Homogeneously distributed dark matter of second kind as an alternative to 'dark energy'

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A vast isothermal main part of homogeneously distributed dark matter of second kind (hDM) might exist instead of the 'dark energy' assumed today. The known smaller inhomogeneous part of first kind (iDM) is commonly accepted to exist in form of usual dark matter halos, whether or not bound to galaxies or clusters. The macroscopically non-lensing hDM can fill the gap between observable matter and critical density, the latter required by flat space solutions of Einstein's original gravitational equations without cosmological constant. Dark matter of weakly interacting particles could be at least partially responsible for the observed cosmic microwave background (CMB) radiation. It does not necessarily consist of only one fraction (various components may also include unseen macroscopic objects). In the framework of a stationary universe model (SUM) – and in accordance with the universal Supernova Ia data deduced there – an alternative Planck microwave background is mathematically shown to be composable of redshifted radiation emitted within the universe. Thus 'dark' matter may get rid of its mysterious lack of non-gravitational interaction.

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1. Introduction

Thinking free of the ΛCDM 'big bang' paradigm, there seem to be several widely ignored chances of 'dark' matter. The simplest conceivable ansatz for a stationary universe model[1] (SUM) deduced from two postulates is

$$d\sigma^*_{\mathrm{SUM}} \;=\; e^{Ht^*} d\sigma^*_{\mathrm{SRT}} \tag{1}$$

with a significant Hubble constant H (in contrast to its conventional parameter) and c, h, k the natural constants; in the following an asterisk '*' always means *universal* like e.g. universal coordinates (i.e. 'conformal' t^* and 'comoving' l^*). The model SUM stands out with redshift values statistically independent of time according to $z = e^{Hl^*/c} - 1$. With no need for 'dark energy', this alternative explains the SNe-Ia data[2] on universal scales z > 0.1 straightforwardly[1,3].

2. Ordinary inhomogeneous dark matter of first kind (iDM)

A physical question is: What is the temperature of that iDM, which seems necessary to explain the otherwise unexpected rotation curves in galaxies[4] or the puzzling peculiar velocities in clusters[5] as well as gravitational lensing far from visible objects? A simple calculation like in particular that of a pure Emden (singular isothermal) sphere 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 similar rotation curves as actually observed if only the temperature of this dark matter in each galaxy took a respective nearly constant value. In view of the ΛCDM cosmology the idea that dark matter might consist of 'thermal' massive neutrinos seems disproved. But from non-zero rest masses, it follows that neutrinos – despite propagating after their release at almost the speed of light – will be slowed down according to SUM by universal deceleration in the gravitational field of an infinite eternal universe (at thermal velocities they may show unexpected features). A possible mean mass of such iDM particles might be estimated in order of magnitude. From the assumption of an isothermal distribution leading to the observed rotation curves in our galaxy follows a particle mass of roughly 1/1000 the mass of the electron. In this view a search for candidates in the high energy range would seem not promising.

3. Isothermal homogeneous dark matter of second kind (hDM)

In addition to the currently assumed inhomogeneous parts, a macroscopically non-lensing hDM background – an approximately homogeneous isothermal distribution of dark matter of second kind – can fill the gap to critical density instead of 'dark energy'. This is required in SUM as flat space solution of Einstein's original gravitational equations without cosmological constant. Then, the hDM may be the main source of a universal microwave radiation, where – in contrast to the mm-range of the non-Planckian cosmic infrared background – what is called 'CMB' would be only the dominating 'black body' part.

The nature of possible hDM particles raises the question of non-baryonic dark neutrino-matter again. If spin-½ particles are primarily involved, then, in spite of all 'big bang' arguments, these particles may be probably neutrinos since on basis of the following consideration other such candidates seem not available.

4. Torsion particles

In accordance with SUM there is a strange hint that the inflationary ΛCDM big-bang model – though of unprecedented numerical success in describing the observational facts of modern cosmology – might fail, namely because of an apparent materialization of an antisymmetric torsion tensor

$$\mathrm{T}_{\mathrm{ikl}}.$$

The universe seems constituted of 24 elementary spin-½ particles which are 6 leptons + 3 colors $\cdot$ 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 $\cdot$ 6 'spatial' constituents

$$\mathrm{T}^{\mathrm{i}}{}_{\mathrm{kl}} = \mathrm{T}^{0}{}_{\alpha\beta} + \mathrm{T}^{\gamma}{}_{\alpha\beta} \tag{2}$$

[Latin indices i, $(k \neq l)$ = 0,1,2,3 in contrast to Greek spatial indices $(\alpha \neq \beta)$, γ = 1,2,3], what seems more than a mere coincidence. In addition, of the 6 'lepton'-components there are 3 'electric' + 3 'magnetic' reflecting three e, μ, τ particles and their respective ν_e, ν_μ, ν_τ neutrinos

$$T^{0}{}_{\alpha\beta} = T^{0}{}_{0\alpha} + (T^{0}{}_{32} + T^{0}{}_{13} + T^{0}{}_{21}). \tag{3}$$

As has been shown by Landau & Lifshitz[6] long time ago, however, the physical existence of a non vanishing torsion tensor would contradict Einstein's equivalence principle, which underlies the geometric interpretation of his gravitational equations (in view of SUM applicable to real physical objects instead of only mathematical space and time). And thus it seems to contradict today's Concordance (Consensus) Model of cosmology relying on this spacetime concept which might prove misleading in the end. In view of extended elementary spin-½ 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 unrealistically presupposed 'point' particles so far.

