Exact calculation of the Fine Structure Constant sets the lepton and quark masses

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ABSTRACT

In 2014, the Fine Structure Constant (FSC) was calculated to be 137.035999209569 [1], and in 2020, a refined measurement landed within one standard error at 137.035999206(11) [2] suggesting this calculated value is accurate. The hypothesis behind this calculation claims bonded particles absorb precise quantities of force carrier energy to share common factor energy quanta between their adjusted Compton wavelengths. Subsequent analysis presented in this paper provides additional evidence suggesting the FSC, lepton masses, quark masses, and their coupling constant energies are all interdependent and their precise values, all within current CODATA measured values, are set by these shared common factor quanta.

HYPOTHESIS

The origin of the Fine Structure Constant remains one of the greatest mysteries in modern physics. Any valid attempt to unravel this mystery must address the fundamental question. Why does an electron share such a precise amount of photon energy to bond with a proton? One plausible answer is so that it can share a much larger quanta of energy.

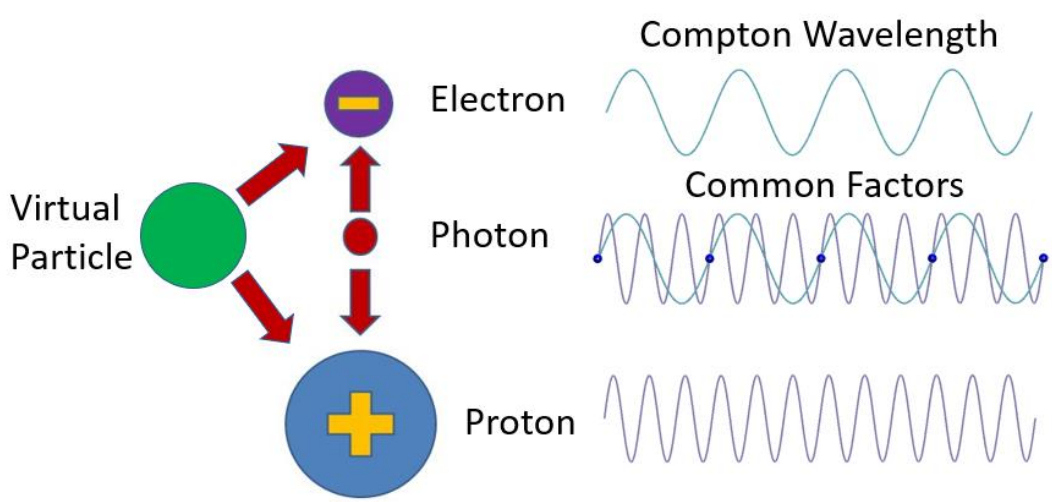


Figure 1. Sharing of Common Factor Quanta

Figure 1 shows an electron sharing a photon with the proton as defined in the Standard Model. The Compton wavelengths of electron and proton shorten slightly with the addition of the shared photon energy. At an exact photon energy value, the electron and proton share common factors between these adjusted Compton wavelengths. Whether these common wavelengths interlace to form standing waves, or they allow virtual particles to be shared is open to interpretation. For this analysis, the shared wavelengths will be referred to as common factor quanta.

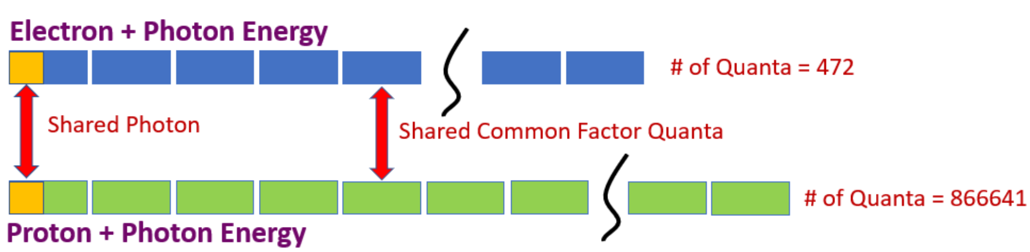
PROTON-ELECTRON MODEL

To search for common factors between wavelengths, all masses and energies were converted to long integers. A common factor search is exact, and dimensionless. The reciprocal of the Fine Structure Constant is proportional to the ratio of photon energy to the electron energy as shown in Equation (1):

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

Based on Plank's Law, there is an inversely proportional relationship between a particle's wavelength and its energy. Given the integer energy of the photon is n_v and the integer mass energy of the electron is n_{me} the equation may be updated to Equation (2).

