

GR meets QED

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Abstract

General Relativity meets Quantum-Electro-Dynamic

This article explains the results from General Relativity in combination with Thermo-Dynamic-Principles capable of completing the QED's issue to explain the nature of the Sommerfeld Fine Structure Constant (FSC) α as suggested by Pauli and other physicists. From GR+TD we derive: $1/\alpha$ is proportional to the Einstein-Metric-Number (g_{44}) of space. So within GR+TD the FSC is not space invariant - already proved by astrophysical experiments. So on the moon we expect from Interferometry: $1/\alpha=137.035\,999\,229$ (Moon Lab, expected) compared to $1/\alpha=137.035\,999\,047$ (27) (Earth Lab, measured) due to the change of the metric.

I. INTRODUCTION

The Sommerfeld FSC (α) is an unsolved problem discovered in Electrodynamics about 100 years ago. The reason must be that the solution cannot be found within QED [1] up to now but within General Relativity the solution is hidden since 100 years too. We need to combine GR with Thermodynamic Principles to come up with a derivation of the FSC from a Principle Theory [2,2a] as Wolfgang Pauli and others [3] claimed during their times of research. Today GR+TD, the principle theory, is able to derive the restmass and charge from the corresponding equation of motion. Both values mass and charge depend on the fine structure constant number shown in equation (1) [2a]

$$\alpha = \left[\frac{3}{\beta^2 \cdot g_{44} \cdot 4} (1 + \gamma \cdot \ln 1/3)^2 \right] \quad (1)$$

II. GR+TD AND SCHWARZSCHILD HYPOTHESIS

$$g_{44} = 1 + \Phi_{int} - \frac{2GM_E}{c^2 R_E} - \frac{2GM_S}{c^2 R_{SE}} \quad (2)$$

In formula (2) we have two distinguish two parts: positive and negative contributions. The first $\Phi(int)$ is a combination of (non-point-like) internal action exchange particles ($dQ>0$ so $m>0$, mass-quants, absorbed), based on the GR+TD [2,2a] approach and on im-ponderable exchange particles ($dQ=0$, so $m=0$) [2,2a] or internal electromagnetic action (photons) that belongs to QED [3]. These GR and QED based number $\Phi(int)$ covers internal contributions. The next two contributions are due to the well-known and common external Schwarzschild Metric [2] influence from “Earth” and “Sun on Earth” on the g_{44} number.

TABLE I. Estimation of the FSC

Alpha (calculated)	Φ -int (estimated)	ϕ -earth-field (calculated)	ϕ -sun-earth-field (calculated)
137,036001942	$+8.8530 \cdot 10^{-5}$	-0	-0
137,035999 046	$+8.8530 \cdot 10^{-5}$	$-1.39157 \cdot 10^{-9}$	$-1.97371 \cdot 10^{-8}$

The two $1/\alpha$ values above are calculated values from formula (2). The experimental Parker value ^[4] (second row) is the basis for the estimated $\Phi(\text{int})$. We used $ME=5.9722 \cdot 10^{24} \text{kg}$, $RE=6.3710 \cdot 10^6 \text{m}$ and $MS=1.98892 \cdot 10^{30} \text{kg}$, $RSE=1.4959 \cdot 10^{11} \text{m}$ for to respect the two Schwarzschild Contributions. (Although we cannot switch off the Schwarzschild metric the first value demonstrates such picture.)

III. CONCLUSION

There is today a tiny difference in the last two figures (of twelve) of the $1/\alpha$ number ($\alpha=1/137.035\ 999\ 047\ (27)$) ^[4] (Earth Lab, measured) because of high accuracy (10^{-11}) within the Atom Interferometry Measurement of the Fine Structure Constant on earth. So, if we change the Gravity then we change the FSC-number is a theoretical prediction from GR combined with TD Principles. ^[2,2a] Therefore on the moon we would have a different experimental $1/\alpha$ value than on the earth. Applying the moon data instead of the earth data we can estimate an experimental value: $1/\alpha=137.035\ 999\ 229$ (Moon Lab, expected) based on our GR+TD approach. Furthermore in the space shuttle we would expect to measure the value: $1/\alpha=137.035\ 999\ 048$ (Space Lab, expected). So only the experiment on the moon can clarify the prediction from GR+TD.

