sqrt{(\Delta m_{21})^2} \approx 0.008\mathrm{eV}/c^2$ today (Olive et al. 2014). Both values just mentioned, though of neighbored orders in magnitude, may mean nothing, but they do not exclude a chance that neutrinos might be involved in the emission of hDM radiation. If so, then in contrast to the relativistic neutrinos found usually, an unknown energy exchange possibly of oscillating thermal neutrinos might be responsible for interactions of ‘dark’ matter.

5.2. *Split of the CMB emitted within or beyond $z = Z$*

According to its mathematical composition above, there would result a split of the CMB statistically emitted within or beyond $z = Z$. In view of any local observer at $z = 0$ the total Planck spectral density (75) is found by integration of (73) to include two respective parts, where [with substitutions $x \equiv h_\nu/(k\Theta_{\mathrm{hDM}})$, $C \equiv 8\pi(k\Theta_{\mathrm{hDM}})^3/(h^2c^3)$] the part emitted from beyond a redshift distance $z = Z$ results in

$$\begin{aligned} \rho^*_Z &\equiv C\frac{x^3}{\mathrm{e}^{x(1+Z)}-1} \\ &= C\frac{x^3}{\mathrm{e}^x-1}\left\{1-\frac{\mathrm{e}^x\left(\mathrm{e}^{Zx}-1\right)}{\mathrm{e}^{x(1+Z)}-1}\right\}. \end{aligned} \tag{76}$$

Thus ρ^*_Z is seemingly another Planck spectrum at mathematically reduced temperature $\Theta_{\mathrm{Z}} = \Theta_{\mathrm{hDM}}/(1+Z)$. According to (71) it apparently would equal the surface brightness from any black body at redshift Z in local thermal equilibrium with the CMB of constant temperature Θ_{hDM}.

The thin red solid lines of the right panel in Fig. 8 show that by far most of the CMB radiation reaching the instruments would have been emitted within $Z < 1$. The bold red broken line raises the question of hDM particles again which would possibly emit radiation of a probably non-baryonic ‘emissivity’ in the corresponding frequency range.

This idealized local ‘dark’ emissivity $\beta(\nu_{\mathrm{E}})$ as theoretically found in (74) tends to the linear expression $h\nu_{\mathrm{E}}/(k\Theta_{\mathrm{DM}})$ for frequencies $\nu_{\mathrm{E}} \to \infty$. Such a behavior cannot hold over the full frequency range, of course. Therefore in Fig. 8 is used a cut-off with $\beta(\nu_{\mathrm{E}} < 10^{12}\mathrm{Hz})$ according to (74) [otherwise $\beta = 0$] without visible deviations from a perfect Planck spectrum in the observable frequency distribution. The latter is shown here as black solid line.

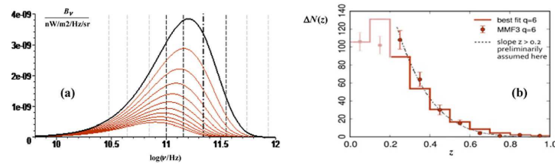

Figure 9. — *Left panel (a)*: The CMB parts ρ^*_Z (78) coming from *behind* $z = Z$ according to SUM. In contrast to Fig. 8 of this paper, thin curved red lines are shown here *from top to bottom* for $Z = 0.1, 0.2, ..1.0$.
— *Right panel (b)*: the Planck “$q = 6$" SZ cluster counts (excerpt from Fig. 4 of the respective Planck paper (Ade 2015) with an assumed slope at $z > 0.2$ added for illustration), where a systematic mismatch appears down from the 3rd redshift bin.

5.3. *Universal radiation equilibrium*

The mathematical solution for a perfect black-body spectrum of redshifted microwave radiation emitted from hDM interaction may be more compactly written

$$\rho^*_{\mathrm{hDM}\nu} = C\int_0^\infty \frac{x_{\mathrm{E}}^4\mathrm{e}^{x_{\mathrm{E}}}}{(\mathrm{e}^{x_{\mathrm{E}}}-1)^2}(1+z)^{-2-\kappa}\mathrm{d}z \tag{77}$$

using the abbreviations $x_{\mathrm{E}} \equiv h\nu_{\mathrm{E}}/(k\Theta_{\mathrm{hDM}}) \equiv h\nu(1+z)/(k\Theta_{\mathrm{hDM}})$, while C is the constant already used before. As well $\kappa_{(\mathrm{mm})} = 2$ still stands for an absorption factor $1/(1+Z)^2$ in the mm range. Correspondingly the mean free path of photons would be $R_H/2$ in this frequency range.

Unexpectedly an energetic equilibrium results for emission and attenuation in the same local shell, thus allowing a statistical energy recycling (possibly including hDM fall into active galactic nuclei). Even the photon energy loss due to redshift seems to be compensated.

On the one hand, according to the SUM concept there has to exist a universal radiation equilibrium. On the other hand – with respect to (71) and in contrast to emission from local black bodies only – it seemed impossible so far to keep a redshifted Planck spectrum of constant temperature Θ_{hDM} within a stationary universe. Now to observe a *universal* BB background in equilibrium with all *local* counterparts, there have to be also non-thermal components, emitted in accordance with (77), where the integration limits may be replaced by Z and $Z + \Delta z$. Comparing the local radiance

$$\Delta B^{*\mathrm{local}}_{\mathrm{hDM}} = \frac{c}{4\pi}\Delta\rho^{*\mathrm{local}}_{\mathrm{hDM}} \tag{78}$$

in a shell of universal thickness $\mathrm{d}r^*$ with the local attenuation $\mathrm{d}A^{*\mathrm{local}}_{\mathrm{hDM}}$, the first is found after a re-substitution of z according to (39). Setting $r^* = 0$, $x = x_{\mathrm{E}}$, and making use of

$$\rho^*_{\mathrm{hDM}\nu} = \frac{\mathrm{d}\rho^*_{\mathrm{hDM}}}{\mathrm{d}\nu} \tag{79}$$

it follows

$$\Delta B^{*\mathrm{local}}_{\mathrm{hDM}} = \frac{2(k\Theta_{\mathrm{hDM}})^4}{h^3c^2}\frac{\Delta r^*}{R_H}\int\limits_0^\infty \frac{x_{\mathrm{E}}^4 \mathrm{e}^{x_{\mathrm{E}}}}{(\mathrm{e}^{x_E}-1)^2}\mathrm{d}x_{\mathrm{E}}\,. \quad (80)$$