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



	Color	Integer Energy	*MeV Energy (approximate)
Electron Mass		139602083	0.5109989497
Proton Mass		256330738058	938.27208816
Photon Energy		3717	0.0000136057
Quanta Energy		295775	0.0010826537

$$137.035999209569 = \frac{1}{\sqrt{\frac{2 * 3717}{139602083}}}$$

Figure 2. Electron-Proton Common Factor Quanta

Figure 2 shows a shared quanta diagram between the electron and proton. By sharing a photon with an exact integer mass energy of 3717 (shown in yellow), the electron $(n_{me} + n_v) = 139602083 + 3717$ and proton $(n_{mp} + n_v)$ = 256330738058 + 3717 integer energies share a common factor of 295775, about 80X the energy of the photon. The Fine Structure Constant may be calculated using Equation (3):

$$(3)\ \ 137.035999209569 = \frac{1}{\sqrt{\frac{2 * 3717}{139602083}}}$$

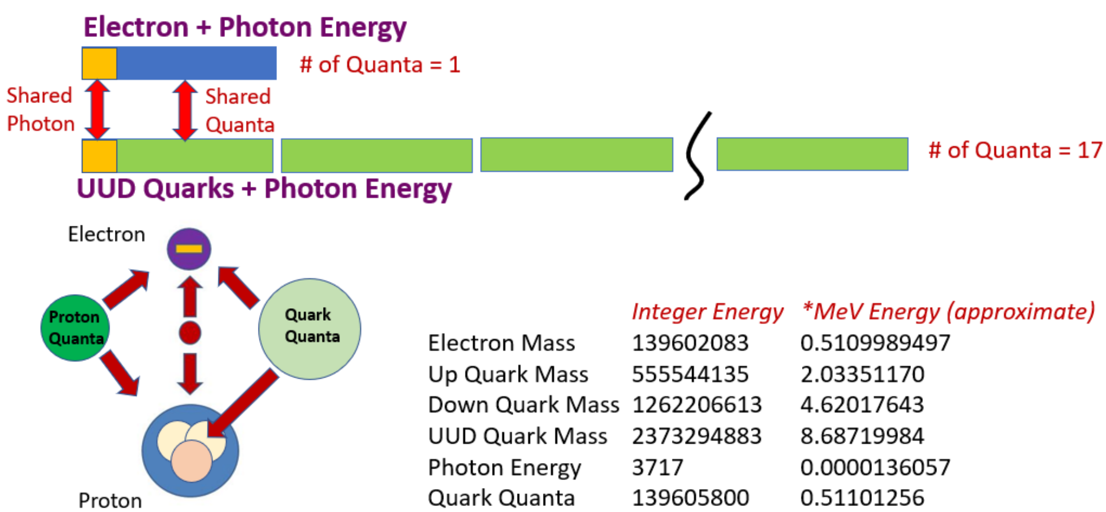
These integers are multiples of 59, and may be further simplified to Equation (4):

$$(4)\ \ 137.035999209569 = \frac{1}{\sqrt{\frac{2 * 63}{2366137}}}$$

This common factor analysis not only sets the value of the Fine Structure Constant, it also sets the exact values of the electron and proton masses. These masses can be converted into more recognizable MeV units through a conversion factor shown in Equation (5). This is a simple ratio of the proton integer mass n_{mp} and the 2018 CODATA value of the proton mass in MeV. The integer values are exact, the MeV values are approximate since they involve measurement error.

