The Hydrogen-to-Helium-4 Ratio in the Expanding Universe

Sylwester Kornowski

Abstract: Ludwig et al. derived solar ages up to 22.3 Gyr (2009). The applied Th/Eu ratio is most credible. But the upper limit of the obtained interval is inconsistent with the mainstream-cosmology age of the Universe (about 13.8 Gyr). On the other hand, the Scale-Symmetric Theory (S-ST) shows that the age of the Universe is about 21.614 +- 0.096 Gyr but due to the duality of relativity (the speed of light, c, is the speed in relation to source of light or to a last-interaction object) we cannot see the initial period about 7.75 Gyr of evolution of the protogalaxies/quasars. The calculated time distance to the observed most distant galaxies is 13.866 +- 0.096 Gyr but they are already 7.75 Gyr old. The era of the quasars and the big stars in quasars lasted about 10 Gyr but we can see only the last period about 2.3 Gyr. The GASER (the Gamma Amplification by Stimulated Emission of Radiation) leads to conclusion that in big stars dominates the transition from helium to iron. With time the abundance of helium in big stars decreases. Here, by an analogy to the Stefan-Boltzmann law, we obtain formulae for change in abundance of helium-4 and hydrogen in the expanding Universe. On the assumption that today abundances are 24.5% for helium and 75.5% for hydrogen (ratio = 3.1; we neglect the other chemical elements), we obtain that at the end of the era of quasars there should be 29% of helium (ratio = 2.45) whereas in the most distant observed Universe there should be about 30% helium (ratio = 2.3). The ratio for the primordial unobserved Universe was close to 1.

1. Introduction

The Scale-Symmetric Theory [1] starts from the scales which appear due to the succeeding phase transitions of the superluminal Higgs field. There appears the cosmological scale as well. The evolution of the cosmic-structure/Protoworld leads to results consistent with experimental and observational facts.

When the mean distance between nucleons increased to the reduced Compton size of bare electron there appeared baryonic plasma composed of 50% free protons and 50% bound nucleons in nuclei of helium-4. It leads to conclusion that the primordial hydrogen-to-helium-4 ratio (by mass) was very close to 1. Such plasma leads to the today temperature of CMB on the assumption that age of the Universe is 21.614 ± 0.096 Gyr. It is consistent with the Ludwig data (2009) [2]. Here [3] we can find a recapitulation concerning the ages of stars. There are cited the results obtained by Ludwig *et al.* (see References: [91]). Ludwig *et al.* derived solar ages from 1.7 to 22.3 Gyr. The applied Th/Eu ratio is most credible. But the upper limit of the obtained interval is inconsistent with the age of the Universe, about 13.8 Gyr, calculated within the mainstream cosmology.

The big mistake in the mainstream cosmology follows from the wrong interpretation of the Michelson-Morley experiment [4]. In reality, due to the quantum entanglement, the speed of light, c, is the speed of photons in relation to the source or in relation to the last-interaction object. Detectors are always the last-interaction objects so measured speed of photons is the c always. But it is untrue that a photon has simultaneously the speed c in relation to all reference systems. The duality of relativity leads to conclusion that we cannot see the initial period 7.75 Gyr of expansion of the Universe so of evolution of quasars and big stars as well [5]. We can see the last period about 13.866 ± 0.096 Gyr [1]. We can see that in the observed most distant Universe there are already the big galaxies and big black holes so on assumption that age of the Universe is 13.8 Gyr, there was no time to form the very big cosmological objects. In reality, the era of quasars lasted about 10 Gyr but we can see only the end of this era i.e. the last 2.3 Gyr. The quasars transformed into the massive galaxies whereas in explosions of the quasars were produced the satellite/dwarf galaxies – generally, it happened during the invisible period 7.75 Gyr.

The observed 'oscillations' of neutrinos are the only exchanges of free neutrinos for the neutrinos in the non-rotating-spin binary systems of neutrinos the Einstein spacetime consists of. But number density of such 'oscillations' is too low to explain the only 33% of the electron neutrinos in the solar neutrino flux [1]. To explain this result we need the atom-like structure of baryons and acting GASER (Gamma Amplification by Stimulated Emission of Radiation) in cores of stars [1].

2. Calculations

Due to the GASER, with time abundance of helium-4 in the Universe should decrease.

