MEAN SEPARATION BETWEEN NUCLEATION SITES AND COSMIC QUARK - HADRON PHASE TRANSITION

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Following an analysis of Kajantie and Kurki-Suonio [1] and Alcock et al. [2], the mean separation between the nucleation sites (phases) ℓ , after the nucleation had occured in the expansion of the Universe, is given by [2]

$$\ell = 0.3\, \sigma^{3/2}\; t \,/\, T_c^{1/2}\; L, \qquad (1)$$

where t is the age of the Universe, T_c is the phase transition temperature, L is the latent heat, and σ is the surface tension. This length ℓ will assume a greater significance in the calculations of the light element abundances of the early Universe using non-standard big bang theory [1-4].

Fuller et al. [3] have calculated the amount of latent heat released, during the quark - hadron phase transition, for different coexistence temperatures T_c. In their calculations, the latent heat L is fixed for a given T_c (see Table I of Ref. 3). To obtain the appropriate value of nucleation sites for PNS calculations, they have to change the value of T_c. But in our lowest order perturbative QCD model [5], we can calculate different values of L for a given T_c by adjusting the QCD scale fixing parameter Λ. Our calculated values of T_c, L and phase transition time Δt for different values of B and Λ are presented in Table I. The calculated values of latent heat released during the phase transition is always larger than that of Ref.6, this being due to the inclusion of the proper volume correction (Hagedorn) in the HRG phase. Addition of more and more hadronic resonances in the hadronic phase decreases the release of latent heat during the cosmic quark-hadron phase transition. Inclusion of Hagedorn's correction, however, decreases the critical energy density. Our calculation presented in Table I may be useful to estimate the appropriate distance between nucleation sites [1-4] and to reproduce the correct values of the light element abundances using the non-standard big bang model.

Table I.

B	Λ	T_c	L	Δt
(MeV/fm^3)	(MeV)	(MeV)	(MeV^4)	(us)
30	100	102	8.95×10^8	93
60	0	104	1.81×10^9	98
60	250	150	1.59×10^9	23
150	100	150	4.30×10^9	29
250	0	150	7.30×10^9	97

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