$$(5)\qquad Conversion\ Factor = \frac{256330738058}{938.27208816}$$

ELECTRON-UUD QUARK MODEL

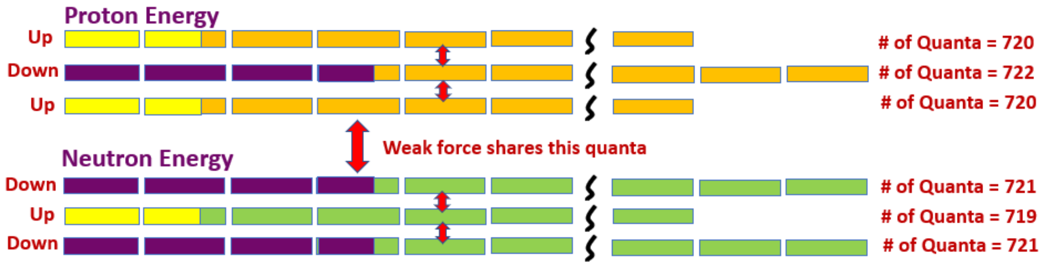


	Integer Energy	**MeV Energy (approximate)*
Electron Mass	139602083	0.5109989497
Up Quark Mass	555544135	2.03351170
Down Quark Mass	1262206613	4.62017643
UUD Quark Mass	2373294883	8.68719984
Photon Energy	3717	0.0000136057
Quark Quanta	139605800	0.51101256

Figure 3. Electron-UUD Quarks Common Factor Quanta

Using the exact same values for the FSC, photon, electron, and proton mass/energy integer values shown above, another large quanta was found to be shared between the electron and the Up-Up-Down quarks in the proton as shown in Figure 3. In this case, the shared common factor quanta equals the entire electron energy (electron mass + photon), which is the maximum possible value of a shared quanta between these bonded particles. By sharing a photon with an exact integer mass energy of 3717 (shown in yellow), the electron $(n_{me} + n_v) = 139602083 + 3717$ and UUD quarks $(n_{muud} + n_v)$ = 2373294883 + 3717 integer energies share a common factor of 139605800. This analysis also sets the Up quark mass at 55544135 (2.0335117MeV), and the Down quark mass at 1262206613 (4.62017643 MeV).

PROTON NEUTRON QUARK MODEL

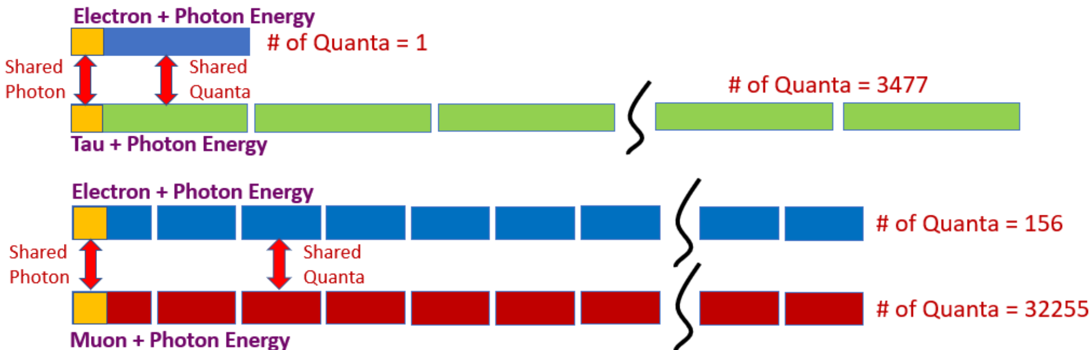


	Color	Integer Energy	*MeV Energy (approximate)
Proton Mass		256330738058	938.27208816
Neutron Mass		256684069297	939.56542052
Up Quark Mass	Yellow	555544135	2.03351170
Down Quark Mass	Purple	1262206613	4.62017643
Proton Gluon Energy	Orange	253842947945	929.16579041
Neutron Gluon Energy	Green	254196279184	930.45912277
Quanta Energy		353331239	1.29333236