With the bolometric radiance of hDM black-body radiation

$$B^{*\mathrm{SB}}_{\mathrm{hDM}} \equiv \frac{2\pi^4}{15}\frac{k^4\Theta^4_{\mathrm{hDM}}}{c^2h^3} \quad (81)$$

according to Stefan-Boltzmann's law, relation (80) yields

$$\Delta B^{*\mathrm{local}}_{\mathrm{hDM}} = 4B^{*\mathrm{SB}}_{\mathrm{hDM}}\frac{\Delta r^*}{R_H}\,. \quad (82)$$

Expression (82) now turns out to equal the local attenuation $\mathrm{d}A^{*\mathrm{local}}_{\mathrm{hDM}}$, because the effective attenuation in total of the hDM radiation (75) is due to local absorption *plus* local redshift

$$\Delta A^{*\mathrm{local}}_{\mathrm{hDM}} = (2+\kappa)\frac{2(k\Theta_{\mathrm{hDM}})^4}{h^3c^2}\frac{\Delta r*}{R_H}\int\limits_0^\infty \frac{x_{\mathrm{E}}^3}{\mathrm{e}^{x_{\mathrm{E}}}-1}dx_{\mathrm{E}} \quad (83)$$

resulting in

$$\Delta A^{*\mathrm{local}}_{\mathrm{hDM}} = (2+\kappa)B^{*\mathrm{SB}}_{\mathrm{hDM}}\frac{\Delta r^*}{R_H}\,. \quad (84)$$

Given the assignment $\kappa = 2$ again, then – unexpected in these details – there is an energetic equilibrium for emission and total local attenuation in the same shell

$$\Delta B^{*\mathrm{local}}_{\mathrm{hDM}} = 4B^{*\mathrm{SB}}_{\mathrm{hDM}}\frac{\Delta r^*}{R_H} = \Delta A^{*\mathrm{local}}_{\mathrm{hDM}}\,. \quad (85)$$

This result however, seems to imply the strange compensation also for energy loss by redshift mentioned above. The reason is that the factor $[2+\kappa_{(\mathrm{mm})}]$ in (84) has to be regarded in the relevant mm range an effective 'extinction coefficient' $\kappa_{\mathrm{effective}}$, where according to (42) its first summand "2" clearly originates from redshift. As stated in Section 2.6, one part of the latter is caused by local time dilation and the other part by the quantum mechanical energy-frequency relation of photons equivalent to (41).

Furthermore, the same result (85) would even suggest the possibility of a tentative answer to the general question, where the energy of any redshifted photons might be partially lost before they are absorbed anywhere in the multiverse. In view of SUM the seeming deficit would effectively correspond to the analogous outcome of ordinary gravitational redshift, where the 'kinetic' photon energy is partially converted to 'potential' energy and vice versa. Here it would be presupposed, that there must be an effective statistical energy re-cycling back from stellar radiation to keep the stars shining, though not forever the same.

It is simply wrong to claim an expanding universe necessary for a solution of Olbers' paradox. This has been easily shown (Ostermann 2003b) by explicit direct calculation on base of relation (42) above.

5.4. *Expected anisotropies, fluctuations, inhomogeneities*

In accordance with the new concept, universal microwave radiation originates from 'dark' matter, whose vast isothermal main part is distributed homogeneously (hDM instead of the assumed 'dark energy'), while a smaller inhomogeneous part, iDM, seems gravitationally condensed to halos (usual 'dark matter'). Thus in view of (73) - (75) old arguments against CMB emission from individual sources become meaningless. While here is no horizon concerning the infinite universe as a whole, stationary features may include some fiducial lengths to explain the CMB anisotropies. In any case this chance seems also to imply acoustic hDM oscillations.

Though such oscillations are easily conceivable within voids, there cannot be an unnecessary consistent phase coherence of fluctuations all over the infinite universe. If it were not for peculiarities like in particular the low-multipole alignments (Schwarz et al. 2015) ('axis of evil'), a hemispherical power asymmetry or e.g. the strange 'cold spot', it might seem an unreasonable attempt to question the assumed single-bang origin of the CMB and thereby the exceptionally successful inflationary ΛCDM cosmology.

Any structure at a universal ('comoving') distance of about 70 times its diameter, however, is observed at about a scale angle of 0.8° on the sky, as might roughly apply from e.g. galaxy halos at cluster distances, up to large voids at Hubble distance $R_H \equiv c/H$, or particularly from cluster distances themselves in the transition zone to universal homogeneity at $Z \approx 0.1$ (order 400 Mpc). Accordingly the anisotropies of the temperature distribution in the microwave background may be caused by acoustic hDM oscillations in voids or also by the well-accepted existence of resolvable iDM halos. Analogously to ΛCDM cosmology – though the other way round – also an appropriate SUM transfer function will contain information including a set of quite a few adjustable parameters relating the CMB as actually observed to the distributions of luminous and 'dark' matter. The chance for a corresponding explanation of the CMB anisotropies as correlated to e.g. baryon acoustic peaks (Eisenstein et al. 2005), seems almost evident by taking a glance at Fig. 14-e of Sharp (1986) if compared to Fig. 7 of WMAP (Bennett et al. 2003). This will need detailed further investigations.

The possibility for both kinds of dark matter of whether or not lumping together might correspond to a different behavior of e.g. thermalized or non-thermalized neutrinos. Therefore again, the whole microwave background has to be newly considered without ΛCDM priors.

