Exact Calculation of the Fine Structure Constant and Lepton Mass Ratios

Brian Dale Nelson

ABSTRACT

This paper presents an analytical method used to calculate the exact value of the Fine Structure Constant (FSC) and the exact proton-electron, muon-electron, and tau-electron mass ratios. The method is based on a hypothesis that elementary particles absorb precise quantities of kinetic energy in order to bond using integer multiples of their total energy wavelengths in addition to their deBroglie momentum wavelengths. Overlapping wavelengths between bonded particles are calculated by finding common factors using an integer based derivation of Einstein's energy momentum equation. Common factors have been found in the electron, muon, and tau mass regions. The probability of finding a fine structure constant candidate with the largest common factors within ±2 standard uncertainty range of the 2012 FSC measurement 137.035999173(35) [1] search window was 3.8% suggesting this method is valid.

$$\frac{1}{\propto} = 137.035999209569$$

$$\frac{m_{proton}}{m_{electron}} = 1836.15267444111$$

$$\frac{m_{muon}}{m_{electron}} = 206.76829908726$$

$$\frac{m_{tau}}{m_{electron}} = 3477.0925509$$

INTRODUCTION

Many attempts have been made over the years to calculate the Fine Structure Constant (FSC). Many of these attempts were based on mathematical equations with no supporting conjecture, hypothesis, or theory supporting them. An infinite number of equations can be constructed to generate a known FSC value. As the agreed upon value of the FSC has continued to be refined, many of these equations have become obsolete, and they were never capable of providing insight into the mechanism governing the calculation.

A much more valuable approach is to construct a FSC equation based on a first principles hypothesis, an equation that was never implicitly designed to generate a particular value. Then the hypothesis can be tested over a wide range of possible FSC values. If the hypothesis yields a value within the measured range, out of much wider range of possibilities, it provides a high degree of confidence that the hypothesis and resulting value are correct. And, because it was based on a hypothesis, it provides insight into the mechanism governing the FSC. This is

especially useful as the method can then be applied to discovering the exact values of other mass ratios and coupling constants.

This attempt is based on a first principles hypothesis that expands upon the known integer multiple of the deBroglie wavelength in orbital bonding. The hypothesis presented in this paper states that *elementary particles absorb precise quantities of kinetic energy in order to form integer multiples of their total energy wavelength in addition to their deBroglie wavelengths*. The total energy wavelength, like the Compton wavelength, is an intrinsic property of a particle in motion and is likely superimposed on top of the deBrogile wavelength.

In order to facilitate the analysis of wavelength integer factors and multiples, and to explain these interacting wavelengths, integer based derivations of Einstein's energy equations have been derived and shown to be mathematically equivalent to their classical counterparts.

METHODS

Integer based derivations used in the analysis

Einstein equated energy with mass and momentum in his famous relativistic energy momentum equation shown in Equation (1) [2].

$$(1) \qquad E^2 = (mc^2)^2 + (pc)^2$$

Energy (E)	in Joules
Mass (m)	in Kg
Speed of Light (c)	2.99792456E08 m/s
Velocity (v)	in m/s
Momentum (p)	mv in Kgm/s

The relativistic energy momentum equation can be written using dimensionless integers by including a rest mass (n_m) and a kinetic energy (n_v) term. The integers can be converted to energy units by the use of Plank's Law [3] where the wavelength is represented by a constant unit wavelength λ_u divided by the integer terms of mass (n_m) and kinetic energy (n_v). The total energy is simply the sum of these two unit energy units as shown in Equation (2).

$$(2) \qquad E = \frac{hc(n_m + n_v)}{\lambda_u}$$

Energy (E)	in Joules
Plank's Constant (h)	6.62606896E-34 Js
Speed of Light (c)	2.99792456E08 m/s
Unit Energy Wavelength (λ_u)	constant, in meters
Number of Rest Mass Energy Units (n_m)	dimensionless integer
Number of Kinetic Energy Units (n_v)	dimensionless integer

Equation (3) equates the number of rest mass energy units (n_m) with rest mass.

$$(3) \qquad m = \frac{hn_m}{\lambda_u c}$$

Einstein's relativistic energy momentum equation, Equation (1), is in the form $C^2=A^2+B^2$ which is Pythagorean's Theorem equating the sides of a right triangle. The two energy Equations (1) and (2) are equated by matching the sides of this right triangle as shown in Figure 1. In this case, the hypotenuse C is the total unit energy count ($n_m + n_v$), the adjacent side A is the rest mass energy count (n_m), and the opposite side B can be calculated using Pythagorean's Theorem to be $\sqrt{n_v^2 + 2n_m n_v}$ which is inversely proportional to the deBroglie Wavelength.

