Naturally Encoded and Compressed Data from Measurements and Observations

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Abstract

The numbers of steps in arbitrary journeys on foot, the times elapsed (in numbers of Planck times) in arbitrary journeys on foot, the times elapsed between random events, race times and random pure numbers all take, on measurement or observation, values equal to discrete integer and fractional powers of π and e. By way of the Quantum/Classical connection, an equation relating small (quantum) quantities and large (classical) quantities, the various measured and observed numbers map onto much smaller numbers that are also equal to discrete integer and fractional powers of π and e.

1 Introduction

On measurement, macroscopic distances, elapsed times, speeds and masses adopt values that are related to Planck scale through multiplication by integer and fractional powers of π and e [1, 2, 3]. Measured values of distance, for example, are equal to the Planck length (the natural unit of length) multiplied by π raised to the power n_π and also by e raised to the power n_e, where one of the numbers n_π and n_e is either an integer or an improper fraction, in lowest terms, whose denominator is 2^p, where p is an integer. Low values of p are preferred. The act of measurement fixes the value of the distance probabilistically, recalling how measurement causes the wave function describing a quantum system to collapse into a single state with a definite value.

The Quantum/Classical connection [4, 5] maps a large number, for example the value in Planck units of a macroscopic parameter, onto a smaller number, which may be the value in Planck units of a quantum parameter. Using Planck units, the connection may be written as:

$$2r^5 = R^2 \tag{1}$$

or

$$2m^{-5} = R^2 \tag{2}$$

The radius ($R = R_\mathrm{OU}$) of the observable universe is 'connected' to the Bohr radius ($r = a_0$) through equation (1). The radii ($R = R_*$) of Main Sequence stars are connected to the masses ($m = m_a$) of specific atomic nuclides through equation (2). The values in Planck units of the quantum parameters are related to Planck scale through multiplication by integer and fractional powers of π and e: π raised to the power n'_π and e raised to the power n'_e.

Step-counting experiments [2] have shown that random numbers (of steps) adopt values within the scheme described above. More generally, then, the Q/C connection may be written as:

$$2{N_\mathrm{Q}}^5 = {N_\mathrm{C}}^2 \tag{3}$$

where N_C is a large number, which may be the value in Planck units of a macroscopic parameter or the number of steps counted or, as we shall see, a pure number, and N_Q is a much smaller number, which may be the value in Planck units of a quantum parameter or a pure number.

In this paper, N_C (the measured or observed quantity) and N_Q (the 'reduced number': the quantity calculated using (3)) are plotted as powers of π and e on the number spaces n_π-n_e and n'_π-n'_e, respectively, for the numbers of steps in arbitrary journeys on foot, the times elapsed in arbitrary journeys on foot, the times elapsed between random events, race times and random pure numbers. Since n_π and n_e, and n'_π and n'_e, are in constant ratio the markers lie on straight lines in each number space.

2 Numbers of Steps in Walks of Arbitrary Length

The numbers of steps in 12 walks of arbitrary length have been measured using a 3D pedometer. The step counts were: 10762; 5541; 17755; 16085; 5334; 12229; 7117; 4920; 7223; 5269; 4641; 3014. The values of N_C and N_Q are presented graphically in Figures 1-4. All values of N_C are closely associated with the 'sub-levels' shown, as are the values of N_Q for the longest walks. The values of N_Q calculated for some of the shortest walks (marked with an X in Figures 3 and 4) are associated with 'high-order'[1] sub-levels, not shown. A comparison of Figures 3 and 4 shows that when N_Q is associated with a particularly high-order sub-level, the corresponding value of N_C is associated with a level or particularly low-order sub-level.