Measuring a redshift dependence of the CMB monopole temperature using the tSZ effect in the CCM framework (de Martino et al. 2012; Luzzi et al. 2015) does mean little or can be even misleading. The CCM-assumed development of the CMB monopole temperature seems as questionable as the assumed temporal development of universal iron content from population III to population I stars (s. remarks in Section 2.7). Corresponding results as reported by e.g. Noterdaeme et al. (2011) have to be reviewed with regard to particularly Sato et al. (2012) and also in view of the strange Planck spectrum ρ^*_Z observed from behind distant clusters at a remarkably coincident temperature difference $\Theta_Z = \Theta_{\mathrm{hDM}}/(1+Z)$ as found in (76) above.

It may be remarked, that if dark matter was built of e.g. thermalized neutrinos, then it might be possible to disprove the big-bang origin of the CMB directly by identifying these hDM particles emitting the CMB or by detecting any such photons within shielded cavities (today assumed to come from $z > 1000$). A preliminary assessment on base of relation (82) would yield about 10 locally emitted hDM photons a year within a 1000-m^3 tank (in rough order of magnitude; ideally such a 'surrounding detector' would have to be cooled below 2.7 K). The unavoidable thermal radiation emitted from any respective measuring device, however, will make a clear classification of single photons most likely difficult if not impossible in that frequency range.

6. THE PLANCK 2015 MODEL PREDICTION MISMATCH OF SUNYAEV-ZEL'DOVICH CLUSTER COUNTS

The Planck 2015 model predictions do not match the observed Sunyaev-Zel'dovich cluster counts well. The discrepancy increasing towards lower signal-to-noise thresholds suggests that the data favor a steeper slope. The question is whether this behavior could be in better agreement with a alternative Planck microwave background mathematically composed of redshifted radiation from homogeneous 'dark' matter within a stationary multiverse. The SZE amplitude would appear continuously reduced to higher values of z due to an ab-

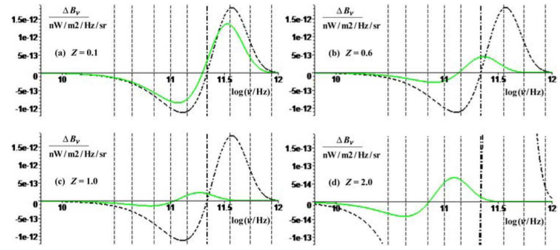

Figure 10. *Panels (a),(b),(c),(d):* — The curved green lines show the isolated pure thermal SZ-SUM effect ΔB_ν for various values of redshift with spectral function $g(x_{\mathrm{E}}) = x_{\mathrm{E}}^4 e^{x_{\mathrm{E}}}[x_{\mathrm{E}} \coth(x_{\mathrm{E}}/2) - 4]/(e^{x_{\mathrm{E}}} - 1)^2$ shifted according to $\Theta_{\mathrm{Z}} = \Theta_{\mathrm{hDM}}/(1+Z)$ of *radiation from behind* (a) $Z = 0.1$, (b) $Z = 0.6$, (c) $Z = 1.0$, (d) $Z = 2.0$ without any additional inhomogeneities. The respective curved dashed black line in all panels indicate the SZE as expected in ΛCDM cosmology [note that the vertical scale in panel (d) is reduced by a factor of ten].

sorption constant $\kappa_{(\mathrm{mm})} = 2$ in the mm range together with a SUM frequency shift.

Though increasingly weakened with redshift, however, the modified effect would stay present in any hot-gas cluster due to full local CMB, while a gradual shift of the SZ spectral profile to lower frequencies seems ruled out at first sight. But with respect to the subtraction of unavoidable noise and various 'foregrounds', a definite clarification turns out to be more difficult than expected.

The bold black line on top of Fig. 9(a) shows the total CMB spectrum as actually observed (the vertical dashed lines mark the nine Planck frequencies), while thin red solid lines show *top down* statistical respective parts of the universal hDM radiation *coming from behind* $Z = 0.1, 0.2, \ldots 1.0$. These parts ρ^*_Z decrease with distance according to relation (76). The other way round, by far most of the BB radiation reaching telescopes would have been emitted within $Z < 1$. In Fig. 9(b) the curved dashed black line is added for illustration to the Planck-2015 model prediction mismatch of Sunyaev-Zel'dovich cluster counts (Ade 2015), numerically unexpected in high precision ΛCDM cosmology.

6.1. *The isolated thermal SZ effect in the SUM framework*

A pure thermal Sunyaev-Zel'dovich effect from a 'dark' matter microwave background, according to SUM composed of redshifted universal radiation, may be briefly discussed at first. In each cluster the full local CMB radiation is subject to inverse Compton scattering. According to (71), (76) all particular clusters may be regarded as local 'sources' of the SZE signal at redshift Z. With respect to Section 5 the SUM counterpart to the well-known traditional SZE should appear increasingly reduced at high redshifts according to

$$\Delta I^{\rm SZ}_{\rm SUM} = I_0 y \frac{g(x_{\rm E})}{(1+Z)^3}\,, \tag{86}$$

where y is correlated as usual to cluster masses, the latter often unknown – s. also Melia (2016c,d) – and $g(x_{\rm E})$ arises from

$$g(x) \equiv \varepsilon(x)\cdot f(x) \equiv \frac{x^4 {\rm e}^x}{({\rm e}^x-1)^2}\cdot\left[x\coth\left(\frac{x}{2}\right)-4\right] \tag{87}$$

after replacing x by $x_{\rm E} \equiv h\nu_{\rm E}/(k\Theta_{\rm hDM}) \equiv h\nu(1+z)/(k\Theta_{\rm hDM})$. Regarding the Planck results as well as previous measurements (Vanderlinde et al. 2010) however, frequency shifts according to (86) are exemplarily shown in Fig.s 10(a)-(d) for $y = 10^{-4}$.