Figure 3. Proton-Neutron Quark Common Factor Quanta

The analysis was extended to the gluon-quark bonds within the proton and neutron as shown in Figure 3. At the proton mass integer value (256330738058) set by the calculated FSC (137.035999209569), another massive common factor quanta was discovered between the up and down quarks. The common factor quanta is equal to the difference in mass between the proton and neutron, and common to both particles. The common factor quanta is also equal to 2X the difference in mass between the down and up quark. In the proton, by sharing a gluon with an exact integer energy of 253842947945 (shown in orange), the up quark $(n_{mu} + n_{vp}) = 555544135 + 253842947945$ and down quark $(n_{md} + n_{vp})$ = 1262206613 + 253842947945 integer energies share a common factor of 353331239 (1.29333236MeV). In the neutron, by sharing a gluon with an exact integer energy of 254196279184 (shown in green), the up quark $(n_{mu} + n_{vp}) = 555544135 + 254196279184$ and down quark $(n_{md} + n_{vp})$ = 1262206613 + 254196279184 integer energies also share a common factor of 353331239 (1.29333236MeV).

ELECTRON-MUON-TAU MODEL



	Color	Integer Energy	*MeV Energy (approximate)
Tau Mass	green	485409362883	1776.79064156
Muon Mass	red	28865285251	105.65838367
Tau Quanta Energy		139605800	0.51101256
Muon Quanta Energy		894909	0.00327572

Figure 4. Electron-Tau-Muon Common Factor Quanta

The muon and tau leptons also share large common factor quanta with the electron as shown in Figure 4. The electron mass integer value (139602083) and photon energy (3717) remain set by the calculated FSC (137.035999209569). As in the case of the uud quarks, the shared common factor quanta between the tau and electron equals the entire electron energy (electron mass + photon), which again, is the maximum possible value of a shared quanta between these bonded particles. In the tau, by sharing a photon with an exact integer energy of 3717 (shown in yellow), the electron $(n_{me} + n_v) = 139602083 + 3717$ and tau $(n_{mt} + n_v)$ = 485409362883 + 3717 integer energies share a common factor of 139605800 (0.51101256MeV). In the muon, by sharing a photon with an exact integer energy of 3717 (shown in yellow), the electron $(n_{me} + n_v) = 139602083 + 3717$ and muon $(n_{mm} + n_v)$ = 28865285251 + 3717 integer energies share a common factor of 894909 (0.00327572MeV).

UNCERTAINTY IN SOME CALCULATED CONSTANTS

The common factor analysis used to calculate constants is exact without uncertainties for a given sets of constants. However, multiple sets of constants do add uncertainty in the case of the proton and neutron analysis because there are too many variables to pin down certain constants to exact values. However, these uncertainties are very small, and the predictions of constants with variability remain very precise. The uncertainty ranges shown in Table 2 depend on the search range used for acceptable neutron masses, a +/- 3 uncertainty range was used for the 2018 CODATA neutron mass. As additional shared quanta are discovered (e.g. top, down, charm, strange quarks), these uncertainties will likely converge to a single, exact solution for all of the lepton and quark constants. Several of the calculated constants remain exact with no uncertainty in their integer values as shown in Table 1.

