Properties of Dark-Matter Particles

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Abstract: To ensure invariance of the basic physical constants, spacetime can not expand. The Scale-Symmetric Theory (SST) shows that when in the Einstein spacetime the gravitational pressure surpassed the dynamic pressure, it produced a stable boundary and it considerably increased the local spacetime density which is a necessary condition for the production of dark matter (DM) particles with a mass of 727.43 MeV. The vast majority of such DM particles decayed into single DM loops.

Introduction and motivation

The Scale-Symmetric-Theory (SST) initial inflation field was, as a whole, left-handed [1], [2]. During the SST inflation almost whole such field transformed into the Einstein spacetime (ES) composed of the spin-1 neutrino-antineutrino pairs. Neutrinos are built of the superluminal entanglons which are responsible for the superluminal quantum entanglement. The non-gravitating energy frozen inside the ES components is $\sim 0.6 \cdot 10^{119}$ times higher than their kinetic energy. The residual inflation field is the SST Higgs field – its interaction with the ES components causes that neutrinos acquire their gravitational mass [3].

To ensure invariance of the basic physical constants, spacetime can not expand – see the derived formulae for the basic physical constants in paper [1]. The SST shows that when in the Einstein spacetime the gravitational pressure surpassed the dynamic pressure, it produced a stable boundary and it considerably increased the local spacetime density [2]. Here we show that spacetime with considerably increased density is a necessary condition for the production of dark matter (DM) particles/tori with a mass of $M_{DM,torus} = 727.43$ MeV. In SST, the same mass has the core of baryons: 727.44 MeV – there is the torus/electric-charge with a mass of 318.2955 MeV (which is responsible for the electromagnetic and nuclear strong interactions) and there is the central ES condensate with a mass of 424.1245 MeV (which is responsible for the nuclear weak interactions) – the binding energy is 14.98 MeV [1]. Emphasize that the DM particle/torus has shape and size the same as the torus/electric-charge but arrangements of the ES components are very different – it causes that the DM torus interacts only gravitationally and weakly.

The spins of the spin-1 neutrino-antineutrino pairs (directions of the half-integral spins overlap) on the surface of the electric torus are perpendicular to the surface so distances between the pairs are $L_{Electric} = 2\pi\, r_{neutrino}$, where $r_{neutrino} = 1.1184555 \cdot 10^{-35}$ m is the equatorial radius for a non-rotating neutrino. A closed string the entanglons consist of is built of K^2 tachyons ($K = 0.78966855 \cdot 10^{10}$) [1] so we can assume that on the equator are K^2 neutrino pairs in distance $L_{Electric}$. It leads to following radius A of the equator

$$A = K^2 L_{Electric} = K^2 \, 2 \pi r_{neutrino} / (2\pi) = 0.6974425 \text{ fm} . \quad (1)$$

In [1], we calculated A in a different way. The inner radius of the electric torus is $A/3$ [1].

In the DM loops, spins of the ES components are tangent to the loops so distances between the neutrinos are $L_{DM} = 2\pi r_{neutrino}/3$ so radius of a DM loop composed of K^2 neutrinos is $A/3$ – it is equal to the inner radius of the electric torus. We can assume that there can be created a DM torus composed of K^2 entangled DM loops so its inner radius is the same as the electric torus

$$R_{DM,inner} = K^2 L_{DM} / (2\pi) = K^2 (2 \pi r_{neutrino} / 3) / (2\pi) = A / 3 . \quad (2)$$

But mass of the DM torus is different

$$M_{DM,torus} = K^4 m_{Neutrino} = 727.43 \text{ MeV} , \quad (3)$$

where $m_{Neutrino} = 3.3349306 \cdot 10^{-67}$ kg is the mass of non-rotating lightest neutrino [1].

The initial inflation field had left helicity and such helicity is responsible for the matter-antimatter asymmetry [1], [2]. Because of the tremendous non-gravitating energy frozen inside neutrinos, such asymmetry can not concern the Einstein spacetime. The asymmetry appeared simultaneously with the ES boundary. Nucleons, contrary to antinucleons, have left-handed internal helicity so there appeared a surplus of baryons over antibaryons. Simultaneously with the ES boundary there appeared a return shock wave which created in the centre of the Cosmos the core of the Protoworld built of the DM tori/particles. Inside the cosmological torus of the Protoworld there was created the very early Universe – it was created similar as is created the neutral pion inside the core of baryons [1]. Emphasize that the Protoworld is the result of the fourth phase transition of the SST Higgs field [1].

The SST cosmology leads to the correct abundances of baryonic matter, dark matter and dark energy in our Universe [2].

Due to the Core-of-Protoworld→neutrino transition [2], the vast majority of the DM tori decayed into the single DM loops. SST shows that, contrary to the orthodox cosmology, initially sizes of protogalaxies increased and, next, cores of them increased their density so angular momentums of them decreased in the cost of the angular momentum of the DM loops, i.e. the radii of the DM loops increased.

Summary

Properties of the DM tori/particles (we will call it the $T^o(727)_{DM}$ particle) are as follows.

1) The rest mass is 727.43 MeV.
2) It is a scalar torus, i.e. it is the spin-0 DM particle.
3) Due to the arrangement of the spins of the ES components, it is electrically neutral particle.
4) Contrary to the electric torus, the poloidal speed (which concerns the weak interactions) is higher than the toroidal one).
5) Range of the weak interactions in the plane of the equator of $T^o(727)_{DM}$ is $2\pi A$ while in the axial direction is $2\pi A/3$.

6) The DM particle interacts only gravitationally and weakly.
7) Today, abundance of such particles should be very low but we can detect (today only indirectly) the DM loops with a mass of $M_{DM,loop} = 2.08 \cdot 10^{-47}$ kg.

We need the $T^o(727)_{DM}$ particle to explain the abundances of baryonic matter, dark matter and dark energy [2].

References

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