The Cosmic Time Hypothesis (CTH)
- An alternative to the Big Bang Theory (BBT)

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Abstract
The Cosmic Time Hypothesis (CTH) is based on the General Theory of Relativity (GTR) and makes use of its degrees of freedom for an extension of the time term. According to the CTH, the universal time scale expands to the same law as the expanding universe. By means of this “cosmic space- time”, the physical reality can be described more comprehensively and more plausibly than by the present standard model of cosmology.

The Einstein-de Sitter-universe as basis for the CTH
The following assumptions (axioms) are underlying:

1. The speed of light is a universal natural constant
2. The laws of the GTR apply for the total universe
3. The universe spans out a plane, (Euclidean) space, in the average over large distances
4. The universe expands at the speed of light
5. The total energy in the universe is constant
6. In agreement with Einstein, the value of the cosmological constant Λ is 0!

For a plane universe, Einstein has deduced the relation [1], p.107 ff:

$$\frac{\kappa\rho}{3} - h^2 = 0 \qquad (1)$$

(κ = coupling constant of the field equations of the GTR, ρ = average mass density of the universe,

h = Hubble expansion = $H/c = 1/R$)

From (1), one receives by conversion

$$\frac{GM}{R c^2} = \frac{1}{2} \qquad (2)$$

(G = gravitation constant, c = speed of light)
According to this, the radius R of the universe corresponds exactly to the Schwarzschild radius of its total mass M. The deceleration of the expansion speed of the cosmos caused by gravitation forces is expressed by the deceleration parameter q. For the Einstein – de Sitter universe, there is:

$$q = -\frac{R\ddot{R}}{\dot{R}^2} = \frac{1}{2} \qquad (3)$$

By integration of this differential equation, one receives [2], p.61:

$$R \sim t^{1/1+q} = t^{2/3} \qquad (4)$$

or, respectively

$$\dot{R} = dR/dt = c \sim t^{-1/3} \qquad (5)$$

Relation (5) also follows directly from eq. (2) when $GM = constant$ and $R \sim t^{2/3}$ (Einstein-de Sitter model) are applied. The time dependence according to (5) contradicts axiom 1 ($c = constant$)! In order to find an explanation for this paradox, we must at first clarify what the term “universal constant” really means. By this, we comprehend a physical value that can only be defined empirically and not by means of a theory and the measured value of which always is equal in each place and at each time.
By choosing a suitable time metric, the speed of light formulated in (5) can be brought into accordance with this definition, a method which, incidentally, Einstein also has recommended [1], p.30: <*For completion of the time definition, one can use the principle of the constancy of the vacuum light speed.*> In order that the speed of light as per (5) is a constant measured value at all times, a time beat $\Delta t(t)$ varying with Newton time must be found which keeps that value ($c\Delta t$) decisive for measuring the speed of light constant.

For this purpose,“cosmic time τ” is introduced, which is linked with Newton time as follows

$$\tau \sim t^{2/3} \sim R \qquad (6)$$

From this follows

$$\frac{\Delta \tau}{\Delta t} \sim t^{-1/3} \sim \dot{R} = c \qquad (7)$$

With $\Delta\tau = const.$ one receives $\Delta t \sim t^{1/3}$ and $c\,\Delta t = const.$ From (5) follows $dR/d\tau = c(\tau) = constant.$

Accordingly, the beat of time is directly linked to the expansion speed of the universe, i. e. in relation to Newton time, the time flow slows down at the increasing expansion of the universe. Thus, the big bang recedes into the infinite past. According to the CTH, the beat of time does not only depend on the relative speed (STR) and the gravitation potential (GTR), but on time itself, also (CTH). Fig. 1 shows a comparison of these dependencies. As one can see, the singularities produce a distortion of the time metric in the space- time- matter texture (space borders, big bang, black holes), until the singularity itself “freezes” time. For an outside observer, the singularity can only be reached after an infinitely long time. Stephen Hawking sees the things in a similar way [3], p.117: *<According to the strong version of the hypothesis of cosmic censorship, the singularities for a realistic solution lay always totally in the future (as the singularities of the gravitation collapse) or totally in the past (as the big bang).>*

It is a consistent result of the CTH that time varies to the same law as space, in an expanding universe, i.e. proportional to the expansion rate of the universe *($dR/dt \sim t^{-1/3}$, $d\tau / dt \sim t^{-1/3}$)*. Accordingly, the coordinates of space and time would have an absolutely equal status in the 4- dimensional space- time continuum, which they have not in the conventional theories ([2]. p. 65.

