Mass levels of stability

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All massive particles occupy mass levels that descend in geometric sequence from the Planck Mass. There are three fundamental sequences, of common ratio 1/π, 2/π and 1/e. Stable and long-lived charged particles, including the electron, the light quarks, the proton and the charged pions, are arranged systematically, in association with the Higgs field vacuum expectation value, within a network of mass levels.

1 Introduction

Massive particles of all kinds occupy mass levels that descend in geometric sequence from the Planck Mass [1, 2, 3]. Sequence 1 is of common ratio 1/π, Sequence 2 is of common ratio 2/π and Sequence 3 is of common ratio 1/e. A level of number *n* in a sequence of common ratio *r* is of mass $m_n = m_{Planck} r^n$. Coincident mass levels are evidently favourable locations for particles [4]. The most recent evaluations of the Particle Data Group [5] have made it possible to discern with precision the arrangement of the quarks, in addition to the other particles, on the mass levels of the network [6]. The quarks of each doublet (u-d, s-c and b-t) are arranged symmetrically about mass levels within Sequences 2 and 3, as shown in Figure 1. The occupied level numbers[2] are multiples of 5. Individual quarks occupy levels and sublevels within the superstructure, as shown in Figure 2. From the arrangement of the quarks upon the mass levels of Sequence 3, the following quark mass relationship is evident:

$$m_s/m_u \approx e^{3.75} \tag{1}$$

In view of the relationship

$$m_p/m_e \approx e^{7.5} \tag{2}$$

a systematic arrangement of the lightest or most stable particles was sought within a sequence of common ratio $e^{-3.75}$ (1/42.5).

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[2] For example, level 50 in Sequence 3 is of mass $M_{Planck}e^{-50}$.

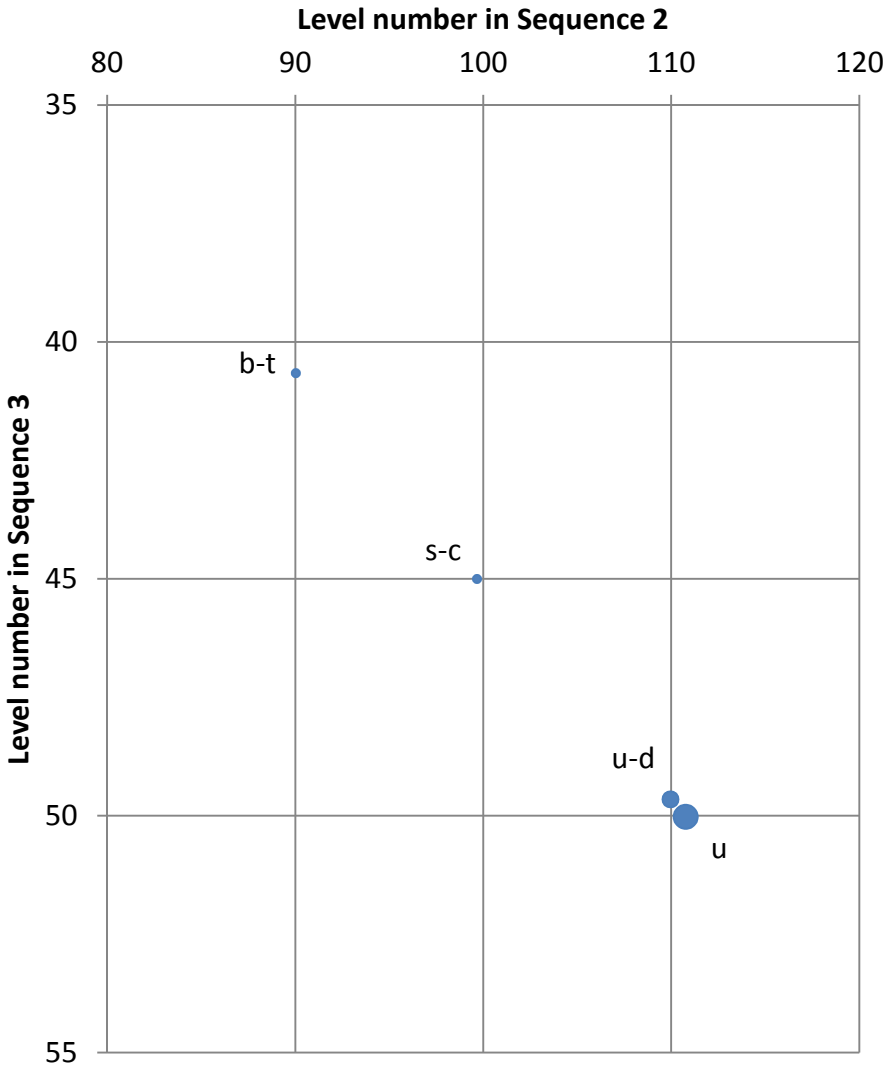
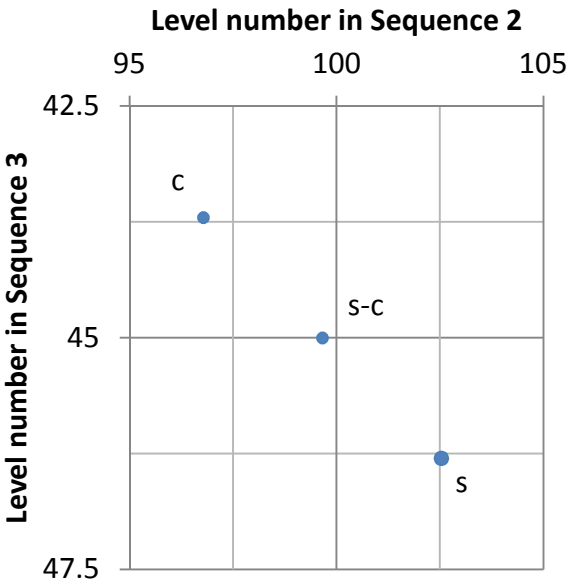


