A SMALL BANG MODEL

T. Jacobsen

Department of Physics, University of Oslo
P.O.Box 1048 Blindern
N-0316 Oslo, Norway

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T.Jacobsen,
Institute of Physics,
University of Oslo,
PB-1048-Blindern,
N-0316-Oslo,
Norway.

Abstract

We assume that vacuum dissociation to fermion - antifermion pairs with subsequent recombination of quarks to baryons have caused the production of matter of our universe. The total energy of the universe is according to this model zero.

Zusammenfassung

Es wird angenommen dass Vakuum Dissoziation zu Fermion - Antifermion Paaren mit nachfolgender Rekombination der Quarken zu Baryonen die Produktion der Materie unserer Welt verursacht hat. Die totale Energie des Universums ist laut dieser Modelle gleich zu null.

We assume that if at time zero "nothing" existed, vacuum dissociation would immediately produce a dense fermion-antifermion gass.

The Q-value $Q(q\bar{q})$ of a quark-antiquark pair produced by vacuum dissociation is given by

$$Q(q\bar{q}) = - E(q\bar{q}),$$

where $E(q\bar{q})$ is the positive energy of this system due to the masses and kinetic energies of q and $\bar{q}$. If three q's from three nearby $q\bar{q}$-pairs (before they collaps and disappear) recombine to a baryon with simultaneous emission of a boson with mass m, (and three $\bar{q}$'s recombine to an antibaryon with simultaneous emission of a boson with mass m), we have for the Q-value of the qqq-system (and of the $\bar{q}\bar{q}\bar{q}$-system) that

$$|Q(qqq)| = |Q(\bar{q}\bar{q}\bar{q})| \geq 3|Q(q\bar{q})|/2 + mc^2,$$

and the three q's and the three $\bar{q}$'s would be trapped in separate systems, unable to return to three $q\bar{q}$-pairs.

Such a "small bang" with total energy equal to zero [1] could happen "everywhere", not only in a very small region, consistent with the observed uniformity of the universe. Unless continuous creation of matter is prevented by local saturation, it could go on for ever.

Since no similar recombination mechanism exists for leptons due to vacuum dissociation to lepton-antilepton pairs, such pairs collaps and disappear unless energy is supplied.

Energy is supplied by the (unknown) initial kinetic energy of the boson with mass m and by its decay, and by the decay of qqq-baryons with mass larger than the mass of a nucleon, e.g. $\Delta(1232)$ or $\Lambda(uds)$. Since the lifetime of strange hadrons decaying by weak interaction is 10^{-9}-10^{-6}s, and about 10^{-23}s for non-strange decaying by strong interaction, the production of kinetic energy by the decay of strange hadrons is postponed as compared to the non-strange. The end-products are nucleons and leptons.

If these particles have kinetic energies of the order 100 MeV, corresponding to a temperature of the order 10^{12} °K, the created matter would tend to expand. If matter is created everywhere and tends to expand equally everywhere, it would be in accord with Hubbles law.

Nucleon syntesis starts when the temperature due to expansion has decreased to about 10^{9} °K. When a uniform universe due to expansion is transparent for electromagnetic radiation, a uniform background radiation can be expected.

If it is true that antiparticles are equivalent to particles moving backwards in time [2], these particles created about 10^{10} years ago are far away from our space-time position.

Reference :

1) S.W.Hawking, "A Brief History of Time",
   Bantam Press, London 1988, page 129.
2) R.P.Feynman, Quantum Electrodynamics,
   W.A.Benjamin, Inc., New York, 1961, page 68.