

# 99.04% of the Proton's Mass Is Not the Higgs

— The Electron Is **100%** Higgs, So Within One Word “Mass” There Is a Factor of **104** — Set the Vacuum Expectation Value to **0** and the Proton Loses Only **0.96%** — [Paper 286]

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— *From thinking to syncing.* —

## Abstract

It is said that “the Higgs particle gives things their mass.” This paper asks what fraction of “things”——the answer, for the proton, is **0.96%**. No new mathematical theorem and no new law is claimed. First, we add the rest masses of the quarks. The proton is  $uud$ , so  $2 \times 2.16 + 4.67 = \mathbf{8.99}$  MeV (Section 2). Second, this is the core of the paper. The proton's mass is **938.27209** MeV, so the Higgs share is **0.9581%**, that is **99.0419%** is not of Higgs origin (Section 2). Third, the electron is **100%** of Higgs origin. Within the one word “mass” there is a factor of **104.37** (Section 3). Fourth, setting the vacuum expectation value to **0** leaves the proton nearly untouched. **938.27** MeV merely becomes **929.28** MeV——while the electron vanishes entirely (Section 4). Fifth, there is a place where the naive count fails. Against the neutron--proton difference of **1.29333** MeV, the quark mass difference of **2.51** MeV overshoots by **194%** (Section 5). Sixth, the separator is where the mass comes from. Yukawa coupling and confinement energy are different categories, differing in amount by **103.37** (Section 6).

Scope of this paper (scope note): No new mathematical theorem and no new law is claimed—the PDG quark masses, the proton and neutron masses, mass generation by the Higgs mechanism, and mass generation by confinement are all standard. We do not build quantum chromodynamics—all we use is three additions and four divisions. We do not explain confinement—neither why quarks are confined nor the mass gap is treated at all. We count only the resulting mass. We do not derive the Higgs mechanism—we do not enter spontaneous symmetry breaking, nor the origin of the Yukawa couplings' values. We perform no lattice calculation—the number 99.04% is the result of a subtraction, not a first-principles computation. The quark masses carry a definitional premise— $m_u = 2.16$  and  $m_d = 4.67$  MeV are values in the  $\overline{\text{MS}}$  scheme at renormalisation point 2 GeV. Change the scheme or the point and the values change, so the figure 0.9581% depends on this convention. We do not break down the 99%—the mass from confinement divides into quark kinetic energy, gluon field energy, and the chiral condensate, but this paper lumps them together as “non-Higgs”. We do not explain the neutron–proton difference—the 194% of Section 5 only shows that the naive count breaks, and asserts no value for the electromagnetic contribution. Relation to earlier papers: Paper 240 counted seven things called “mass” and in its scope note explicitly stated “we do not discuss the origin of mass—neither the Higgs mechanism nor confinement is treated”—this paper enters that explicitly ceded ground and compares the two origins numerically. Papers 35 and 51 used the proton mass as a number—this paper asks what it is made of. Paper 112 counted “six distinct roots sharing one rhyme”—the “mass” here likewise has two distinct roots under one word. Paper 274 showed that Drude was right through the cancellation of two errors—Section 5 here is likewise a case where two opposite signs cancel. What is added is computing the proton's non-Higgs share as 99.0419%, writing the contrast with the electron as a factor of 104.37, showing by the thought experiment of setting the vacuum expectation value to 0 that 929.28 MeV remains, and recording, as the limit of the naive count, that the quark mass difference overshoots the neutron–proton difference by 194%.

## 1. Notation and Standing

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The Higgs mechanism gives an elementary particle its mass as the product of a Yukawa coupling  $y$  and the vacuum expectation value  $v$ :  $m = yv/\sqrt{2}$ . Quarks and leptons alike acquire mass this way.

Meanwhile, the proton is made of three quarks. So the proton's mass would appear to be the sum of the quark masses.

Question: What is that sum?

Observation 1.1

Paper 240 counted seven things called “mass” and in its scope note explicitly stated “we do not discuss the origin of mass—neither the Higgs mechanism nor confinement is treated”.This paper enters that ceded ground—not to explain the origins, but to count the two of them.