5. Microwave background of redshifted radiation within a stationary universe

There is a mathematical solution for a perfect black-body spectrum of redshifted microwave radiation emitted from thermal hDM interaction (possibly including effects of ν-oscillations) within a stationary universe. With $x_\mathrm{E} \equiv h\nu_\mathrm{E}/(k\Theta_\mathrm{hDM}) \equiv h\nu(1+\mathrm{z})/(k\Theta_\mathrm{hDM})$ and $Y \equiv 8\pi(k\Theta_\mathrm{hDM})^3/(h^2\mathrm{c}^3)$ the Planck background seems composed according to

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

where the constant $\kappa=2\;[/R_H]$ stands for an absorption factor $1/(1+Z)^\kappa$ of intensity in the mm range (an index '$_\mathrm{E}$' means respective quantities at place and time of their origin). The total attenuation is due to local absorption *plus* local redshift.

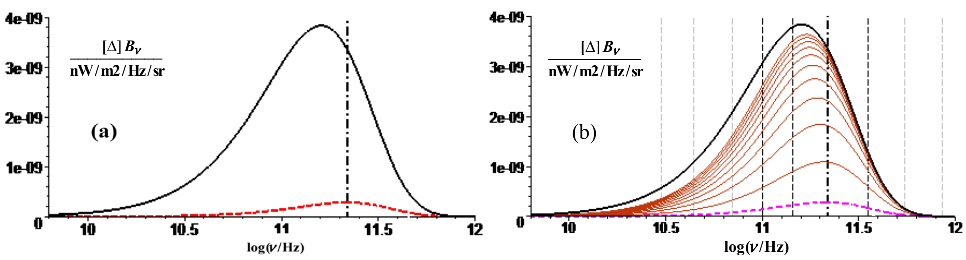

Fig. 2. The bold solid black lines show the total CMB spectrum according to (4) for $\kappa=2\,[/R_H]$ as actually observed. (a) The broken red line shows the emission of the hDM radiation exemplarily in a local shell of 100 Mpc. (b) In addition, the thin red solid lines show respective parts coming from within $z = Z$. The upper integration limit ∞ of relation (4) is replaced and evaluated there from bottom to top by Z = 0.1, 0.2, .. 1.0 respectively.

6. Universal radiation equilibrium

The thin red solid lines of Figure 2.(b) show that by far most of the CMB radiation reaching the instruments would have been emitted within $Z < 1$. The bold red broken lines of 2.(a), 2.(b) raise the question of hDM particles which according to relation (4) would emit radiation of a probably non-baryonic 'emissivity' $x_\mathrm{E}/(1-\mathrm{e}^{-x_\mathrm{E}}) \rightarrow x_\mathrm{E}$ in the corresponding frequency range. – On the one hand, there should exists a universal radiation equilibrium within a stationary universe. On the other hand, in contrast to local black bodies, it seems impossible to keep a redshifted Planck spectrum of constant temperature Θ_{hDM} there.

In accordance with relation (4), however, an energetic equilibrium results for emission and attenuation in the same shell, allowing for statistical energy recycling. In this model the mean free path of 3K-photons is $R_H/2$ (with $R_H = c/H$ the Hubble radius). Unexpectedly even the photon energy loss due to redshift seems to be compensated.

This tentative SUM approach should be testable in particular by evaluation of the PLANCK 2015 model mismatch of predicted Sunyaev-Zeldovich cluster counts[7], though without any hypothetical ΛCDM priors for this time.

7. Possible absorption by dark matter of non detectable gravitational waves

By today there are only indirect observations of gravitational waves primarily from decreasing periods of binary pulsars. In case that gravitational waves should escape direct measurements further on, such a failure might lead here to the simple conclusion that gravitational waves are absorbed by dark matter near the respective places of their emission. So they would not reach terrestrial detectors (at least not in the expected form[8]).

In addition to all excellent agreement of General Relativity Theory (GRT) in local gravitational fields, non-Euclidean geometry may be understood to be nothing but the mathematical tool to deal with 'proper' rods and 'proper' clocks which are systematically affected by gravitation and motion relative to the universal frame (whose coordinates are otherwise denoted as 'comoving' or 'conformal' ones). It is widely believed that on Planck scales General Relativity (GR) and Quantum Mechanics (QM) prove incompatible. Such a statement, however, seems premature as long as a necessary clarification of Einstein's equations

$$R_{ik} - \frac{1}{2} R\, g_{ik} \;=\; \kappa T_{ik}^{\mathrm{QM-detailed}} \tag{5}$$

(a first attempt[9]) is not solved consistently for a detailed quantum energy-momentum-stress tensor on its right hand side but only for Einstein's phenomenological substitute, whose provisional nature once let him write of 'lumber instead of marble'[10].