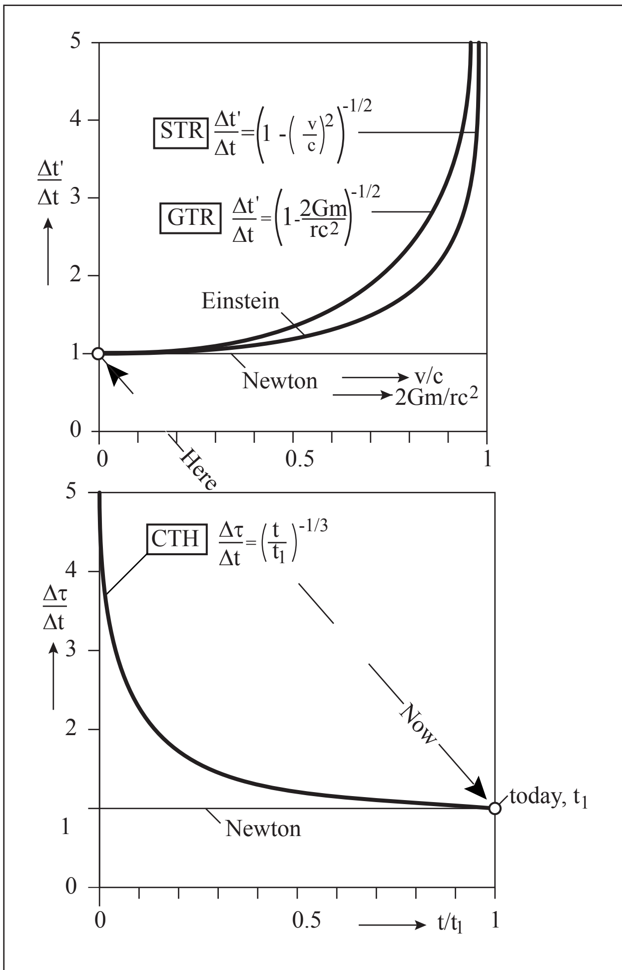

Fig. 1: Time scales of STR, GTR and CTH

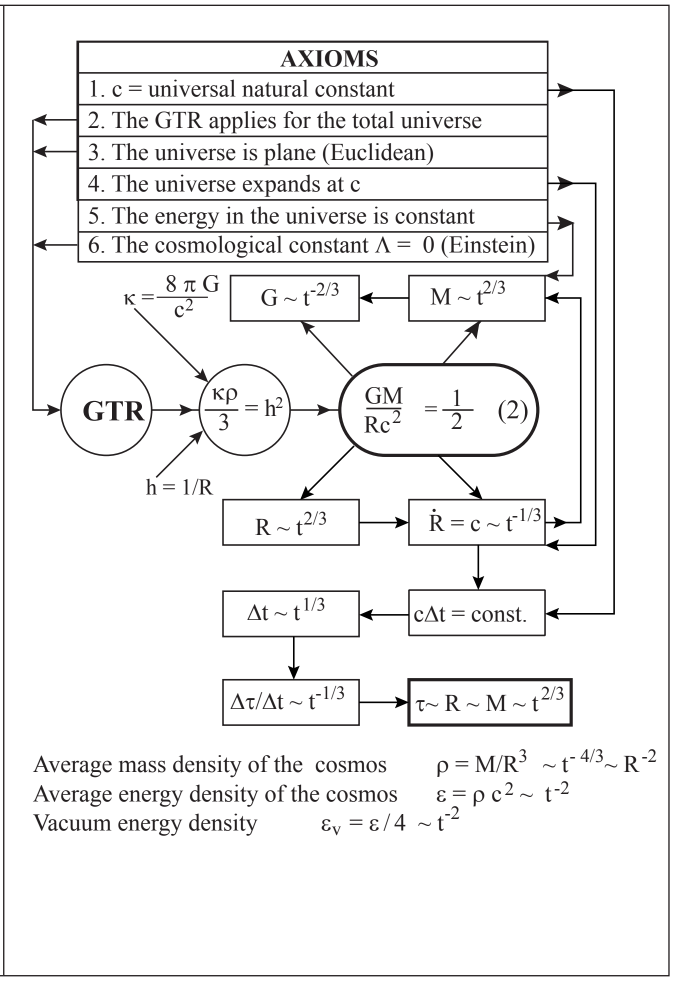

Fig. 2: Results of the CTH (Survey)

Remark:

Alexander Friedmann, who transferred the original Einstein field equations ($\Lambda = 0$) to the total cosmos and reached the result that the universe cannot be static, but must have a metric which varies with time, has already pointed out the arbitrariness of the time scale [4], p. 73: *The (abstract) time can be arithmetised in a fully arbitrary way*>.... and further: <*but if abstract time is now not observed alone as such, but in combination with three- dimensional space, then the space- time itself can be arithmetised in an arbitrary way by number quadruples.*> Friedmann deliberates if there could not be a time, the beat of which varies with time [4], p 73: <*... then, there is* $d\tau = T\,dt$*, in which T is dependent on t*.>

The CTH makes use of this degree of freedom of the GTR

According to axiom 5 ($E = Mc^2 = const.$), for he total mass of the universe results:

$$M \sim t^{2/3} \sim R \qquad (8)$$

and for the gravitation constant *G*

$$G \sim M^{-1} \sim R^{-1} \sim c^{2} \sim t^{-2/3} \qquad (9)$$

For the average mass density of the universe, one finally receives

$$\rho \sim t^{-4/3} \sim R^{-2} \qquad (10)$$

and

$$\varepsilon = \rho c^2 \sim t^{-2} \sim R^{-3} \qquad (11)$$

The results (1) thru (11) of the CTH are assembled in Fig. 2. The vacuum energy ε_v still calls for a thorough explanation. Contrary to current doctrine according to which $\varepsilon_v \sim \Lambda$ = constant and gravitationally repellent, according to the CTH the vacuum energy density is time dependent ($\varepsilon_v \sim t^{-2}$) and acts, the same as all other contributions to the total energy density of the universe, gravitationally attracting. Between ε_v and Λ there exist no connections according to the CTH ($\varepsilon_v > 0$, $\Lambda = 0$).