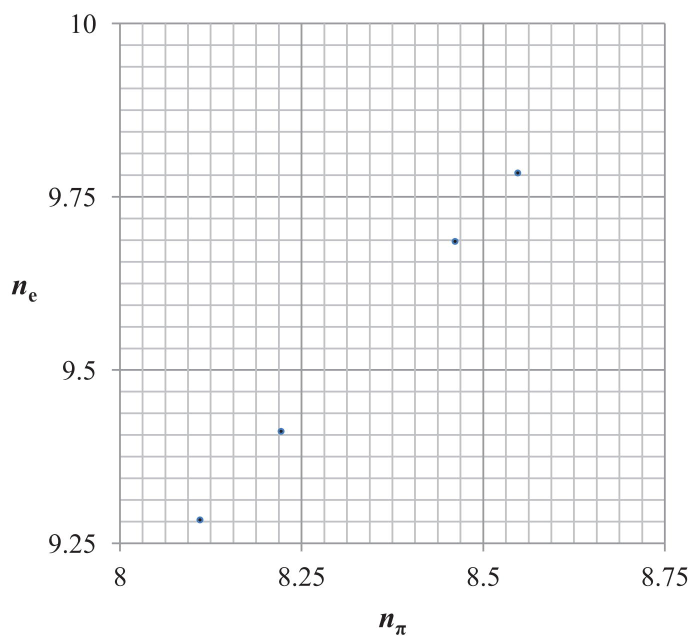

Figure 1: Number of steps, N_C, counted for the four longest walks, as powers n of π and e.

[1] The order of the sub-level is p, as defined in Section 1.

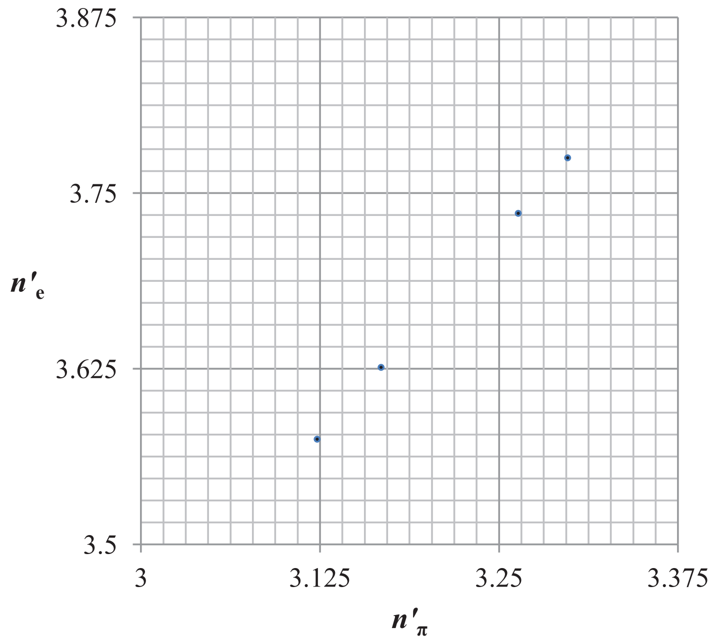

Figure 2: Reduced numbers, N_Q, calculated for the four longest walks, as powers n' of π and e.