The change of the Schwarzschild contribution from earth to space shuttle is negligible – as expected.

IV. SUMMARIZED FACTS

Facts from QED ^[1]

- The Landé g-Factor $g(\alpha)/2=1+C_2(\alpha/\pi)+ \dots$ can only be calculated from QED (α here is not free from $g(\alpha)$)

Facts from GR+TD: ^[2a]

- The FSC is not an invariant can only be derived from GR+TD (α is free from charge $e(\alpha)$ and mass $m(\alpha)$)

Suggested Experiment and expected value from Interferometry
FSC on the moon: $M=7.35 \cdot 10^{22} \text{kg}$, $R=1738 \text{km}$

- $1/\alpha=137.0359\ 999\ 229$

Facts from Astrophysical Experiments

White dwarf: $M=0.5 \cdot MS$, $R=0.022 \cdot RS$ ^[5]

- $\Delta\alpha/\alpha_{\text{exp}}=(+4.2+-1.6) \cdot 10^{-5}$ Fe-Spectrum: $1/\alpha=137.030$
based on $1/\alpha(\text{exp})=137.035\ 999\ 047\ (27)$
 $\Delta\alpha/\alpha_{\text{exp}}=(-6.1+-5.8) \cdot 10^{-5}$ Ni-Spectrum: $1/\alpha=137.044$
based on $1/\alpha(\text{exp})=137.035\ 999\ 047\ (27)$

White dwarf: G191-B2B ^[6]

- $\Delta\alpha/\alpha_{\text{exp}}=(0.007 \pm 0.087) \times 10^{-6}$ Fe-Spectrum: $1/\alpha=137.035\ 9$
based on $1/\alpha(\text{exp})=137.035\ 999\ 047\ (27)$

V. ENDNOTES AND REFERENCES

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- (1) Aoyama,1,2 Toichiro Kinoshita,3,4 and Makiko Nio² (Received 18 December 2017; published 8 February 2018)
(Revised and improved value of the QED tenth-order electron anomalous magnetic moment Tatsumi)
- (2) Albert Einstein: Grundzüge der Relativitätstheorie, Vieweg & Sohn, Braunschweig, 1969
[2a] Manfred Geilhaupt, Norbert Dahmen (2015) "Zur Entstehung der Ruhemasse des Elektrons" Virtuelle Instrumente in der Praxis 2015, VDE Verlag GMBH, Berlin Offenbach, ISBN978-3-8007-3669-0
- (3) Feynman, Richard; Leighton, Robert; Sands, Matthew (1964). *The Feynman Lectures on Physics, Vol. 3*. California Institute of Technology. p. 1.1. ISBN 0201500647. From the book QED by Richard Feynman...There is a most profound and beautiful question associated with the observed coupling constant e the amplitude for a real electron to emit or absorb a real photon. It is a simple number that has experimentally determined to be close to $\sqrt{e/m}$. My physicist friends won't recognize this number, because they like to remember it as the inverse of its square: about 137.035997... with an uncertainty of about 2 in the last decimal place. It has been a mystery ever since it was discovered more than fifty years ago and all good theoretical physicists put this number up on their wall and worry about it. Immediately you would like to know where this number for a coupling comes from: is it related to π or perhaps to the base of the natural log? Nobody knows. It's one of the greatest damn mysteries of physics: a magic number that comes to us with no understanding by man. You might say the "hand of God" wrote that number and "we don't know how He pushed His pencil". We know what kind of a dance to do experimentally to measure this number very accurately, but we don't know what kind of a dance to do on a computer to make this number come out---without putting it in secretly..."
- (4) R.H. Parker (2018): Measurement of the fine-structure constant as a test of the Standard Model, Atomic Physics, Science 13 Apr 2018: Vol. 360, Issue 6385, pp. 191-195
- (5) Webb et al., Physics Review Letters, 107, 191101 (2011)
- (6) J Hu J K Webb T R Ayres M B Bainbridge J D Barrow M A Barstow J C Berengut R F Carswell V A Dzuba V V Flambaum, Monthly Notices of the Royal Astronomical Society, Volume 485, Issue 4, June 2019, Pages 5050–5058, Constraining the magnetic field on white dwarf surfaces; Zeeman effects and fine structure constant variation,