Like in ΛCDM cosmology a temperature Θ of radiation coming from behind Z is observed at $\Theta_Z/(1+Z)$; the difference is, that here applies $\Theta_Z = \Theta_{\rm CMB} =$ *constant* $(= \Theta_{\rm hDM})$. According to the tentative approach above, the total hDM radiation of macroscopically non lensing sources is constituting the SUM Planck spectrum statistically. Hence the green solid lines in Fig. 10 should be considered as *isolated pure thermal SZ effects*. In contrast to the ΛCDM cosmology, however, additional 'primordial' microwave inhomogeneities will also arise between cluster and observer.

6.2. *The realistic SZ effect among other CMB distortions*

From relations (73), (74), the SUM contribution of one spherical shell to the CMB blackbody spectrum is

$$\begin{aligned}\Delta\rho^*_{\rm HDM\nu} &= C\int\limits_Z^{Z+\Delta Z} \varepsilon(x_{\rm E})(1+z)^{-2-\kappa}{\rm d}z \\ &\approx C\frac{x^4{\rm e}^{x_{\rm E}}}{({\rm e}^{x_{\rm E}}-1)^2}\Delta Z\end{aligned} \tag{88}$$

what thus may imply isothermal fluctuations of order 10^{-4} within respectively ≈ 100 kpc.

It is remarkable that for $z = 0$ the integrand of (73), (77), or (88), which leads to the observed CMB Planck spectrum, equals the well-known SZ-factor $\varepsilon(x)$ of $g(x)$ in (87) exactly. This seems indication that a *universal* SZ effect might be essentially involved in the origin of the CMB within a stationary multiverse, where a mean Comptonization parameter $y_{\rm universal}$ due to the natural ionization of hot intergalactic gas may exist. While once has been discussed an origin of the CMB from radiation thermalized by e.g. iron whiskers in the SST framework, only in combination with a universal SZ effect there might be a chance to get a Planck spectrum of such a redshifted radiation coming from cosmic distances.

A more complete spectral distortion of the microwave background according to SUM should be written as

$$\frac{\Delta I_{\rm SUM}}{I_0} = y\frac{g(x_{\rm E})}{(1+Z)^3} + X_{\rm back}\varepsilon(x_{\rm E}) + X_{\rm fore}\varepsilon(x_{\rm fore})\,, \tag{89}$$

since, given a CMB origin within the multiverse, one has to discern between inhomogeneities in the 'back'-ground and those in the 'fore'-ground of any SZ-clusters. It is important to realise, that the latter may compensate a SUM frequency shift as shown in e.g. Fig. 11(b).

It may be remarked that the assumed redshift $Z = 0.6$ of Fig.s 10(b), 11(b) corresponds only coincidentally to that of SPT-CL J2344-4243 (Phoenix Cluster, the most X-ray luminous cluster known in the universe, whose SZE has been detected with a signal-to-noise ratio (SNR) of $\xi = 27.44$ in the SPT-SZ Survey (Bleem et al. 2015), while a SNR-value of $\xi = 6.73$ is given in the Planck data psz1v2_1). It has to be noted, too, that any resolvable contribution of the additional CIB if observed e.g. from this Phoenix Cluster, may not be resolvable if observed from the solar system due to uncertainties described by relation (89). No doubt that there is a plenty of corresponding distant point sources. As well, any exact distinction between the CMB and CIB can hardly make a clear sense (Ostermann 2014) particularly in the overlapping frequency range, where the CIB contributions do not completely vanish at all (Hauser & Dwek 2001; Wright 2004; Kashlinsky 2005).

The second summand in (89) corresponds formally to a *kinematic* SZ effect in the SUM framework. Here, however, not only the numerical modification is of interest but also the contribution of the low-z environment to the 'local part' of the CMB, which might raise questions particularly in the context of an assumed 'dark flow' (Tsagas 2011; Kashlinsky et al. 2012).

Originally, the aim of SZ cluster surveys has been to detect previously unknown galaxy clusters via the thermal SZ (tSZ) effect at frequencies mostly below 218 GHz. Now the Planck data encompass nine frequencies (s. vertical broken lines in Fig.s 8 - 11). At frequencies from 353 GHz, however, the radiation is increasingly dominated by galactic and extragalactic emission as stated in Planck-XIII (Ade 2015). In the 220 GHz SPT-SZ maps the relative noise levels were found too high to significantly improve cluster detection (Bleem et al. 2015).

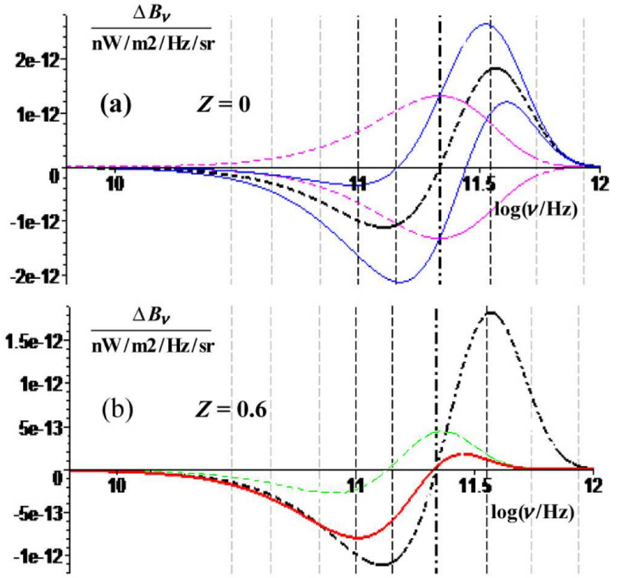

Figure 11. The realistic SZ effect among other CMB distortions like e.g. re-shifting inhomogeneities.
– *Upper panel (a):* Isothermal CMB fluctuations of order $y \approx 10^{-4}$ are plotted in faint red, while the thin curved blue and grey lines show changes of the local SZE.
– *Bottom panel (b):* As stated by relation (89) this highly important Figure demonstrates a possibly resulting realistic SZ signal as bold red line ($X_{\rm back} \approx -5 \cdot 10^{-5}$) where SUM's isolated frequency shift according to the broken green line [s. also Fig. 10(b)] seems largely compensated by such a random 'back'-ground inhomogeneity (lower intensities might be understood as lower y's).