Figure 1: Quark doublets on the mass levels of Sequences 2 and 3 [6]. Sequences 2 and 3 descend in geometric sequence from the Planck Mass with common ratios $2/\pi$ and $1/e$, respectively. Each doublet is represented by the geometric mean of the two values of quark mass evaluation (Particle Data Group mean values [5]). The up quark (mean value 2.3 MeV) appears to occupy level 50, of mass 2.35 MeV, in Sequence 3. Marker size provides an indication of the experimental uncertainty.



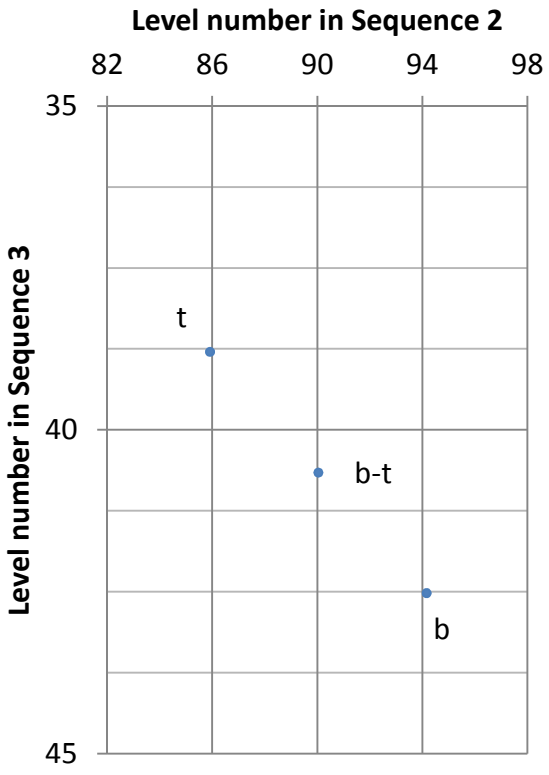


Figure 2: The flavoured quarks on the mass levels of Sequences 2 and 3 [6]. Mean values of the Particle Data Group evaluations [5] have been used.

2 The arrangement of the lightest charged particles on mass levels

The electron, the light (up, down and strange) quarks, the charged pions and the proton are arranged systematically upon mass levels in Sequences 2 and 3, as shown in Figure 3. The occupied levels in Sequence 3 lie within an incorporated sequence of common ratio $e^{-3.75}$ that descends from the Planck Mass, $1.220932(73)\times10^{19}$ GeV [7]. The up and down quarks are arranged symmetrically about coincident mass levels,[3] while the other particles occupy mass levels, the proton lying upon coincident mass levels.

