Internal Structure of All Particles

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Abstract: In my book, I described internal structure of gauge bosons, Higgs bosons, leptons, masses of quarks, lightest mesons, all Upsilons, nucleons, hyperons and all chi-b (42 particles). In other my paper, I described the Type-X particles (8 particles). Here we described all other baryons with 3- or 4-star status (144 baryons) and all other mesons marked with a dot on the list of mesons (116 mesons). We described also the pseudoscalar axion and solved the strong CP problem not via an axion field.

1. Introduction

In the Scale-Symmetric Theory (SST), we present the atom-like structure of baryons [1] – it leads to masses of all baryons and mesons.

In [1], we described internal structure of gauge bosons, Higgs bosons, leptons, masses of quarks, lightest mesons, all Upsilons, nucleons, hyperons and all chi-b (42 particles). In [2], we described the Type-X particles (8 particles).

Here we described additional 144 baryons and 116 mesons.

All masses are in MeV so for simplicity we omit units.

From SST [1] follows that in baryons is a core and relativistic pions (we call them the W pions) in the d = 1, 2 and 4 states. At higher energies, there can appear relativistic pion or kaon in the d = 0 state that transform into the spacetime condensates, C, that are scalars. There can be created also neutral or charged gluon loops overlapping with the d states (we call them the S particles). The approximate masses of the W pions and S loops are listed in Table 1 [1]. The $XX = X^+X^- = 2 \cdot 318.2955$ MeV ≈ 637 MeV is mass of the pair composed of the torus/electric-charge in the core of baryons and its antiparticle – mass of it in d = 0 state is 5732 MeV and such pseudoscalar, Ps_{XX}, appears in the bottom charmed mesons.

Table 1 *Masses of W pions and S loops* [MeV]

States d	$S_{(+-),d}$	$S_{(o),d}$	$W_{(+-),d}$	$W_{(o),d}$
0	727	725	$C_{\pi\pm} = 1257$ $C_{K\pm} = 4445$	$C_{\pi} = 1215$ $C_K = 4480$ $Ps_{XX} = 5732$
1	423	421	216	209
2	298	297	182	176
4	188	187	162	157

For properties of hyperons are responsible the relativistic pions in the d = 2 state which is the ground state above the Schwarzschild surface for the nuclear strong interactions.

The experimental central masses of baryons and their resonances are from [3], [4] and [5].

The symbol Δ(1232 | 1233) means that it concerns the Δ(1232) resonance and that our theoretical mass is 1233 MeV and it is marked in red.

The symbol {$3/2^+$u} means that J = 3/2, the sense of J is "up", and the parity is P = +1. Our results are marked in red. The "d" in {$3/2^+$d} means that the sense of J is "down".

2. The $I^G(J^{PC})$ quantum numbers in SST

The basic objects presented in Table 2 are created inside the nucleons, hyperons, and are the parts of mesons.

The transitions of the relativistic pions from the d = 2 state to the d = 4 state, cause that there appear the vector bosons with a mean mass ΔW_{2-4} = 19.367 MeV ≈ 19 MeV {$I^G(J^{PC}) = 0^-(1^{--})$} [1].

Notice that neutral pions are the binary systems of the FGLs [1].

We know that the baryon resonances decay due to the nuclear strong interactions. On the other hand, parity, P, is conserved in nuclear strong interactions and electromagnetic ones.

Table 2 *Basic objects created in baryons*

Object	**Mass** [MeV]	$I^G(J^{PC})$}
π^o (the single neutral pion)	135	$1^-(0^{-+})$
$\pi^{o,\pm}$	Mean 138	(0^-)
m_{FGL} (spin-1 fundamental gluon loop) $W_{(o)}$ gluons or $S_{(o)}$ open gluon loops ΔW_{2-4} (a gluon [1])	67.5 19.4	$0^-(1^{--})$
$2m_{FGL}$ $2W_{(o)}$ or $2S_{(o)}$ $2\Delta W_{2-4}$ The single gluons in the pairs interact one with other	135 39	$0^+(0^{-+})$ or $0^+(2^{--})$*
$2m_{FGL}$ $2W_{(o)}$ or $2S_{(o)}$ or $2\Delta W_{2-4}$ The single gluons in the pairs do not interact with each other	135	$0^+(0^{++})$ or $0^+(2^{++})$
$3m_{FGL}$ The single gluons in the triplet do not interact with each other	203	$0^-(1^{--})$
Spacetime condensates C		$0^+(0^{++})$
Pseudoscalar Ps_{XX}	5732	$0(0^-)$
X^+X^-	637	(0^-) or (1^-)

*When spins are antiparallel then it behaves as neutral pion. When we change the sense of a vector boson in a particle then parity is conserved.

Below we present some examples concerning the SST [1].

The SST Higgs boson is the non-rotating spacetime condensate composed of the confined SST-absolute-spacetime (SST-As) components so it is a *scalar* $I^G(J^{PC}) = 0^+(0^{++})$. Such scalars decay, generally, to two photons. The same concerns the condensate in centre of baryons or the predicted in SST scalar with a mass of ~17.2 ÷ 17.3 TeV.

The SST neutral pion is the *pseudoscalar* $J^{PC} = 0^{-+}$ (two spin-1 loops with antiparallel spins and the same internal helicity) – it decays to two photons. In such a way was organized the neutron matter in the Protoworld – there were the thin-disc massive protogalaxies composed of neutron stars so we observe too many massive thin-disc galaxies in comparison to the predicted number of them in the mainstream Lambda cold dark matter (ΛCDM) model in the standard model of cosmology.

Photon and gluon are the rotational energies of the SST-As components so they are the *vectors* $J^{PC} = 1^{--}$. The same concerns the spin-1 gluon loops and the open gluon loops created in the nuclear strong interactions. For the single vectors is C = –1 (photons in strong fields behave as gluons [1]).

We define isospin as a number of members in a multiplet, N, minus one and then we divide it by two.

The isospin selection rules for nucleons and hyperons are described in [1].

Isospins, I, of the baryon resonances, because of the attached only neutral objects, are the same as the basic particles: I = 1/2 for N, I = 3/2 for Δ, I = 0 for Λ, I = 1 for Σ, I = 1/2 for Ξ and I = 0 for Ω. Isospin of baryons follows from number of charge states, N_Q

$$N_Q = 2\,I + 1\,. \tag{1}$$

The G-parity is defined as follows

$$G = (-1)^{I + S + L}\,. \tag{2}$$

But SST shows that for the gluon loops (due to their behaviour) is L = 0 [1] so we have

$$G = (-1)^{I + S}\,. \tag{3}$$

For the neutral pion is I = 1 and there are two gluon loops so we have G = –1.

For a single gluon we have I + S = 1 so G = –1.

But there are 17 mesons (about 12% of all mesons with defined $I^G(J^{PC})$) that do not fit to the above SST model: the 10 Type-X particles [2] and 7 other particles, i.e. two a_1 mesons, two π_1 mesons, $\psi_2(3823)$, $R_{c0}(4240)$ and $Y_2(1D)$. We claim that such discrepancy follows from the fact that such particles contain the spin-0 quadrupole composed of one real spin-1 electron-positron pair and one virtual spin-1 electron-positron pair – for such an object is $I^G(J^{PC}) = 0^+(0^{++})$ but the unobserved spin-1 of the virtual pair causes that the observed quantum numbers are as follows: $\{I^G(J^{PC})\}_{Observed} = 0^+(1^{++})$ – its mass is Q ≈ 1 MeV.

Part 1: Baryons

3. Δ(1232) resonance

The Δ(1232) resonance is the only one to behave in an unusual way that results from the dynamics of baryons [1]. Decay of such resonance starts from d = 2 state as it is for all baryon resonances. But the relativistic radial speed of the charged pions, $\pi^{\pm}$, in the d = 4 state is [1]

$$v_{radial} = (c^2 - v_{spin,d=4}{}^2)^{1/2} = 0.8614778\ c\,, \tag{4}$$

where $v_{spin,d=4}{}^2 / c^2 \approx 0.6974$ fm / 2.7048 fm (here the 0.6974 fm is the equatorial radius of the core of baryons, and 2.7048 fm is the radius of the d = 4 state) [1].

It causes that the relativistic mass of the charged pions in the d = 4 state is (it moves in radial direction)

$$\pi^{\pm}_{rel,d=4} = 274.8557 \text{ MeV and it is close to } \pi^{\pm}_{rel} = \pi^{\pm} + \pi^{o} = 274.5472 \text{ MeV}\,, \qquad (5)$$

so there is a resonance! Such a resonance does not apply to the neutral pion. But notice that the second value in (5) is a little lower so it is the ground state. It causes that in our theory of the Δ(1232) resonance, there will appear following mass

$$\pi^{\pm}_{rel}\,\{0^-\} = \pi^{\pm} + \pi^{o} = 274.5472 \text{ MeV}\,. \qquad (6)$$

Notice that following sum of masses

$$N(938.9187) \approx 939) + \pi^{\pm}_{rel}\,\{0^-\} = 1213.466 \text{ MeV} \qquad (7)$$

is close to the experimental value of the real part for mixed charges (~1210 MeV) [6].

There is also the virtual part that leads to the mean mass of the vector boson (gluon) $\Delta W_{2-4} = 19.367$ MeV $\{J^P = 1^-\}$ that interacts with the relativistic charged pion – then the spin is equal to 1 as it is for the SST-absolute-spacetime components [1].

