A Classical Relation of the Higgs Mechanism

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Subatomic mass scales derived from the radii of the planets of the solar system, by way of the 'quantum/classical connection', lie on the mass/energy levels of the Planck Model. The geometric mean of the eight planetary radii maps onto the Higgs field vacuum expectation value (246 GeV), while the radius of Jupiter maps onto the mass of the Higgs boson (125 GeV). While Higgs field coupling constants derived from a ten-dimensional geometry relate particle masses to the expectation value of the field, coupling constants derived from the ten-dimensional geometry relate the planetary radii to the (geometric) mean planetary radius.

The quantum/classical connection (10D/4D correspondence [1]), found as a consequence of an analysis of dark energy as vacuum energy [2, 3], relates (four dimensional) cosmological and astrophysical length scales to subatomic mass scales that derive from a ten-dimensional geometry [4]. Working in natural units (ħ = c = G = 1), the connection is written as

$$2\mathrm{m}_{10}{}^{-5} = l_4{}^2 \tag{1}$$

where m_{10} is a subatomic mass scale and l_4 is a cosmological or astrophysical length scale, specifically a radius. The connection has been applied to stars, their radii being shown to correspond to the masses of stable atomic nuclei [5]. Here, the connection is applied to the eight planets of the solar system.

Mass scales related, through (1), to the planetary radii will be shown to occupy the mass/energy levels of the Planck and the (incorporated) Higgs sequences, which descend in geometric progression from Planck scale and the Higgs field vacuum expectation value, respectively, and are occupied by particles [6]. The planetary radii themselves will be shown to occupy levels of length scale in 'planetary sequences' allied to the Higgs sequences.

First, the occupation by subatomic particles of the mass levels and sublevels of the Planck sequences will be reviewed. The sequences descend from the Planck Mass (1.220910(29) x 10^{19} GeV [7]) with common ratios 1/π (Sequence 1), 2/π (Sequence 2) and 1/e (Sequence 3).[1] Levels in each sequence number up from n = 0 at Planck scale. Sublevels are of half-integer, quarter-integer, eighth-integer, etc n. Particle masses used in the calculations are the evaluations of the Particle Data Group [8].

The lightest charged lepton (electron), quark (up), meson (π^0) and baryon (proton) occupy, or at least lie close to, mass levels of integer n, as shown in Figure 1. In such graphs, the mass scales lie on a straight line since n_1, n_2 and n_3 are in constant ratio. The Higgs boson and the vector bosons $W^{\pm}$ and Z occupy sublevels, $W^{\pm}$ and Z actually being arranged symmetrically about coincidental half-levels, as shown in Figure 2.

The particles of Figures 1 and 2 are shown in Figures 3 and 4 to occupy the mass/energy levels and sublevels of the Higgs sequences, which descend from the Higgs field vacuum expectation value (246 GeV) and are incorporated in the Planck sequences.

[1] The common ratios 1/π and 2/π may derive from the lengths of orbifold intervals, while the common ratio 1/e may derive from the radius of a sphere [4].

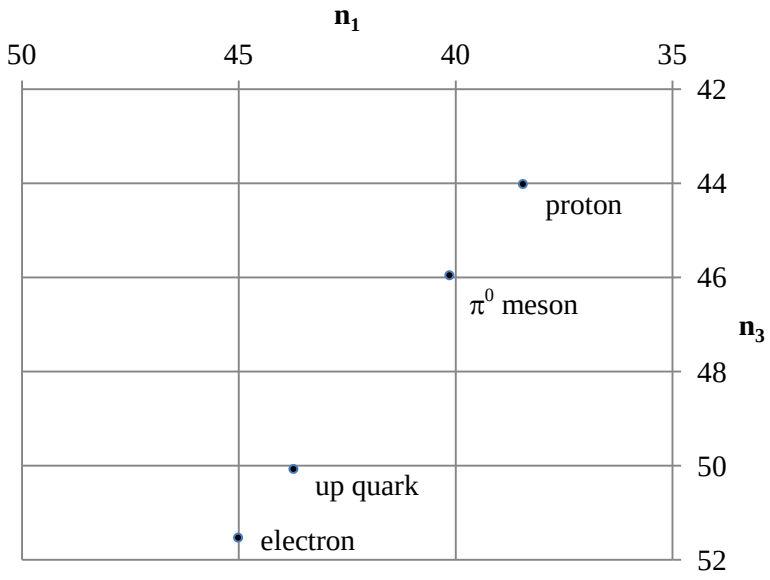

Figure 1: The lightest charged lepton, quark, meson and baryon on the levels of Planck Sequences 1 and 3, which descend from the Planck Mass with common ratios 1/π and 1/e, respectively.