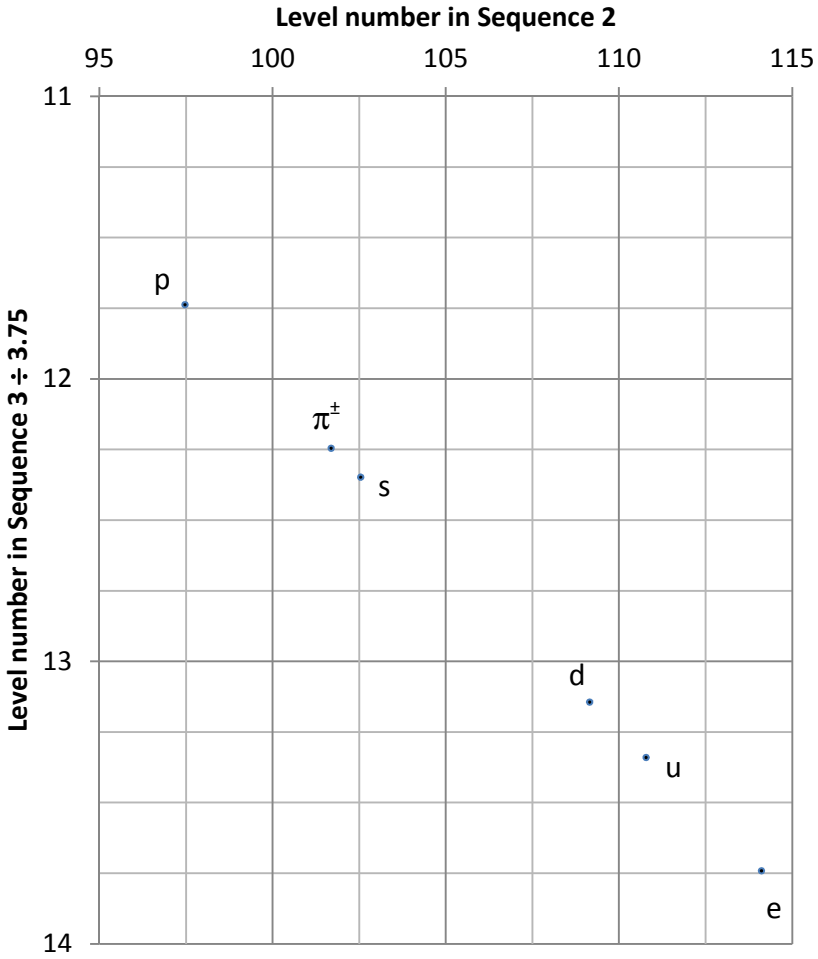


Figure 3: The arrangement of the lightest charged particles within Sequences 2 and 3. The occupied levels in Sequence 3 lie within an incorporated sequence of common ratio $e^{-3.75}$. Mean values of the Particle Data Group quark mass evaluations [5] have been used.

[3] Isospin doublets are found in symmetrical arrangement about mass levels [1].

The particles of Figure 3 are shown upon the mass levels of Higgs Sequences 2 and 3 in Figure 4. The Higgs sequences [2, 8] descend from the Higgs field vacuum expectation value, 246.22 GeV. The common ratio of each Higgs sequence is equal to that of its Planck sequence counterpart. Clearly, the values of couplings with the Higgs field are incorporated within a unified model. The occupied levels in Higgs Sequence 3 lie within an incorporated sequence of common ratio $e^{-3.75}$ that descends from the Higgs field VEV.