In SST, we have the four charge states of the Δ(1232) resonance:

$$\Delta(1232)^{++}\,\{3/2^+u\} = p\,\{1/2^+u\} + \pi^{+}_{rel}\,\{0^-\} + \Delta W_{2-4}\,\{J^P = 1^-u\} =$$

$$= 1232.186 \text{ MeV}\,, \qquad (8)$$

$$\Delta(1232)^{+}\,\{3/2^+u\} = n\,\{1/2^+u\} + \pi^{+}_{rel}\,\{0^-\} + \Delta W_{2-4}\,\{J^P = 1^-u\} =$$

$$= 1233.480 \text{ MeV}\,, \qquad (9)$$

$$\Delta(1232)^{o}\,\{3/2^+u\} = p\,\{1/2^+u\} + \pi^{-}_{rel}\,\{0^-\} + \Delta W_{2-4}\,\{J^P = 1^-u\} =$$

$$= 1232.186 \text{ MeV}\,, \qquad (10)$$

$$\Delta(1232)^{-}\,\{3/2^+u\} = n\,\{1/2^+u\} + \pi^{-}_{rel}\,\{0^-\} + \Delta W_{2-4}\,\{J^P = 1^-u\} =$$

$$= 1233.480 \text{ MeV}\,. \qquad (11)$$

The arithmetic mean of the four masses is

$$\Delta(1232\,|\,1233)\,\{3/2^+\} = 1232.83 \text{ MeV}\,. \qquad (12)$$

The basic objects in Δ(1232) are created in the d = 2 state, i.e. in the ground state above the Schwarzschild surface for the nuclear strong interactions [1]. Radius of the d = 2 state is $R_{d=2} = 1.7011$ fm [1]. It means that the FGL produced in the core of baryons reaches the d = 2 orbit after $\tau = R_{d=2} / c = 5.67 \cdot 10^{-24}$ s. From formula $\Gamma = \hbar / \tau$ we can calculate the full width that relates to τ: 116 MeV. On the other hand, the Breit-Wigner full width for mixed charges of the Δ(1232) is $114 < \Gamma < 120$ MeV [2] so our result (116 MeV) overlaps with the experimental data – it validates our assumption that the basic objects listed in Table 1 indeed are created in the d = 2 state.

J^P for $S_{(o),d=2}$ can be 1^- for open gluon loop and $\sim 2^-$ for gluon loop (it follows from the fact that when it behaves as the $S_{(o),d}$ object then there is $J \approx 2.6\,\hbar$ while when it behaves as the $W_{(o),d}$ object there is $J \approx 1.6\,\hbar$ so the mean value is $\sim 2.1\,\hbar$ [1]). The mean value $\sim 2.1\,\hbar$ is not equal to J = 2 so the correct structure of Δ(1232) is defined by formulae (8) – (11). Moreover, the sum N(939) + $S_{(o),d=2}$ > Δ(1232 | 1233) so the second state is the ground state.

From formula $\Gamma = \hbar c / R$ we know that width is inversely proportional to distance covered by gluons and that for R ≈ 1.7 fm is about Γ ≈ 116 MeV – it is for the Λ and Σ resonances. It means that when most of gluons are created in d = 0 state (R ≈ 1 fm) then Γ ≈ 200 MeV, when most are created in d = 1 (R ≈ 0.5 fm) then Γ ≈ 400 MeV – it is for the N and Δ resonances. When most are created on the d = 2 (then maximum distance is equal to diameter: R ≈ 3.4 fm) then Γ ≈ 60 MeV – it is for the Ξ and Ω resonances. But different intrinsic interactions can change value of the mean full width. Generally, in more massive resonances gluons cover bigger distances.

There are the four charge states so isospin of $\Delta(1232)^{++,+,o,-}$ is I = 3/2.

4. Nucleon resonances

N(939 | 939) {$1/2^+$u} + 4 π^o {0^+} + m_{FGL} {1^-d} = N(1535 | 1547) {$1/2^-$}

N(939 | 939) {$1/2^+$u} + 2 $S_{(o),d=2}$ {2^-d} = N(1520 | 1533) {$3/2^-$}

N(1520 | 1533) {$3/2^-$u} $\rightarrow$ m_{FGL} {1^-u} + N(1440 | 1465) {$1/2^+$u}

N(1440 | 1465) {$1/2^+$u} + 3 m_{FGL} {1^-d} = N(1650 | 1668) {$1/2^-$}

N(1650 | 1668) {$1/2^-$u} + m_{FGL} {1^-u} = N(1720 | 1736) {$3/2^+$}

N(939 | 939){$1/2^+$u} + $S_{(o),d=2}${1^-u} + $S_{(o),d=2}${1^-d} + 2 m_{FGL}{2^-u} = N(1675 | 1668) {$5/2^-$}

N(1535 | 1547) {$1/2^-$u} + 2 m_{FGL} {2^-u} = N(1680 | 1682) {$5/2^+$}

N(1680 | 1682) {$5/2^+$u} + ΔW_{2-4} {1^-d} = N(1700 | 1701) {$3/2^-$}

N(1700 | 1701) {$3/2^-$u} + ΔW_{2-4} {1^-d} = N(1710 | 1720) {$1/2^+$}

N(1720 | 1736) {$3/2^+$u} + 2 π^o {0^+} + m_{FGL} {1^-u} = N(2060 | 2074) {$5/2^-$}

N(2060 | 2074) {$5/2^-$u} + 4 π^o {0^+} = N(2570 | 2614) {$5/2^-$}

N(2060 | 2074) {$5/2^-$u} $\rightarrow$ ΔW_{2-4} {1^-u}+ N(2040 | 2055) {$3/2^+$u}

N(1710 | 1720) {$1/2^+$u} + $S_{(o),d=2}${1^-d} + m_{FGL} {1^-u} = N(2100 | 2085) {$1/2^+$}

N(2100 | 2085) {$1/2^+$u} $\rightarrow$ 3 m_{FGL} {1^-d} + N(1875 | 1882) {$3/2^-$u}

N(1875 | 1882) {$3/2^-$u} $\rightarrow$ ΔW_{2-4} {1^-d} + N(1860 | 1863) {$5/2^+$u}

N(1875 | 1882) {$3/2^-$u} + ΔW_{2-4} {1^-d} = N(1880 | 1901) {$1/2^+$}

N(1880 | 1901) {$1/2^+$u} + ΔW_{2-4} {1^-d} = N(1895 | 1920) {$1/2^-$}

N(1895 | 1920) {$1/2^-$u} + ΔW_{2-4} {1^-u}= N(1900 | 1939) {$3/2^+$}

N(1710 | 1720) {$1/2^+$u} + 2 π^o {0^+} + 4 m_{FGL} {4^+u} = N(2220 | 2260) {$9/2^+$}

N(2220 | 2260) {9/2^{+}u} + 2 π^{o} {0^{+}} + m_{FGL} {1^{-}u} = N(2600 | 2598) {11/2^{+}}

N(2220 | 2260) {9/2^{+}u} → m_{FGL} {1^{-}u} + N(2190 | 2192) {7/2^{-}u}

N(2600 | 2598) {11/2^{+}u} + m_{FGL} {1^{-}u} + 2 $\Delta W_{2\text{-}4}$ {0^{-}} = N(2700 | 2705) {13/2^{+}}

N(1700 | 1701) {3/2^{-}u} + $S_{(o),d=2}$ {1^{-}u} = N(2000 | 1998) {5/2^{+}}

N(1720 | 1736) {3/2^{+}u} + π^{o} {0^{-}} + 2 m_{FGL} {2^{-}u} = N(1990 | 2006) {7/2^{+}}

N(1680 | 1682) {5/2^{+}u} + 4 π^{o} {0^{+}} + 2 $\Delta W_{2\text{-}4}$ {2^{-}u} = N(2250 | 2261) {9/2^{-}}

N(1990 | 2006) {7/2^{+}u} + 2 m_{FGL} {2^{-}d} = N(2120 | 2141) {3/2^{-}}

N(2100 | 2085) {1/2^{+}u} + π^{o} {0^{-}} + m_{FGL} {1^{-}d} = N(2300 | 2288) {1/2^{+}}

5. Delta resonances

Δ(1232 | 1232.8) {3/2^{+}u} = N(938.92) {1/2^{+}u} + π^{+}_{rel}(274.55) {0^{-}} + $\Delta W_{2\text{-}4}$(19.37) {1^{-}u}

Δ(1232 | 1233) {3/2^{+}u} + $S_{(o),d=2}$ {1^{-}u} + m_{FGL} {1^{-}d} = Δ(1600 | 1598) {3/2^{+}}

Δ(1600 | 1598) {3/2^{+}u} + $\Delta W_{2\text{-}4}$ {1^{-}d} = Δ(1620 | 1617) {1/2^{-}}

Δ(1620 | 1617) {1/2^{-}u} + π^{o} {0^{-}} = Δ(1750 | 1752) {1/2^{+}}

Δ(1750 | 1752) {1/2^{+}u} → m_{FGL} {1^{-}d} + Δ(1700 | 1684) {3/2^{-}u}

Δ(1620 | 1617) {1/2^{-}u} + 2 π^{o} {0^{+}} = Δ(1900 | 1887) {1/2^{-}}

Δ(1900 | 1887) {1/2^{-}u} + 2 $\Delta W_{2\text{-}4}$ {2^{-}u} = Δ(1905 | 1926) {5/2^{+}}

Δ(1900 | 1887) {1/2^{-}u} + $\Delta W_{2\text{-}4}$ {1^{-}d} = Δ(1910 | 1906) {1/2^{+}}

Δ(1900 | 1887) {1/2^{-}u} + $\Delta W_{2\text{-}4}$ {1^{-}u} = Δ(1920 | 1906) {3/2^{+}}

Δ(1920 | 1906) {3/2^{+}u} + $\Delta W_{2\text{-}4}$ {1^{-}u} = Δ(1930 | 1925) {5/2^{-}}

Δ(1910 | 1906) {1/2^{+}u} + $\Delta W_{2\text{-}4}$ {1^{-}u}= Δ(1940 | 1925) {3/2^{-}}

Δ(1930 | 1925) {5/2^{-}u} + $\Delta W_{2\text{-}4}$ {1^{-}u} = Δ(1950 | 1944) {7/2^{+}}

Δ(1700 | 1684) {3/2^{-}u} + $S_{(o),d=2}$ {1^{-}u} = Δ(2000 | 1981) {5/2^{+}}

Δ(1940 | 1925) {3/2^{-}u} + π^{o} {0^{-}} + m_{FGL} {1^{-}d} = Δ(2150 | 2128) {1/2^{-}}

Δ(1905 | 1926) {5/2^{+}u} + $S_{(o),d=2}$ {1^{-}u} = Δ(2200 | 2223) {7/2^{-}}

Δ(2200 | 2223) {7/2^{-}u} + m_{FGL} {1^{-}u} = Δ(2300 | 2291) {9/2^{+}}

$\Delta(2300 \mid 2291)\ \{9/2^{+}u\} + \pi^{o}\ \{0^{-}\} = \Delta(2400 \mid 2426)\ \{9/2^{-}\}$