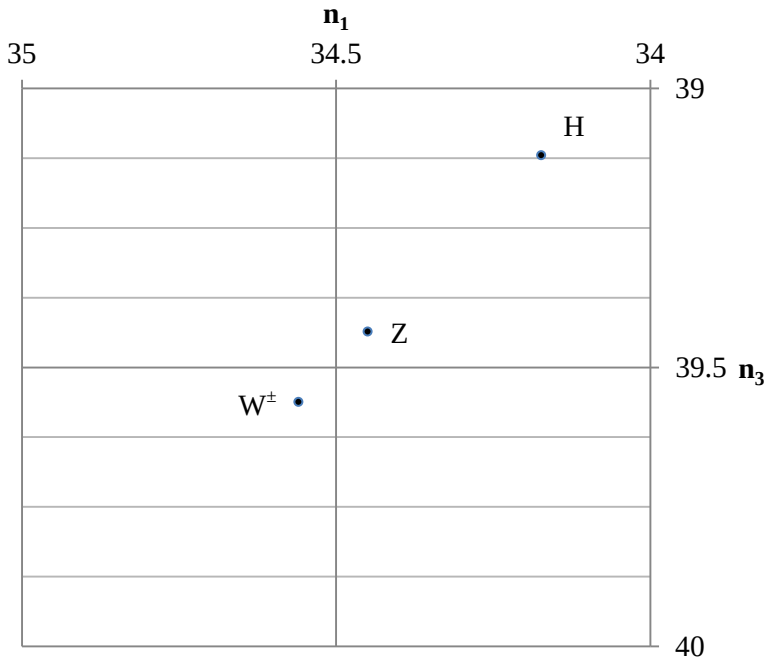

Figure 2: The Higgs boson and the vector bosons $W^{\pm}$ and Z on the levels and sublevels of Planck Sequences 1 and 3.

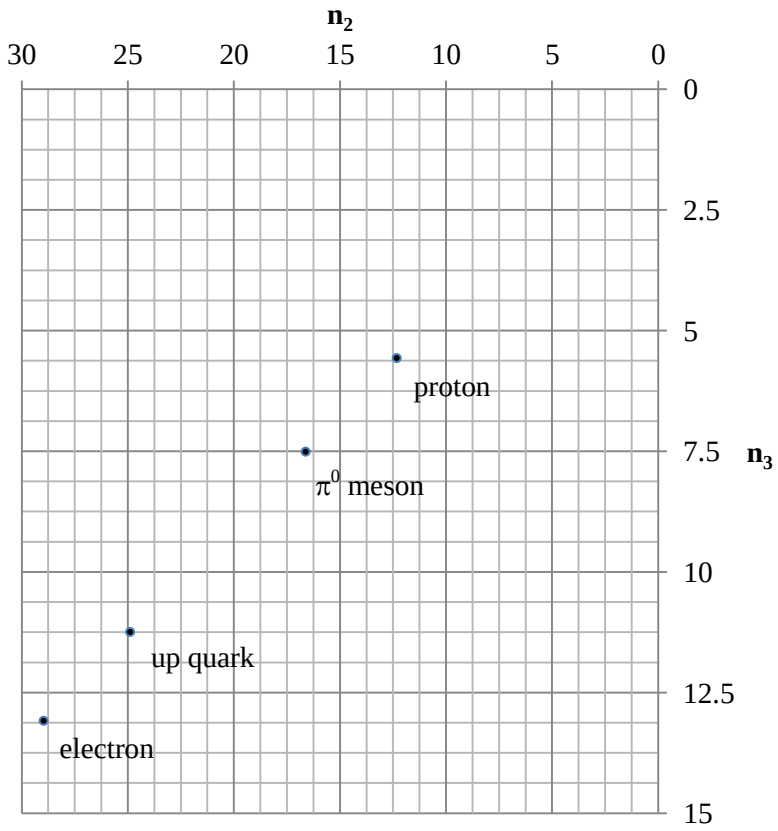

Figure 3: The lightest charged lepton, quark, meson and baryon on the levels and sublevels of Higgs Sequences 2 and 3, which descend from the Higgs VEV (246 GeV) with common ratios $2/\pi$ and $1/e$, respectively.