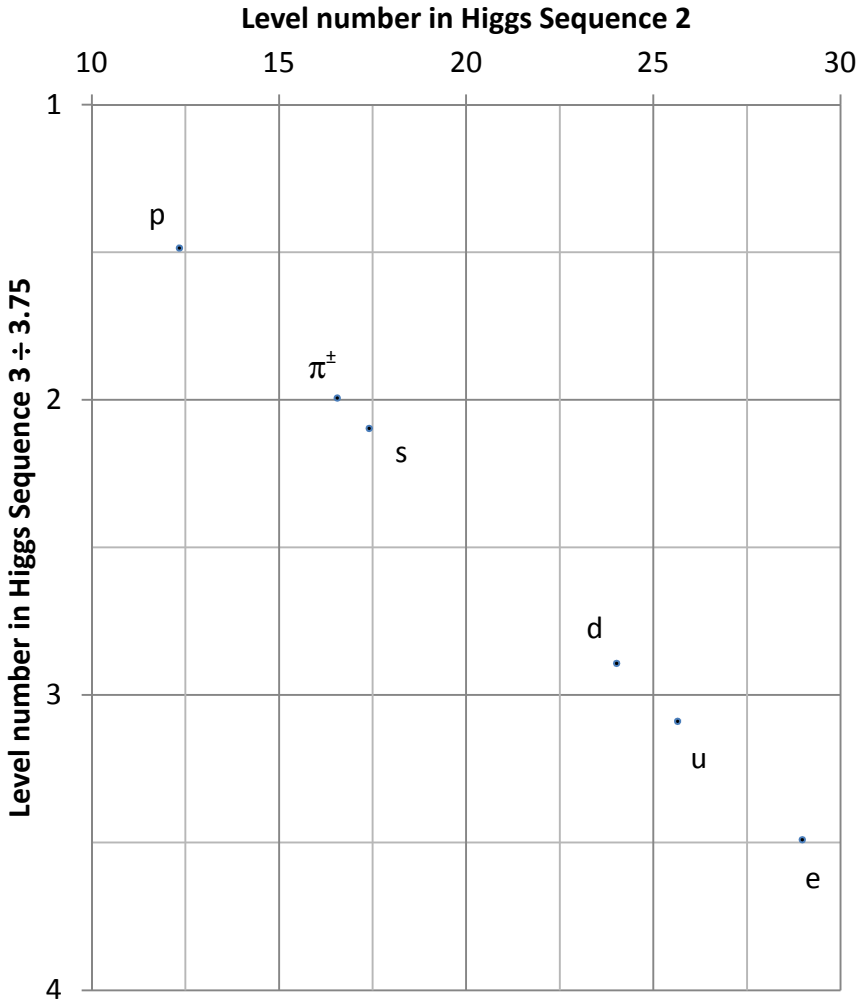


Figure 4: The arrangement of the lightest charged particles within Higgs Sequences 2 and 3, which descend in geometric sequence from the Higgs field vacuum expectation value with common ratios 2/π and 1/e, respectively. The occupied levels in Higgs Sequence 3 lie within an incorporated sequence of common ratio $e^{-3.75}$.

3 The arrangement of the double magic number atomic nuclei on mass levels

The low mass number and double magic number atomic nuclei have been shown to occupy mass sublevels within Sequences 1 and 2 [8, 9]; see Figure 5. The double magic number atomic nuclei are now shown, in Figure 6, to lie close to sublevels within Higgs Sequences 2 and 3. Nuclear masses have been calculated from tables of nuclide mass [10] by subtracting the mass of Z electrons from each value. The occupied levels in Higgs Sequence 3 lie within an incorporated sequence of common ratio $e^{-3.75}$ that descends from the Higgs field VEV.

4 Discussion

We have conjectured that all fields except gravity are confined to 3-branes at the intersections of 4-branes that wrap 1-cycles of a rectangular toroidal orbifold with Planck-scale compactification radii [11]. The sides of the orbifold are of length π and π/2, in Planck units. 4-branes intersect in the covering space of the orbifold after winding around the long and short sides of the extra space n_1 and n_2 times. The mass scale on the intersection is transformed from Planck scale by a factor $\pi^{-n_1} = \pi^{-n_2}$. The scale factor drops off exponentially with winding number, and, although the orbifolded extra space is flat, exponentially with distance from the Planck brane [11]. The existence of Sequence 3, of common ratio e^{-1} suggests the presence of a warped extra space [3].

All massive particles lie upon mass levels. The fundamental particles occupy 'low order' levels, of integer and half-integer number. The quarks, as doublets, occupy levels of integer number in Sequences 2 and 3, adjacent to near-coincident levels of integer number; all the integers are multiples of 5. Individually, the quarks occupy levels and sublevels within the superstructure. The charged leptons, in partnership with pseudoscalar mesons, occupy levels of integer number in Sequences 1 and 2; the integers are multiples of 3 [3]. The weak gauge bosons form a partnership centred on coincident levels of half-integer number in Sequences 1 and 3 [6].