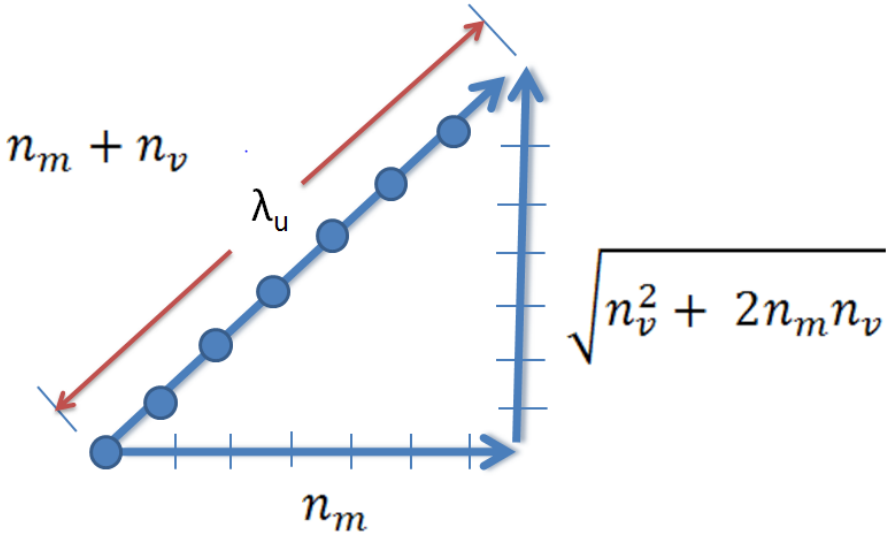

Figure 1. Right triangle relationship between integer based energy components.

Equation (4) equates velocity with the energy relationship shown in Figure 1. The velocity equation is an energy relationship multiplier of the speed of light (c), with the maximum speed being light speed when $n_m = 0$, or, the rest mass equals zero.

$$(4) \qquad v = \frac{\sqrt{n_v^2 + 2n_m n_v}}{n_m + n_v} c$$

The integer based Lorentz factor Equation (6) is a much simpler form than the classic Lorentz version Equation (5). The relativistic mass increases as the sum of n_m and n_v divided by n_m, only when n_v=0 (no kinetic energy), does the relativistic mass equal rest mass.

$$(5) \qquad \gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$(6) \qquad \gamma = \frac{n_m + n_v}{n_m}$$

Louis de Broglie introduced the matter wave shown in his famous Equation (7) [4]. The Lorentz factor has been added in this version to account for relativity.

$$(7) \qquad \lambda_{dB} = \frac{h}{\gamma m v}$$

By inserting the integer based Lorentz Equation (6), the integer based mass Equation (3), and the integer based velocity Equation (4) into Equation (7) and simplifying, the integer based deBroglie Equation (8) can be calculated. Singularities are eliminated in this integer based version since the maximum value of the deBroglie wavelength can obtain is λ_u when $n_v = 1$ and $n_m = 0$.

$$(8) \quad \lambda_{dB} = \frac{\lambda_u}{\sqrt{n_v^2 + 2 n_v n_m}}$$

Although the integer based versions of Einstein's relativistic mass-energy equation and deBroglie's wave equation are very different in form, they are mathematically equivalent as shown in Table 1. The first two columns of Table 1 provide various ratios of kinetic energy units (n_v) and rest mass units (n_m). Since the number of rest mass units (n_m) is held constant at 100000000, the resulting mass is also a constant 2.2102E-34 kg. Column 3 is the velocity of the inertial system from Equation (4) displayed as a decimal multiple of the speed of light (c). The next two columns show the classical Equation (1) and integer based Equation (2) total energy calculations which show identical values over all velocities including those nearing light speed. The next columns show the classical Equation (5) and integer based Equation (6) Lorentz equation results which also show identical values over all velocities. The deBroglie wavelengths, Equations (7) and (8), also yield identical results over all velocities.

Table 1: Validation of equivalency between classical mass-energy equations and integer based mass-energy equations using a normalized unit wavelength $\lambda_u = 1$.

N_m	N_v	Velocity factor of light speed c	Equation (1) Classical Energy (E-17 J)	Equation (2) Integer Energy (E-17 J)	Equation (5) Classical Lorentz Factor	Equation (6) Integer Lorentz Factor	Equation (7) Classical deBroglie (m)	Equation (8) Integer deBroglie (m)
100000000	1	0.0001414	1.986446	1.986446	1.0000000	1.0000000	7.07107E-05	7.07107E-05
100000000	10	0.0004472	1.986446	1.986446	1.0000001	1.0000001	2.23607E-05	2.23607E-05
100000000	100	0.0014142	1.986448	1.986448	1.0000010	1.0000010	7.07107E-06	7.07107E-06
100000000	1000	0.0044721	1.986466	1.986466	1.0000100	1.0000100	2.23606E-06	2.23606E-06
100000000	10000	0.0141411	1.986644	1.986644	1.0001000	1.0001000	7.07089E-07	7.07089E-07
100000000	100000	0.0446879	1.988432	1.988432	1.0010000	1.0010000	2.23551E-07	2.23551E-07
100000000	1000000	0.1403708	2.006310	2.006310	1.0100000	1.0100000	7.05346E-08	7.05346E-08
100000000	10000000	0.4165978	2.185090	2.185090	1.1000000	1.1000000	2.18218E-08	2.18218E-08
100000000	100000000	0.8660254	3.972891	3.972891	2.0000000	2.0000000	5.77350E-09	5.77350E-09
100000000	1000000000	0.9958592	21.850903	21.850903	11.0000000	11.0000000	9.12871E-10	9.12871E-10