Observation 1.2

The quark masses used are  $m_u = 2.16 \text{ MeV}$  and  $m_d = 4.67 \text{ MeV}$  ( $\overline{\text{MS}}$ , 2 GeV).These values depend on the scheme and renormalisation point—the percentages below are numbers on top of that convention.

2. The Core: 99.0419% Is Not of Higgs Origin

Check 2.1: We add the rest masses of the quarks.

| Particle | Content    | Sum of rest masses                            |
|----------|------------|-----------------------------------------------|
| Proton   | $uud$      | $2 \times 2.16 + 4.67 = \mathbf{8.9900}$ MeV  |
| Neutron  | $udd$      | $2.16 + 2 \times 4.67 = \mathbf{11.5000}$ MeV |
| $\pi^+$  | $u\bar{d}$ | $2.16 + 4.67 = \mathbf{6.8300}$ MeV           |

Check 2.2: We compare with the actual masses.

| Particle | Mass [MeV] | Quark sum | Higgs origin | Non-Higgs       |
|----------|------------|-----------|--------------|-----------------|
| Proton   | 938.27209  | 8.9900    | 0.9581%      | <b>99.0419%</b> |
| Neutron  | 939.56542  | 11.5000   | 1.2240%      | <b>98.7760%</b> |
| $\pi^+$  | 139.57039  | 6.8300    | 4.8936%      | <b>95.1064%</b> |
| Electron | 0.51099895 | —         | <b>100%</b>  | <b>0%</b>       |

Observation 2.3

This is the core of the paper.**99.0419%** of the proton’s mass does not come from the Higgs—the proton is **104.3684** times heavier than the quark sum.

Observation 2.4

Only the bottom row is 100%.The electron is not composite, so its mass comes wholly from a Yukawa coupling—within the one word “mass,” 0.96% and 100% stand side by side.

Observation 2.5

The pion is somewhat higher at 4.89%.As the Nambu–Goldstone boson of chiral symmetry breaking, its mass is exceptionally light—the fraction rises because the denominator is small, not because the Higgs acts strongly.

3. The Contrast with the Electron Is a Factor of 104.37

Check 3.1:

| Particle | Fraction of Higgs origin |
|----------|--------------------------|
| Electron | 100.0000%                |
| Proton   | 0.9581%                  |
| Ratio    | <b>104.37</b>            |

Observation 3.2

The single sentence “the Higgs gives mass” is completely right for the electron and almost entirely wrong for the proton.Both are “particles with mass”—one explanation is right to within a factor of 104 of itself.

Check 3.3: We count for ordinary matter.A hydrogen atom is one proton and one electron.

| Quantity                                                      | Value           |
|---------------------------------------------------------------|-----------------|
| Fraction of a hydrogen atom's mass in the proton              | <b>99.9456%</b> |
| Fraction of a hydrogen atom's mass of <b>non-Higgs origin</b> | <b>98.9879%</b> |

**Observation 3.4**

**99% of the mass of visible matter comes from confinement, not the Higgs.** Your weight, and the weight of a desk, are 99% energy held by fields inside nucleons—the left-hand side of  $E = mc^2$  is the body of the thing.

### 4. Setting the Vacuum Expectation Value to 0

Setting: As a thought experiment we set the Higgs vacuum expectation value  $v$  to 0. Every Yukawa mass vanishes.

Check 4.1:

| Particle | Now               | At $v = 0$        | Fraction lost  |
|----------|-------------------|-------------------|----------------|
| Proton   | <b>938.27</b> MeV | <b>929.28</b> MeV | <b>0.9581%</b> |
| Electron | <b>0.511</b> MeV  | <b>0</b> MeV      | <b>100%</b>    |

**Observation 4.2**

The proton does not lose even **1%**. Confinement acts independently of the Higgs—nucleons exist at nearly the same weight in a  $v = 0$  world.

**Observation 4.3**

The electron, by contrast, vanishes entirely. A massless electron travels at the speed of light and so is not bound to a nucleus—atoms cease to exist, but nucleons remain.

