On the Cold Big Bang Cosmology and the Flatness Problem

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]. It must be pointed out that the result obtained here in this paper on the flatness problem does not contradict the solution in [3], viz., does not contradict the open universe, with $k = -1$, obtained in [3], since the solution in [3] had negative pressure and negative total cosmological energy density, hence lesser that the critical positive density. The critical density we obtain here is due to the positive fluctuations I previously discussed regarding the Heisenberg mechanism in [4]. Hence, the energy density due to fluctuation turns out to be positive, the critical one, this being calculated in [4] from the fluctuations within the $t$-sliced spherical shell at its $t$-sliced hypersurface, being the total energy density that generates the fluctuations, actually, negative in [3] and [4], hence, again, lesser than the critical one and supporting $k=-1$. These results are complementary and support my previous results.

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:

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

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:

$$E^\ast = \frac{c^4 R}{2G}, \quad (2)$$

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:

$$\rho_t = \frac{c^4 R^3}{2G 4\pi R^3} = \frac{3c^4}{8\pi G R^2}. \quad (3)$$

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

$$H_t = \frac{\dot{R}}{R}, \quad (4)$$

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):

$$\rho_t = \frac{3c^2 H_t^2 c^2}{8\pi G R^2}. \quad (5)$$

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

$$\rho_t \rightarrow \rho_{crit} = \frac{3c^2 H_t^2}{8\pi G}, \quad (6)$$

deviates very rapidly, and it will continue being the critical energy density $\rho_{crit}$ forever'. The time domain within which $\rho_t$ deviates from the critical is $t \approx 0$, at which it reads:

$$\rho_0 = \frac{3c^7}{16\pi G h} \approx 10^{111} J m^{-3}, \quad (7)$$

provided the energy density $\rho_0$ 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].
References