Einstein's relationship between the momentum term (opposite side B) and the total energy term (hypotenuse side C) must follow Pythagorean's theorem. By definition, the hypotenuse ($n_m + n_v$) and the adjacent side A (n_m) are integers, the opposite side ($\sqrt{n_v^2 + 2n_v n_m}$) does not need to be an integer.

When a particle is at rest where $n_v = 0$, the total energy is equal to n_m. Here, the particle has a wavelength equal to the Compton wavelength. When a particle is moving and has a positive momentum energy $n_v > 0$, the particle continues to exhibit a wavelength which shall be termed the total energy wavelength equal to:

$$(9) \qquad \lambda_e = \frac{\lambda_u}{n_m + n_v}$$

The shape of the total energy wavelength is unknown, for the purposes of this paper it shall be considered sinusoidal. The right triangle shown in Figure 1 also represents the lead of a helix suggesting deBroglie's matter waves may be helical waves overlaid on top of a sinusoidal total energy wavelength. The shapes of the waves are not important, what is important is that they are different wavelengths, and both play a key role in the stability of orbital bonds.

Integer based derivation of the Fine Structure Constant

The Rydberg Constant relates the shared photon energy in the lowest orbital with the Fine Structure Constant in the following Equation (10) [6]:

$$(10) \qquad R_\infty = \frac{1}{\lambda_{photon}} = \frac{\propto^2}{2\lambda_{electron}}$$

Relating the ratio of photon energy to the electron energy with the Fine Structure Constant and taking the reciprocal of each, this equation takes the form of Equation (11):

$$(11) \qquad \frac{1}{\propto} = \frac{1}{\sqrt{\frac{2\lambda_{electron}}{\lambda_{photon}}}}$$

The integer constants n_v and n_{me} are related to the electron and photon wavelengths in Equations (12) and (13):

$$(12) \qquad \lambda_{electron} = \frac{\lambda_u}{n_{me}}$$

$$(13) \qquad \lambda_{photon} = \frac{\lambda_u}{n_v}$$

Inserting Equations (12) and (13) into Equation (11) and simplifying, the result is Equation (14) relating the reciprocal of the Fine Structure Constant to n_v and the mass of the electron n_{me}.

$$(14) \quad \frac{1}{\propto} = \frac{1}{\sqrt{\frac{2n_v}{n_{me}}}}$$

Factor Analysis

The hypothesis states that *elementary particles absorb precise quantities of kinetic energy in order to form integer multiples of their total energy wavelength in addition to their deBroglie wavelengths*. This means that particles that bond, like the electron and proton with their respective masses (n_{me} and n_{mp}), absorb the same quantity of kinetic energy (n_v) in order for their total energy wavelengths ($\frac{\lambda_u}{n_{me}+n_v}$ and $\frac{\lambda_u}{n_{mp}+n_v}$) to share common factors. The quantity of kinetic energy is the same because they share a common photon. The first particle pair tested was the proton-electron pair. Because the Fine Structure Constant has been measured to such high precision, it allowed the $\frac{n_v}{n_{me}}$ ratio to be calculated with in a very tight range using equation (14). Once common factors were found between the proton and electron, factors were searched in the muon-electron and tau-electron mass ratios assuming particles in common families (leptons) would also share common factors.

Common factors between wavelengths mean that periodically, the two wavelengths start at the same point in space provided that are in phase with each other. This overlapping wave hypothesis is a natural extension of the overlapping deBroglie wave hypothesis which has been accepted as a key factor in predicting the wave functions of atomic orbitals.

An illustration of overlapping sinusoidal waves is found in Figure 2. Here, a particle with a total energy wavelength of $\frac{\lambda_u}{12}$ bonds with another particle with a total energy wavelength of $\frac{\lambda_u}{4}$. The maximum common factor between the two wavelengths is 3 meaning that at every 3rd wave period (of the highest energy wave), the two total energy waves overlap (assuming they are in phase).