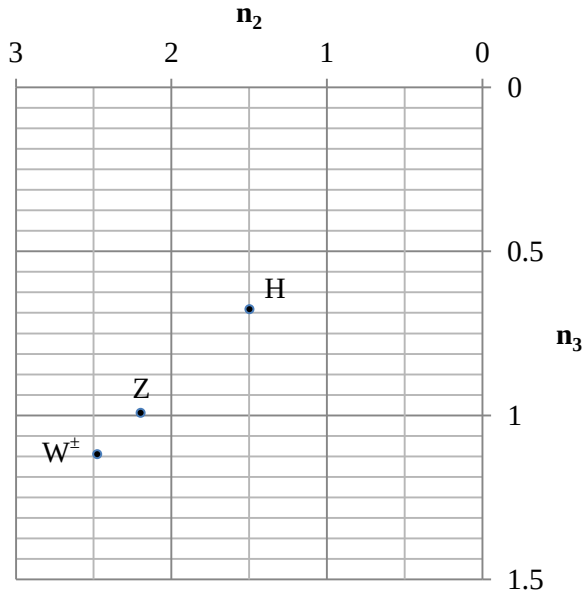

Figure 4: The Higgs boson and the vector bosons $W^{\pm}$ and Z on the levels and sublevels of Higgs Sequences 2 and 3.

Mass scales related (through the quantum/classical connection) to the volumetric mean radii of the planets of the solar system [9] are shown on the levels and sublevels of the Planck sequences in Figures 5 and 6. Planets of similar radius (Earth and Venus; Uranus and Neptune) lie either side of sublevels, although not symmetrically.

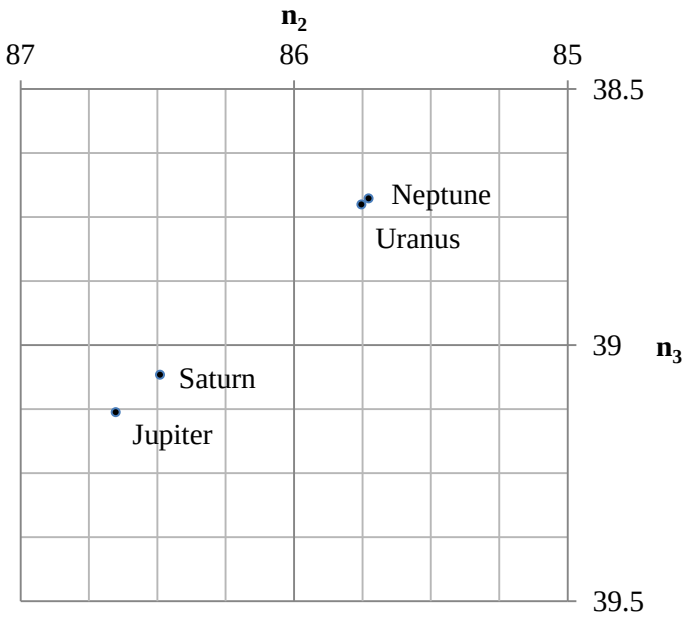

Figure 5: Mass scales related (through the quantum/classical connection) to the radii of the gas giant planets of the solar system, on the levels and sublevels of Planck Sequences 2 and 3, which descend from the Planck Mass with common ratios 2/π and1/e, respectively.

