Why does group theory fail to describe charge structure of particles?

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Abstract
It is pointed out that the group theory cannot describe the charge structure of particles. Set theory is necessary to describe the charge structure of particles but the set of charges form group.

1 Introduction

Despite its greater significance, the charge structure of particles has not been adequately discussed in the existing literature. Only recently, Gilani has pointed out a flagrant violation of group property in the charge structure of gluons [1]. This violation in the charge structure of the gluons changes [2, 3] the entire scenario of the well established theory of strong interactions [4] i.e. Quantum Chromodynamics (QCD). Also, many of the experimental results [5, 6, 7] are only confirmed by the failure of perturbative QCD [7]. An interacting gluon model is reviewed in Ref. [8], in which the failure of perturbative QCD is elaborated. The exploration of physics with $b$-flavoured hadrons offers a very fertile testing ground for the standard model (SM) description of electroweak interactions [9, 10, 11, 12, 13]. The theoretical [14, 15] and experimental [16, 17, 18, 19] results for the radiative $B$-decays to kaons resonances are quite opposite. In short, the form factors

$$F_{K^*}^{\text{theory}} > F_{K^*}^{\text{exp}},$$
$$F_{K_1}^{K^*} \ll F_{K_1}^{K^*}.$$
Kown and Lee explained some of the possible candidates of the discrepancy [15].

Gilani successfully discussed the issue of charge structure in his recent articles [1, 2, 3]. There was also a big confusion whether we totally escape from group concept or group concept provide some constraints upon the choice of set of charges. The answer of these issues are tried to discuss in this article.

2 Charge structure by group theory

The universe is made up of matter and it is neutral as a whole. Matter is composed of two charges + (plus) and − (minus). Charge ‘0’ is a composite of charges + and −, i.e. when we add + and − we obtain ‘0’. Let us form a group of these charges i.e.

\[ g_1 \equiv \{+1, -1\} \]

The group \( g_1 \) is a group under multiplication but not a group under addition. To make this a group under addition, we have to add additive identity in it, say

\[ g_2 \equiv \{+1, -1, 0\} \].

So, \( g_2 \) can never be group under multiplication because the inverse of ‘0’ does not exist. We can never make +2 and/or −2 from the above groups by using group theory.

To understand the charge structure +2 and/or −2, we have to define another group under multiplication, i.e.

\[ g_3 \equiv \cdots, +2, +1, +\frac{1}{2}, -\frac{1}{2}, -1, -2, \cdots \]

\[ = \text{Set of rational and irrational numbers} \]

but again we are unable to make ‘0’ from the group \( g_3 \). Also, let us take another group

\[ g_4 \equiv \cdots, +2, +1, 0, -1, -2, \cdots \]

\[ = \text{Set of whole numbers} \].

The group \( g_4 \) is a group under addition. The groups \( g_3 \) and \( g_4 \) are not finite groups. If we set up the charge structure with the help of groups \( g_3 \) and/or \( g_4 \), we are unable to get finite number of fundamental particles.
3 Another aspect

The question is: Can we take any set of charges to predict the charge structure? Not at all. We have to take a set which form a group. But to predict the charge structure of the particles, we have to use set theory. Let us take an example: The square roots of unity are

\[ S_1 \equiv \{ +1, -1 \}, \]

and the cube roots of unity are

\[ S_2 \equiv \left\{ +1, \frac{1}{2} + \frac{\sqrt{3}}{2}i, \frac{1}{2} - \frac{\sqrt{3}}{2}i \right\}. \]

The sets \( S_1 \) and \( S_2 \) are groups under multiplication but not groups under addition. By using the set properties of sets \( S_1 \) and \( S_2 \), the charge structure and prediction of particles is explained in Refs. [1, 2, 3]. With the help of set theory, we can make charges like \(+2\) and/or \(-2\) easily and so on.

The set of charge in case of Casimir force is an empty set \( \{ \} \) while in case of gravitational force, the set of charge consists of ‘0’ i.e. \( \{0\} \). These sets also form group.

4 Conclusions

We can describe the charge structure of particles only by set theory but the set of charges form group.

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References

[1] A. H. S. Gilani, Are gluons massive?, [hep-ph/0404026]

[2] A. H. S. Gilani, The value of color charges and structure of gauge bosons, [hep-ph/0410207]

[3] A. H. S. Gilani, How many quarks and leptons?, [hep-ph/0501103]
[4] F. Wilczek, Physics Today, August 2000; B. Schwarzschild, Physics Nobel prize goes to Gross, Politzer, and Wilczek for their discovery of asymptotic freedom, Physics Today, Page 21, December 2004; S. L. Adler, Remarks on the history of quantum chromodynamics, [hep-ph/0412297]

[5] N. Cartiglia, Leading baryons at low $x_L$ in DIS and photoproduction at ZEUS, [hep-ph/9706416]

[6] A. Szczurek, N. N. Nikolaev, and J. Speth, Phys. Lett. B 428 (1998) 383

[7] M. Derrick et al., (ZEUS collaboration), Phys. Lett. B 384 (1996) 388 [hep-ex/9606006]

[8] F. O. Duraes, F. S. Navarra, and G. Wilk, The interacting gluon model: a review, [hep-ph/0412293]

[9] J. Baines et al., $B$ decays at the LHC, CERN-TH/2000-101 (2000) [hep-ph/0003238]

[10] N. Cabbibo, Phys. Rev. Lett. 10 (1963) 531

[11] M. Kobayashi and T. Maskawa, Prog. Theor. Phys. 49 (1973) 652

[12] P. Ball, $B$ decays into light mesons, [hep-ph/9803501]

[13] M. Battagila et al., The CKM matrix and the unitarity triangle, CERN-2003-002-corr (2003) [hep-ph/0304132]

[14] A. Ali and A. Y. Parkhomenko, Eur. Phys. J. C 23, 89 (2002) [arXiv:hep-ph/0105302].

[15] Y. J. Kown and J.-P. Lee, Implications of the first observation of $B \to K \gamma$, [hep-ph/0409133]

[16] T. E. Coan et al. [CLEO Collaboration], Phys. Rev. Lett. 84, 5283 (2000) [arXiv:hep-ex/9912057].

[17] S. Nishida et al. [Belle Collaboration], Phys. Rev. Lett. 89, 231801 (2002) [arXiv:hep-ex/0205025].

[18] B. Aubert et al. [BABAR Collaboration], [arXiv:hep-ex/0308021].
[19] Belle Collaboration, K. Abe et al., BELLE-CONF-0411, ICHEP04 11-0656, [arXiv:hep-ex/0408138].