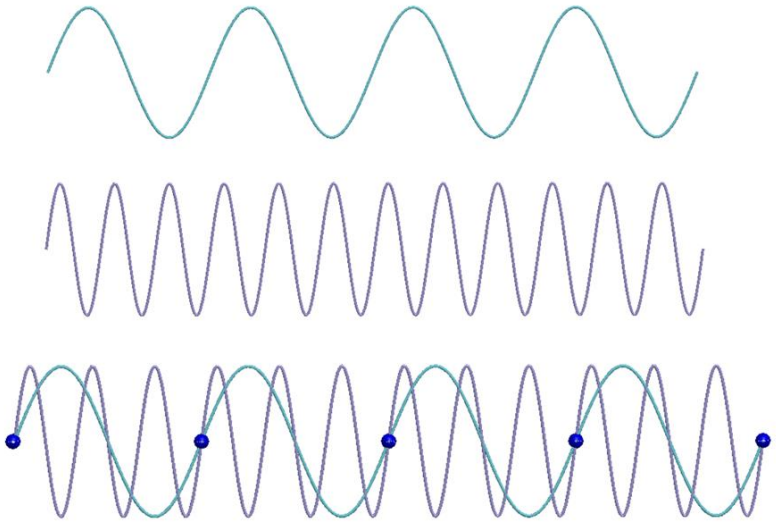

Figure 2 Overlapping waves with a common factor of four.

Generation of the Particle Factors

A simple VISUAL BASIC computer program was written to generate the factors for various particle pairs. The source code can be found in Appendix A.

The program used the following sequential steps:

1. Search Limits were established for the Fine Structure Constant and the lepton mass ratios. The Proton-Electron, Muon-Electron, and Tau-Electron Mass ratio limits came from the 2006 CODATA published limits with ±3 times its standard uncertainty. The Fine Structure limits were established by taking +/- 3 standard uncertainties (+/-.000000035 x 3) of the 2012 published FSC value [1], 137.035999173+/-.000000105.

2. The limits used in the search were:
    a. Fine Structure Constant Minimum 137.035999068
    b. Fine Structure Constant Maximum 137.035999278
    c. Proton Electron Mass Ratio Minimum 1836.1526702
    d. Proton Electron Mass Ratio Maximum 1836.1526747
    e. Muon Electron Mass Ratio Minimum 206.7682687
    f. Muon Electron Mass Ratio Maximum 206.7682999
    g. Tau Electron Mass Ratio Minimum 3476.22
    h. Tau Electron Mass Ratio Maximum 3478.08

3. The program was run initially by testing the proton-electron pair with mass numbers of n_{me} and n_{mp}.
4. N_v was iterated between 1 and 12258. Larger values of N_v produced multiples of previously discovered energy triangles with a given Fine Structure Constant.
5. The electron mass limits N_{me}_Max and N_{me}_Min values were calculated based on the Fine Structure Constant Minimum and Maximum values (2a &2b above) for the given N_v value using equation (14). N_{me} was iterated between the minimum and maximum values.
6. The legs of the electron energy triangle where calculated (see Figure 1.)
7. The proton mass limits N_{mp}_Max and N_{mp}_Min values were calculated based on multiplying the electron mass number N_{me} by the Min and Max Proton-Electron Mass Ratios (2c and 2d above). N_{mp} was iterated between the minimum and maximum values.
8. The legs of the electron energy triangle where calculated (see Figure 1.)
9. The largest common factor between the total energy legs ($N_{me} + N_v$) and ($N_{mp} + N_v$) of the electron and proton energy triangle where calculated.
10. The exact proton-electron mass ratio and exact fine structure constant was calculated.
11. The largest factor calculation process was repeated for the electron-muon and electron-tau particle combinations.

RESULTS

Table 2 shows the largest common factors and multiples for electron-proton bonds that produce fine structure constants (FSC) within a ±3 standard error window of the measured 2012 fine structure constant value (137.035999173+/-.000000105)[1]. The factor analysis is periodic, with several FSC candidates appearing within the search window. The factor analysis also shows that the top FSC candidates with the highest common factors, all exhibited the same multiple, 472. This means that at every 472nd electron wave period, the electron and proton total energy waves overlap (assuming they are in phase).

Table 2: Largest common factors for electron-proton bonds with Fine Structure Constants between 137.035999068 and 137.035999278.