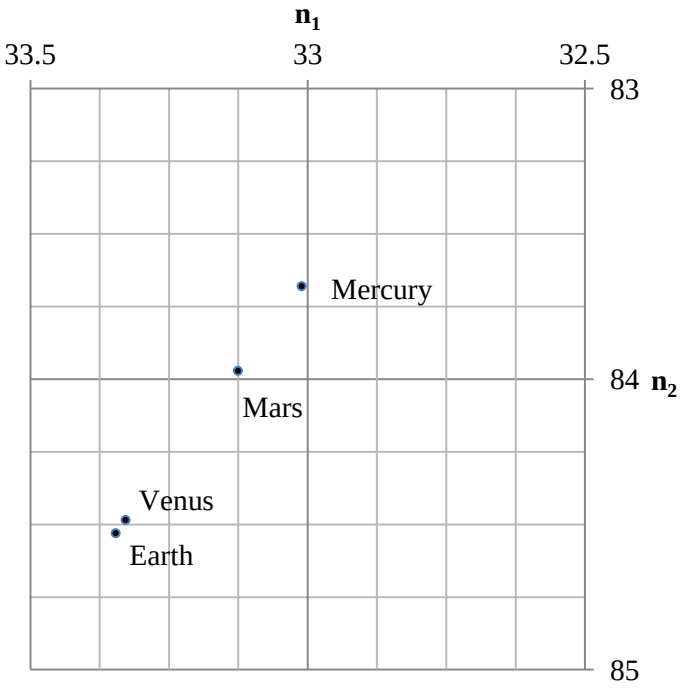

Figure 6: Mass scales related (through the quantum/classical connection) to the radii of the rocky planets of the solar system, on the levels and sublevels of Planck Sequences 1 and 2, which descend from the Planck Mass with common ratios 1/π and 2/π, respectively.

Mass scales related (through the quantum/classical connection) to the geometric mean $r_{GM(G)}$ (39,930 km) of the gas giant planetary radii and the geometric mean $r_{GM(R)}$ (4,226 km) of the rocky planetary radii both lie close to levels of integer n, as shown in Figure 7. The mass scale related to the geometric mean $r_{GM(8)}$ (12,992 km) of all eight planets is 243 GeV, while the mass scale related to the radius of Jupiter is 124 GeV. So the quantum/classical connection maps the geometric mean of the eight planetary radii and the radius of Jupiter onto mass/energy scales very nearly equal to those of the Higgs field vacuum expectation value (246 GeV) and the Higgs boson (125 GeV), respectively, as can be seen from Figures 7 and 8.

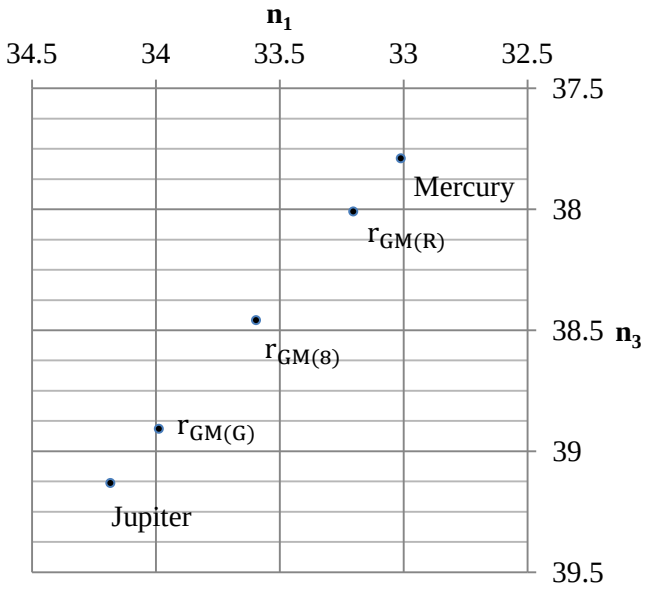

Figure 7: Mass scales related (through the quantum/classical connection) to the radii of Jupiter and Mercury, the geometric mean $r_{GM(G)}$ of the gas giant planetary radii, the geometric mean $r_{GM(R)}$ of the rocky planetary radii and the geometric mean $r_{GM(8)}$ of the radii of all eight planets of the solar system on the levels and sublevels of Planck Sequences 1 and 3, which descend from the Planck Mass with common ratios $1/\pi$ and $1/e$, respectively.