$\Delta(2400 \mid 2426)\ \{9/2^{-}u\} \rightarrow \Delta W_{2\text{-}4}\ \{1^{-}d\} + \Delta(2390 \mid 2407)\ \{7/2^{+}u\}$

$\Delta(2400 \mid 2426)\ \{9/2^{-}u\} + \Delta W_{2\text{-}4}\ \{1^{-}u\} = \Delta(2420 \mid 2445)\ \{11/2^{+}\}$

$\Delta(2400 \mid 2426)\ \{9/2^{-}u\} + S_{(o),d=2}\ \{1^{-}u\} + \Delta W_{2\text{-}4}\ \{1^{-}u\} = \Delta(2750 \mid 2742)\ \{13/2^{-}\}$

$\Delta(2750 \mid 2742)\ \{13/2^{-}u\} + 3\ m_{FGL}\ \{1^{-}u\} = \Delta(2950 \mid 2945)\ \{15/2^{+}\}$

$\Delta(2390 \mid 2407)\ \{7/2^{+}u\} \rightarrow m_{FGL}\ \{1^{-}d\} + \Delta(2350 \mid 2339)\ \{5/2^{-}u\}$

6. Lambda resonances

$\Lambda(1116)\ \{1/2^{+}u\} + S_{(o),d=2}\ \{1^{-}d\} = \Lambda(1405 \mid 1413)\ \{1/2^{-}\}$

$\Lambda(1116)\ \{1/2^{+}u\} + 2\ \pi^{o}\ \{0^{+}\} + 2\ m_{FGL}\ \{2^{-}d\} = \Lambda(1520 \mid 1521)\ \{3/2^{-}\}$

$\Lambda(1520 \mid 1521)\ \{3/2^{-}u\} \rightarrow m_{FGL}\ \{1^{-}u\} + m_{FGL}\ \{1^{-}u\} + \Lambda(1385 \mid 1386)\ \{1/2^{-}d\}$

$\Lambda(1405 \mid 1413)\ \{1/2^{-}\} + 2\ \pi^{o}\ \{0^{+}\} = \Lambda(1670 \mid 1683)\ \{1/2^{-}\}$

$\Lambda(1670 \mid 1683)\ \{1/2^{-}u\} \rightarrow m_{FGL}\ \{1^{-}u\} + \Lambda(1600 \mid 1615)\ \{1/2^{+}d\}$

$\Lambda(1405 \mid 1413)\ \{1/2^{-}u\} + S_{(o),d=2}\ \{1^{-}d\} = \Lambda(1710 \mid 1710)\ \{1/2^{+}\}$

$\Lambda(1710 \mid 1710)\ \{1/2^{+}u\} \rightarrow \Delta W_{2\text{-}4}\ \{1^{-}d\} + \Lambda(1690 \mid 1691)\ \{3/2^{-}u\}$

$\Lambda(1520 \mid 1521)\ \{3/2^{-}u\} + S_{(o),d=2}\ \{1^{-}u\} = \Lambda(1820 \mid 1818)\ \{5/2^{+}\}$

$\Lambda(1670 \mid 1683)\ \{1/2^{-}\} + \pi^{o}\ \{0^{-}\} = \Lambda(1810 \mid 1818)\ \{1/2^{+}\}$

$\Lambda(1810 \mid 1818)\ \{1/2^{+}u\} \rightarrow \Delta W_{2\text{-}4}\ \{1^{-}u\} + \Lambda(1800 \mid 1799)\ \{1/2^{-}d\}$

$\Lambda(1820 \mid 1818)\ \{5/2^{+}\} + 2\ \Delta W_{2\text{-}4}\ \{0^{-}\} = \Lambda(1830 \mid 1857)\ \{5/2^{-}\}$

$\Lambda(1830 \mid 1857)\ \{5/2^{-}u\} + m_{FGL}\ \{1^{-}d\} = \Lambda(1890 \mid 1925)\ \{3/2^{+}\}$

$\Lambda(1800 \mid 1799)\ \{1/2^{-}u\} + \pi^{o}\ \{0^{-}\} + 2\ m_{FGL}\ \{2^{-}u\} = \Lambda(2080 \mid 2069)\ \{5/2^{-}\}$

$\Lambda(2080 \mid 2069)\ \{5/2^{-}u\} \rightarrow \Delta W_{2\text{-}4}\ \{1^{-}u\} + \Lambda(2070 \mid 2050)\ \{3/2^{+}u\}$

$\Lambda(2070 \mid 2050)\ \{3/2^{+}u\} \rightarrow 2\ \Delta W_{2\text{-}4}\ \{0^{-}\} + \Lambda(2050 \mid 2011)\ \{3/2^{-}u\}$

$\Lambda(2080 \mid 2069)\ \{5/2^{-}u\} + \Delta W_{2\text{-}4}\ \{1^{-}u\} = \Lambda(2085 \mid 2088)\ \{7/2^{+}\}$

$\Lambda(1710 \mid 1710)\ \{1/2^{+}u\} + S_{(o),d=2}\ \{1^{-}d\} = \Lambda(2000 \mid 2007)\ \{1/2^{-}\}$

$\Lambda(1820 \mid 1818)\ \{5/2^{+}u\} + S_{(o),d=2}\ \{1^{-}u\} = \Lambda(2100 \mid 2115)\ \{7/2^{-}\}$

$\Lambda(2100 \mid 2115)\ \{7/2^{-}u\} \rightarrow \Delta W_{2\text{-}4}\ \{1^{-}u\} + \Lambda(2110 \mid 2096)\ \{5/2^{+}u\}$

$\Lambda(2050 \mid 2011)\ \{3/2^{-}u\} + 2\ \pi^{o}\ \{0^{+}\} = \Lambda(2325 \mid 2281)\ \{3/2^{-}\}$

$\Lambda(2050 \mid 2011)\ \{3/2^{-}u\} + 4\ \pi^{o}\ \{0^{+}\} = \Lambda(2585 \mid 2551)\ \{3/2^{-}\}$

$\Lambda(1810 \mid 1818)\ \{1/2^{+}u\} + 2\ \pi^{o}\ \{0^{+}\} + 4\ m_{FGL}\ \{4^{+}u\} = \Lambda(2350 \mid 2358)\ \{9/2^{+}\}$

7. Sigma resonances

$\Sigma(1193)\ \{1/2^{+}u\} + \pi^{o}\ \{0^{-}\} + m_{FGL}\ \{1^{-}u\} = \Sigma(1385 \mid 1396)\ \{3/2^{+}\}$

$\Sigma(1385 \mid 1396)\ \{3/2^{+}u\} + \pi^{o}\ \{0^{-}\} + 2\ m_{FGL}\ \{2^{-}d\} = \Sigma(1660 \mid 1666)\ \{1/2^{+}\}$

$\Sigma(1660 \mid 1666)\ \{1/2^{+}u\} + \Delta W_{2\text{-}4}\ \{1^{-}u\} = \Sigma(1670 \mid 1685)\ \{3/2^{-}\}$

$\Sigma(1385 \mid 1396)\ \{3/2^{+}u\} + 4\ \pi^{o}\ \{0^{+}\} = \Sigma(1940 \mid 1936)\ \{3/2^{+}\}$

$\Sigma(1940 \mid 1936)\ \{3/2^{+}u\} \rightarrow S_{(o),d=2}\ \{1^{-}u\} + \Sigma(1620 \mid 1639)\ \{1/2^{-}u\}$

$\Sigma(1620 \mid 1639)\ \{1/2^{-}u\} + 2\ \pi^{o}\ \{0^{+}\} = \Sigma(1900 \mid 1909)\ \{1/2^{-}\}$

$\Sigma(1900 \mid 1909)\ \{1/2^{-}u\} + 2\ \Delta W_{2\text{-}4}\ \{2^{-}u\} = \Sigma(1915 \mid 1948)\ \{5/2^{+}\}$

$\Sigma(1620 \mid 1639)\ \{1/2^{-}u\} + \pi^{o}\ \{0^{-}\} + 2\ m_{FGL}\ \{2^{-}d\} = \Sigma(1910 \mid 1909)\ \{3/2^{-}\}$

$\Sigma(1910 \mid 1909)\ \{3/2^{-}u\} \rightarrow \pi^{o}\ \{0^{-}\} + \Sigma(1780 \mid 1774)\ \{3/2^{+}u\}$

$\Sigma(1780 \mid 1774)\ \{3/2^{+}u\} \rightarrow \Delta W_{2\text{-}4}\ \{1^{-}d\} + \Sigma(1775 \mid 1755)\ \{5/2^{-}u\}$

$\Sigma(1780 \mid 1774)\ \{3/2^{+}u\} \rightarrow \Delta W_{2\text{-}4}\ \{1^{-}u\} + \Sigma(1750 \mid 1755)\ \{1/2^{-}u\}$

$\Sigma(1750 \mid 1755)\ \{1/2^{-}u\} + \pi^{o}\ \{0^{-}\} = \Sigma(1880 \mid 1890)\ \{1/2^{+}\}$

$\Sigma(1880 \mid 1890)\ \{1/2^{+}u\} \rightarrow S_{(o),d=2}\ \{1^{-}d\} + \Sigma(1580 \mid 1593)\ \{3/2^{-}u\}$

$\Sigma(1780 \mid 1774)\ \{3/2^{+}u\} + 2\ \pi^{o}\ \{0^{+}\} = \Sigma(2080 \mid 2044)\ \{3/2^{+}\}$

$\Sigma(2080 \mid 2044)\ \{3/2^{+}u\} + m_{FGL}\ \{1^{-}d\} = \Sigma(2110 \mid 2112)\ \{1/2^{-}\}$

$\Sigma(2110 \mid 2112)\ \{1/2^{-}u\} + 2\ m_{FGL}\ \{2^{-}d\} = \Sigma(2230 \mid 2247)\ \{3/2^{+}\}$

$\Sigma(2230 \mid 2247)\ \{3/2^{+}u\} \rightarrow 2\ m_{FGL}\ \{2^{-}d\} + \Sigma(2110 \mid 2112)\ \{7/2^{-}u\}$

$\Sigma(1880 \mid 1890)\ \{1/2^{+}u\} + 2\ m_{FGL}\ \{2^{-}d\} = \Sigma(2010 \mid 2025)\ \{3/2^{-}\}$

$\Sigma(2010 \mid 2025)\ \{3/2^{-}u\} + 2\ \Delta W_{2\text{-}4}\ \{2^{-}u\} = \Sigma(2030 \mid 2064)\ \{7/2^{+}\}$

Notice also that mass distances between some resonances with the highest masses are close to mass of four pions, for example

$\Sigma(3170) - \Sigma(2620) = 550\ \text{MeV} \approx 4\ \pi^{o}$

$\Sigma(3000) - \Sigma(2455) = 545$ MeV $\approx 4\ \pi^o$.