Electron Mass Number N_{me}	Proton Mass Number N_{mp}	Kinetic Energy Number N_v	Exact Fine Structure Constant (FSC)	Largest Common Factor	Multiple	Exact Proton-Electron Mass Ratio (N_{mp}/N_{me})
301663688	553900587503	8032	137.035999065357	639135	472	1836.15267444121
236839046	434872647725	6306	137.035999080312	501791	472	1836.15267444119
441265771	810231325561	11749	137.035999110981	934910	472	1836.15267444118
204426725	375358677836	5443	137.035999124446	433119	472	1836.15267444117
376441129	691203385783	10023	137.035999140230	797566	472	1836.15267444116
172014404	315844707947	4580	137.035999158988	364447	472	1836.15267444115
311616487	572175446005	8297	137.035999181648	660222	472	1836.15267444113
451218570	828506184063	12014	137.035999190287	955997	472	1836.15267444113
139602083	256330738058	3717	137.035999209569	295775	472	1836.15267444111
386393928	709478244285	10288	137.035999232087	818653	472	1836.15267444110
246791845	453147506227	6571	137.035999244824	522878	472	1836.15267444109
353981607	649964274396	9425	137.035999258728	749981	472	1836.15267444108
461171369	846781042565	12279	137.035999266169	977084	472	1836.15267444107

In order to narrow the search for FSC candidates, the factor analysis was extended to the other leptons, the muon and tau particles. Since these leptons carry the same ½ spin, it is assumed that they also share large common factors between their total energy waves. When scaling the particle masses, the other legs of the energy triangle were also scaled up meaning the angles of the triangles and the governing Lorentz factors were held constant.

Table 4 shows the results of the common factor analysis between the electron and the muon. As expected, large common factors were found with multiples even smaller than the electron-proton bonds. The smallest multiple found was 156 meaning that at every 156th electron wave period, the electron and muon total energy waves overlap (assuming they are in phase). In cross referencing the values in Table 2 with Table 3, only one FSC candidate (shown in bold in Table 3), was found in both Tables, 137.035999209569. This value also resulted in the lowest multiple of 156. Because this value resulted in the lowest multiple for both the proton-electron bond and the electron-muon comparison, this became the best candidate for the true fine structure constant.

Table 3: Largest common factors for electrons and muons with Fine Structure Constants between 137.035999068 and 137.035999278.

Electron Mass Number N_{me}	Muon Mass Number N_{mm}	Kinetic Energy Number N_v	Exact Fine Structure Constant (FSC)	Largest Common Factor	Multiple	Exact Muon-Electron Mass Ratio (N_{mm}/N_{me})
70270513	14529714449	1871	137.035999085752	450464	156	206.768299087271
139151390	28772092077	3705	137.035999092331	647233	215	206.768269271331
103396431	21379102383	2753	137.035999125420	278704	371	206.768281808489
80298427	16603166776	2138	137.035999141848	373491	215	206.768269271327
81274928	16805078621	2164	137.035999156043	521007	156	206.768299087266
92279343	**19080442793**	**2457**	**137.035999209569**	**591550**	**156**	**206.768299087262**
103283758	21355806965	2750	137.035999251690	662093	156	206.768299087258
123189355	25471649726	3280	137.035999253712	572989	215	206.768269271318

Further analysis (see Table 4) comparing the electron and tau particles, the highest common factor resulted in a multiple of 1, meaning that at every electron wave period, the electron and tau total energy waves overlap (assuming they are in phase). The fact that there is just a single value of 137.035999209569 within our search range (which is our best candidate from the proton-muon search) provides further evidence that this is the true FSC value. This FSC value is within ±2 standard uncertainty values of the 2012 published FSC value [1], 137.035999173+/-.000000035

Table 4: Largest common factors for electrons and tau particles with Fine Structure Constants between 137.035999068 and 137.035999278.

Electron Mass Number N_{me}	Tau Mass Number N_{mt}	Kinetic Energy Number N_v	Exact Fine Structure Constant (FSC)	Largest Common Factor	Multiple	Exact Tau-Electron Mass Ratio (N_{mt}/N_{me})
2366137	8227277337	63	137.035999209569	2366200	1	3477.0925509

DISCUSSION

Without further refinement of the measured values for lepton mass ratios and the fine structure constant, it is difficult to validate the accuracy of this analysis and its underlying hypothesis. One way to provide confidence in the method is to calculate that probability that the method would find the highest factor fine structure constant (FSC) within the ±2 standard uncertainty ranges of the most accurate 2012 FSC measurement (137.035999173+/-.000000070). An arbitrary method based on an arbitrary hypothesis would be expected to have an equal 50/50 chance of picking a FSC value within the measured window. Chances lower than 50/50 would suggest the method is not arbitrary and the lower the probability of success, the more likely the method is valid.

The best FSC candidate (137.035999209569) was within ±2 standard uncertainties of the measured value and resulted in a proton multiple of 472, a muon multiple of 156, and a tau multiple of 1. By searching for other FSC candidates with at least this level of performance (Factors $\leq$ 472:156:1) over a wide range of FSC possibilities, we can calculate the probability of finding the best candidate within the measured range. The search range was widened to ±1000

uncertainty ranges or 137.035999173+/-.000035. Table 5 shows the results of the widened search. There were 19 unique FSC candidates found. The multiples 156:472:1 repeat themselves periodically, although they are relatively rare.