Correspondingly cluster searches have been mostly relying on smaller frequencies before. Since SZ-measurements in the bands ≥ 218 GHz are particularly problematic, in view of unknown individual masses or re-shifting CMB inhomogeneities these seem to make no clear differences between both alternatives of the tSZ particularly in count ranges $z < 1$. So it cannot be excluded, that actually the Planck 2015 model prediction mismatch might partially arise from a correspondingly reduced signal-to-noise ratio. Planck's major objectives – encompassing tests for theories of inflation and providing a direct probe into the Concordance Model's initial inhomogeneities – have been exclusively focused on the ΛCDM cosmology so far.

According to Fig. 10, using frequency bands respectively up to 143 GHz, 100 GHz, 70 GHz, 44 GHz, or 30 GHz, a SUM cluster search should straightforwardly apply up to $Z \approx 0.1$, $Z \approx 0.6$, $Z \approx 1$, $Z \approx 2$, $Z \approx 3$ even without any re-shifting inhomogeneity in spite of SUM's SZ frequency shift increasing with Z. Thus actually without taking any additional inhomogeneities into account, the SUM-SZE would stay definitely detectable also at e.g. $Z = 1.9$ (XLSSU J0217-0345) using the same 30 GHz band as in Mantz (2014). This can be seen from the last panel (d) of Fig. 10 (where the vertical scale is reduced by a factor ten).

Even if there were found any particular SZ clusters at $z > 2$ showing e.g. a 143 GHz signal as conventionally expected, this could not be a certain disproof for the tentative SUM approach according to (89) of this section.

So far, primarily clusters were found best showing a SZ signal as assumed in ΛCDM cosmology of course. Anyway, however, also the risk of another significant selection bias has to be taken into consideration (Rossetti et al. 2015). Particularly in view of the Planck 2015 cluster count prediction mismatch it appears doubtful whether the data can be fully explained without ascribing any more *ad-hoc* features to the 'big bang' universe.

Since the alternative CMB solution requires an attenuation $1/(1+z)^2$ of intensity in the mm range [due to $\kappa_{(\rm mm)} = 2$ in addition to the usual photon energy loss by redshift], it is possible that a gradual reduction of the SZ intensity (in total up to about 15% the value expected for clusters at $z = 1$) should lead to a steeper $'q = 6'$ slope in the Planck 2015 prediction down from the 3rd redshift bin as illustrated in Fig. 9(b) above, while other 'free' parameters might be adjustable to match the absolute values of the first and second redshift bin, too. Therefore this tentative CMB approach to the microwave background should be testable in particular by evaluation of the SZ data streams still split up for each distinct Planck frequency channel on its own. Such a test, however, can only convincingly work by future consideration of the full SUM framework, too (Battistelli et al. 2016).

7. DISCUSSION AND CONCLUSION

Several facts which are assumed as main pillars seem to prove 'big bang' cosmology beyond all doubt. Almost as strong as those pillars, however, as weak seems some ground. There are fundamental problems of single-bang cosmology suggesting a paradigm shift to SUM as the mathematically simplest alternative based on Einstein's equations with no need for universal expansion:

(a) a scalar inflaton field, in experiments never observed, necessary to solve the problems of spatial flatness and unacceptable horizons among other difficulties,

(b) 'anthropic' features, which need an unreasonable fine tuning of big-bang cosmology, in particular concerning the assumed coincidental 'age of the universe' equaling the Hubble time just only today,

(c) an *imperfect* cosmological principle unnecessarily excluding time from universal symmetry,

(d) above all the baryon asymmetry contradicting an assumed origin either from nothing or from vacuum fluctuations not represented by any known line element of Einstein's equations (in contrast to SUM).

Since hardly a physicist today still believes in a single-bang cosmology, many of them are seeking refuge in fictive 'parallel universes'. This, however, seems only a defensive half-hearted pretext actually to conceal the acceptance of one all-embracing universal background instead a 'big bang' creation out of nothing. Effectively in form of one multiverse, only SUM's stationary line element (4) is providing the chance for an appropriate relativistic counterpart. In this framework, particular problems seem to disappear or, at least, are seen in different light. Several of them have been explicitly addressed in the various sections of the paper on hand:

- The problem of cosmic redshift and universal expansion
- The problem of misleading pseudo-proper FLRW cosmologies
- The problem of one singular 'big bang'
- The problem of real dark matter particles
- The problem of hypothetical 'dark energy' from Einstein's 'biggest blunder'
- The problem of *two different* values for the CCM Hubble 'constant' H_0
- The problem of *one ignored significant* Hubble constant
- The problem of a physical origin for the microwave background within the universe
- The problem of a universal CMB rest frame
- The problem of entropy in non-evolutionary processes
- The problem of purely fictional 'parallel universes'

All of the problems above are far from being solved in ΛCDM single-bang cosmology, which seems only got used to them. Historically these unexplained features may have been widely accepted in view of unfortunately no arguable alternative so far. In consequence, there is a serious risk to accept even more unphysical hypotheses to escape any new dilemma of unwelcome future results.

Now with SUM obviously representing the only arguable stationary cosmological solution of Einstein's original equations without a cosmological constant, there is no need for 'dark energy'. The new model also offeres an alternative concept for a perfect black-body CMB composed of redshifted microwave radiation, which allows to decide whether or not the CMB once originated after a 'big bang', or whether, the other way round, the CMB is emitted from dark matter within a non-expanding background multiverse.

Concerning both SZ effects, also the results of Lieu et al. (2006), or a 'dark flow' (Kashlinsky et al. 2012), had already raised doubts in the 'big bang' origin of this radiation. According to SUM this is assumed to be only a special part of extragalactic background light. Corresponding numerical SZ modifications primarily in the high-z range have been derived in Section 6. Taking into account the natural DM inhomogeneities, there is apparently no clean SZE, except for many clusters at $z \ll 1$ (like e.g. Abell 2319 at $z = 0.056$ whose multi-band observations are shown on ESA's web page exemplarily). Selected low-redshift clusters, however, prove the existence of such an effect not only in ΛCDM cosmology but as well in the SUM framework, too.

