Cosmological constant of GRT as a radial function in dependence of velocity

- A short notice -

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Abstract:
Under special circumstances cosmological „constant“ of GRT can be formulated as a function in dependence of radial term. This calculation will be shown. In fact this system of physical ideas is now described only for local state of Schwarzschild-lineelement with cosmological variable but it can be easily developed to cosmic terms.

Key-words: Cosmological constant; Einstein-equation; gravity-equation; Schwarzschild-solution, flat space-time; Planck-length; radial function.

1. Introduction:
Since Einstein introduced this cosmological term \( \Lambda \) to correct and complete his gravity equations in 1917 ad hoc for logically consistent description in four spacetime dimensions [1.], this term plays an important role in description of universe in its global states, particularly as a form of „dark energy“, which determines the observed acceleration of cosmic expansion or can be interpreted as a form of a vacuum-energy. Mostly this term is considered as a constant but, as is shown, it also can be interpreted as a function in dependence of radius.

2. Calculation:
If the Schwarzschild-lineelement of a local spacetime is written with cosmological constant [2.]:

\[
    ds^2 = \frac{dr^2}{1 - \frac{2M}{r} - \frac{\Lambda r^2}{3}} + r^2 \left( d\theta^2 + \sin^2(\theta) \cdot d\phi^2 \right) - c^2 \cdot dt^2 \left( 1 - \frac{2M}{r} - \frac{\Lambda r^2}{3} \right) 
\]

(1.)
where: \( M = \frac{2 \cdot G \cdot m}{c^2} \) is Schwarzschild-radius with \( m \) central-matter-mass of gravity-field which causes the material part of the gravity-field [3.] and the limit is now done for \( m = 0 \Rightarrow M = 0 \), then the lineelement is describing a local flat form of spacetime without a central-mass but with the cosmological term \( \Lambda \). From materia its empty like a geon, first formulated by Wheeler [4.]. This g-field now can be described far from its empty source by setting:

\[
ds^2 = d r^2_{pl} \quad \text{(far out in the wilderness) as its physical minimal size.}
\]

This field then can be written as:

\[
dr^2_{pl} = \frac{dr^2}{\left(1 - \frac{\Lambda \cdot r^2}{3}\right)} - c^2 \cdot dt^2 \cdot \left(1 - \frac{\Lambda \cdot r^2}{3}\right)
\]

which leads directly to:

\[
\Lambda = \frac{1}{r^2} + \frac{3}{2 \cdot r^2} \cdot \frac{dr^2_{pl}}{2 \cdot c^2 \cdot dt^2} \pm \frac{3}{r^2} \cdot \sqrt{\frac{dr^4_{pl}}{4 \cdot c^4 \cdot dt^4} + \frac{v^2}{c^2}}
\]

where in local spacetime is defined:

\[
\frac{dr^2}{c^2 \cdot dt^2} = \frac{v^2}{c^2} \quad \text{neglecting the term } \ d \text{ in space-and timelike coordinate-differentials because it can be left out of consideration for this theme.}
\]

3. Conclusion:

Cosmological term \( \Lambda \) can be written as a function, which depends local on the variables of velocity \( v \) and radial variable \( r \) resp. timelike differential \( dt \). In „classical“ GRT without Planck-length as a fundamental minimal length with the continuity condition \( \hbar \Rightarrow 0 \), this term reduces then to:

\[
\Lambda = \frac{1}{r^2} \cdot \left(1 \pm \frac{3 \cdot v}{c}\right)
\]

If this function can be also interpreted as a global cosmic description, then dark energy can’t be a constant but must depend from cosmical expansion-radius and in interpretation from cosmical expansion-velocity.

Solution: \( \Lambda = \Lambda(r, v) \neq \text{const.} \)
4. Summary:

The cosmological term $\Lambda$ of GRT can be written as a function in dependence from velocity and of radius. This result comes from explanation of a local examination in Schwarzschild-lineelement with cosmological-term but can be developed in an explanation to global cosmic expansion like is actually written and observed in [5].

5. Comment:

Since Ricci-scalar is coupled with cosmological term via

$$\Lambda = \chi \cdot T - R$$

(6.)

where $\chi$ is Einstein-gravitational constant and $T$ is $diag \sum_{i=1}^{4} T_i^j; i=k$, Ricci-scalar then can also be written as a function from distance $r$ and velocity $v$. With the assumption $m=0 \Rightarrow M=0$ there is also $T=0$. This leads to a result for Ricci-scalar as a function of $R(r,v,dt)$:

$$R = -\frac{4}{r^2} \sqrt{\left(1 \pm \frac{3v}{c}\right)} \cdot \frac{dr^2_{PL}}{c^2 \cdot dt^2} \pm \frac{12}{r^2} \sqrt{\frac{dr^4_{PL}}{4 \cdot c^4 \cdot dt^4} + \frac{v^2}{c^2}}$$

(7.)

which reduces in classical GRT with the continuity condition $\hbar \Rightarrow 0$ to:

$$R = -\frac{4}{r^2} \cdot \left(1 \pm \frac{3v}{c}\right)$$

(8.)

5. References:


. [2.] Weyl, H., Phys.ZS.20, 31, 1919

. [3.] Trefftz, E., Mathematische Annalen, 86, 317, 1922


. [5.] Wood, C., Dark energy may be weakening, major astrophysics study finds, https://www.quantamagazine.org/dark-energy-may-be-weakening-major-astrophysics-study-finds-20240404/?mc_cid=27ab9f2b7c&mc_eid=e5782364ed. 04.04.2024
6. Verification:

This paper is written without help from a chatbot like Chat-GPT4 or other AIs. It’s fully human work.

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