On the other hand, SST shows that one of a few new symmetries is the four-particle symmetry [1]. Moreover, SST shows that range of an association of four neutral pions is equal to the equatorial radius of the core of baryons [1].

8. Xi resonances

$\Xi(1315)\ \{1/2^+u\} + \pi^o\ \{0^-\} + m_{FGL}\ \{1^-u\} = \Xi(1530\ |\ 1518)\ \{3/2^+\}$

$\Xi(1315)\ \{1/2^+u\} + S_{(o),d=2}\ \{1^-d\} = \Xi(1620\ |\ 1612)\ \{1/2^-\}$

$\Xi(1620\ |\ 1612)\ \{1/2^-u\} + m_{FGL}\ \{1^-u\} = \Xi(1690\ |\ 1680)\ \{3/2^+\}$

$\Xi(1690\ |\ 1680)\ \{3/2^+\} + \pi^o\ \{0^-\} = \Xi(1820\ |\ 1815)\ \{3/2^-\}$

$\Xi(1820\ |\ 1815)\ \{3/2^-\} + \pi^o\ \{0^-\} = \Xi(1950\ |\ 1950)\ \{3/2^+\}$

$\Xi(1950\ |\ 1950)\ \{3/2^+u\} + m_{FGL}\ \{1^-u\} = \Xi(2030\ |\ 2018)\ \{5/2^-\}$

$\Xi(1820\ |\ 1815)\ \{3/2^-u\} + S_{(o),d=2}\ \{1^-d\} = \Xi(2120\ |\ 2112)\ \{1/2^+\}$

$\Xi(2120\ |\ 2112)\ \{1/2^+\} + \pi^o\ \{0^-\} = \Xi(2250\ |\ 2247)\ \{1/2^-\}$

$\Xi(2250\ |\ 2247)\ \{1/2^-\} + \pi^o\ \{0^-\} = \Xi(2370\ |\ 2382)\ \{1/2^+\}$

$\Xi(2370\ |\ 2382)\ \{1/2^+\} + \pi^o\ \{0^-\} = \Xi(2500\ |\ 2517)\ \{1/2^-\}$

9. Omega resonances

$\Omega(1672)\ \{1/2^+u\} + 2\ \pi^o\ \{0^+\} + m_{FGL}\ \{1^-u\} = \Xi(2012\ |\ 2010)\ \{3/2^-\}$

$\Omega(1672)\ \{1/2^+u\} + 2\ S_{(o),d=2}\ \{2^-d\} = \Xi(2250\ |\ 2266)\ \{3/2^-\}$

10. Masses of the charmed and bottom baryons

In decays of the charmed and bottom baryons, very frequently appear pions and kaons. On the other hand, such baryons live relatively long so it suggests that there appears a spacetime condensate which interacts due to the slow weak interactions. We claim that there is a transition of relativistic neutral pion or relativistic neutral kaon in the d = 0 state (their mass increases about 9.0036 times – see (2.5.27) in [1]) into spacetime condensate. Masses of the condensates are as follows

$$C_\pi = 1215 \text{ MeV} \quad \text{and} \quad C_K = 4480 \text{ MeV} . \qquad (13)$$

Notice that these masses are close to masses of the charm and bottom quarks [2]

$$m_c = 1270(20) \text{ MeV} \quad \text{and} \quad m_b = 4180^{+30}{}_{-20} \text{ MeV} . \qquad (14)$$

Within SST we calculated masses of gluon loops that relate to the masses of quarks [1]. Such gluon loops can transform into spacetime condensate [1]. Here we need mass of spacetime condensate which is equal to mass of the SST charm quark (see Paragraph **2.23** in [1])

$$C_{c,SST} = 1267 \text{ MeV} . \quad (15)$$

The gluon-condensate ambiguity causes that it is difficult to determine clearly parity and spin of the charmed and bottom baryons so here we concentrate, first of all, on the masses.

In [1], we calculated the mean lifetime of hyperons: $\tau_{H,lifetime} \approx 1.1 \cdot 10^{-10}$ s (see (2.18.8) in [1]) that decay due to the nuclear weak interactions – the coupling constant is $\alpha_{w(p)}$ = 0.018722909. On the other hand, due to the additional pions, FGLs, and transitions from relativistic pions to condensates in the c-baryons and b-baryons, we have a transition from the nuclear weak interactions into the nuclear strong interactions (inside slowly moving baryons, the coupling constant for the nuclear strong interactions is α_s = 1) so, because $\tau_{lifetime} \sim 1/\alpha$ (see (1.4.29) in [1]), lifetime of the b-baryons and the c-baryons should be close to

$$\tau_{lifetime,Bb,Bc} = \tau_{H,lifetime}\, \alpha_{w(p)} / \alpha_s \approx 2 \cdot 10^{-12} \text{ s} . \quad (16)$$

Notice also that the additional condensate in c-baryons has lower mass so it should have an influence on lifetime.

Masses of the charmed baryons are as follows.

Λ_c(2286 | 2288)$^+$ {1/2$^+$u} = p(938) {1/2$^+$u} + C_π {0$^+$} + m_{FGL} {1$^-$u} + m_{FGL} {1$^-$d}

Λ_c(2595 | 2597)$^+$ {1/2$^-$u} = Λ_c(2286 | 2288)$^+$ {1/2$^+$u} + 2 π^o {0$^+$} + 2 $\Delta W_{2\text{-}4}$ {0$^-$}

Λ_c(2625 | 2626)$^+$ {3/2$^-$u} = Λ_c(2286 | 2288)$^+$ {1/2$^+$u} + 2 π^o {0$^+$} + m_{FGL} {1$^-$u}

Λ_c(2860 | 2867)$^+$ {3/2$^+$u} = Λ_c(2595 | 2597)$^+$ {1/2$^-$d} + π^o {0$^-$} + m_{FGL} {1$^-$u} + m_{FGL} {1$^-$u}

Λ_c(2880 | 2867)$^+$ {5/2$^+$u} = Λ_c(2595 | 2597)$^+$ {1/2$^-$u} + π^o {0$^-$} + m_{FGL} {1$^-$u} + m_{FGL} {1$^-$u}

Λ_c(2940 | 2935)$^+$ {3/2$^-$u} = Λ_c(2880 | 2867)$^+$ {5/2$^+$u} + m_{FGL} {1$^-$d}

Σ_c(2455 | 2460) {1/2$^+$u} = Σ(1193) {1/2$^+$u} + $C_{c,SST}$ {0$^+$}

Σ_c(2520 | 2528) {3/2$^+$u} = Σ_c(2455 | 2460) {1/2$^+$u} + m_{FGL} {1$^-$u}
J^P has not been measured, 3/2$^+$ is the quark-model prediction [2]. Our value is 3/2$^-$.

Σ_c(2800 | 2798) = Σ_c(2520 | 2528) {3/2$^-$u} + 2 π^o {0$^+$}

Ξ_c(2468 | 2461)$^+$ + π^- = Ξ(1315 | 1315)^o + $C_{c,SST}$ + $\Delta W_{2\text{-}4}$
J^P has not been measured, 1/2$^+$ is the quark-model prediction [2].

Ξ_c(2470 | 2466)^o + π^o = Ξ(1315 | 1315)^o + $C_{c,SST}$ + $\Delta W_{2\text{-}4}$
J^P has not been measured [2].

Ξ'_c(2578 | 2596) = Ξ_c(2468 | 2461) + π^o

$\Xi_c(2645 \mid 2635) = \Xi'_c(2578 \mid 2596) + 2\ \Delta W_{2\text{-}4}$

$\Xi_c(2790 \mid 2770) = \Xi_c(2645 \mid 2635) + \pi^o$

$\Xi_c(2815 \mid 2809) = \Xi_c(2790 \mid 2770) + 2\ \Delta W_{2\text{-}4}$

$\Xi_c(2970 \mid 2944) = \Xi_c(2815 \mid 2809) + \pi^o$

Notice also that $\pi^o + 2\ \Delta W_{2\text{-}4} = 174$ MeV $\approx W_{(o),d=2} = 175.7$ MeV so there is an additional resonance [1].

$\Xi_c(3055 \mid 3040) = \Xi_c(2790 \mid 2770) + 2\ \pi^o$

$\Xi_c(3080 \mid 3079) = \Xi_c(2815 \mid 2809) + 2\ \pi^o$

$\Omega_c(2695 \mid 2666)^o + \pi^- + \pi^o = \Omega(1672 \mid 1674)^- + C_{c,SST}$

$\Omega_c(2770 \mid 2734)^o = \Omega_c(2695 \mid 2666)^o + m_{FGL}$

$\Omega_c(3000 \mid 3004)^o = \Omega_c(2770 \mid 2734)^o + 2\ \pi^o$

$\Omega_c(3065 \mid 3072)^o = \Omega_c(3000 \mid 3004)^o + m_{FGL}$

$\Omega_c(3050 \mid 3053)^o + \Delta W_{2\text{-}4} = \Omega_c(3065 \mid 3072)^o$

$\Omega_c(3090 \mid 3092)^o = \Omega_c(3050 \mid 3053)^o + 2\ \Delta W_{2\text{-}4}$

$\Omega_c(3120 \mid 3111)^o = \Omega_c(3090 \mid 3092)^o + \Delta W_{2\text{-}4}$

Mass of the doubly charmed baryon is as follows.
$\Xi_{cc}(3622 \mid 3638)^{++} + 2\ \pi^- = \Xi(1315 \mid 1315)^o + 2\ C_{c,SST} + m_{FGL}$

Masses of the bottom baryons are as follows.
$\Lambda_b(5620 \mid 5595)^o\ \{1/2^+u\} = \Lambda(1116 \mid 1115)^o\ \{1/2^+u\} + C_K\ \{0^+\}$