Table 5: Largest common factors between electrons, protons, muons, and tau particles with Fine Structure Constants between 137.035964173 and 137.036034173.

Electron Mass Number N_{me}	Mass Number N_{mx}	Kinetic Energy Number N_v	Exact Fine Structure Constant (FSC)	Largest Common Factor	Multiple	Exact Mass Ratio (N_{mx}/N_{me})
127433319	26349170617	3393	137.035967256188	816902	156	206.7682990898
192783739	353980377958	5133	137.035967256188	408451	472	1836.1526744639
3267521	11361472929	87	137.035967256188	3267608	1	3477.0925508972
13671008	2826731071	364	137.035970251818	87637	156	206.7682990896
124090688	227849448647	3304	137.035970251818	262911	472	1836.1526744618
262904	914141540	7	137.035970251818	262911	1	3477.0925508931
118644825	24531988661	3159	137.035973469346	760564	156	206.7682990893
179488325	329567967983	4779	137.035973469346	380282	472	1836.1526744595
3042175	10577924031	81	137.035973469346	3042256	1	3477.0925508888
36618777	7571602235	975	137.035980676609	234742	156	206.7682990887
55397637	101718519336	1475	137.035980676609	117371	472	1836.1526744543
938943	3264791711	25	137.035980676609	938968	1	3477.0925508790
22947769	4744871164	611	137.035986887123	147105	156	206.7682990882
208295134	382461667369	5546	137.035986887123	441315	472	1836.1526744499
1765213	6137808973	47	137.035986887123	1765260	1	3477.0925508706
101067837	20897624749	2691	137.035989137309	647888	156	206.7682990881
152897497	280743148033	4071	137.035989137309	323944	472	1836.1526744483
2591483	9010826235	69	137.035989137309	2591552	1	3477.0925508676
32224530	6663011257	858	137.035993944524	206573	156	206.7682990877
97499860	179024628697	2596	137.035993944524	206573	472	1836.1526744449
413135	1436508631	11	137.035993944524	413146	1	3477.0925508611
23736484	4907952423	632	137.035994994201	152161	156	206.7682990876
47472968	87167617157	1264	137.035994994201	100581	472	1836.1526744441
5934121	20633487925	158	137.035994994201	5934279	1	3477.0925508597
92279343	19080442793	2457	137.035999209569	591550	156	206.7682990873
139602083	256330738058	3717	137.035999209569	295775	472	1836.1526744411
2366137	8227277337	63	137.035999209569	2366200	1	3477.0925508540
60054813	12417431536	1599	137.036002034715	384977	156	206.7682990870
181704306	333636847419	4838	137.036002034715	384977	472	1836.1526744391
1539867	5354260075	41	137.036002034715	1539908	1	3477.0925508502
129386387	26753003165	3445	137.036002706354	829422	156	206.7682990870
9952799	18274858502	265	137.036002706354	21087	472	1836.1526744386
9952799	34606803263	265	137.036002706354	9953064	1	3477.0925508493

Electron Mass Number N_{me}	Mass Number N_{mx}	Kinetic Energy Number N_v	Exact Fine Structure Constant (FSC)	Largest Common Factor	Multiple	Exact Mass Ratio (N_{mx}/N_{me})
9276761	1918140093	247	137.036011402305	59468	156	206.7682990863
42102223	77306109361	1121	137.036011402305	89202	472	1836.1526744324
713597	2481242813	19	137.036011402305	713616	1	3477.0925508375
92617386	19150339369	2466	137.036016541943	593717	156	206.7682990859
61744924	113373107335	1644	137.036016541943	130819	472	1836.1526744288
15436231	53673203823	411	137.036016541943	15436642	1	3477.0925508306
130362921	26954919439	3471	137.036020033117	835682	156	206.7682990856
197215701	362118136830	5251	137.036020033117	417841	472	1836.1526744263
3342639	11622665167	89	137.036020033117	3342728	1	3477.0925508259
51266319	10600249580	1365	137.036022375766	328639	156	206.7682990854
155113478	284812027469	4130	137.036022375766	328639	472	1836.1526744246
1314521	4570711177	35	137.036022375766	1314556	1	3477.0925508227
74702355	15446078881	1989	137.036026463918	478874	156	206.7682990851
113011255	207505918108	3009	137.036026463918	239437	472	1836.1526744217
1915445	6660179541	51	137.036026463918	1915496	1	3477.0925508172
121574427	25137737483	3237	137.036029911757	779344	156	206.7682990848
183920287	337705726855	4897	137.036029911757	389672	472	1836.1526744192
3117293	10839116269	83	137.036029911757	3117376	1	3477.0925508125
114025320	23576821469	3036	137.036029998634	730951	156	206.7682990848
76016880	139578597513	2024	137.036029998634	161057	472	1836.1526744192
9502110	33039715898	253	137.036029998634	9502363	1	3477.0925508124
79584869	16455627996	2119	137.036032608686	510173	156	206.7682990846
12243826	22481533855	326	137.036032608686	25941	472	1836.1526744173
6121913	21286458089	163	137.036032608686	6122076	1	3477.0925508089

