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ON GRAVITATION AND FIELD THEORY

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(SUMMARIES)

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ELEMENTARY PARTICLES IN COSMOLOGY

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Using the results of the mesonic theory of nuclear forces for nucleon-antinucleon interactions, one can discuss the thermodynamic behaviour of a system of strongly interacting particles at very high energies ($kT > 100$ MeV). A calculation of the virial expansion for the free energy up to quadratic terms in the densities of nucleons and antinucleons is performed. Truncating the expansion at this level, it is found that there is evidence for a phase transition which tends to produce a spatial separation between nucleons and antinucleons above a critical temperature $kT_c = 350$ MeV.

The consequences of such an effect have been investigated in the behaviour of a model of the universe containing initially only thermal radiation. There is a separation of nucleons and antinucleons which is due to the aforementioned effect. This separation is employed later on as a consequence of the Leidenfrost mechanism (the pressure which is due to annihilation products). The corresponding analysis of the hydrodynamics of matter and antimatter is sketched: it is shown that matter and antimatter units grow rapidly in size.

Numerical results show that, at the end of the period where the universe is in thermal equilibrium, one predicts successfully, but with some numerical uncertainties, the density of matter in the universe and the characteristics of protogalaxies.

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