Lifetimes of Higgs, W and Z Bosons in the Scale-Symmetric Physics

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Abstract: Here, within the Scale-Symmetric Physics, we calculated the rigorous lifetimes of Higgs (H) boson, W and Z bosons expressed in yoctoseconds [ys] (yocto is the inverse of the 24 powers of ten): for H is 0.282 ys, for W is 0.438 ys whereas for Z is 0.386 ys. They are the upper limits for experimental data and it is obvious that the experimental data should be close to such limits. The decay width of H boson (about 3.4 GeV/(cc) gives 0.194 ys, the decay width of W boson (about 2.1 GeV/(cc) gives 0.316 ys whereas the decay width of Z boson (about 2.5 GeV/(cc) gives 0.264 ys. The calculated here theoretical results are consistent with experimental data. The lifetime of Higgs boson predicted within the Standard Model (SM), 0.156 zeptoseconds [zs] (zepto is the inverse of the 21 powers of ten), is inconsistent with experimental data - it suggests that SM is at least incomplete or partially incorrect. The main method to determine the lifetimes of particles follows from measurement of the decay width. But using this widely accepted method, we obtain the lifetime of the Higgs boson a factor of one thousandth of the value predicted by the Standard Model. It causes that some “scientists” try to change the widely accepted method to obtain from the experimental data the SM value. As usually, when a mainstream theory fails, to fit theoretical results to experimental data, “scientists” apply some approximations, mathematical tricks and free parameters. The truth is obvious - the experimental lifetime of the sham Higgs boson with a mass of 125 GeV is inconsistent with the SM prediction. Photons inside strong fields behave as gluons.

1. Introduction

The succeeding phase transitions of the Higgs field and the symmetrical decays of bosons, which lead to the atom-like structure of baryons, are the foundations of the Scale-Symmetric Physics (S-SP) [1].

Within S-SP, we described internal structure of the detected composite sham Higgs boson with a mass of 125 GeV, we calculated its mass, solved the hierarchy problem, calculated branching ratios, showed why its mass is very messy, calculated masses of next composite sham Higgs bosons, described the real Higgs mechanism, quantum entanglement and confinement, and we calculated the coupling constant responsible for interactions of the constituents of the composite sham Higgs boson – the References are listed here [2].

Here, applying the S-SP we calculated the rigorous lifetimes of Higgs, W and Z bosons.

2. Calculations

According to S-SP, the composite sham Higgs boson (the H; spin = 0) and the W and Z bosons (spin = 1) are the condensates composed of the confined Einstein-spacetime components (the W and Z bosons rotate). The luminal Einstein-spacetime components are the still undetected neutrino-antineutrino pairs. They are the carriers of gluons and photons which are their rotational energies. The different properties of the gluons and photons do not follow from different structure of the carriers (their properties are the same and they have the three internal helicities/colors) but due to their internal helicities they behave differently in fields having internal helicity (the strong fields have internal helicity so there are 8 different gluons [1]) and in fields without internal helicity (the electromagnetic fields do not have internal helicity so there is 1 photon). We can see that photons interacting with nucleons interact strongly i.e. the photons inside the strong fields behave as gluons.

The coupling constant defining the interactions/confinement of the constituents of the composite H is very small [2] so the condensates are very unstable. The condensates, as a whole, decay due to the weak interactions characteristic for baryons. The coupling constant for the weak interactions of baryons is $\alpha_{W(proton)} = 0.0187229 \approx 1 / 53.41$ ([1]: formula (51)). The H, W and Z bosons decay due to their weak mass, M_{Weak},

$$M_{Weak} = \alpha_{W(proton)} M = \Gamma / c^2, \tag{1}$$

where M is the mass of a condensate whereas the ($M_{Weak}\, c^2$) is the decay width Γ.

On the other hand, lifetime of a condensate is defined as follows

$$\tau = \hbar / \Gamma = \hbar / (M_{Weak}\, c^2) = \hbar / (\alpha_{W(proton)}\, M\, c^2). \tag{2}$$

Applying formula (2) we obtain the rigorous theoretical lifetimes – they are the upper limits for experimental data. It follows from the fact that theoretical decay width always has higher accuracy than experimental ones (it is due to the systematic and statistical errors)

$$\Gamma_{H,theory(S\text{-}SP)} \approx 2.34 \text{ GeV} / c^2 \rightarrow \tau_{H,theory} = 2.82 \cdot 10^{-25} \text{ s}, \tag{3a}$$

$$\Gamma_{W,theory(S\text{-}SP)} \approx 1.51 \text{ GeV} / c^2 \rightarrow \tau_{W,theory} = 4.38 \cdot 10^{-25} \text{ s}, \tag{3b}$$

$$\Gamma_{Z,theory(S\text{-}SP)} \approx 1.71 \text{ GeV} / c^2 \rightarrow \tau_{Z,theory} = 3.86 \cdot 10^{-25} \text{ s}. \tag{3c}$$

Applying formula (2) and knowing the decay widths, [3], we obtain the experimental lifetimes

$$\Gamma_{H,exp.} \approx 3.4 \text{ GeV} / c^2 \rightarrow \tau_{H,exp.} = 1.94 \cdot 10^{-25} \text{ s}, \tag{4a}$$

$$\Gamma_{W,exp.} \approx 2.1 \text{ GeV} / c^2 \rightarrow \tau_{W,exp.} = 3.16 \cdot 10^{-25} \text{ s}, \tag{4b}$$

$$\Gamma_{Z,exp.} \approx 2.5 \text{ GeV} / c^2 \rightarrow \tau_{Z,exp.} = 2.64 \cdot 10^{-25} \text{ s}. \tag{4c}$$

We can see that calculated here theoretical results are consistent with experimental data. The lifetime of Higgs boson predicted within the Standard Model (SM) is inconsistent with experimental data - it suggests that SM is at least incomplete or partially incorrect

$$\tau_{H,theory(SM)} = 1.56 \cdot 10^{-22}\ s. \qquad (5)$$

The main method to determine the lifetimes of particles follows from measurement of the decay width. But using this widely accepted method, we obtain the lifetime of the Higgs boson a factor of one thousandth of the value predicted by the Standard Model. It causes that some “scientists” try to change the widely accepted method to obtain from the experimental data the SM value. As usually, when a mainstream theory fails, to fit theoretical results to experimental data “scientists” apply some approximations, mathematical tricks and free parameters. The truth is obvious - the experimental lifetime of the sham Higgs boson with a mass of 125 GeV is inconsistent with the SM prediction.

Notice as well that

$$\tau_{theory} / \tau_{exp.} = \Gamma_{exp.} / \Gamma_{theory} = sqrt(2). \qquad (6)$$

It suggests that the energy responsible for decay, Γ_{theory}, appears on the Schwarzschild surface for the strong interactions [1]. Then, its relativistic mass is $\Gamma_{exp.} = \Gamma_{theory}$ sqrt(2), [1], and it leads to the perfect consistency of the Scale-Symmetric Physics with experimental data concerning the lifetimes of H, W and Z bosons.

References

[1] Sylwester Kornowski (6 March 2015). “The Scale-Symmetric Physics” http://vixra.org/abs/1203.0021

[2] Sylwester Kornowski (25 March 2015). “The Composite Sham Higgs Boson with a Mass of 125 GeV in the Scale-Symmetric Physics” http://vixra.org/abs/1503.0181

[3] K. A. Olive *et al.* (Particle Data Group), Chin. Phys. **C38**, 090001 (2014). http://pdg.lbl.gov .