Important CCM features resorting to peculiar phases in the assumed history of the universe have to be alternatively explained by selection effects – including Malmquist biases together with various forms of attenuation – or by *local cosmic evolution* possibly with peculiar flows.[2] For example, the observed distributions of quasars or Lyman-α blobs are briefly addressed in Section 2.9. The SNe-Ia breakthrough at the turn to the 21st century will not remain the last unexpected cosmological discovery forever.

According to SUM our cosmos can be only a known part of the stationary background multiverse today. An infinite number of many such areas might arise and pass by in such a 'multiverse' again and again, just like the stars, galaxies, clusters, and all individual beings therein. There is a struggle of ultralarge-scale entropic balance against local evolution with no need for a physical beginning of space and time themselves.

If Einstein's original equations had been accepted *without* his 'biggest blunder' of a cosmological constant, then the SNe-Ia measurements would have confirmed SUM straightforwardly.

After the science-fiction breaking Hossenfelder wake-up call, the central question reamains: What does the

[2] In contrast to the natural search for the vital history of our cosmos it does not make sense to search for a continuous history of the entire universe. The discovery in our Milky Way of SMSS 03132-6708 (Keller et al. 2014), with an age concluded to be about 13.6 Gyrs, raises serious doubts in formation particularly of a star only 200 Myrs after the alleged 'big bang' of the universe (a previous observation has been that of HD 140283, the 'Methuselah star' (Bond et al. 2013), with an assumed age of even 14.46 ± 0.8 Gyrs). In the context of the assumed ages, it may be mentioned that according to SUM the maximum mean universal lifetime of macroscopic structures should be $T_H \equiv T_{\rm SUM} \equiv 1/H_{\rm SUM} \approx 14.6$ Gyrs (instead of $T'_{0-\rm CCM} \approx 13.8$ Gyrs).

TABLE 1

The Stationary Universe Model (SUM) in comparison with the current Cosmological Concordance Model (CCM)

Some characteristic FEATURES (list extensible)	**Model of a STATIONARY BACKGROUND UNIVERSE (SUM)**	**Concordance/Consensus Model of OUR COSMOS (CCM)**
line element - - - *scale factor* (for $\Omega_{\rm rad}=0$)	$\mathrm{d}s^*_{\rm SUM} = \mathrm{e}^{Ht^*}\mathrm{d}s^*_{\rm SRT}$ - - - $a_{\rm SUM} = 1+Ht'$	$\mathrm{d}\sigma^2_{\rm CCM} = c^2\,\mathrm{d}t'^2 - a^2_{\rm CCM}\,\mathrm{d}l^{*2}$ $a_{\rm CCM}(t') = \left\{\left(\frac{1}{\Omega_\Lambda}-1\right)\sinh^2\left[\frac{1}{2}\ln\left(\frac{1-\sqrt{\Omega_\Lambda}}{1+\sqrt{\Omega_\Lambda}}\right)-\frac{3}{2}\sqrt{\Omega_\Lambda}Ht'\right]\right\}^{1/3}$
t^*, l^*	universal time, universal space	conformal time, 'comoving' space
model parameters	natural constants c, G, H	independent parameters T_0, H_0, q_0, Ω_0, $\Omega_{\rm M}$, Ω_Λ, (several additional parameters of inflation)
cosmological constant (*dark energy*)	– none – (homogeneous background of 'dark' matter)	$\Omega_\Lambda \approx 0.73$, value coincidental if not determined by SUM 'boundaries'
redshift of starlight from sources at rest (*in 'comoving' coordinates*)	$z = \mathrm{e}^{Hl^*}$, where $l^* = \mathrm{constant}\vert_{t^*}$, independent of time, directly showing stationarity*⁾	$z = z(t', l^*)$, dependent on time [as well as all functions of z, e.g. $H(z)$, $q(z)$, …]
H	galaxies at rest in the universal ('comoving') frame imply $H_{\rm s} \equiv \dot{a}$ with the constant $H \equiv H_{\text{s-SUM}}$ as the *significant* Hubble parameter	both the significant parameter $H_{\text{s-CCM}}$ as well as the *conventional* Hubble parameter $H_{\text{c-CCM}}(t') \equiv \dot{a}/a$ depend on time
space and time	$\equiv T_H$, R_H maximum age/radius of structures subject to any SRT concepts	$T_0 \approx T_{H0}$ the age, $R_0^* \approx 3.4\,R_{H0}$ the radius of 'the universe' today
H_0T_0	$HT \equiv 1$ due to stationary values $H_0 \equiv H$ and $T_0 \equiv 1/H$	$H_0T_0 \approx 1$ coincidentally today (a temporary value)
'deceleration' parameter $q \equiv -a(\mathrm{d}^2a/\mathrm{d}t^2)/(\mathrm{d}a/\mathrm{d}t)^2$	according to postulate I of stationarity*:* $q \equiv 0$	assumedly *positive* after 'big bang', *negative* while inflation, then *positive* for some 10^9 years, *negative* today again (uncertain for the future)
initial singularity	none with respect to universal coordinates, local pseudo-singularities instead, modified by quantum mechanics (breakdown of proper length and time)	unexplained origin in one 'big bang' concerning the entire universe, or 'big bang' from e.g. chaotic inflation within a background unexplained in GRT
spatial flatness	deduced from postulate II of a constant universal speed of light $c^* = c$	approximately after a phase of 'superluminal inflation'
horizon problems	none	overcome by 'superluminal inflation'
law of entropy	restricted to *any* evolutionary environments	restricted to *one* evolution after 'big bang'
'black holes'	supermassive (active) gravitational centers, 'bright sources', QM retains matter from vanishing forever	limits of phenomenological GRT-applicability like e.g. the Schwarzschild-radius (accepted there to limit physical reality again)
CMB	from homogeneously distributed 'dark'-matter, (anisotropies, acoustic oscillations, voids, halos)	'big bang' relic radiation, anisotropies caused by acoustic oscillations (ad-hoc fitted inflation)
Sunyaev-Zeldovich effect	reduced to higher values of z, with gradual shift, (direct agreement at low-z clusters)	undiminished signal, indpendent of redshift (Planck-15 cluster count mismatch, 'dark flow'?)
n-bamg nucleosynthesis	ongoing re-creation from 'local-bang' events in the stationary universe (multiverse)	only one 'big bang' of the entire universe
straight-off compatibility with the SNe-Ia data (if *local Hubble contrast*...)	$0.1 < z < 1.8$ excluding the local region z < 0.1 (… then $0.01 < z < 1.8$)	$0.01 < z < 1.8$ the full range of observational data (… then $0.025 < z < 1.8$)