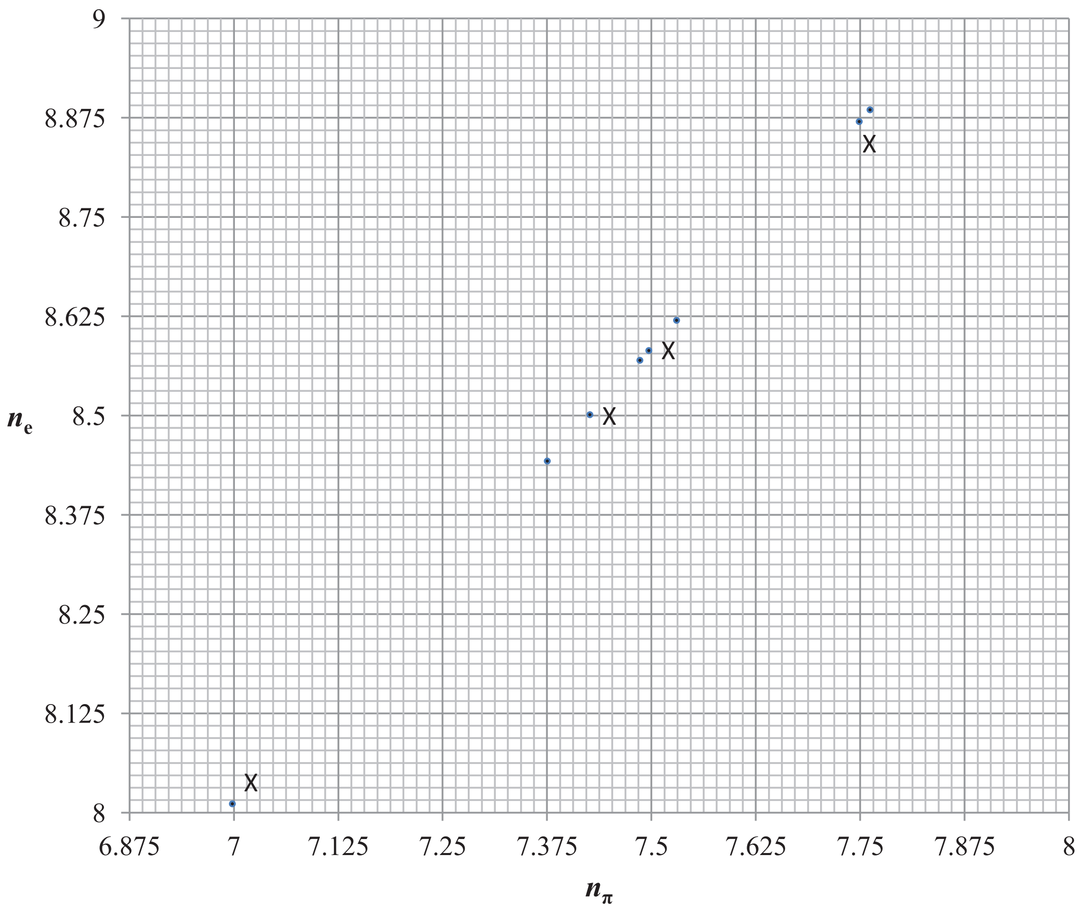

Figure 3: Number of steps, N_C, counted for the eight shortest walks, as powers n of π and e.