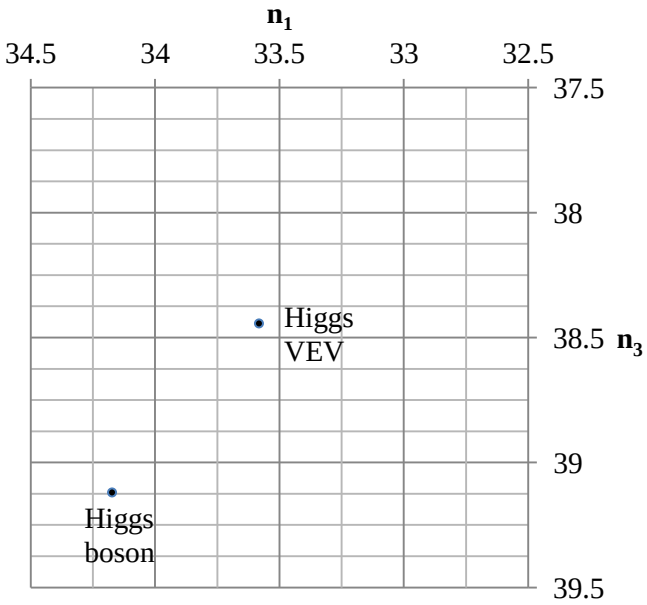

Figure 8: The Higgs boson (125 GeV) and the Higgs field VEV (246 GeV) on the levels and sublevels of Planck Sequences 1 and 3. For comparison with Figure 7.

In the light of the above mappings, and of the existence of the Higgs sequences, the radii of the individual planets have been found to lie on levels of length scale within sequences - the 'planetary sequences' - that ascend and descend with common ratios equal to those of the Planck and Higgs sequences from the geometric mean $r_{GM(8)}$ of the eight planetary radii, as shown in Figures 9 and 10.

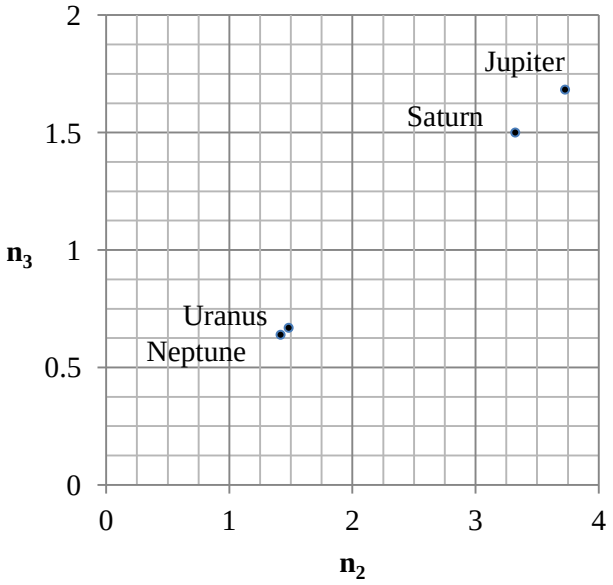

Figure 9: Radii of the gas giant planets of the solar system, on the levels and sublevels of Planetary Sequences 1 and 2. The sequences as shown here ascend with common ratios π/2 and e, respectively, from the geometric mean $r_{GM(8)}$ of the eight planetary radii.

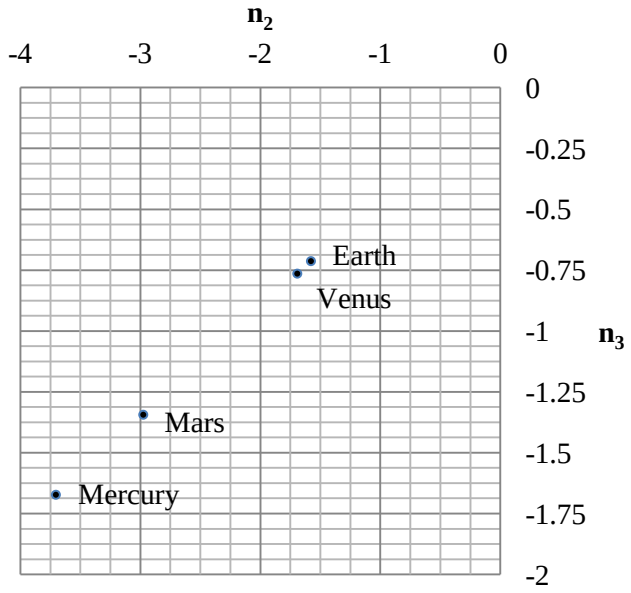

Figure 10: Radii of the rocky planets of the solar system, on the levels and sublevels of Planetary Sequences 1 and 2. The sequences as shown here descend with common ratios 2/π and 1/e, respectively, from the geometric mean $r_{GM(8)}$ of the eight planetary radii.

