Planck power with Joule heating applied to cosmology?

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Abstract:

Recent advances in deterministic models of quantum cosmology of the R_H=c t_H type have paved the way for the possible appearance of Planck power in the ΛCDM model as a constant, beyond the Planck era, thanks to Joule heating applied to cosmology.

Introduction.

The discovery of the accelerating expansion of the universe by A. Reiss et al [1] in 1998 led to the concept of dark energy in cosmology. While quintessence is one explanation for dark energy, its most accepted explanation is the cosmological constant of Einstein's general relativity model ΛCDM. Steady progress in the accuracy of the cosmological parameters of this model is increasingly constraining its theoretical advances with values having ever smaller margins of error. This article summarizes two recent advances in R_H=c t_H models that have led to the proposal of a possible application of the Joule heating in cosmology. This application is proposed to highlight Planck's power as a cosmological constant.

The determination of the Hubble constant.

In 2015, E. Tatum et al. put forth a cosmological model of R_H=c t_H type that included a formula connecting the temperature of the cosmic microwave background, T_{cmb}, to the Hubble sphere [2].

$$Tcmb = T_{H_0} = \frac{\hbar c^3}{k_b 8\pi G\sqrt{M_{H_0} m_p}} \tag{1}$$

where T_{H_0} is the Hubble temperature, $\hbar$ is the reduced Planck constant, c is the speed of light, k_b is the Boltzmann constant, G is the gravitational constant, H_0 is the Hubble constant, $M_{H_0} = \frac{1}{2}\frac{c^3}{H_0 G}$ is the Hubble mass and m_p is the Planck mass.

The aforementioned formula was demonstrated in 2023 by Haug and Wojnow [3] and published in 2024 [4], thereby providing a solid theoretical foundation for $R_H = c\ t_H$ models.

The equation 1 can be rewritten as follows:

$$T_{cmb}{}^2 = \frac{\hbar^2 c^6}{k_b^2 64\pi^2 G^2 M_{H_0} m_p} = \frac{\hbar^2 c^3 H_0}{k_b^2 32\pi^2 G m_p} \tag{2}$$

$$H_0 = \frac{T_{cmb}^2 k_b^2\ 32\pi^2 G m_p}{\hbar^2 c^3} = \frac{T_{cmb}^2\ 32\pi^2}{T_{Pl}^2\ t_{Pl}} \tag{3}$$

where T_{cmb} is the temperature of the cosmological microwave background and T_{Pl} is the Planck temperature and t_{Pl} the Planck time. The determination of the Hubble constant with precision represents a pivotal objective within the field of modern astrophysics, as it is intimately linked to all the components of the Hubble sphere. Here, we always use Eq.3 to calculate H_0. For example, today: $Tcmb = 2.72458K$ [5] for calculate H_0= 2,1679 x 10^{-18} s^{-1}.

The cosmological constant in a double universe model.

We have proposed a double universe model [6] builds upon and attempts to extend the hypothesis of Andrei Sakharov's bi-metric cosmological model. In this model, Wojnow established that the Newtonian force, denoted $FM_{H0}^{\pm}$, attracting two adjacent universes of Hubble sphere with radius $R_{H_0} = \frac{c}{H0\_}$ and mass $M_{H0}^{\pm}$, one of antimatter the other of matter for example but not necessary, and/or having opposite time arrows is:

$$FM_{H0}^{\pm} = G\frac{M_{H_0}^{+}\ M_{H_0}^{-}}{R_{H_0}^2} = \frac{c^4}{G\ \ 4} = \frac{F_{Pl}}{4}\ N = \frac{F_{Pl}}{4}\ kg^1\ m^1\ s^{-2} \tag{5}$$

In this $R_H = c\ t_H$ model, $M_{H_0} = \frac{1}{2}\frac{c^3}{H_0 G}$ is the Hubble mass and the Planck force is represented by F_{Pl}, which interacts at the speed of light. This hypothesis leads to the speculation that the value and the dimension of the theoretical cosmological constant could be, always in this model:

$$\Lambda = \frac{4G}{c\ c^4} = \frac{4}{c\ F_{Pl}} = \frac{4}{P_{Pl}}\ kg^{-1}\ m^{-2}\ s^3 \tag{6}$$

where $P_{Pl} = \frac{c^5}{G}$ is the Planck power.

$$\Lambda = 1.102458\ 10^{-52}\ \ kg^{-1}\ m^{-2}\ s^3 \tag{7}$$

This theoretical value is close to the measured values (for example $\Lambda = 1.1056\ 10^{-52}\ m^{-2}$ from Planck results 2018 [7]) but does not have the m^{-2} dimension of the standard cosmological model. It is important to highlight that que $kg^{-1}\, s^{3}$ the inverse of a power flux, of measurement in question is added to the unit m^{-2}. This prompts us to seek an alternative electromagnetic surface density with a corresponding current density, and to investigate the phenomenon of Joule heating. This is because, by analogy, it could be considered a form of power in cosmology.

Joule heating represents the thermal consequence of electrical resistance, occurring when an electric current traverses any conductive material. This phenomenon is evidenced by an increase in the conductor's internal energy (here internal energy of the Hubble universe) and, in general, in its temperature.

The average power of Joule heating is [8][9]:

$$P = \frac{Q}{t_1 - t_2} \tag{8}$$

where P is a power in watt ($kg\, m^2\, s^{-3}$), Q an energy in Joule ($kg\, m^2\, s^{-2}$), t_i a time in seconds.

In a cosmological ΛCDM model and in $R_H = c\, t_H$ models, we assume for Hubble sphere:

$$Q = \rho_c c^2 \frac{4}{3} \pi R_{H_0}^3 \; J \tag{9}$$

$$\frac{1}{t_1 - t_2} = H_0\, s^{-1} \tag{10}$$

where H_0 is the Hubble constant. With Eq.8, 9 and 10 we obtain with $\rho_c = \frac{3H_0^2}{8\pi G}$ as critical density and $R_{H_0} = c\, t_{H_0} = \frac{c}{H_0}$:

$$P = \frac{3H_0^2}{8\pi G}\, c^2 \frac{4}{3\pi} \frac{c^3}{H_0^3} H_0 = \frac{c^5}{2\, G} = \frac{P_{Pl}}{2}\; kg\, m^2\, s^{-3} \tag{11}$$

Conclusion.

If the Joule heating can indeed be extended to cosmology, then the Planck power appears as a new constant in both ΛCDM model today and the R_H=c t_H models. This appears to be true from the Big Bang to the present day and beyond for the R_H=c t_H model and at Planck era and today for ΛCDM model. One consequence could be, for example, to progress in models of electric universe with the analogy of electric power and the Joule heating.

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