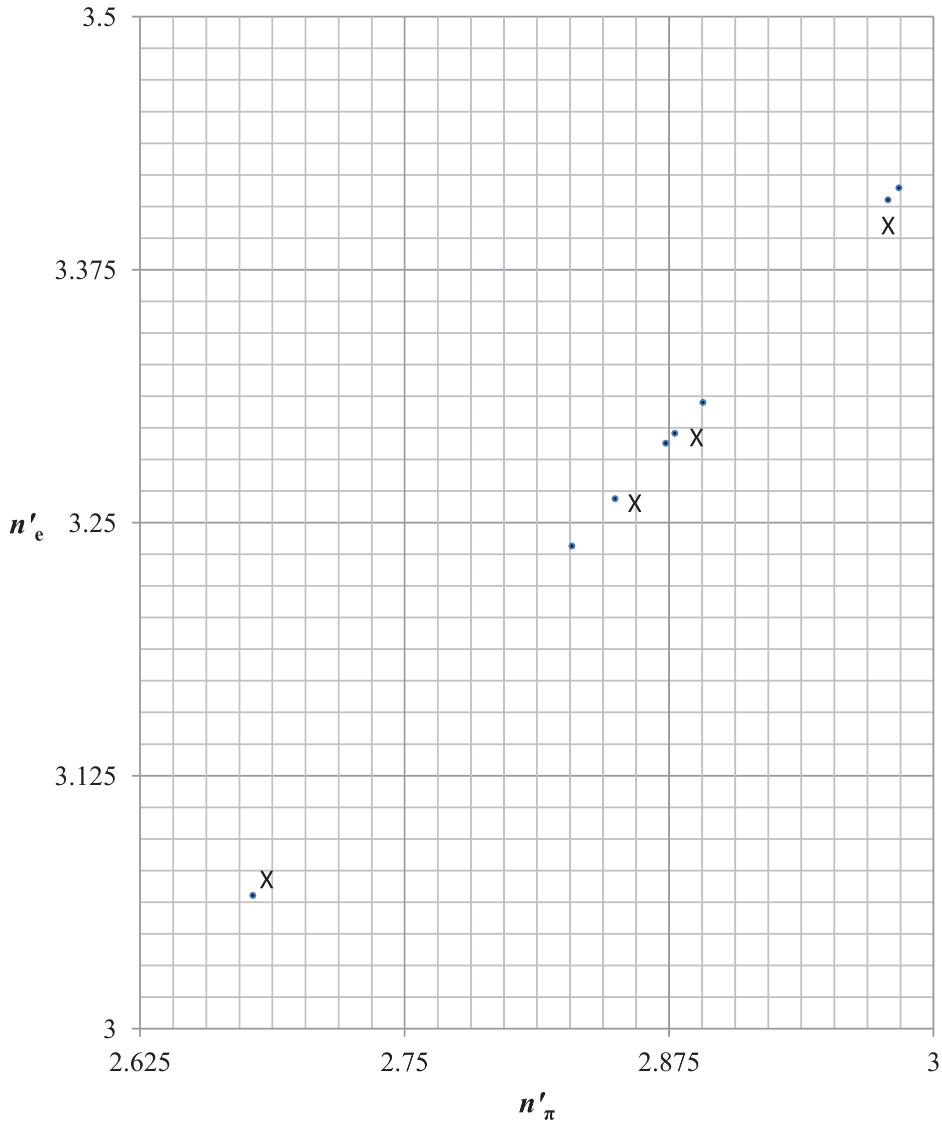

Figure 4: Reduced numbers, N_Q, calculated for the eight shortest walks, as powers n' of π and e.

3 Interrupting a Journey on Foot

Interrupting a journey on foot (in this case, a run) to take a measurement of the number of steps taken up to that point does not compromise subsequent sub-level occupation by either N_C or N_Q, as shown in Figures 5 and 6. The six step counts in the interrupted run were: 1490; 2619; 3446; 5537; 6163; 6721. The interruptions were made arbitrarily.

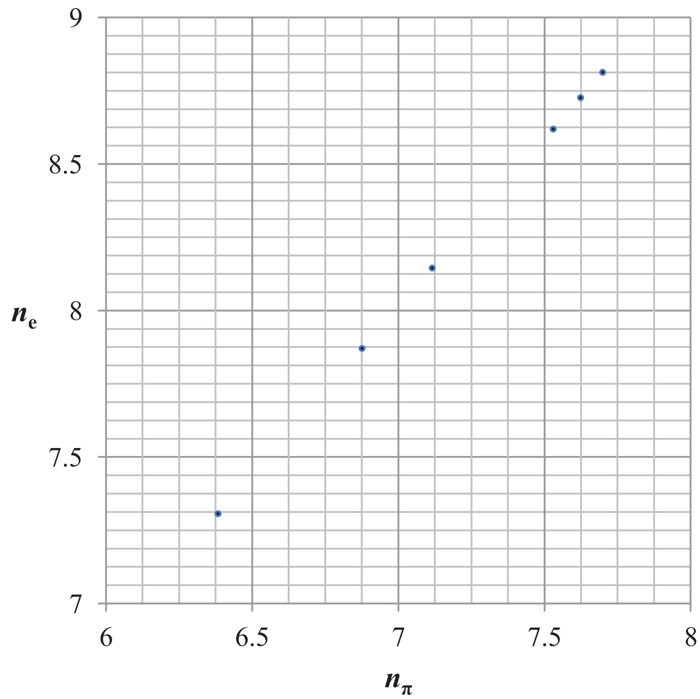

Figure 5: Number of steps, N_C, counted up to arbitrary points during the interrupted run, as powers n of π and e.