$\Lambda_b(5912 \text{ and } 5920 \mid 5933)^o\ \{1/2^-u \text{ or } 3/2^-u\} =$

$= \Lambda_b(5620 \mid 5595)^o\ \{1/2^+u\} + 2\ \pi^o\ \{0^+\} + m_{FGL}\ \{1^-d \text{ or } 1^-u\}$

$\Lambda_b(6070 \mid 6068)^o = \Lambda_b(5912 \text{ and } 5920 \mid 5933)^o + \pi^o$

$\Lambda_b(6146 \text{ and } 6152 \mid 6136)^o = \Lambda_b(6070 \mid 6068)^o + m_{FGL}$

$\Sigma_b(\sim 5813 \mid 5808) = \Sigma(1193)^o + C_K + \pi^o$

$\Sigma^*_b(\sim 5833 \mid 5827) = \Sigma_b(\sim 5813 \mid 5808) + \Delta W_{2\text{-}4}$

$\Sigma_b(6097 \mid 6097) = \Sigma^*_b(\sim 5833 \mid 5827) + 2\ \pi^o$

Ξ_b(~5795 | 5795) = Ξ(1315 | 1315) + C_K

Ξ'_b(~5945 | 5930) = Ξ_b(~5795 | 5795) + π^o

Ξ_b(6227 | 6200) = Ξ'_b(~5945 | 5930) + 2 π^o

Ω_b(6046 | 6019) + π^o = Ω(1672 | 1674) + C_K

Ω_b(6316 | 6311) = Ω(1672 | 1674) + C_K + $W_{(o),d=4}$

Masses of the P_c^+ baryons

In the Type-X mesons, there is the spacetime condensate with a mass of C_X = 3736 MeV [2]. We claim that such a condensate is in $P_c^+(4312)^+$

$P_c(4312 | 4310)^+ + 2W_{(+-),d=2}$ = p(938 | 938) + C_X

$P_c(4380 | 4378)^+ = P_c(4312 | 4310)^+ + m_{FGL}$

$P_c(4440 | 4445)^+ = P_c(4312 | 4310)^+ + \pi^o$

$P_c(4457 | 4464)^+ = P_c(4440 | 4445)^+ + \Delta W_{2\text{-}4}$

Notice that the six objects, i.e. m_{FGL}, π^o, $\Delta W_{2\text{-}4}$, W and S vectors in the d = 2 state, and spacetime condensates C, are the typical objects inside baryons.

Part 2: Mesons

11. Light unflavored mesons

Internal structure of pions is described in [1].

η(548 | 549) $0^+(0^{-+})$ = C_Y $0^+(0^{++})$ + m_{FGL} $0^-(1^{--}u)$ + 2 $\Delta W_{2\text{-}4}$ $0^+(0^{-+})$ + $\Delta W_{2\text{-}4}$ $0^-(1^{--}d)$

In centre of all baryons, there is the spacetime condensate $C_Y \approx$ 424 MeV [1] so it also appears in the mesonic nuclei.

η'(958 | 964) $0^+(0^{-+})$ = η(548 | 540) $0^+(0^{-+})$ + C_Y $0^+(0^{++})$

η(1295 | 1292) $0^+(0^{-+})$ = f_2(1270 | 1253) $0^+(2u^{++})$ + 2 $\Delta W_{2\text{-}4}$ $0^+(2d^{-+})$

η(1405 | 1379) $0^+(0^{-+})$ = η(1295 | 1292) $0^+(0^{-+})$ + (m_{FGL} + $\Delta W_{2\text{-}4}$) $0^+(0^{++})$

η(1475 | 1494) $0^+(0^{-+})$ = η(548 | 549) $0^+(0^{-+})$ $0^+(0^{-+})$ + 14 m_{FGL} $0^+(0^{++})$

η_2(1645 | 1610) $0^+(2u^{-+})$ + 2 $\Delta W_{2\text{-}4}$ $0^+(2d^{++})$ = η(1405 | 1379) $0^+(0^{-+})$ + 4 m_{FGL} $0^+(0^{++})$

$\eta_2(1870 \mid 1846)\ \ 0^+(2^{-+}) = \eta(1475 \mid 1494)\ \ 0^+(0^{-+}) + 2\ W_{(o),d=2}\ \ 0^+(2^{++})$

$f_o(500 \mid 510)\ \ 0^+(0^{++}) + 2\Delta W_{2\text{-}4}\ \ 0^+(0^{-+}) = \eta(548 \mid 549)\ \ 0^+(0^{-+})$

$f_o(980 \mid 983)\ \ 0^+(0^{++}) = 2\ C_Y\ \ 0^+(0^{++}) + 2\ m_{FGL}\ \ 0^+(0^{++})$

$f_o(1370 \mid 1350)\ \ 0^+(0^{++}) = C_\pi\ \ 0^+(0^{++}) + 2\ m_{FGL}\ \ 0^+(0^{++})$

$f_o(1500 \mid 1485)\ \ 0^+(0^{++}) = f_o(1370 \mid 1350)\ \ 0^+(0^{++}) + m_{FGL}\ \ 0^-(1u^{--}) + m_{FGL}\ \ 0^-(1d^{--})$

$f_o(1710 \mid 1702)\ \ 0^+(0^{++}) = f_o(1370 \mid 1350)\ \ 0^+(0^{++}) + 2\ W_{(o),d=2}\ \ 0^+(0^{++})$

$f_2(1270 \mid 1253)\ \ 0^+(2^{++}) = 2\ C_Y\ \ 0^+(0^{++}) + 4\ m_{FGL}\ \ 0^+(0^{++}) + 2\ m_{FGL}\ \ 0^+(2^{++})$

f_2‘$(1525 \mid 1523)\ \ 0^+(2^{++}) = f_2(1270 \mid 1253)\ \ 0^+(2^{++}) + 4\ m_{FGL}\ \ 0^+(0^{++})$

$f_2(1950 \mid 1966)\ \ 0^+(2^{++}) = 4\ C_Y\ \ 0^+(0^{++}) + 2\ m_{FGL}\ \ 0^+(0^{++}) + 2\ m_{FGL}\ \ 0^+(2^{++})$

$f_2(2010 \mid 2016)\ \ 0^+(2^{++}) = f_o(1710 \mid 1702)\ \ 0^+(0^{++}) + 2\ W_{(o),d=4}\ \ 0^+(2^{++})$

$f_4(2050 \mid 2055)\ \ 0^+(4^{++}) = f_2(2010 \mid 2016)\ \ 0^+(2u^{++}) + 2\ \Delta W_{2\text{-}4}\ \ 0^+(2u^{++})$

$f_2(2300 \mid 2296)\ \ 0^+(2^{++}) = f_o(1710 \mid 1702)\ \ 0^+(0^{++}) + 2\ S_{(o),d=2}\ \ 0^+(2^{++})$

$f_2(2340 \mid 2335)\ \ 0^+(2^{++}) = f_2(2300 \mid 2296)\ \ 0^+(2^{++}) + 2\ \Delta W_{2\text{-}4}\ \ 0^+(0^{++})$

$\rho(770 \mid 782)\ \ 1^+(1^{--}) = \eta(548 \mid 540)\ \ 0^+(0^{-+}) + \pi^o\ 1^-(0^{-+}) + m_{FGL}\ \ 0^-(1^{--}) + 2\ \Delta W_{2\text{-}4}\ \ 0^+(0^{++})$

$\rho(1450 \mid 1457)\ \ 1^+(1^{--}) = \rho(770 \mid 782)\ \ 1^+(1^{--}) + 10\ m_{FGL}\ \ 0^+(0^{++})$

$\rho(1700 \mid 1690)\ \ 1^+(1^{--}) = \rho(770 \mid 782)\ \ 1^+(1^{--}) + 4\ m_{FGL}\ \ 0^+(0^{++}) + Q_{XXee}\ \ 0^+(0^{++})$
Here the $Q_{XXee} = X^+X^-e^+e^- \approx 638$ MeV is the real spin-0 quadrupole that transforms into spacetime condensate.

$\rho_3(1690 \mid 1690)\ \ 1^+(3^{--}) = \rho(770 \mid 782)\ \ 1^+(1u^{--}) + 3\ m_{FGL}\ \ 0^-(3u^{--}) + m_{FGL}\ \ 0^-(1d^{--}) + Q_{XXee}\ \ 0^+(0^{++})$

$\omega(782 \mid 782)\ \ 0^-(1^{--}) = 11\ m_{FGL}\ \ 0^-(1^{--}) + 2\ \Delta W_{2\text{-}4}\ \ 0^+(0^{++})$

$\omega(1420 \mid 1418)\ \ 0^-(1^{--}) = C_\pi\ \ 0^+(0^{++}) + 3\ m_{FGL}\ \ 0^-(1^{--})$

$\omega(1650 \mid 1688)\ \ 0^-(1^{--}) = \omega(1420 \mid 1418)\ \ 0^-(1^{--}) + 4\ m_{FGL}\ \ 0^+(0^{++})$

$\omega(1670 \mid 1688)\ \ 0^-(3^{--}) = \omega(1420 \mid 1418)\ \ 0^-(1u^{--}) + 3\ m_{FGL}\ \ 0^-(3u^{--}) + m_{FGL}\ \ 0^-(1d^{--})$

$a_o(980 \mid 983)\ \ 1^-(0^{++}) = 2\ C_Y\ \ 0^+(0^{++}) + \pi^o\ \ 1^-(0^{-+}) + 2\ \Delta W_{2\text{-}4,virtual}\ \ 0^+(0^{-+})$

$a_1(1260 \mid 1254)\ \ 1^-(1^{++}) = a_o(980 \mid 983)\ \ 1^-(0^{++}) + Q\ \ 0^+(1^{++}) + 4\ m_{FGL}\ \ 0^+(0^{++})$

$a_1(1640 \mid 1678)\ \ 1^-(1^{++}) = a_1(1260 \mid 1254)\ \ 1^-(1^{++}) + C_Y\ \ 0^+(0^{++})$
It contains $Q\ \ 0^+(1^{++})$.