NOTE. – *⁾ The stationary model SUM should not be confused with the 'Steady-state' Theory (SST) whose e.g. redshift parameters depend on time.

dilemma of today's mainstream physics mean in reality? Conclusions from SUM – completely new in contrast to the fictitiously asssumed big bang – allow for a solution in principle of the most puzzling questions of today's Lambda-CDM Concordance Cosmology, which after a paradigm shift to SUM might be resolved at one blow:

* matter-antimatter baryon asymmetry is a natural fact in a stationary universe without need for justification.

* cosmological redshift without universal spatial expansion is due to another kind of ordinary gravitational redshift

* 'dark energy' may be a homogeneous distribution of e.g. neutrinos (or other WIMPs) filling the gap to critical density

* dark matter seems constituted by neutrinos (thermalized in parts)

* SNeIa magnitude vs. resdshift measurements are requiring two Hubble 'constants' (the local and the universal one) particularly instead of one accelerated expansion ('Hubble trouble')

* the Planck spectrum from a black-body background of redshifted microwave radiation should be emitted within a non-expanding multiverse

* the law of entropy seems restricted to evolutionary processes (without conflict against any laboratory experience – time after time allowing for 'primordial' nucleosynthesis in 'multi bang' processes of re-creation)

* SUM may describe a local-bang 'multiverse' (which is just another word for actually one universe with multiple cosmoses).

Kant answered the decisive question of today's dilemma in natural science: "Enlightenment is man's emergence from his self-incurred immaturity." He argues that the immaturity is self-inflicted not from a lack of understanding, but from the lack of courage to use one's reason, intellect, and wisdom without the guidance of another. He exclaims that the motto of enlightenment is "Sapere aude"!

A brief review together with some remarks on the underlying concept, its origin and related earlier attempts is given in Appendix A. In any case it is no longer possible to take the sheer existence of a black-body microwave background radiation as a certain proof for a big-bang origin of the universe.

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A. SOME CONCLUDING REMARKS ON THE SUM CONCEPT AND ITS ORIGIN

It is hard to believe that Einstein's equations should definitely fail to describe a stationary background while, on the other hand, it is widely assumed today that something like quantum fluctuations existed, before according to the CCM a 'big bang' had taken place. A 'false vacuum', however, would have been anything but empty space, thus requiring its own line element in the framework of Einstein's gravitational equations.

From a lack of clear observations suffer several more fundamental CCM features, too, here only to mention the assumed 're-combination' (following the miraculous 'big bang' but then compensated after a 'dark phase' by 're-ionization' necessary to reflect actual reality).

The difference to be not static but stationary now provides the chance for one 'multiverse'. When Einstein developed his first relativistic cosmology (Einstein 1917), he tacitly took for granted an eternal universe according to what later has been called the 'perfect cosmological principle' in the SST. In the meantime, with Friedman (n,n) relativistic cosmology had turned to temporal evolving solutions of Einstein's equations. These solutions were supported by Hubble (1929) whose law has been actually found by Lemaître in 1927 (about a decade after Slipher's early discovery of galaxy redshifts). Once the 1917 cosmological constant was finally discarded by Einstein & de Sitter in 1932 a pressureless flat-space model (EdS) has been proposed. In contrast to previous approaches, then Bondi & T. (1948) as well as in particular Hoyle (1948, 1949) tried to reconcile the 'expanding' universe (Lemaître 1931a,b,c) with the concept of a 'steady state', which model soon after was deplored almost hastily to conflict with observational facts (for details Hoyle et al. (2000); Weinberg (1972)). Recently Nussbaumer (2014) has revealed that in 1931 Einstein temporarily thought to have found the solution for a "stationary, dynamic universe in expansion" thereby anticipating the SST with regard to an assumed steady particle creation out of the vacuum (governed by his cosmological constant Λ representing an energy reservoir corresponding to 'dark energy' today). In this context Einstein's meaningful attempt to a "stationary, dynamic universe" seems highly enlightening, because apparently for the first time he clearly realized that 'stationary' does not imply a 'static' universe. Correspondingly the stationarity of SUM does not at all mean literally a 'steady state', but a lively process instead. The term 'stationary' has to be understood to describe an eternal background where, necessarily in an ongoing interplay with quantum mechanics – resulting in local gravitational recreation events – each evolutionary cosmos may take a limited life time.

While in sense of natural philosophy Einstein was clearly right to assume a universe without peculiar history, his static solution has been an unnecessary assumption. At those times it has been correspondingly assumed that stable radiationless atoms should be static, while the characteristic feature in both cases turned out to be stationarity after all. Lemaître's 'primeval atom' (Lemaître 1931c) would have been in a universal multiplicity, though not as a mere singularity (this nonphysical overstatement has been assumed only later). Contrary to the 'single-bang' concept underlying the CCM, there is the suggesting possibility of 'multi-bang' events instead, which may have taken – and will take – place within the one and only stationary background multiverse.

Free of any coincidences or horizon problems and with no need for a universal phase of inflation, SUM is capable of embedding our own evolutionary cosmos into an upcoming stationary 'tohu-va-bohu' multiverse. Actually no explicit line element other than that of SUM has been found to provide such a background (also for assumed 'vacuum fluctuations', if necessary).