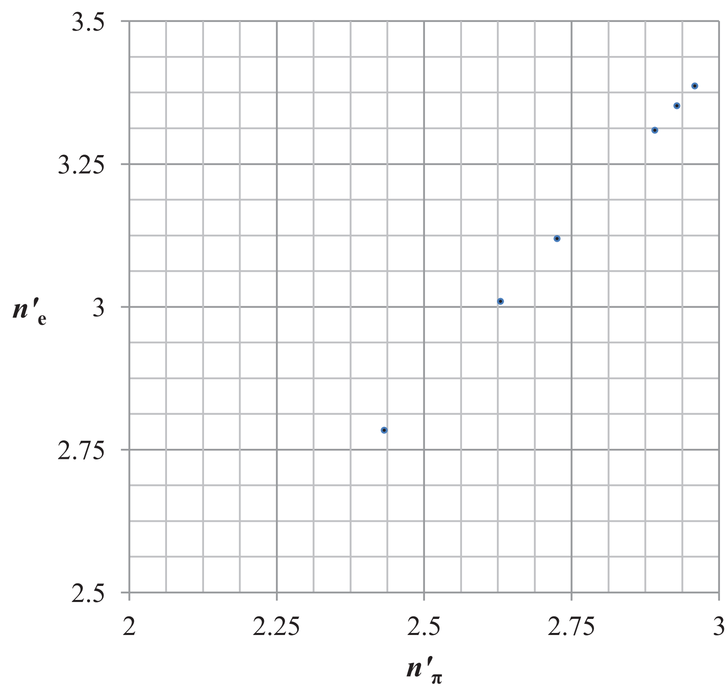

Figure 6: Reduced numbers, N_Q, calculated for the interrupted run, as powers n' of π and e.

4 Timed Journeys on Foot

Three walks (W) and three runs (R) were timed over different ad hoc routes. The times in seconds were: 1361 (W); 1374 (W); 2430 (R); 1103 (W); 1575 (R); 2140 (R). The journey times have been converted into numbers, N_{C}, of Planck times ($t_P = 5.391247(60) \times 10^{-44}$ s [6]), which are plotted as powers of π and e in Figure 7. The corresponding numbers N_{Q} are plotted as powers of π and e in Figure 8.

As in the step-counting journeys, the numbers N_{C} and N_{Q} occupy[2] sub-levels, although they are sub-levels of high-order.

Of the two walks marked with an X in Figures 7 and 8, one is precisely aligned with a sub-level of Figure 7 and the other is precisely aligned with a sub-level of Figure 8. Simultaneous low-order sub-level occupation in both number spaces seems to be preferred but is not always feasible.