The geometric mean $r_{GM(G)}$ of the gas giant planetary radii, the geometric mean $r_{GM(R)}$ of the rocky planetary radii, the geometric mean $r_{GM(8)}$ of all eight planetary radii and the radii of Jupiter and Mercury are shown on the levels of Planetary Sequences 1 and 2 in Figure 11.

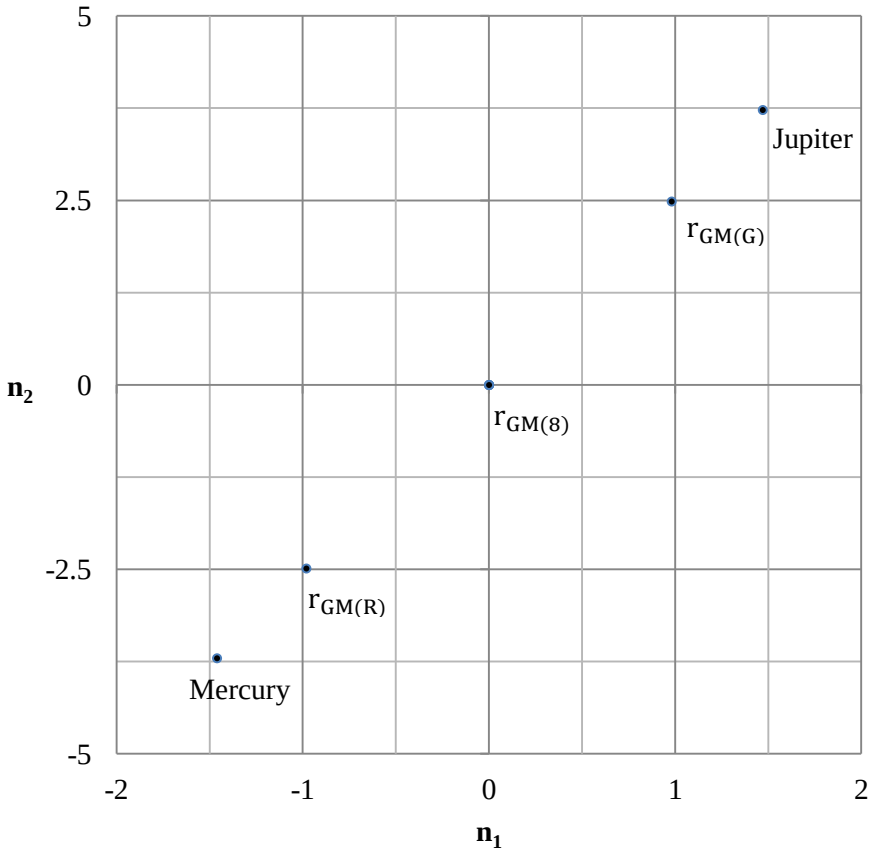

Figure 11: The geometric mean $r_{GM(G)}$ of the gas giant planetary radii, the geometric mean $r_{GM(R)}$ of the rocky planetary radii, the geometric mean $r_{GM(8)}$ of all eight planetary radii and the radii of Jupiter and Mercury, on the levels and sublevels of Planetary Sequences 1 and 2. The sequences ascend with common ratios π and $\pi/2$, respectively, from the geometric mean $r_{GM(8)}$ of all eight planetary radii and descend with common ratios $1/\pi$ and $2/\pi$ from $r_{GM(8)}$.

The planetary sequences are incorporated into the 'solar sequences', which descend from the radius of the sun with common ratios equal to those of the Planck and Higgs sequences, as shown in Figures 12 and 13.