It seems almost a miracle, that on basis of Einstein's equations the idea of an infinite stationary multiverse turns out to imply clear indication that individual cosmic structures are of *finite* dimensions in space and time. It is in particular this conclusion that arises from the interplay of local special relativity (macroscopically representing quantum mechanics) and universal general relativity (representing gravitation). The unexpected feature is that – describing our cosmos as part of a stationary multiverse – the same mathematically structured model is bringing ideas of various cultural areas to mind about existence of the universe and creation of cosmoses. While these ideas seem implausibly unbalanced in the prevailing single-bang standard approach, the new concept SUM, if understood in sense of a Tao Cosmology, seems naturally incorporated into the picture of a multiverse as an oscillation of forces, which might be philosophically also named Yin and Yang.

The fact that SUM stand for a stationary background is most clearly revealed in universal coordinates instead of those in a misleading pseudo-proper FLRW form [developed in general by Friedman (n,n); Lemaître (1927, 1931a,b,c); Robertson (1935, 1936); Walker (1936)].

According to Occam's law of parsimony ('Occam's razor'), it is a proven intellectual requirement to select among competing models the one with the fewest unprovable assumptions (in addition to an instructive CCM overview by Schneider (2006), Table 1 above may give some alternative hints). It seems that only the stationary solution SUM offers the chance of keeping a modified CCM as a description of our cosmos without having to assign all of its implausible features to the entire universe.

Now there is a realistic chance to check evidence for a CMB origin essentially from $z \ll 1000$, thus possibly disproving the whole 'single'-bang concept.

In addition to today's standard cosmology, there has been a chaotic inflationary approach where some early papers once also referred to a "stationary universe model" (Mezhlumian 1993, 1994; Linde & Mezhlumian 1993; Linde et al. 1993). Besides this heading expressing a corresponding intention, however, that approach is quite different from the SUM proposed here. Instead, it seems to give rise to those disconnected fictional 'parallel universes' of inflationary scalar fields already mentioned above. Each of them should be described by a variant of today's ΛCDM model respectively. The one fundamental relativistic line element of a coherent background is missing. On the other hand, in view of SUM, it is a big advance of the 'chaotic inflation' concept (Linde 1983) that has established something like a universal background at all, though only in form of mere quantum fluctuations (Mukhanov & Chibisov 1981) in a physically unknown inflaton field. Nevertheless the concept of a singular 'big bang' has been effectively overcome.

Though Melia's '$R_h = ct$' concept falls short of achieving the overdue paradigm shift from today's ΛCDM 'big-bang' model to that of a stationary universe (SUM), it has provided important insights together with valuable criticism of the standard cosmology.

In accordance to SUM as the cosmological model of general *and* special relativity theory, there would be alternating processes of evolution and revolution all over the multiverse, the latter processes possibly in quasars, 'black holes', SMOs and AGNi, hot core structures before blown up to bubbles, or also in hypernovae leading even to 'local-bang' cosmoses, which respectively are the largest structures of conjoint local origin.

On the one hand without the invaluable SNe-Ia measurements, the SUM concept would have not been developed to an arguable level. On the other hand without the conscientious evaluation of the 2015 SZ data by the Planck collaboration, the chance to elaborate this falsifiable concept would not have arisen. In addition to overwhelming discoveries and the achievements of observational cosmology in the last decades, now new evaluations, future telescopes, and perfected devices will decide after all. The risk has to be taken into account, however, that in spite of even higher precision, several phenomena if taken separately without the respective fundamental context might stay ambiguous in their interpretation.

Independent of SUM there are at least six fundamental challenges for modern cosmology waiting for ultimate clarification:

(I) The redshift of galaxies does not prove a real Doppler effect due to a spatial expansion of the entire universe. Just as little it can prove a hypothetical big-bang origin out of nothing [there have been refuted only false alternatives thus far, while using a Tolman surface brightness test (Sandage 2009), or the Alcock-Paczynski test (Melia & Lopez-Corredoira 2016), might apply in the SUM framework after all].

(II) An apparent problem for straight SUM so far is the lack of a detailed explanation for the CMB anisotropies. The relevant measurements, with increasing precision from COBE, WMAP up to the PLANCK 2015 results, provide collectively excellent numerical support for the CCM except e.g. the SZ cluster count prediction mismatch (Section 6) or the Hubble constant dilemma (Section 3.2). The other way round, these measurements do not exclude a stationary background, where the CMB anisotropies may be caused by DM oscillations or inhomogeneities due to halos, but are not yet explicitly resolved.

(III) The observed changes of the CMB monopole temperature with redshift are not as clear as they should be. The results of e.g. Noterdaeme et al. (2011) have to be reviewed with regard to particularly Sato et al. (2012) and in view of the strange Planck spectrum ρ^*_Z [probably observed from behind distant clusters at a confusable reduced temperature $\Theta_Z = \Theta_{\mathrm{hDM}}/(1+Z)$].

(IV) Actually the best opportunity for a provisional quick decision between standard cosmology and particularly the CMB alternative should be to evaluate the SZ data streams still split up for each distinct Planck frequency channel on its own. The question is whether there could be found a statistically restricted applicability of the conventional SZ cluster search procedure corresponding to the panels of Fig.s 10, 11 (Section 6.1).

(V) It would mean a real pardigm shift to confirm the reported result of Jha, Riess, & Kirshner (2007) in accordance with two different values for the local and the universal Hubble constant without any priors, thus proving 'dark energy' a fiction.

(VI) There is a scientific obligation to find out, whether it is possible to identify e.g. neutrinos as hDM particles effectively emitting the CMB or to disprove the big-bang origin by detecting any such photons within shielded cavities.

No new model could ever be claimed to apply immediately in all its various aspects. As compared to the development of current ΛCDM single-bang cosmology, now different from the original big-bang theory, there remains a lot of disposable adaption space also for SUM. In view of the universe being subject, it is obvious that the latter chance needs public cooperation.

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