The probability of finding a FSC candidate within ±2 standard uncertainty ranges of the most accurate 2012 FSC measurement [1] (137.035999173+/-.000000070) can be found by dividing the number of FSC candidates found (number of balls rolled at the roulette table) by the number of uncertainty ranges in the search window (# of pockets in the roulette wheel).

$$(15) \qquad \%\text{Probablity} = \frac{\#\ of\ FSC\ candidates}{\#\ of\ \pm 2\ uncertainty\ ranges} x\ 100 = \frac{19}{2000/4}\ x\ 100 = 3.8\%$$

There was only a 3.8% probability this method could have produced a FSC candidate within ±2 standard uncertainties of the 2012 measured range [1]. While this does not prove this method is valid, it does provide compelling evidence to suggest it is. This method may be applied to find other mass ratios and coupling constants which will in turn provide additional confidence this method and its underlying hypothesis are valid.

REFERENCES

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[5] Joyce, D. E. (June 1997), "Book X , Proposition XXIX", *Euclid's Elements*, Clark University

[6] Wikipedia Rydberg Constant – Alternative expressions

Appendix A: Visual BASIC program source code

```
     Public Class Form1
    Private Sub Button1_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles
Button1.Click
        FileOpen(1, "C:\VBOutput\Leg C Factors.txt", OpenMode.Output)


        '*** Program Overview ****
        '1)      Iterate Nme then Nv for Nv=1,2,3,4,5 ....
        '2)      Calculate FSC
        '3)      Test FSC to see if it is within the accepted search range
        '4)      Iterate Nmp using calculated mass range limits based on mass ratio
        '5)      Calculate the Common Factors between Nhe and Nhp
        '6)      Print to file the solutions with the highest factors.

        '*********** define constants *************
        Dim ElectronProtonRatio As Decimal   'electron proton mass ratio
        Dim ElectronMuonRatio As Decimal     'electron muon mass ratio
        Dim ElectronTauRatio As Decimal

        Dim FineStrMin As Decimal            'Fine Structure Constant Min Value Sweep
        Dim FineStrMax As Decimal            'Fine Structure Constant Max Value Sweep
        Dim FineStrCst As Decimal            'Calculated Fine Structure Constant

        Dim Proton_Ratio_Min As Decimal
        Dim Proton_Ratio_Max As Decimal
        Dim Muon_Ratio_Min As Decimal
        Dim Muon_Ratio_Max As Decimal
        Dim Tau_Ratio_Min As Decimal
        Dim Tau_Ratio_Max As Decimal


        '*********** define variables *************

        Dim Nv As Decimal                      'Nv integer (same for electron and proton)
        Dim Nme As Decimal                     'Nme integer (A triangle leg) Electron
        Dim Nce As Decimal                     'Nce integer (B triangle leg) Electron
        Dim Nhe As Decimal                     'Nhe integer (C triangle leg) Electron
        Dim Nmp As Decimal                     'Nme integer (A triangle leg) Proton
        Dim Ncp As Decimal                     'Nce integer (B triangle leg) Proton
        Dim Nhp As Decimal                     'Nhe integer (C triangle leg) Proton

        Dim FSC_Best As Decimal
        Dim Factor_Best As Decimal

        Dim Max_Factor As Decimal
        Dim Max_Sum As Decimal
        Dim Nme_Min As Decimal
        Dim Nme_Max As Decimal                  'Maximum iterative value of Nme (set)
        Dim Nv_Max As Decimal                   'Maxmimum value of Nv (calculated)
        Dim Nmp_Min As Decimal                  '
        Dim Nmp_Max As Decimal
        Dim k As Decimal
        Dim k_Max As Decimal
        Dim k_Nme As Decimal
        Dim k_Nmp As Decimal
        Dim k_Min As Decimal
        Dim i_Max As Decimal
        Dim i_Min As Decimal

        Dim Highest_Factor As Decimal

        Dim Factor_Ratio As Decimal
        Dim Num_Factors As Decimal

        Dim Test1 As Decimal
```

```
Dim Test2 As Decimal
Dim Test3 As Decimal
Dim Test4 As Decimal
Dim Test5 As Decimal
Dim Test6 As Decimal
Dim Test7 As Decimal
Dim Test8 As Decimal
Dim Test9 As Decimal

'********* set constants **********
ElectronProtonRatio = 1836.15267245    '(75) for last 2 digits, CODATA 2006
ElectronMuonRatio = 206.7682843        '(52) for last 2 digits CODATA 2010
ElectronTauRatio = 3477.15             '(31) for last 2 digits
FineStrCst_Measured1 = 137.035999173   '(35) for last 2 digits (2012)

'FineStrMin = 137.035999068             'latest 2012 tight limits +/-3 sigma error range
'FineStrMax = 137.035999278             'latest 2012 tight limits +/-3 sigma error range

'FineStrMin = 137.035998823             'widened limits 10X 2012 Error range