Observation 4.4

A point to write honestly——this is not a rigorous prediction. At  $v = 0$  the pattern of chiral symmetry breaking also changes, and the nucleon mass moves somewhat——what this paper shows is that the order does not change, not the value 929.28 MeV.

5. Where the Naive Count Fails

Setting: So far the naive count “add the quark masses” has served well. We show one place where it does not.

Check 5.1: We see whether the neutron--proton mass difference can be explained by the quark mass difference.

| Quantity                                                   | Value              |
|------------------------------------------------------------|--------------------|
| Neutron − proton (measured)                                | <b>1.29333</b> MeV |
| Difference of quark sums $(u + 2d) - (2u + d) = m_d - m_u$ | <b>2.5100</b> MeV  |
| Fraction accounted for                                     | <b>194.07%</b>     |

Observation 5.2

194%, that is, it overshoots. Looking only at the quark mass difference, the neutron ought to be about twice as much heavier as it is——not short, but in surplus.

Observation 5.3

What absorbs the surplus is the electromagnetic contribution. The proton carries charge +1 and is made heavier by its self-energy, narrowing the difference——two contributions of opposite sign cancelling (the same figure as Paper 274).

Observation 5.4

Hence the 99.04% of Section 2 is not a number usable for every question. For the total mass the naive count works to 1%; for the mass difference it is off by a factor of 2—one must not use the same quantity for a different question.

6. Separator: The Two Origins Are Different Categories

Observation 6.1

Separator——what must be moved for these two to exchange places? They do not exchange. They are different categories.

| Source             |                                                   | Amount       |
|--------------------|---------------------------------------------------|--------------|
| Higgs origin       | Yukawa coupling $\times$ vacuum expectation value | 8.9900 MeV   |
| Confinement origin | Energy of fields and motion                       | 929.2821 MeV |
| Ratio              |                                                   | 103.3684     |

Observation 6.2

The first row is a coupling to a constant; the second is a consequence of dynamics. The former is written into the Lagrangian; the latter emerges only upon solving——both measurable in MeV, but of different standing.

Observation 6.3

Paper 112 counted “six distinct roots sharing one rhyme.” This paper is one such case, and one where the amounts can be measured——under one word (mass), two distinct roots coexist in a ratio of 103.

#### Observation 6.4

And although one of them occupies only 0.96%, it is that one which is widely told as the explanation. This is not an error—for the electron it is 100% correct. But one must say which particle is meant.

## 7. Roll Call and Closing

1. Proton quark sum 8.9900 MeV (Check 2.1): *uud*.
2. Non-Higgs 99.0419% (Check 2.2): 104.3684 times the quark sum.
3. The electron is 100% Higgs (Check 2.2): It is not composite.
4. The contrast is 104.37 (Check 3.1): Within the one word “mass.”
5. 98.9879% for a hydrogen atom (Check 3.3): Ordinary matter.
6. At  $v = 0$  the proton is 929.28 MeV (Check 4.1): It loses under 1%.
7. At  $v = 0$  the electron vanishes (Check 4.1): Atoms do not exist.
8. Quarks give 194.07% of the n--p difference (Check 5.1): It overshoots.
9. Electromagnetism cancels it (Observation 5.3): The same figure as Paper 274.
10. Ratio of the two origins 103.3684 (Observation 6.1): Different categories.

Closing: “The Higgs gives things their mass” is 100% right for the electron and only 0.9581% right for the proton. The proton is *uud*, and the sum of the quarks’ rest masses is a mere 8.99 MeV—the actual 938.27 MeV is 104.3684 times that, and 99.0419% is not of Higgs origin. The thought experiment of setting the vacuum expectation value to 0 shows it—the proton merely becomes 929.28 MeV; the electron vanishes entirely. Counting for ordinary matter, 98.9879% of a hydrogen atom’s mass is of non-Higgs origin. But this naive count has a limit—applying it to the neutron--proton difference overshoots at 194.07%. One thing separates them—whether the mass comes from a coupling written into the Lagrangian, or from a consequence of dynamics that emerges only upon solving. The former is the Yukawa coupling, the latter confinement, and they differ in amount by 103.37. Both are measured in MeV, but their standing differs. So when one says “the Higgs gives mass,” one must say which particle is meant.

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