$a_2(1320 \mid 1335)\ \ 1^-(2^{++}) = a_o(980 \mid 983)\ \ 1^-(0^{++}) + 2\ W_{(o),d=2}\ \ 0^+(2^{++})$

$a_o(1450 \mid 1470)\ \ 1^-(0^{++}) = a_2(1320 \mid 1335)\ \ 1^-(2u^{++}) + 2\ m_{FGL}\ \ 0^+(2d^{++})$

$a_2(1700 \mid 1701)\ \ 1^-(2u^{++}) + 2\ \Delta W_{2\text{-}4}\ \ 0^+(2d^{++}) = a_o(1450 \mid 1470)\ \ 1^-(0^{++}) + 4\ m_{FGL}\ \ 0^+(0^{++})$

$a_4(1970 \mid 1971)\ \ 1^-(4^{++}) = a_2(1700 \mid 1701)\ \ 1^-(2u^{++}) + 3\ m_{FGL}\ \ 0^-(3u^{--}) + m_{FGL}\ \ 0^-(1d^{--})$

$\Phi(1020 \mid 1013)\ \ 0^-(1^{--}) = 15\ m_{FGL}\ \ 0^-(1^{--})$

$\Phi(1680 \mid 1651)\ \ 0^-(1^{--}) = \Phi(1020 \mid 1013)\ \ 0^-(1^{--}) + Q_{XXee}\ \ 0^+(0^{++})$

$\Phi_3(1850 \mid 1855)\ \ 0^-(3^{--}) = \Phi(1020 \mid 1013)\ \ 0^-(1u^{--}) + 2\ S_{(o),d=1}\ \ 0^+(2u^{++})$

$\Phi(2170 \mid 2169)\ \ 0^-(1^{--}) = \Phi_3(1850 \mid 1855)\ \ 0^-(3u^{--}) + 2\ W_{(o),d=4}\ \ 0^+(2d^{++})$

$h_1(1170 \mid 1148)\ \ 0^-(1^{+-}) = 17\ m_{FGL}\ \ 0^-(1^{--}) + 2\ \Delta W_{2\text{-}4,virtual}\ \ 0^+(0^{-+})$

$h_1(1415 \mid 1418)\ \ 0^-(1^{+-}) = h_1(1170 \mid 1148)\ \ 0^-(1^{+-}) + 4\ m_{FGL}\ \ 0^+(0^{++})$

$b_1(1235 \mid 1234)\ \ 1^+(1^{+-}) = 16\ m_{FGL}\ \ 0^+(0^{++}) + \pi^o\ \ 1^-(0^{-+}) + \Delta W_{2\text{-}4}\ \ 0^-(1^{--})$

$\pi(1300 \mid 1350)\ \ 1^-(0^{-+}) = C_\pi\ \ 0^+(0^{++}) + \pi^o\ \ 1^-(0^{-+})$

$\pi_1(1400 \mid 1351)\ \ 1^-(1^{-+}) = \pi(1300 \mid 1350)\ \ 1^-(0^{-+}) + Q\ \ 0^+(1^{++})$

$\pi_1(1600 \mid 1621)\ \ 1^-(1^{-+}) = \pi_1(1400 \mid 1351)\ \ 1^-(1^{-+}) + 4\ m_{FGL}\ \ 0^+(0^{++})$
It contains $Q\ \ 0^+(1^{++})$.

$\pi_2(1670 \mid 1663)\ \ 1^-(2^{-+}) + 2\ \Delta W_{2\text{-}4}\ \ 0^+(0^{++}) = \pi(1300 \mid 1350)\ \ 1^-(0^{-+}) + 2\ W_{(o),d=2}\ \ 0^+(2^{++})$

$\pi(1800 \mid 1798)\ \ 1^-(0^{-+}) = \pi_2(1670 \mid 1663)\ \ 1^-(2u^{-+}) + 2\ m_{FGL}\ \ 0^+(2d^{++})$

$\pi_2(1880 \mid 1890)\ \ 1^-(2^{-+}) = \pi(1300 \mid 1350)\ \ 1^-(0^{-+}) + 6\ m_{FGL}\ \ 0^+(0^{++}) + 2\ m_{FGL}\ \ 0^+(2^{++})$

12. K strange mesons
For all kaons is I = 1 so we define only J^P.
One of the two FGLs in a charged pion (it is a pseudoscalar), due to the transition from its circumference to its radius, transforms into the spacetime condensate Y – it means that the [Y

$+ m_{FGL} + (e^{\pm}\nu)_{virtual}]$ is a pseudoscalar. The $4m_{e,bare}$ is a scalar, so $K^{\pm}$ is a pseudoscalar $J^P = 0^-$. The $(e^{\pm}\nu)_{virtual}$ stabilizes the $[Y + m_{FGL}]$ pair. We have

$K(493.677(16)$ [3] | $493.708)^{\pm} = K(493.7 \mid 493.7)^{\pm} = [Y + m_{FGL} + (e^{\pm}\nu)_{virtual}] + 4\, e^{\pm}{}_{bare}$

The spin-0 neutral kaon K^o is created because the neutral pion, after the transition described above, attaches the electromagnetic mass of the quadrupole of neutral pions ($M_{em} = 4\pi^o\alpha_{em}$ = 3.940 **MeV**) to stabilize the $[Y + m_{FGL}]$ pair – SST shows that range of the quadrupole $4\pi^o$ is equal to the equatorial radius of the core of baryons so it is distinguished.

$K(497.611(13)$ [3] | $497.648)^o = K(497.6 \mid 497.6)^o = [Y + m_{FGL} + M_{em}] + 4\, e^{\pm}{}_{bare}$

The spacetime condensate $C_Y \equiv Y$ in $K(497.6 \mid 497.6)^o$ can decay to maximum 6 FGLs. On the other hand, the FGLs occupy the nuclear shells for FGLs [2] and there is the four-particle symmetry. We have $1s^2 2s^2 2p^6$ so there are two possibilities, i.e. $1s^2 2s^2$ (there appear 2 pions) or $2p^6$ (there appear 3 pions) – it solves the Tau-Theta problem.

The composition of K_o*(700) is as follows
$K_o*(700)_{mass} = 2\, C_Y\ \ 0^+$ so mass is 848 MeV.
But one of the two C_Y condensates can decay to two neutral pions so the mean mass is
$K_o*(700)_{mean} = C_Y\ \ 0^+ + 2\, \pi^o\ \ 0^+ = 694$ MeV ≈ 700 MeV.
We will denote this kaon as $K_o*(700 \mid 848)\ \ 0^+$.

$K*(892 \mid 897)\ \ 1^- = C_Y\ \ 0^+ + 3\, m_{FGL}\ \ 1^- + 2\, \pi^o\ \ 0^+$

$K_1(1270 \mid 1249)\ \ 1^+ = K*(892 \mid 897)\ \ 1^- + 2\, W_{(o),d=2}\ \ 0^-$

$K_1(1400 \mid 1384)\ \ 1^+ = K_1(1270 \mid 1249)\ \ 1^+ + 2\, m_{FGL}\ \ 0^+$

$K*(1410 \mid 1437)\ \ 1^- = K*(892 \mid 897)\ \ 1^- + 4\, \pi^o\ \ 0^+$

$K_o*(1430 \mid 1422)\ \ 0^+$: there are two possibilities
$K_o*(700 \mid 848)\ \ 0^+ + 4\, \pi^o\ \ 0^+ = 1388$ MeV
$K*(1410 \mid 1437)\ \ 1u^- + \Delta W_{2\text{-}4}\ \ 1d^- = 1456$ MeV,
so the mean mass is 1422 MeV.

$K_2*(1430 \mid 1422)\ \ 2^+$: there are two possibilities
$K_o*(700 \mid 848)\ \ 0^+ + 3\, \pi^o\ \ 0^- + 2\, m_{FGL}\ \ 2^- = 1388$ MeV
$K*(1410 \mid 1437)\ \ 1u^- + \Delta W_{2\text{-}4}\ \ 1u^- = 1456$ MeV,
so the mean mass is 1422 MeV.

$K(1460 \mid 1461)\ \ 0^- = K_o*(1430 \mid 1422)\ \ 0^+ + 2\, \Delta W_{2\text{-}4}\ \ 0^-$

$K_1(1650 \mid 1664)\ \ 1^+ = K(1460 \mid 1461)\ \ 0^- + 3\, m_{FGL}\ \ 1^-$

$K*(1680 \mid 1703)\ \ 1^- = K_1(1650 \mid 1664)\ \ 1^+ + 2\, \Delta W_{2\text{-}4}\ \ 0^-$

$K_2(1770 \mid 1775)\ \ 2^- = K*(1460 \mid 1461)\ \ 0^- + 2\, W_{(o),d=4}\ \ 2^+$

$K_3(1780 \mid 1789)\ \ 3^- = K*(1410 \mid 1437)\ \ 1u^- + 2\, W_{(o),d=2}\ \ 2u^+$

K_2(1820 | 1805) 2^- = K_1(1400 | 1384) $1u^+$ + $S_{(o),d=1}$ $1u^-$

K_2*(1980 | 2001) 2^+ = K(1460 | 1461) 0^- + 3 π^o 0^- + 2 m_{FGL} 2^+

K_4(2045 | 2040) 4^+ = K_2*(1980 | 2001) $2u^+$ + 2 $\Delta W_{2\text{-}4}$ $2u^+$

13. D charmed mesons
For all D charmed mesons is I = 1 so we define only J^P.

D(1865 | 1864)^o 0^- = $C_{c,SST}$ 0^+ + 2 $S_{(+-),d=2}$ 0^-

D(1870 | 1869)$^\pm$ 0^- = D(1865 | 1864)^o 0^- + $\Delta\pi^\pm$ = 4.6 MeV 0^+

D*(2007 | 2010)^o 1^- = $C_{c,SST}$ 0^+ + 11 m_{FGL} 1^-

D*(2010 | 2015)$^\pm$ 1^- = D*(2007 | 2010)^o 1^- + $\Delta\pi^\pm$ 0^+

D_o*(2300 | 2348) 0^+ = D*(2007 | 2010)^o $1u^-$ + 2 π^o 0^+ + m_{FGL} $1d^-$

D_1(2420 | 2415) 1^+ = D*(2007 | 2010)^o 1^- + 3 π^o 0^-

D_1(2430 | 2424) 1^+ = D*(2007 | 2010)^o 1^- + $\pi^o\pi^+\pi^-$ 0^-

D_2*(2460 | 2458) 2^+ = D*(2010 | 2015)$^\pm$ $1u^-$ + C_Y 0^+ + $\Delta W_{2\text{-}4}$ $1u^-$