'FineStrMax = 137.035999523

'FineStrMin = 137.035995675             'ULTRA WIDE 100X 2012 Error range +/-3500
'FineStrMax = 137.036002675

FineStrMin = 137.0359641                'SUPRA WIDE 1000X 2012 Error range +/-35000
FineStrMax = 137.0360342

Proton_Ratio_Min = 1836.1526702       'narrow limits 3X Error range 3 sigma error range
Proton_Ratio_Max = 1836.1526747

Muon_Ratio_Min = 206.7682687          'narrow limits 3X Error range 3 sigma error range
Muon_Ratio_Max = 206.7682999

Tau_Ratio_Min = 3476.22          'narrow limits 3X Error range 3 sigma error range
Tau_Ratio_Max = 3478.08


Highest_Factor = 0
Nv_Max = 100000000
Factor_Best = 1000000                              'highest recorded Factor
FSC_Best = 0                                      'FSC with highest recorded Factor

'*** Enter Nv Loop ***
For Nv = 1 To Nv_Max
    ' print counter for Nme
    Test1 = Nv / 10
    Test2 = Math.Abs(Int(Test1) - Test1)
    If Test2 = 0 Then
        Debug.WriteLine(Nv)
    End If

    'compute limits of Nme
    Nme_Min = Int(2 * Nv * FineStrMin * FineStrMin) - 10
    Nme_Max = Int(2 * Nv * FineStrMax * FineStrMax) + 10


    '*** Enter Nv Loop ***
    For Nme = Nme_Min To Nme_Max

        'compute FSC
        FineStrCst = 1 / Math.Sqrt((2 * Nv) / Nme)

        'only continue if the FSC is in the Min-Max search window

        If FineStrCst >= FineStrMin And FineStrCst <= FineStrMax Then
```

```
                    'compute electron energy triangle Legs
                    Nme = Nme                                       'Leg A electron
                    Nce = Math.Sqrt((Nv * Nv) + (2 * Nme * Nv))     'Leg B electron
                    Nhe = Nme + Nv                                  'Leg C electron

                    'compute limits on Proton Nmp
                    Nmp_Min = Int(Nme * Proton_Ratio_Min) - 10  'minimum possible value of Nmp
                    Nmp_Max = Int(Nme * Proton_Ratio_Max) + 10  'maximum possible value of Nmp

                    'enter proton mass loop
                    For Nmp = Nmp_Min To Nmp_Max

                        'compute proton energy triangle Legs
                        Nmp = Nmp                                       'Leg A proton
                        Ncp = Math.Sqrt((Nv * Nv) + (2 * Nmp * Nv))     'Leg B proton
                        Nhp = Nmp + Nv                                  'Leg C proton

                        'search for common factors between Nhe and Nhp
                        'calculate k_Max and k_Min as allowed factor ratio of 2 to 1000 of Nme

                        'k_Max = Int(Nhe / 2)          'largest possible Nhe factor
                        'k_Min = Int(Nhe / 1000)       'smallest allowed Nhe factor

                        i_Min = 1                      'maximum cut off for large factor
                        i_Max = 500                    'minimum cut off for large factors

                        For i = i_Min To i_Max
                            Test1 = Nhe / i
                            Test2 = Int(Test1) - Test1

                            If Test2 = 0 Then
                                'compute the large factor for the electron
                                k = Nhe / i

                                'test to see if large factors are common
                                Test3 = Nhp / k
                                Test4 = Int(Test3) - Test3

                                If Test4 = 0 Then
                                    Factor_Ratio = i
                                    If Factor_Ratio < Factor_Best Then
                                        Factor_Best = Factor_Ratio
                                        FSC_Best = FineStrCst
                                    End If

                                    Debug.WriteLine(Nme)
                                    Debug.WriteLine(Nmp)
                                    Debug.WriteLine(Nv)
                                    Debug.WriteLine(FineStrCst)
                                    Debug.WriteLine(k)
                                    Debug.WriteLine(Factor_Best)
                                    Debug.WriteLine(FSC_Best)
                                    Debug.WriteLine("")
                                    PrintLine(1, Nme, TAB, Nmp, TAB, Nv, TAB, FineStrCst, TAB, k,
TAB, Factor_Ratio)
                                End If
                            End If
                        Next         'end i loop

                    Next         'end Nmp Loop
                End If
            Next           'end Nme Loop
        Next               'end Nv Loop

        FileClose()
    End Sub
End Class
```