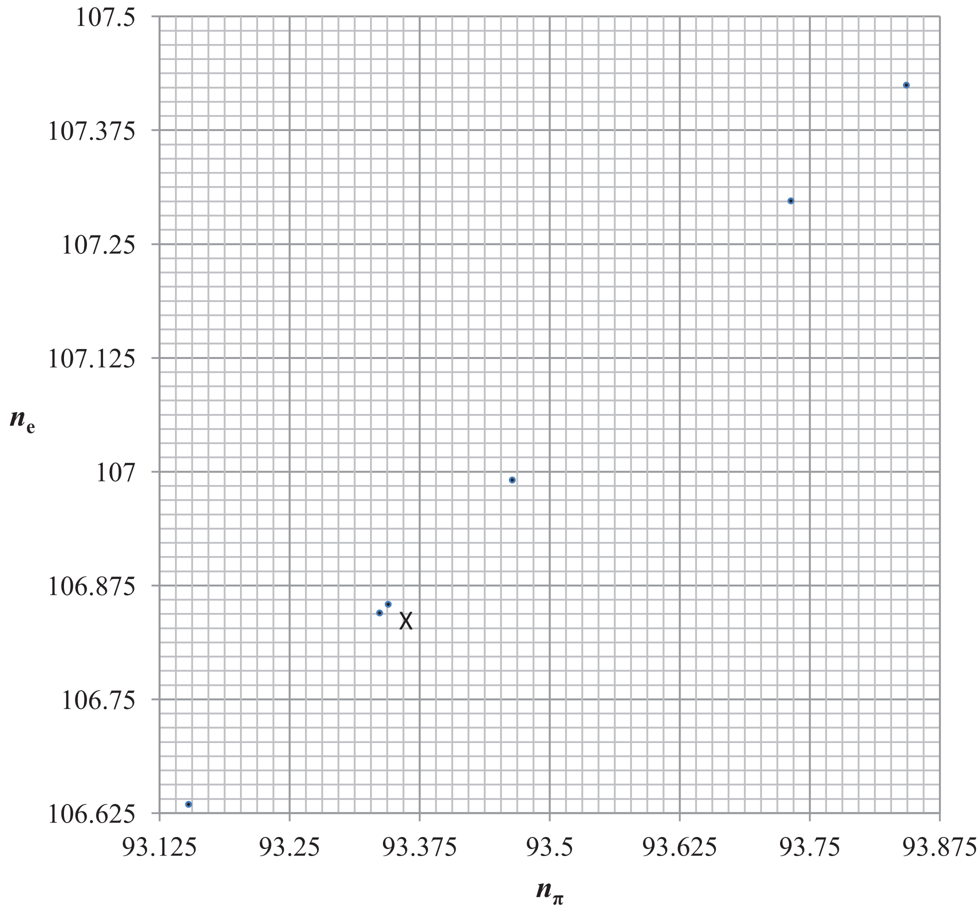

Figure 7: Numbers of Planck times elapsed during timed walks and runs, N_{C}, as powers n of π and e.

[2] 'Occupy' means 'is closely associated with'.

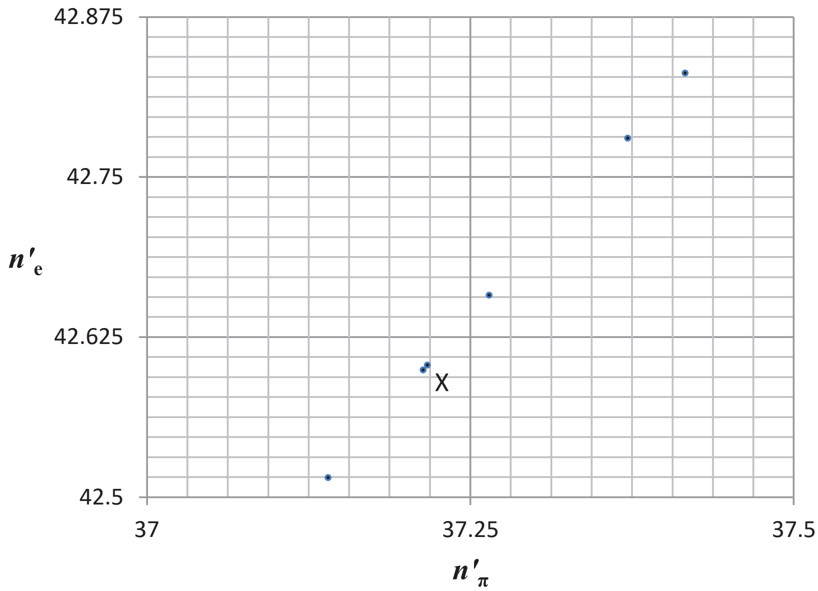

Figure 8: Reduced numbers, N_Q, corresponding to the values of N_C in Figure 7. Shown as powers n' of π and e.

5 Timed Random Events

At a location on a road, distant from traffic lights and roadworks, a timer was started arbitrarily and, after waiting 60s, the times were noted when the next ten white saloon cars, which are unambiguously identifiable, passed. The times in seconds were: 115; 117; 168; 229; 281; 289; 299; 330; 344; 345. The times have been converted into numbers, N_C, of Planck times and are plotted as powers of π and e in Figures 9 and 11. The corresponding numbers N_Q are plotted as powers of π and e in Figures 10 and 12.

All but two values of N_C and N_Q – marked A and B in Figures 9 and 10 – are closely aligned with the sub-levels of Figures 9-12. The value marked A lies at the intersection of sub-levels of relatively low order in Figure 9 but is not closely aligned with a sub-level in Figure 10. The value marked B is not closely aligned with a sub-level in Figure 9 but lies at the intersection of sub-levels of relatively low order in Figure 10. Again, we see that low-order sub-level occupation in both sequences seems to be preferred but is not always feasible. Also, the occupation of intersecting sub-levels seems to be preferred.