A natural approach[1] to Einstein's non-Euclidean line element yields not only GRT's fundamental tensor $g_{ik} = e_{ai}\, e^{a}{}_{k}$ which enables to effectively establish a non-Euclidean geometry of affected rods and clocks, but at the same time leads to the only appropriate form to apply GRT to half-spin particles governed by the Dirac equation. This form and its mathematical features are well-known as *vierbein* or *tetrad* representation[11,6]. In addition, Rosen[12] has pointed out an assumed link between his bi-metric formulation of GRT and this representation. It might be anything but coincidental that the concept of angular momentum going beyond the strict general relativistic approach is closely related to the indirect observation of gravitational waves from decreasing periods of binaries. – Now the legitimacy explicitly shown to understand spatial 'curvature' a gravitational effect on measuring rods instead on mathematical space[1], the latter therefore can be taken Euclidean at all events. Mathematically, the universal (not to say 'Newtonian') coordinates are nothing but a special representation of what is usually called 'system coordinates' in GRT.

Historically, the assumed absence of a universal restframe has been the essential reason for Weyl[13] to keep adhering to the literally geometric interpretation in spite of Poincaré's mathematically equivalent alternative (accepted 1921 in *'Geometrie und Erfahrung'* by Einstein himself). With regard to such a unique universal frame, however, there is no longer a need to speak of 'pseudo'-tensors and -densities of the gravitational field, but rather of true bi-tensors and -densities instead. The transformation properties of such quantities and the mathematical foundations for the transition from a preferred frame to an arbitrary other one is provided by Rosen's the bi-metric formulation[14,12] of GRT on basis of a mathematical ansatz made by Levi-Civita[15] (Rosen's reformulation called 'bi-metric relativity', however, must not be confused with his deviating 'bi-metric theory' later on, see Will[16] with references therein). – Only on this base, the energy content of the gravitational fields does no longer depend on the coordinate system. It is this feature that would guarantee an objective reality of any corresponding energy transport – in particular that of gravitational waves, whether these are directly observable or not.

It may be emphasized here, that Rosen's treatment is not only a chance but even a need, because: From all claims in the framework of GRT it is exactly that of a general covariance in choosing arbitrary coordinate systems, which forces to treat the so called pseudo-tensor as a true bi-tensor with respect to the universal frame apparently established by the CMB. Only in this way it is possible to describe the processes leading to decreasing orbital periods of binary pulsars independently of the coordinates used there. This procedure even works if one might chose an appropriately rotating flexible coordinate system where the binaries are at rest all the time. There are other arguments as concerning the very definition of angular momentum mentioned above[9/V].

GR by itself cannot work without QM if applied to processes going beyond the 'geodesic' equations of motion, which attribute actually reflects only an important geometric analogy[17]. Gravitation regarded as an isolated physical agent alone, however, would be unable to explain in particular how there can be explosions of gravitationally bound systems like supernovae (SNe), for example.

Only with regard to the restframe fixed by the universal potential there is a true energy density of the gravitational field. Even the hDM radiation equilibrium stated in the previous section might be realized via mutual exchange of gravitational energy. This would correspond to the analogous effect of ordinary gravitational redshift, where the 'kinetic' photon energy is partially converted to 'potential' energy and vice versa.

8. Conclusion

Concerning the CMB, a straight SUM approach assumes the microwave radiation from a nearly homogeneous fraction of hDM, particularly distributed in voids. In addition there is the well-accepted fraction of iDM in halos e.g. of galaxies or clusters. Thus anisotropies of the Θ_{hDM} temperature distribution in the microwave background may be caused by hDM acoustic oscillations or by resolvable iDM halos. The difference between both kinds of dark matter does not necessarily mean different particles, since the possibility of whether or not lumping together might correspond to a different behavior of thermalized or non-thermalized neutrinos. Taken together, the SUM concept[1,3] now includes:

(A) Stationarity (with time independence of both the Hubble Constant and redshift);
(B) 'prediction' of the SNe-Ia data on scales $z > 0.1$ with no need for 'dark energy';
(C) the necessary hDM mass-energy for a stationary flat space solution;
(D) the chance for overcoming the concept of 'dark matter without non-gravitational interaction' (necessary for an assumed CMB origin within a stationary universe);
(E) a thinkable non-detection of gravitational waves (from e.g. binary pulsars).

The number of 24 elementary particles in full accordance with the Standard Model mathematically related to the 24 components of the torsion tensor is also addressed here. It seems worthwhile to check the unexpected CMB alternative above, which would prove an CMB origin within a stationary universe. In view of SUM both forms of 'dark' matter get rid of their mysterious lack of physical interaction except for gravitation so far.

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