D_3*(2750 | 2755) 3^- = D_2*(2460 | 2458) $2u^+$ + $S_{(o),d=2}$ $1u^-$

14. D charmed, strange mesons
For all D charmed, strange mesons is I = 0 so we define only J^P.

D_s(1968 | 1966)$^\pm$ 0^- = $C_{c,SST}$ 0^+ + C_Y 0^+ + $\pi^\pm$ 0^- + 2 m_{FGL} 0^+

D_s*(2112 | 2101)$^\pm$ $?^?$ = D_s(1968 | 1966)$^\pm$ 0^- + m_{FGL} $1d^-$ (or 2 m_{FGL})

D_{s0}*(2317 | 2317)$^\pm$ 0^+ = D_s(1968 | 1966)$^\pm$ 0^- + 2 $W_{(o),d=2}$ 0^-

D_{s1}(2460 | 2471)$^\pm$ 1^+ = D_{s0}*(2317 | 2317)$^\pm$ 0^+ + π^o 0^- + $\Delta W_{2\text{-}4}$ 1^-

D_{s1}(2536 | 2520)$^\pm$ 1^+ = D_{s0}*(2317 | 2317)$^\pm$ 0^+ + π^o 0^- + m_{FGL} 1^-

D_{s2}(2573 | 2587) 2^+ = D_{s0}*(2317 | 2317)$^\pm$ 0^+ + π^o 0^- + 2 m_{FGL} 2^-

D_{s1}(2700 | 2741)$^\pm$ 1^- = D_{s0}*(2317 | 2317)$^\pm$ 0^+ + 2 π^o 0^+ + 2 m_{FGL} 0^+ + $\Delta W_{2\text{-}4}$ 1^-

15. B bottom mesons
For all B bottom mesons is I = 1 so we define only J^P.

SST shows that there can be a spacetime condensate with a mass equal to the mass of the charged kaon in the d = 0 state $C_{K\pm}$ = 4445 MeV (see Table 1).

$B(5279\,|\,5279)^{\pm}\ 0^- = C_{K\pm}\ 0^+ + C_Y\ 0^+ + \pi^o\pi^o\pi^{\pm}\ 0^-$
We can see that there are two states because of the $\pi^{\pm}$.

$B(5279\,|\,5279)^o\ 0^- = C_{K\pm}\ 0^+ + C_Y\ 0^+ + 3\,\pi^o\,0^-$ (or $\pi^o\pi^+\pi^-\ 0^-$)
So there are also two states because of $3\pi^o$ and $\pi^o\pi^+\pi^-$.

There can be a loop ($J^P = 1^-$) with a mass equal to the mass of the SST bottom quark: $L_{b,SST} = 4190$ MeV [1].
$B^*(5325\,|\,5325)\ 1^- = L_{b,SST}\ 1^- + 4\,\pi^o\,0^+ + 2\,S_{(o),d=2}\ 0^+$ (or $2\,S_{(+-),d=2}\ 0^+$)
So there are also two states because of $2S_{(o),d=2}$ and $2S_{(+-),d=2}$.

$B_1(5721\,|\,5730)\ 1^+ = B^*(5325\,|\,5325)\ 1^- + 3\,\pi^o\,0^-$

$B_2^*(5747\,|\,5742)\ 2^+ = B(5279\,|\,5279)^{\pm}\ 0^- + C_Y\ 0^+ + 2\,\Delta W_{2\text{-}4}\ 2^-$

$B_I(5970\,|\,5964)\ 0^-$ or 2^- or $4^- = B_2^*(5747\,|\,5742)\ 2^+ + \pi^o\,0^- + m_{FGL}\ 1^- + \Delta W_{2\text{-}4}\ 1^-$

16. B bottom, strange mesons
For all B bottom, strange mesons is I = 0 so we define only J^P.
There can be a spacetime condensate ($J^P = 0^+$) with a mass equal to the mass of the SST bottom quark: $C_{b,SST} = 4190$ MeV [1].

$B_s(5367\,|\,5367)^o\ 0^- = C_{b,SST}\ 0^+ + 4\,\pi^o\,0^+ + X^+X^-\ 0^-$

$B_s^*(5415\,|\,5405)\ 1^- = L_{b,SST}\ 1^- + C_\pi\ 0^+$

$B_{s1}(5830\,|\,5810)^o\ 1^+ = B_s^*(5415\,|\,5405)\ 1^- + 3\,\pi^o\,0^-$

$B_{s2}^*(5840\,|\,5826)^o\ 2^+ = B_s^*(5415\,|\,5405)\ 1u^- + S_{(o),d=1}\ 1u^-$

17. B bottom, charmed mesons
For all B bottom, charmed mesons is I = 0 so we define only J^P.

$B_c(6274\,|\,6277)^+\ 0^- = Ps_{XX}\ 0^- + \pi^o\pi^o\pi^o\pi^+\ 0^+$

$B_c(2S{:}\ 6871\,|\,6871)^{\pm}\ 0^- = Ps_{XX}\ 0^- + \pi^o\pi^o\pi^o\pi^{\pm}\ 0^+ + 2\,S_{(o),d=2}\ 0^+$

18. The cc_{anti} mesons
$J/\psi(1S{:}\ 3097\,|\,3096)\ 0^-(1u^{--}) + X^+X^-\ 0^-(1d^{--}) = 2\,D(1870\,|\,1869)^{\pm}\ 0^+(0^{++})$
or $= 2\,D(1865\,|\,1864)^o\ 0^+(0^{++})$

$\psi(3770\,|\,3771)\ 0^-(1^{--}) = J/\psi(1S{:}\ 3097\,|\,3096)\ 0^-(1u^{--}) + 10\,m_{FGL}\ 0^+(0^{++})$

$\psi(2S{:}\ 3686\,|\,3684)\ 0^-(1^{--}) + m_{FGL}\ 0^-(1u^{--}) + \Delta W_{2\text{-}4}\,0^-(1d^{--}) = \psi(3770\,|\,3771)\ 0^-(1^{--})$

$\psi(4040\,|\,4041)\ 0^-(1^{--}) = \psi(3770\,|\,3771)\ 0^-(1^{--}) + 2\,\pi^o\,0^+(0^{++})$

$\psi(4160\,|\,4176)\ 0^-(1^{--}) = \psi(4040\,|\,4041)\ 0^-(1^{--}) + 2\,m_{FGL}\ 0^+(0^{++})$

$\psi(4230\,|\,4215)\ 0^-(1^{--}) = \psi(4160\,|\,4176)\ 0^-(1^{--}) + 2\,\Delta W_{2\text{-}4}\ 0^+(0^{++})$

$\psi(4360\,|\,4350)\;\;0^{-}(1^{--}) = \psi(4230\,|\,4215)\;\;0^{-}(1^{--}) + 2\,m_{FGL}\;\;0^{+}(0^{++})$

$\psi(4415\,|\,4446)\;\;0^{-}(1^{--}) = \psi(4160\,|\,4176)\;\;0^{-}(1^{--}) + 2\,\pi^{o}\;\;0^{+}(0^{++})$

$\psi(4660\,|\,4620)\;\;0^{-}(1^{--}) = \psi(4360\,|\,4350)\;\;0^{-}(1^{--}) + 2\,\pi^{o}\;\;0^{+}(0^{++})$

$\eta_{c}(1S{:}\;2984\,|\,2978)\;\;0^{+}(0^{-+}) = 2\,C_{c,SST}\;\;0^{+}(0^{++}) + 3\,\pi^{o}\,0^{+}(0^{-+}) + 2\,\Delta W_{2\text{-}4}\;\;0^{+}(0^{++})$

$\eta_{c}(2S{:}\;3638\,|\,3653)\;\;0^{+}(0^{-+}) = \eta_{c}(1S{:}\;2984\,|\,2978)\;\;0^{+}(0^{-+}) + 10\,m_{FGL}\;\;0^{+}(0^{++})$

$\chi_{c0}(1P{:}\;3415\,|\,3420)\;\;0^{+}(0^{++}) = 2\,(C_{c,SST} + C_{Y} + \Delta W_{2\text{-}4})\;\;0^{+}(0^{++})$

$\chi_{c2}(1P{:}\;3556\,|\,3555)\;\;0^{+}(2^{++}) = \chi_{c0}(1P{:}\;3415\,|\,3420)\;\;0^{+}(0^{++}) + 2\,m_{FGL}\;\;0^{+}(2^{++})$

$\chi_{c2}(3930\,|\,3929)\;\;0^{+}(2^{++}) = \chi_{c2}(1P{:}\;3556\,|\,3555)\;\;0^{+}(2^{++}) + 2\,S_{(o),d=4}\;\;0^{+}(0^{++})$

$\psi_{2}(3823\,|\,3820)\;\;0^{-}(2^{--}) = Q\;0^{+}(1d^{++}) + \psi(2S{:}\;3686\,|\,3684)\;\;0^{-}(1u^{--}) + 2\,m_{FGL}\;\;0^{+}(2u^{++})$

$\psi_{3}(3842\,|\,3858)\;\;0^{-}(3^{--}) = \psi(2S{:}\;3686\,|\,3684)\;\;0^{-}(1u^{--}) + 2\,m_{FGL}\;\;0^{+}(2u^{++}) + 2\,\Delta W_{2\text{-}4}\;\;0^{+}(0^{++})$

$h_{c}(1P{:}\;3525\,|\,3549)\;\;0^{-}(1^{+-}) + 2\,m_{FGL}\;\;0^{+}(0^{-+}) = \psi(2S{:}\;3686\,|\,3684)\;\;0^{-}(1^{--})$

$Z_{c}(3900\,|\,3896)\;\;1^{+}(1^{+-}) = \chi_{c0}(1P{:}\;3415\,|\,3420)\;\;0^{+}(0^{++}) + m_{FGL}\;\;0^{-}(1^{--}) + \pi^{o}\pi^{o}\pi^{o\pm}\;\;1^{-}(0^{-+})$

$Z_{c}(4430\,|\,4436)\;\;1^{+}(1^{+-}) = Z_{c}(3900\,|\,3896)\;\;1^{+}(1^{+-}) + 4\,\pi^{o}\,0^{+}(0^{++})$

$X(3915\,|\,3915)\;\;1^{-}(0^{-+}) = Z_{c}(3900\,|\,3896)\;\;1^{+}(1u^{+-}) + \Delta W_{2\text{-}4}\;\;0^{-}(1d^{--})$

$X(4020\,|\,4055)^{\pm}\;?\;(0^{+}) = X(3915\,|\,3915)\;\;1^{-}(0^{-+}) + \pi^{\pm}\;\;(0^{-})$

Note the following:

$\chi_{c1}(3872) - \chi_{c1}(3511) = 361\text{ MeV} \approx 2\,W_{(+-),d=2} = 363.4\text{ MeV}$

$\chi_{c2}(\text{mass} = 3923) - \chi_{c2}(1P{:}\;3556) = 367\text{ MeV} \approx 2\,W_{(+-),d=2}$

19. The bb_{anti} mesons

Notice that in all such mesons there are two the $C_{K\pm}$ spacetime condensates.