	Exact Integer Value	MeV
Fine Structure Constant	137.035999209569	n/a
Photon Energy	3717	0.0000136057
Electron Energy	139602083	0.5109989497
Proton Energy	256330738058	938.27208816
Up-Up-Down Quark Quanta	139605800	0.5110125554

Table 1. Calculated Constants with Exact Integer Values

	Min Value	Max Value	Min MeV	Max MeV
Up Quark Mass	555543885	555544377	2.03351079	2.03351259
Dn Quark Mass	1262206129	1262207113	4.62017466	4.62017826
Neutron Mass	256684068934	256684069672	939.56541920	939.56542190
Proton Gluon	253842686343	253843218195	929.16483284	929.16677963
Neutron Gluon	254196017219	254196549809	930.45816387	930.46011336
Proton Quanta	353330876	353331614	1.29333104	1.29333374

Table 2. Uncertainties in Calculated Constants with Variability

SEARCH FOR ADDITIONAL FINE STRUCTURE CONSTANT CANDIDATES

Search Parameters:

2020 Fine Structure Constant:	137.035999206
Uncertainty Value (+/-)	0.000000011
1000 Uncertainty Range (+/-)	0.000011
Starting Search Value	137.035988206
Ending Search Value	137.036010206

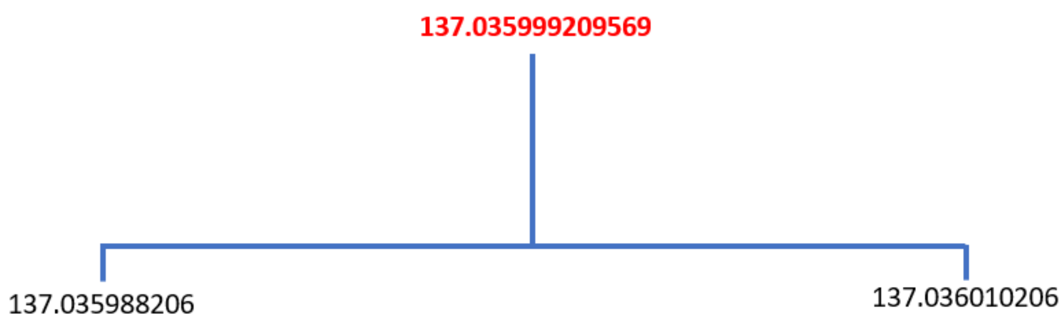


Figure 5. Search for other Fine Structure Constant Candidates

Figure 5 shows the results of a +/-1000 uncertainty search for other Fine Structure Constant candidates that provide the same or higher common factor quanta found in this analysis including:

1) Electron multiple of 472 or less in the bond with a proton
2) Electron-up-up-down quark multiple of 1
3) Proton-quark gluon multiples where the quanta = difference in neutron proton mass
4) Electron-tau multiples of 1

Only one candidate was found, the 2014 calculated value of 137.035999209569. Considering 2000 (+/-1000) possible uncertainty ranges, that's a 1/2000 chance or a greater than 99.95% probability this particular FSC is the correct value.

DISCUSSION

In 2014 when the FSC exact value 137.035999209569[1] was first calculated, it was only based on a 472 electron multiple shared with the proton and the multiples calculated for tau and the muon. When the 2020 FSC was measured at 137.035999206(11) [2], and it converged to within one standard error of this calculated value, it provided validation this value was correct. But the most compelling evidence is this value's ability to set so many other fundamental constants in the Standard Model. Each new constant calculated adds additional evidence including the newly discovered maximum possible common factor quanta between the electron and the uud proton quarks, and the maximum possible common factor quanta between quarks and gluons in the proton and neutron. Each new piece of the puzzle adds further proof this analysis speaks to a foundational law regarding bonded particles and their energy values. Each fundamental constant is interdependent and are all calculated together from a simple relationship defined by the Fine Structure Constant.

My hope is that this hypothesis and its promising results will be vetted, expanded upon, and accepted by the scientific community to help further our understanding of the origin of these constants.

REFERENCES

[1] Brian Dale Nelson, Exact Calculation of the Fine Structure Constant and Lepton Mass Ratios (Copyright 2014).

[2] Morel, L., Yao, Z., Cladé, P. *et al.* Determination of the fine-structure constant with an accuracy of 81 parts per trillion. *Nature* **588,** 61–65 (2020). https://doi.org/10.1038/s41586-020-2964-7