Two More the Type QVRs Groups

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Abstract: Within the Scale-Symmetric Theory (SST), we described a method that leads to the groups containing a quantum, vector boson, and two high-mass narrow composite resonances with low standard deviation both with J = 0 and J = 2 (the Type QVRs groups). Previously we described four such groups whereas in this paper we present two more such groups. Among the SST 12 resonances, there are three resonances with masses close to the mass of resonance with a higher width that appears in the LHC data (its mass is about 2.250 TeV). Their masses are 1.951 TeV, 2.242 TeV, and 2.566 TeV - the arithmetic mean of expected values is 2.253 TeV but signal should be broadened more than for the other narrow resonances. Moreover, 4 other resonances appear in the combined LHC data. We predict existence of 5 other resonances - masses of 3 of them are higher than the present-day range of the LHC experiments whereas 2 of them overlap with the bump around about 190 - 300 GeV. But the most important task is to search for the predicted vector bosons - two of the 6 vector bosons that appear in the six SST QVRs groups are the W and Z bosons whereas the predicted 4 vector bosons should have following masses 25.4 GeV, 30.5 GeV (it is the Heister vector boson), 40.1 GeV, and 280.2 GeV.

Introduction and motivation

Within the Scale-Symmetric Theory (SST) [1], we described a method that leads to the groups containing a quantum, vector boson, and two high-mass narrow composite resonances with low standard deviation (it is their feature (!) [2]) both with $J = 0$ and $J = 2$ (we will call them the QVRs groups). Previously we described four such groups [2], [3], whereas in this paper we present two more such groups.

The energy/mass of the constituents of the QVRs groups we can calculate as follows [2]:

ΔE denotes energy of an electromagnetic quantum (it is a precursor of a QVRs group),

$M_o = X \Delta E$ is the mass of the vector boson [2] where $X = 19{,}685.3$ [1A],

$8\ M_o$ and $64\ M_o$ are the masses of the two high-mass narrow composite resonances with low standard deviation ($\sim 1\sigma - 2\sigma$) both with $J = 0$ and $J = 2$ [2]. Such compositions follow from the fact that there is one type of photons and 8 types of gluons so there can be created resonances built of 8 or $8 \cdot 8$ or $8 \cdot 8 \cdot 8$, and so on, entangled vector bosons [2]. It looks as the topological phase transitions because masses change stepwise.

The full width Γ of the narrow resonances and vector bosons is defined by following formula [4]: $\Gamma = 2^{1/2}\ \alpha_{w(proton)} = 0.0265$ i.e. is 2.65%.

SST shows that experimental results should depend on the integral luminosity for the nucleon-nucleon collisions [2].

The energy of a quantum of the electromagnetic field can be as well the electromagnetic mass of a particle that is $\alpha_{em}\, m$, where $\alpha_{em} = 1 / 137.036$ and m is mass of a particle [1A].

Such groups described within SST [2], [3], and this paper, are consistent with the LHC data [5].

On the other hand, the successive topological phase transitions of the Higgs field lead to the atom-like structure of baryons [1A]. In the $d = 1$ state of baryons, there is the relativistic neutral or charged pion [1A]. Mass of the relativistic neutral pion is $W_{pion(o),d=1} = 208.643$ MeV whereas of the charged one is $W_{pion(+,-),d=1} = 215.760$ MeV [1A].

Mass of a vector boson or composite resonance is defined as follows:

Mass = expected mass ± full width.

To the high-mass narrow composite resonances with low standard deviation we should apply new statistical methods.

The two quanta that are the precursors of the groups described in this paper (Table 1) are the electromagnetic mass of the pion-antipion pair composed of charged pions, and doubled the mass distance between the charged and neutral states of the relativistic pions in the $d = 1$ state. The doubled relativistic masses are needed to create the vector bosons in the rest – it is realized due to the nucleon-nucleon collisions.

Table 1 *Two more the SST QVRs groups*

Quantum ΔE [MeV]	$\alpha_{em}\,(\pi^+\,\pi^-)$ 2.037 [2A]	$2\,(W_{pion(+,-),d=1} - W_{pion(o),d=1})$ 14.234 [2A]
J = 1 $X{\cdot}\Delta E$ [GeV] X = 19,685.3	40.10 ± 1.1 **SST prediction**	280.2 ± 7.4 **SST prediction**
J = 0, J = 2 8 $X{\cdot}\Delta E$ [GeV] 1σ – 2 σ	321 ± 9 SST and [5]*	2242 ± 59** SST and [5]*
J = 0, J = 2 64 $X{\cdot}\Delta E$ [TeV] 1σ – 2 σ	2.566 ± 0.068** SST and [5]*	~~17.93 ± 0.48~~ **SST prediction** The threshold for pp collisions [2A]

*The ATLAS combined results [5]

**It is one of the three resonances that mean is about 2250 GeV [5]

Among the SST 12 resonances with low standard deviation [2], [3], this paper, there are three resonances with masses close to the mass of resonance with a higher width that appears in the LHC data (its mass is about 2.250 TeV). Their masses are 1.951 TeV [3], 2.242 TeV (this paper), and 2.566 TeV (this paper) – the arithmetic mean of expected values is 2.253 TeV but signal should be broadened more (width ~350 GeV) than for the other narrow resonances ($\Gamma = 2^{1/2}\,\alpha_{w(proton)} = 0.0265$). Moreover, 4 other resonances appear in the combined LHC data [5]. We predict existence of 5 other resonances – masses of 3 of them are higher than the present-day range of the LHC experiments whereas 2 of them overlap with the bump around about 190 – 300 GeV [2], [3]. But the most important task is to search for the predicted vector bosons – two of the 6 vector bosons that appear in the six SST QVRs groups are the W and Z bosons [2] whereas the predicted 4 vector bosons should have following masses 25.4 GeV [2], 30.5 GeV [3] (it is the Heister vector boson [6]), 40.1 GeV (this paper), and 280.2 GeV (this paper).

References

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