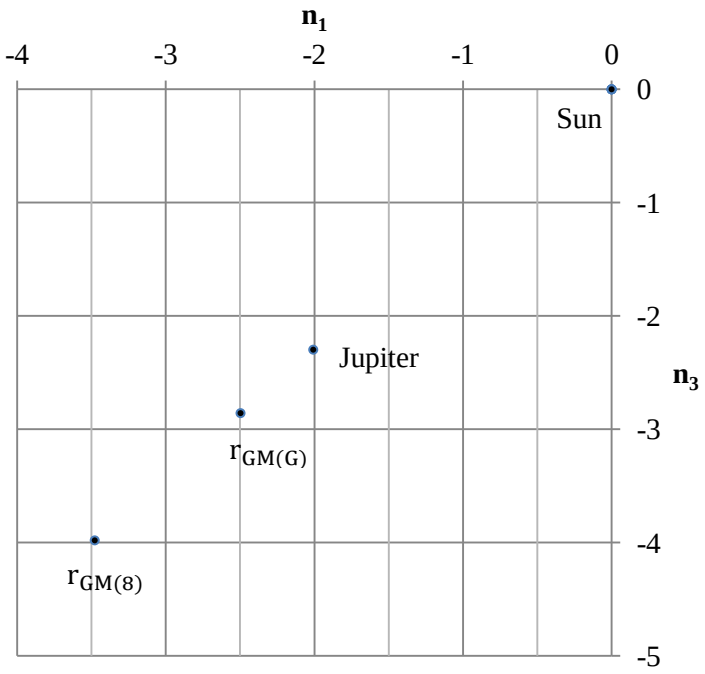

Figure 12: The radius of Jupiter, the geometric mean $r_{GM(G)}$ of the gas giant planetary radii and the geometric mean $r_{GM(8)}$ of all eight planetary radii on the levels and sublevels of Solar Sequences 1 and 3. The sequences descend with common ratios 1/π and 1/e, respectively, from the solar radius.

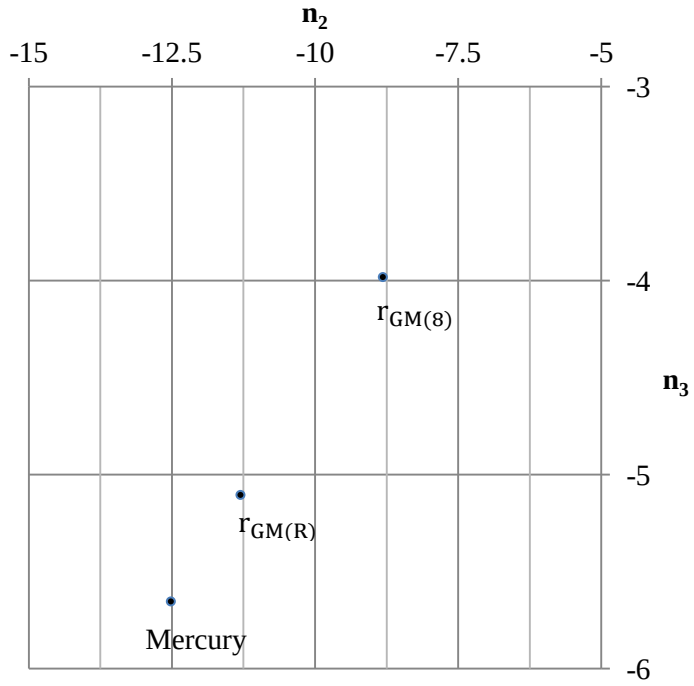

Figure 13: The radius of Mercury, the geometric mean $r_{GM(R)}$ of the rocky planetary radii and the geometric mean $r_{GM(8)}$ of all eight planetary radii on the levels and sublevels of Solar Sequences 2 and 3. The sequences descend with common ratios 2/π and 1/e, respectively, from the solar radius.

In summary:

- Particles occupy the mass levels and sublevels of the Planck sequences, which derive from the geometry of a ten-dimensional spacetime.
- Particles also occupy the mass levels and sublevels of the Higgs sequences, which are incorporated in the Planck sequences.
- Higgs field coupling constants therefore derive from the geometry of the spacetime.
- Mass scales related to planetary radii through the quantum/classical connection occupy the levels and sublevels of the Planck sequences.
- The quantum/classical connection maps the (geometric) mean planetary radius onto the Higgs field vacuum expectation value, and the radius of Jupiter onto the mass of the Higgs boson.
- The planets occupy levels of length scale (radius) within the planetary sequences, which share common ratios with the Planck and Higgs sequences.
- While Higgs field coupling constants derived from the ten-dimensional geometry relate particle masses to the expectation value of the field, coupling constants derived from the ten-dimensional geometry relate the planetary radii to the (geometric) mean planetary radius.
- The planetary sequences are incorporated in the solar sequences.

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