$Y(1S{:}\;9460\,|\,9471)\;\;0^{-}(1^{--}) = 2\,C_{K\pm}\;\;0^{+}(0^{++}) + C_{Y}\;\;0^{+}(0^{++}) + W_{(o),d=4}\;\;0^{-}(1^{--})$

The second proposal is presented in [1] – it leads to 9465 MeV.

$Y_{2}(1D{:}\;10164\,|\,10158)\;0^{-}(2^{--}) = 2\,C_{K\pm}\;0^{+}(0^{++}) + 8\,\pi^{o}\,0^{+}(0^{++}) + S_{(o),d=4}\;0^{-}(1u^{--}) + Q\;0^{+}(1u^{++})$

$h_{b}(2P{:}\;10260\,|\,10262)\;0^{-}(1^{+-}) = 2\,C_{K\pm}\;0^{+}(0^{++}) + \pi^{o}_{d=0}{=}1215\text{ MeV}\;\;0^{+}(0^{-+}) + W_{(o),d=4}\;0^{-}(1^{--})$

$Z_{b}(2P{:}\;10610\,|\,10619)\;1^{+}(1^{+-}) = 2\,(C_{K\pm} + C_{Y} + 5\,m_{FGL})\;0^{+}(0^{++}) + \pi^{o,\pm}\;1^{-}(0^{-+}) + m_{FGL}\;0^{-}(1^{--})$

$Z_b(10650 \mid 10658)\ \ 1^+(1^{+-}) = Z_b(2P{:}\ 10610 \mid 10619)\ \ 1^+(1^{+-}) + 2\ \Delta W_{2\text{-}4}\ \ 0^+(0^{++})$

$\eta_b(1S{:}\ 9399 \mid 9424)\ \ 0^+(0^{-+}) + 2\ W_{(o),d=4}\ 0^+(0^{-+}) = 2\ (C_{K\pm} + C_Y)\ 0^+(0^{++})$

20. The pseudoscalar axion and the strong CP problem

We must pay special attention to dark-matter (DM) particles – we described them in [1] (see formulae (2.1.21) and (2.1.22) in [1]). But we must add a few remarks. SST shows that there should be in existence the stable DM loops with different angular momentums and sizes (their size can be from 0.465 fm up to sizes of the halos of the massive spiral galaxies) but their mass is invariant $\sim 1.17 \cdot 10^{-11}$ eV [1]. Such stable loops with the spin speed equal to the speed of light c, can interact with the "ordinary" matter via the weak interactions of the virtual electron-positron pairs so the coupling constant is $\sim 10^{-6}$ [1] – such interactions are via the spacetime condensates that also appear in this paper. But emphasize that such stable DM loops, due to their internal structure, cannot interact electromagnetically! **Assume that such stable DM loops can create an unstable pion-like pairs which we can call the SST pseudoscalar axions.** Their spin is zero and CP is odd. Their invariant mass is $\sim 2.3 \cdot 10^{-11}$ eV. But emphasize also that similar to the pseudoscalar pions, the SST pseudoscalar axions should be unstable so we rather should try to detect the stable DM loops.

The mainstream axions are described in [7]. In paper [8], it is suggested that an axion field "is the most popular solution to the strong CP problem", i.e. the CP violation has not been observed in the strong interactions – it leads to a conclusion that the neutron has not an electric dipole moment. Here we show that Nature does not realize such popular solution.

SST shows that the CP violation in the weak interactions of the spacetime condensate in the centre of baryons is due to the poloidal motions of the torus/electric-charge in the core of baryons (see Fig.1 and the description in [1]). Very small changes in the mean distance between the SST absolute-spacetime (As) components cause that there appears the confinement of them and confinement between them and the torus which also consists of the SST-As components. The poloidal motions of the torus and the confinement cause poloidal motions to be transferred to spacetime in baryons. But the toroidal speed on the equator of the torus is equal to c so on it, the poloidal speed is equal to zero – it causes that outside the core of baryons, on the plane of the equator (there take place the nuclear strong interactions [1]), the poloidal motions vanish so the CP is not violated in the strong interactions.

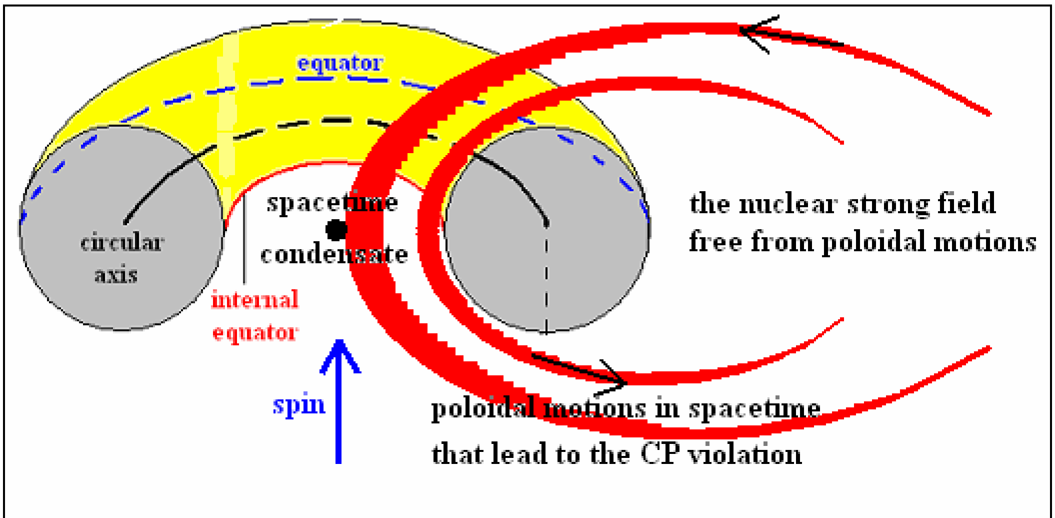

Fig.1. The strong CP problem.

We see that the poloidal speed is maximal in direction of the spin of the torus, i.e. in the surroundings of the central spacetime condensate which is responsible for the weak interactions – it is the reason that the CP violation is characteristic for the weak interactions. In Fig.1, the thickness of the red curves represents the momentum density of the poloidal motion.

Emphasize that to stabilize the torus with different poloidal and toroidal speeds, there are exchanged the SST-As components the torus consists of. Moreover, there appear the radial motions which are responsible for creation of the central spacetime condensate.

In the pseudoscalar axions are two parallel loops with opposite spin speed so an axion field could shield the poloidal motions of the torus on the assumption that the confinement does not apply to the axion field (SST shows that it is untrue). **But then also we should not observe the CP violation in the weak interactions.** We know from experimental data that Nature does not implement such a scenario, so it is not possible to solve the strong CP problem by using an axion field.

21. Summary

Exactly 64 years ago (March 1, 1958), in a letter from Pauli to Gamow, the former commented on Heisenberg's radio interview that they had decoded the structure of all particles known at that time. Pauli drew a blank square and found it depicted the world but lacking technical details [9].

Resonances, due to their interactions and charge states, have experimental widths of about one to even five hundred mega-electron-volts or so. Deciphering their internal structure is not an easy task. Here, using the atom-like structure of baryons and very simple model, our theoretical masses are very close to the experimental central values. Our quantum numbers I, G, J, P and C, are fully in line with the experimental data. It validates the SST.

The charmed and bottom baryons are more stable than the baryon resonances because there is the additional spacetime condensate that interacts due to the nuclear weak interactions (such interactions are much slower than the nuclear strong interactions). Masses of the condensates are close to masses of the charm and bottom quarks.

Very important is the d = 0 state which is in contact with the equator of the core of baryons. Mass of particles in such state increases 9.0036 times. But to conserve the half-integral spin of the core of baryons, such relativistic particles quickly transform into the scalar spacetime condensates, C, which are responsible for the additional nuclear weak interactions. In resonances, most important is the natural spacetime condensate in the centre of baryons, $C_Y = Y$, and the spacetime condensates created from the relativistic pions and kaons which are produced in the core of baryons [1] – it causes that some of the baryonic and mesonic resonances can be created in the nuclear plasma composed of the cores of baryons packed to maximum (i.e. the d = 1, 2 and 4 states are destroyed).

The root-mean-square deviation in mass (RMSDM), i.e. for the mass distances between the SST masses and the mean central values observed, is defined as follows

$$\mathrm{RMSDM} = \pm (\Sigma_i \Delta m_i^2 / N_i)^{1/2} , \qquad (17)$$

where N_i is the number of particles of higher mass, i.e. $\Delta m_i > 0$, (or lower mass, i.e. $\Delta m_i < 0$) plus a half of number of particles with the same mass, i.e. $\Delta m_i = 0$.

Our global result is

$$M_{central}{}^{+RMSDM}{}_{-RMSDM} \approx 2800^{+17}{}_{-15}\ \mathrm{MeV} , \qquad (18)$$

where $M_{central}$ is a mean central-mass observed for all 260 particles described in this paper.

We can see that the mean RMSDM (in plus or in minus) is only about 0.6%.

Generally, the gluons and their associations interact with one or more spacetime condensates because of the nuclear weak interactions. The additional spacetime condensates are produced in collisions of the nucleons.

In the book [1], paper [2] and in this paper, we described a total of about 310 particles – they include all major and all high-status particles. Here we described also the SST pseudoscalar axion and we solved the strong CP problem.

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