On the Cold Big Bang Cosmology and the Flatness Problem

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In my papers [3] and [4], I obtain a Cold Big Bang Cosmology, fitting the cosmological data, with an absolute zero primordial temperature, a natural cutoff for the cosmological data to a vanishingly small entropy at a singular microstate of a comoving domain of the cosmological fluid. Now, in this brief paper, we show the energy density of the t-sliced universe must actually be the critical one, following as consequence of the solution in [3] and [4].

1 Explaining the observed critical energy density for the cosmological substratum

The proof is straightforward. Recalling the t-sliced spherical shell defined in [4], we proved its energy at the instant t of the cosmological time is given by:

$$N_t\,\delta E_\rho = E^+(t) = \frac{E_0^+}{\sqrt{1-\dot{R}^2/c^2}}, \tag{1}$$

being the Eq. (6) in [4] and the Eqs. (56) and (59) in [3]. From the Eq. (36) in [3], the Eq. (1) is simply rewritten:

$$E^+ = \frac{c^4 R}{2G}, \tag{2}$$

from which the energy density of the t-sliced spherical shell pertaining to its t-sliced hypersurface of simultaneity, being full of its t-simultaneous cosmological points of the substratum, turns out to be given by:

$$\rho_t = \frac{c^4 R}{2G}\frac{3}{4\pi R^3} = \frac{3c^4}{8\pi G}\frac{1}{R^2}. \tag{3}$$

Now, once defined the Hubble parameter for the spherical shell of the t-sliced hypersurface, centered at its comoving origin, namely H_t:

$$H_t = \frac{\dot{R}}{R}, \tag{4}$$

one obtains the energy density of the t-sliced spherical shell pertaining to its t-sliced hypersurface of simultaneity from the Eqs. (3) and (4):

$$\rho_t = \frac{3c^2 H_t^2}{8\pi G}\frac{c^2}{\dot{R}^2}. \tag{5}$$

Now, Eq. (35) in [3] shows $\dot{R}$ very rapidly reaches c. Hence, the energy density ρ_t of the t-sliced spherical shell pertaining to its t-sliced hypersurface of simultaneity actually is the very critical energy, viz.:

$$\rho_t \to \rho_{\text{crit}} = \frac{3c^2 H_t^2}{8\pi G}, \tag{6}$$

very rapidly, and it will continue being the critical energy density ρ_{crit} forever*. The time domain within which ρ_t deviates from the critical is $t \approx 0$, at which it reads:

$$\rho_0 = \frac{3c^7}{16\pi G^2 h} \approx 10^{111}\,Jm^{-3}, \tag{7}$$

provided the energy density ρ_t of the t-sliced spherical shell being given by the Eq. (3) and with the $R_0 = \sqrt{2Gh/c^3}$ obtained in [3]. The Hubble parameter vanishes at $t = 0$ in our model†.

Conclusion

We conclude the cosmological model obtained in [3] and [4] provides the critical energy density for the t-sliced spherical shell pertaining to its t-sliced hypersurface of simultaneity of the cosmological substratum.

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*It will continue being given by the Eq. (6), but its value tends to vanish, as one easily infers from the Eq. (3). See [3] and [4].

†See [3] and [4].