The light quarks and the lightest charged lepton, baryon and charged mesons have been shown here to occupy levels of integer, half-integer and quarter-integer number within two sequences, of common ratio $(2/\pi)^5$ and $e^{-3.75}$, that are incorporated within the Planck sequences. The same particles occupy levels of integer and half-integer number within two sequences, of common ratio $(2/\pi)^5$ and $e^{-3.75}$, that are incorporated within the Higgs sequences; long-lived and stable atomic nuclei lie close to higher order levels. Although they

are composite particles, the proton and the charged pions occupy mass levels of the lowest order within the sequences identified here. We have shown that the mass of a composite particle may be constructed from smaller units [1], so it seems that low order mass levels may be targeted in the construction of the lightest composite particles.

Since they lie upon the low order mass levels of the Higgs sequences, which are incorporated within the Planck sequences, long-lived and stable charged particles in general may be associated with the intersections of 4-branes that wrap a (non-fundamental) space within the covering space of the orbifold.

5 References

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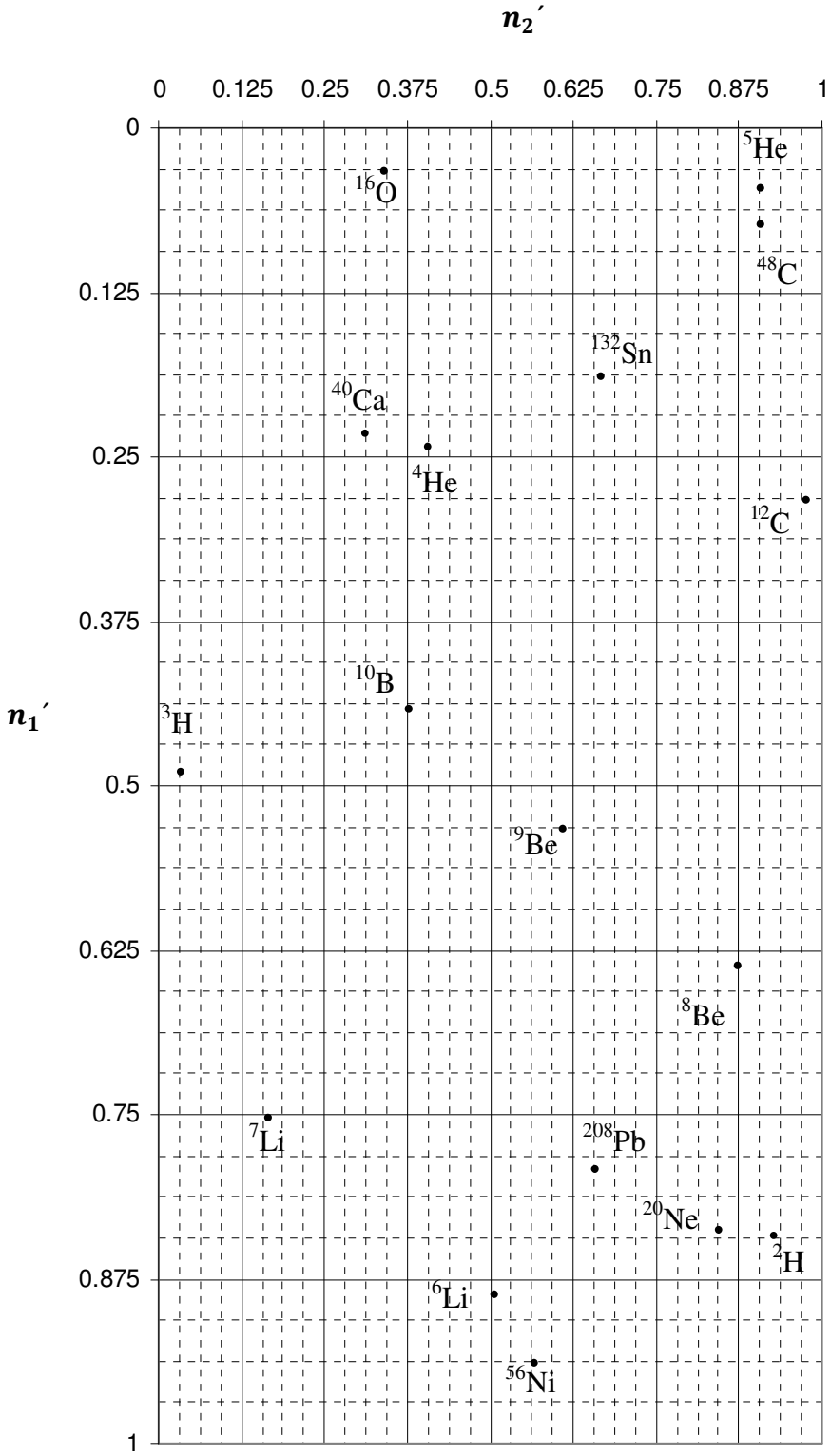

