General Relativity from Planck-Satellite-Data

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Abstract

With the Planck 'constants' length, time, mass and acceleration will be shown, that a Quantum Gravity of the cosmos exists. This paper shows how Planck-Satellite-Data solves Einstein's Field Equations in Friedmann Robertson Walker Metric.

1 Planck 'constants'

Planck Length $\Delta x = \sqrt{\frac{Gh}{c^3}}$

Planck Time $\Delta t = \sqrt{\frac{Gh}{c^5}}$

Planck Mass $\Delta m = \sqrt{\frac{hc}{G}}$

Planck Acceleration $\Delta a = \frac{c}{\Delta t} = \sqrt{\frac{c^7}{Gh}}$

2 Modern Cosmology

Within modern cosmology the Einstein's Field Equations would be written with cosmological term Λ as follows (see [2] and [3]):

$$R_{ik} - \frac{1}{2} g_{ik} R - \Lambda g_{ik} = \frac{8\pi G}{c^4} T_{ik} \quad (2.0)$$

The solutions of the Field Equations in Friedmann-Roberson-Walker-Metric are:

FRW Equation (I)

$$\frac{\dot{R}^2}{R^2} = \frac{8\pi G\rho}{3} + \frac{\Lambda c^2}{3} - \frac{kc^2}{R^2} \quad (2.1)$$

FRW Equation (II)

$$\frac{\ddot{R}}{R} = \frac{\Lambda c^2}{3} - \frac{4\pi G}{3}\left(\rho + \frac{3p}{c^2}\right) \quad (2.2)$$

Einstein abandoned the cosmological term Λ as his "greatest blunder" after Hubble's 1928 discovery that the distant galaxies are expanding away from each other. Within a Universe with ideal Quantum gas and without cosmological term Λ and geometry factor $k = 0$ the equation (2.1) and (2.2) will become:

FRW Equation (I)

$$\frac{\dot{R}^2}{R^2} = \frac{8\pi G\rho}{3} \quad (2.3)$$

and FRW Equation (II)

$$\frac{\ddot{R}}{R} = -\frac{4\pi G}{3}\left(\rho + \frac{3p}{c^2}\right) \quad (2.4)$$

With the relation $p = \frac{\rho c^2}{3}$ (Quantum gas) will change (2.4) as follows: FRW Equation (II)

$$\frac{\ddot{R}}{R} = -\frac{8\pi G\rho}{3} \quad (2.5)$$

Within Thermodynamics we assume $dE = TdS - pdV$ and an adiabatic process it holds $TdS = 0$. We become $d(\epsilon V) = d\epsilon V + \epsilon dV = -pdV$ and it follows:

With $d\epsilon = -(\epsilon + p)\frac{dV}{V}$ and the relation $p = \frac{\epsilon}{3}$ we assume:

$$\frac{d\epsilon}{\epsilon} = -\frac{4dV}{3V} \; or \; \epsilon \sim V^{-4/3} \sim R^{-4} \quad (2.6)$$

3 Planck Satellite Data evaluation

The age of the Universe: $t = 13.80 \pm 0.04$ Gyr (Radius $R = ct = 1.3056e^{28}\ m$).

The Entropy constant $\zeta = \sqrt{\frac{R}{\Delta x}} = 1.7952e^{30}$

The Energy density $\epsilon = \frac{3hc\zeta^4}{8\pi R^4} = \frac{3c^2}{8\pi G t^2} = \tilde{a}T_i^4 = 8.4758e^{-10}\ \frac{J}{m^3}$

Temperature $T_i = \frac{\Delta T}{\zeta} = 32.534\ [K]$

Bekenstein-Hawking Temperature $T_{BH} = \frac{\Delta T}{\zeta^2} = \frac{\Delta T \Delta x}{R} = \frac{hc}{6.08088kR} = 1.8122e^{-29}\ K$

4 References

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