LETTERS TO PROGRESS IN PHYSICS

An Einstein-Cartan Fine Structure Constant Definition

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The fine structure constant definition given in Stone R. A. Jr. *Progress in Physics*, 2010, v.1, 11–13 [1] is compared to an Einstein-Cartan fine structure constant definition. It is shown that the Einstein-Cartan definition produces the correct pure theory value, just not the measure value. To produce the measured value, the pure theory Einstein-Cartan fine structure constant requires only the new variables and spin coupling of the fine structure constant definition in [1].

1 Introduction

Stone in [1] gives Nature's coupling constants, the fine structure constant and the weak angle, and a single mass formula for the W, the proton, the electron and electron generations all as functions of $(4\pi)^n$.

If these 4π coupling constant definitions are correct, then if a literature search found another theoretical definition, one would expect a similar form for the two definitions.

In [1] the fine structure constant (FSC), designated as α_{cs} (α charge to spin), is defined as $\pi\varsigma(4\pi\varrho)^{-2}/(2\sqrt{2})$ with $\varrho = \alpha_{cs}\,\alpha_{sg\,(1)}\, m_p/(m_e\,\pi) = 0.959973785$ where $\alpha_{sg\,(1)} = 2\sqrt{2}/4\pi$ and $\varsigma = (4\pi\varrho)^3\, m_e/m_p = 0.956090324$.

2 An Einstein-Cartan model

Many Einstein-Cartan models are scale independent models where the force magnitude (scale) is related to some internal variable like a length, e.g. l_0. The pure theory scale is l_0 while potential deviation from the pure theory is represented by l. The Einstein-Cartan model of Horie's [2] is such a model.

Equation (4.2) in Horie's paper [2] gives the Einstein-Cartan theoretical definition for the FSC as

$$\alpha_{cs} = \frac{1}{64\pi}\,\frac{l_0^2}{l^2}\,, \tag{1}$$

where l assumed to be less than and approximately l_0.

When $l = l_0$, (1) gives the FSC value of approximately 4.97×10^{-3}. To match the measured FSC value requires l_0/l to equal about 1.2113 ($l_0^2/l^2 \simeq 1.4672$), a value for l not approximately l_0.

The 4π definition of the fine structure coupling constant is given in [1] as $\alpha_{cs} = \pi\varsigma(4\pi\varrho)^{-2}/(2\sqrt{2})$ and the charged particle weak angle coupling constant as $\alpha_{sg} = 2\sqrt{2}(4\pi\varrho)^{-1}$.

Noting that the $\sqrt{2}$ appears with both spin couplings suggests that the origin of the $\sqrt{2}$ is related to the coupling of the other force in the coupling constant to spin.

From the underlying approach, this is true. However the $\sqrt{2}$ is mathematically on the side of the other force because the coupling of spin to charge (and g) is larger than expected by present approaches.

Thus in order to reflect the underlying approach of the 4π definitions, α_{cs} is better written as

$$\alpha_{cs} = \frac{1}{16\pi}\frac{1}{4}\;\sqrt{2}\;\;\frac{1}{\varrho^2}\;\;\varsigma. \tag{2}$$

Rewriting Horie's equation (1) in a similar form yields

$$\alpha_{cs} = \frac{1}{16\pi}\frac{1}{4}\;\;1\;\;\frac{1}{(l/l_0)^2}\;\;1. \tag{3}$$

Where as Horie's pure theory Einstein-Cartan model assumes 1 for the coupling, the underlying source coupling value in α_{cs} (and α_{sg}) is larger by $\sqrt{2}$.

Where as Horie's pure theory Einstein-Cartan model can not give a value for l/l_0 for α_{cs}, the definition in [1] gives the value as ϱ. Note that using the correct spin coupling ($\sqrt{2}$) now results in $l \lessapprox l_0$ as expected.

Lastly, Horie's pure theory Einstein-Cartan model simply lacks an additional factor ς that appears on the charge side of the coupling constants α_{cs} and α_{cg} [1].

Thus, as a pure theory model, Horie's result is correct. To produce the measured FSC value, Horie's pure theory model only needs the correct spin coupling ($\sqrt{2}$), the correct l/l_0 value (ϱ) and the ς adjustment that come from the approach that produced the 4π definition of Nature's constants.

3 Summary

In [1], several 4π coupling constant definitions were given including the fine structure constant.

It is shown that the 4π fine structure constant definition of [1] is in keeping with Horie's complex connection pure theory Einstein-Cartan fine structure constant definition [2].

Thus not only does the 4π definitions in [1] produce the two weak angle values as experimentally observed, the fine structure constant definition has the three missing constants required by a pure theory Einstein-Cartan fine structure constant definition to produce the measured value.

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References

1. Stone R. A. Jr. Is fundamental particle mass 4π quantized? *Progress in Physics*, 2010, v. 1, 11–13.
2. Horie K. Geometric interpretation of electromagnetism in a gravitational theory with space-time torsion. arXiv: hep-th/9409018.