The Stefan-Boltzmann law is a function of total emitted energy of a black body j* proportional to its thermodynamic temperature T

$$j^* = \sigma T^4. \tag{1}$$

Assume that due to the big stars a change in abundance of helium-4 (He-4), $\Delta Y_{A,He\text{-}4}$ [%], is directly proportional to the temperature T (higher temperature means higher changes in abundance) whereas that total emitted energy is directly proportional to age of the Universe, $\tau_{Universe}$ [Gyr]. Then, we can rewrite formula (1) as follows

$$\Delta Y_{A,He\text{-}4}\,[\%] = f\,(\tau_{Universe}\,[Gyr])^{1/4}. \tag{2}$$

The resultant abundance of helium-4 is

$$Y_{He\text{-}4} = Y_{P,He\text{-}4} - \Delta Y_{A,He\text{-}4}\,[\%] = Y_{P,He\text{-}4} - f\,(\tau_{Universe}\,[Gyr])^{1/4}, \tag{3}$$

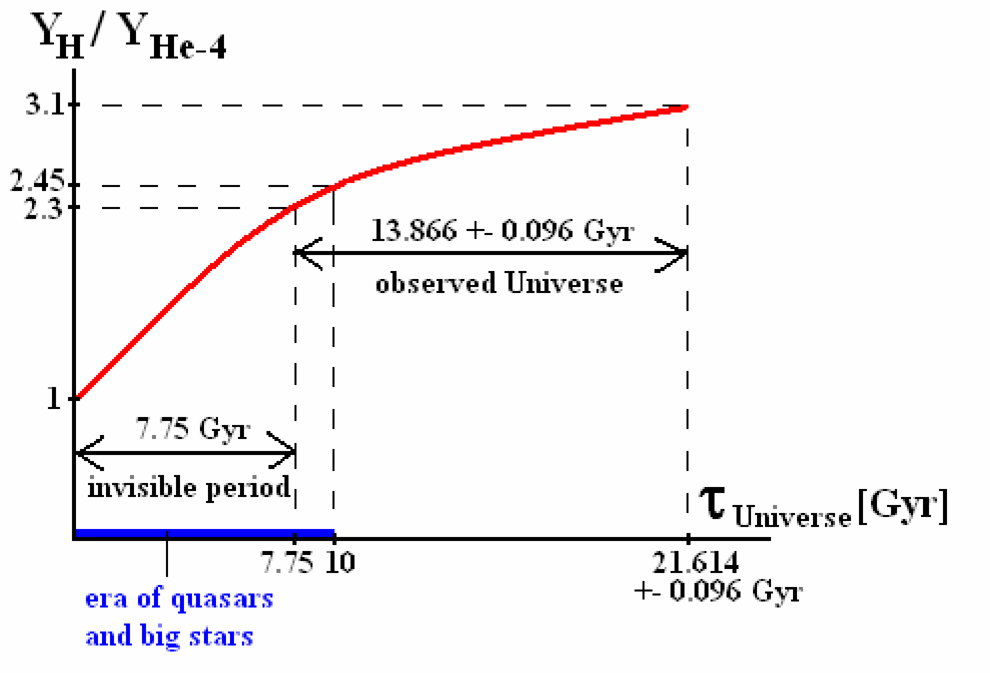
where $Y_{P,He\text{-}4} = 50\%$ is the primordial abundance of helium. On the assumption that the today abundances of helium-4 and hydrogen are respectively 24.5% and 75.5%, we obtain that the factor f is equal to $f = 11.8$.

The era of quasars and big stars lasted about 10 Gyr i.e. $\tau_{Universe}\,[Gyr] = 10$. Applying formula (3) we obtain that at the end of the era of quasars, i.e. in time distance from observer about 21.6 – 10 = 11.6 Gyr, abundance of helium-4 should be 29% whereas in most distant observed Universe, i.e. $\tau_{Universe}\,[Gyr] = 7.75$, should be 30.3%.

Above surfaces of the neutron stars and in the symmetrical decays of nuclei in the supernova explosions, [1], there appear protons so with time abundance of hydrogen increases. The production of neutron stars in the supernova explosions and the symmetrical decays of nuclei in the supernova explosions are cooling down the Universe whereas the transformations in big stars of helium-4 into iron are heating the Universe. On assumption that there is some symmetry, for abundance of hydrogen we obtain

$$Y_H = Y_{P,H} + \Delta Y_{A,H}\,[\%] \;\; = Y_{P,H} + f\;(\tau_{Universe}\,[Gyr])^{1/4}. \qquad (4)$$

Dividing formula (4) by (3) we obtain the hydrogen-to-helium-4 ratio. For the invisible primordial Universe we obtain about 1, for the most distant observed Universe is 2.3, for the end of the era of quasars and big stars is 2.45 whereas for the present-day Universe is about 3.1 – see Fig.



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3. Summary

Due to the atom-like structure of baryons and the GASER (Gamma Amplification by Stimulated Emission of Radiation), in big stars (in a cosmic scale, their lifetime is very short) dominate the transformations of helium-4 into iron so with time abundance of helium-4 decreases. The calculated hydrogen-to-helium-4 ratio for the invisible primordial Universe is very close to 1, for the most distant observed Universe is 2.3, for the end of the era of quasars and big stars (i.e. about 11.6 Gyr ago) is 2.45 whereas for the present-day Universe is about 3.1.

References

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