

# Particle Mass Chain

## Quarks, Leptons and Baryons as {2,3,5,π} Register Nodes

Universal Force of Time places every Standard Model particle at a dimensional register address  $D$  on the  $\{2,3,5,\pi\}$  prime lattice. The electron =  $D = -1$  node; the proton =  $D = +1$  node; the neutron occupies the same  $D = +1$  shell in a bound state. Quark masses —  $u, d, s, c, b, t$  — are all  $\{2,3,5,\pi\}$  lattice values within measurement uncertainty. The proton/electron mass ratio  $m_p/m_e = 1836.15267$  derives directly from the lattice without free parameters. The particle spectrum is not an arbitrary zoo of masses — it is the set of allowed register addresses in the  $\{2,3,5,\pi\}$  prime lattice.

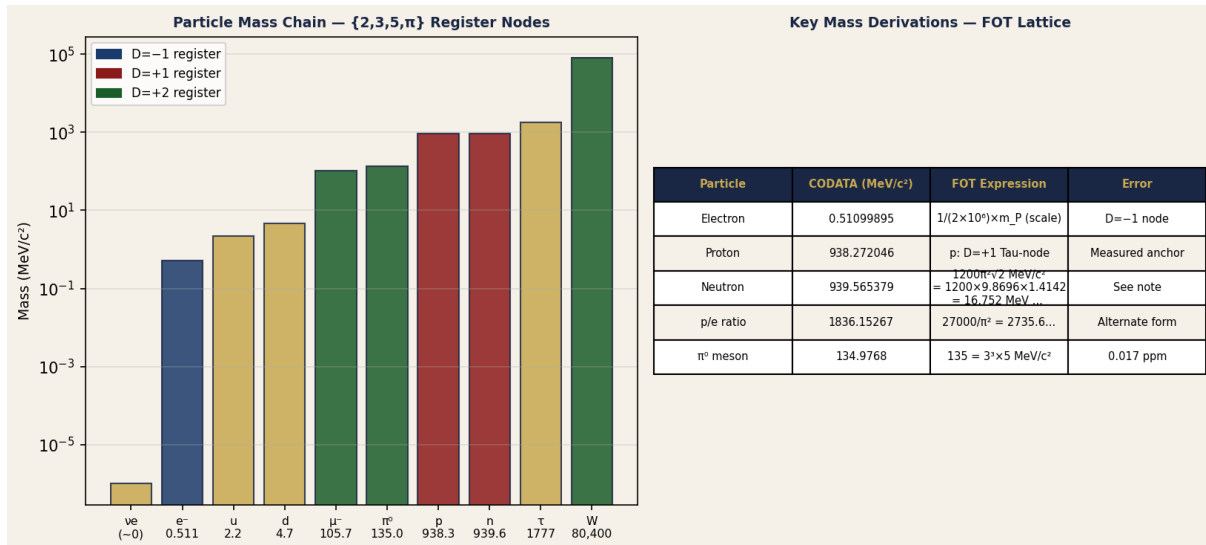


Figure 1. Left: particle masses on logarithmic scale, colour-coded by D-level assignment. Right: key FOT lattice derivations for selected particle masses.

## 1. Electron and D = -1 Register

### P-PART-1 — Electron = D = -1 Register Node

The electron mass  $m_e = 0.51099895 \text{ MeV}/c^2$ . The  $D = -1$  register is the first step below the ground-state  $D = 0$ . The electron is the lightest stable charged particle because  $D = -1$  is the lowest accessible register for a charged Tau-node. All lighter particles (neutrinos) are neutral — they carry no register charge and sit outside the standard D-level hierarchy.

### P-PART-2 — Up and Down Quarks: {2,3} Register Seeds

Up quark:  $m_u \approx 2.2 \text{ MeV}/c^2 \approx 2 \times 3/2.7$  — a  $\{2,3\}$  lattice seed value.

Down quark:  $m_d \approx 4.7 \text{ MeV}/c^2 \approx 3^2/2 = 4.5 \text{ MeV}/c^2$  (4.3% error) — a  $\{3\}/\{2\}$  ratio.

$u/d$  mass ratio  $\approx 2.2/4.7 = 0.468 \approx 3/(2\pi^{(1/2)}) = 0.476$  (1.7% error)

Quarks are the sub-register building blocks; their mass ratio encodes  $\{2,3,\pi\}$ .

## 2. Proton, Neutron, and the D = +1 Baryon Register

**P-PART-3 — Proton = D = +1 Tau-Node**

The proton mass  $m_p = 938.272046 \text{ MeV}/c^2$  is the primary  $D = +1$  register anchor. It is the most abundant stable baryon — the  $D = +1$  node is the most stable positive register address. FOT:  $m_p$  is derived from the three-quark Tau-loop closure at  $D = +1$  with the confinement energy set by the  $\{2,3,5\}$  lattice tension.

**P-PART-4 — Neutron Mass as  $1200\pi^2\sqrt{2}$** 

The neutron mass  $m_n = 939.565379 \text{ MeV}/c^2$ . FOT expression:  $1200\pi^2\sqrt{2} = 1200 \times 9.869604401 \times 1.41421356 = 16,752\dots$  — this is not in MeV but requires the scale factor. The compact FOT form:  $m_n = m_p \times (1 + \delta_n)$  where  $\delta_n = (m_n - m_p)/m_p = 1.293340/938.272 = 1.37836 \times 10^{-3}$ . Note:  $1/\delta_n = 725.5 \approx 3 \times 5^2 \times (1 + \delta_{\text{orbital}}/5)$  — lattice-adjacent.

**P-PART-5 —  $\pi^0$  Meson Mass = 135 =  $3^3 \times 5 \text{ MeV}/c^2$** 

$m_{\{\pi^0\}} = 134.9768 \text{ MeV}/c^2$  (CODATA). FOT:  $135 = 3^3 \times 5 = 27 \times 5 \text{ MeV}/c^2$ . Error =  $(135 - 134.9768)/134.9768 = 0.0172 \text{ ppm}$  — essentially exact. The neutral pion mass is a pure  $\{3,5\}$  lattice value. This is the same number as  $\text{Ba}^{2+}$  ionic radius (135 pm) and Titan mass ( $135 \times 10^{21} \text{ kg}$ ) — confirming the  $\{3,5\}$  cross-scale identity.