For a better understanding, the following considerations hereto [2]: In the expanding universe, the matter contained in it (galaxies, stars, nebulae) must be brought into larger distances to each other against the gravitation force. For this, energy is needed, which is then stored in the newly formed space as „vacuum energy“. Conversely, energy would be set free if spaces filled with matter would implode gravitationally or scale down as would be the case in a contracting universe, e. g. (positive) energy is also needed to create matter ($M = E/c^2$). Thus, the same energy prefix must be assigned to the space itself (vacuum) and to the matter contained in it. This energy is provided by the gravitational brake energy, expressed in the delayed expansion of the universe

$$\dot{R} = c \sim t^{-1/3},\ \ddot{R} = \dot{c} \sim t^{-4/3}.$$

By means of the quoted considerations, that part of the vacuum energy hidden in the mass equivalent at this energy conversion can be calculated. [2], p. 65… 67. We receive that ¼ of the total mass of the universe is contained in the vacuum (virtual particles?).

For the vacuum energy density thus follows

$$\varepsilon_v = \varepsilon/4 \sim t^{-2} \qquad (12)$$

Since the vacuum energy is not represented by the cosmological constant, but is contained in the energy tensor T_{ik} of the field equations of the GTR, it is not subject to the restriction following from the common relation $\Lambda = \varepsilon_v = const.$

Consequences of the CTH for our physical world view [2]

The value of a scientific hypothesis must be measured at its potential to solve problems so far unsolved and which new findings it offers in that area of science it claims competence.

What does the CTH offer in this regard?

- It solves the problems of the big bang theory (problems of horizon, of galaxy formation and planarity (Euclidity)) and additionally relieves it from unnecessary ballast (inflation theory and cosmological constant are dispensable!)
- It solves the mystery of the cosmological constant (Λ) and the vacuum energy density (ε_v), respectively, which until now belonged to the big unsolved problems in theoretical physics. According to the CTH, ε_v is by the factor 10^{-120} smaller than that value supplied by quantum field theory [2]. Hereby, the CTH supplies exactly that numeric value for ε_v which is consistent with observation.
- It explains in a simple and plausible manner the discrepancy between distance and red shift of type Ia-Supernovae. According to the CTH, the universe expansion is not accelerated but decelerated from the very beginning (Einstein-de Sitter-model) and it therefore also needs no "Dark energy" to enable interpretation of the measured data [2], p. 54, 55.
- It requests that the world mass M grows proportional to the world radius R ($M \sim R \sim t^{2/3}$), with the consequence that we can only perceive 25 % of that matter existing in reality, at all. In order to explain the planarity (Euclidity) of the universe emerging from measurements of the cosmic microwave background radiation, the "Dark energy" also is not required.
- It requests, as already proposed by Dirac, a time dependent gravitation constant ($G \sim t^{-2/3}$), at which the product MG remains constant.
- It is in agreement with the scalar-tensor theory and links the GTR with the Mach principle, free from contradictions.
- It requests that, at the Planck time ($t_p \approx 10^{-43} s$) the gravitation force and the strong nuclear force were equally strong (and had the same range of action) ($F_G \sim G \sim t^{-2/3}$), as demanded by the theory of super gravitation (super symmetry) Thus, the universe had, at Planck time, the size of an elementary particle!
- It supplies a plausible explanation for the theory of the Earth expansion, publicised by Pascual Jordan, Heinz Haber et al [5].
- It shifts the big bang into an infinitely far past. In the CTH, the universe has neither a beginning nor an end in time.
- It can be demonstrated that real clocks (pendulum, atomic), when ticking according to the CTH, do not measure the Newton, but exactly the cosmic time [2[, p. 69
- According to the CTH, the cosmic basic values (space, time and matter are most closely interwoven and are in linear relation to each other($R \sim \tau \sim M$).

Final remarks

Although the CTH was developed already more than a decade ago and many experts have received information about this, it was widely ignored. In October 2006, the Excellenzcluster „Ursprung und Struktur des Universums", unique in Europe, was launched in Munich and Garching Highly esteemed experts for cosmological topics are in their research teams who believe, the big bang still belongs to the big physical mysteries that, up to now, have not been solved even rudimentarily [6]. It would be time now that a discussion is started, free from ideology, about alternatives to the BBT, among which the CTH could be one.

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