Figure 5: Occupation by low mass number and double magic number atomic nuclei of mass sublevels in Sequence 1 and Sequence 2 [9]. From the level numbers n_1 and n_2, in Sequence 1 and Sequence 2, the integer part has been subtracted, resulting in the fractions $n_1{}'$ and $n_2{}'$, which may be presented graphically more conveniently than n_1 and n_2.

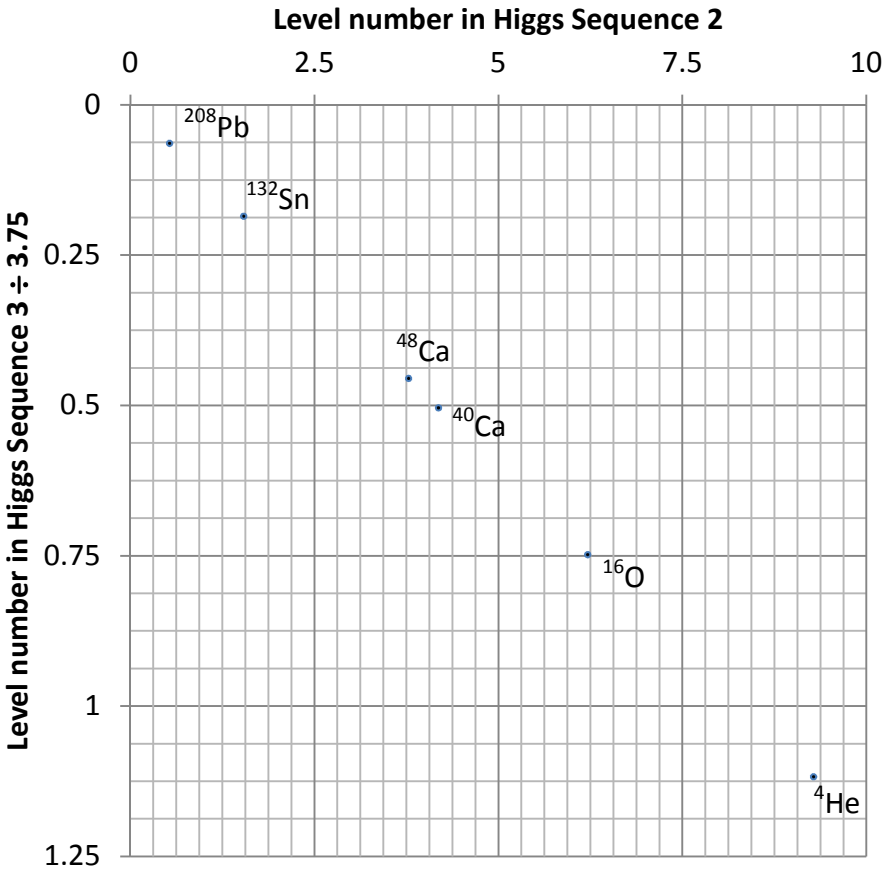

Figure 6: The arrangement of double magic number atomic nuclei within Higgs Sequences 2 and 3. The occupied levels in Higgs Sequence 3 lie within an incorporated sequence of common ratio $e^{-3.75}$. The unstable double magic number nucleus ^{56}Ni lies within Higgs Sequence 2, upon a sublevel that lies midway between two of those shown here.