LENR Solution of the Cosmological Lithium Problem

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The basis of modern cosmology is the Big Bang theory. The validity of this theory is based on three main facts: a) the redshift of spectral lines of distant stars; b) the presence of cosmic microwave background radiation; c) the theory of primary Big Bang nucleosynthesis (BBN) of light H^2, He^3, He^4, Li^6 and Li^7 isotopes in expanding very hot plasma. Calculations of the formation and evolution of the first three isotopes were repeated many times and are in very good agreement with the results of modern astronomical observations. The problem (paradox) arises during the comparison of the results of theoretical calculations based on the BBN model with data of astronomical observations for the concentration of *Li* isotopes. The modern registered relative (Li^A/p) concentration of Li^7 isotope is 3 times less ($K(Li^7) \equiv (Li^7/p)_{observ}/(Li^7/p)_{BBN} \approx 1/3$) than the calculated initial (BBN) value, which according to theoretical estimates should remain approximately the same now. In contrast, observed concentration of Li^6 isotope is 300 ... 500 times higher $(K(Li^6) \approx 300...500)$ than predicted by BBN.

The maximal difference between the BBN estimations and astronomical observations corresponds to old stars of the first generation ($t \approx 10^{10}$years) and decreases for younger stars. This circumstance allows us to conclude that such an effect is associated not with a one-time phenomenon, but with multiple repeatable processes in the volume of stars, the result of which monotonously increases with time!

The lack of a substantiated explanation for such radical differences casts doubt on the correctness of the Big Bang model and all subsequent analysis of the cosmological process of global nucleosynthesis. There were many unsuccessful attempts to resolve this paradox through the use of "standard" nuclear reactions of creation $He^4(H^2,\gamma)Li^6$, $He^4(He^3,\gamma)Be^7 \to Be^7(\beta^-,\gamma)Li^7$ and destruction $Li^6(p,\gamma)Be^7$, $Li^6(p,\alpha)He^3$, $Li^6(H^2,\alpha)He^4$, $Li^6(H^2,\gamma)Be^8$, $Li^7(p,\alpha)He^4$ of Li^6 and Li^7 isotopes in volume of star. Correct analysis based on these reactions shows that the observed changes of the concentrations K_{Li} of these isotopes after the Big Bang can't be provided for any time, any density and any star temperature!

We have shown for the first time that these lithium paradoxes can be well described by the processes of nuclear transformations in the volume of stars in the region near the boundary between the radiative transfer zone and the convective zone if we take into account the influence of star shock waves on these reactions. A specific mechanism for optimizing of nuclear reactions is associated with the formation of coherent correlated states (CCS) of protons and deuterons, which occurs at the front of such shock waves [1,2] and which leads to a short-term generation of very large fluctuations of the energy of these particles $\delta E \geq 10…20keV$ at a typical temperature $kT \approx 100eV$ in this region of star. To realize the observed change in the concentrations of both isotopes, *1...10* powerful shock waves per year for 10^{10} years are needed in any part of discussed star region. The main reasons of Li^7 and Li^6 paradox are connected with effective CCS formation in $Li^7(p,\alpha)He^4$ reaction and fundamental impossibility of CCS formation in alternative $Li^6(p,\gamma)Be^7, Li^6(p,\alpha)He^3$ reactions in any stars [2,3].

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