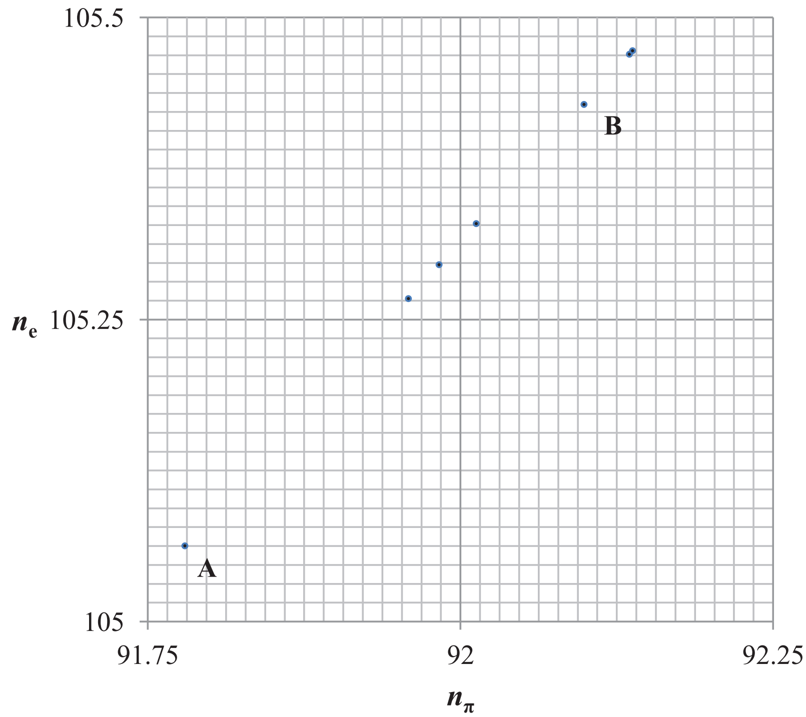

Figure 9: Numbers of Planck times elapsed after an arbitrary start, N_C, before the passing of each of the first seven white cars in the random event experiment. Shown as powers n of π and e.

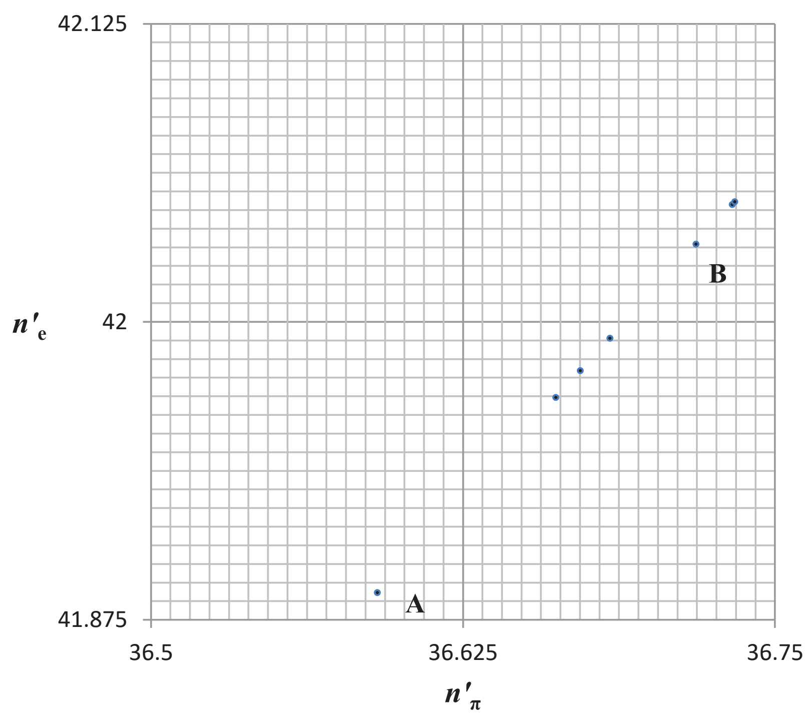

Figure 10: Reduced numbers, N_Q, corresponding to the values of N_C in Figure 9. Shown as powers n' of π and e.

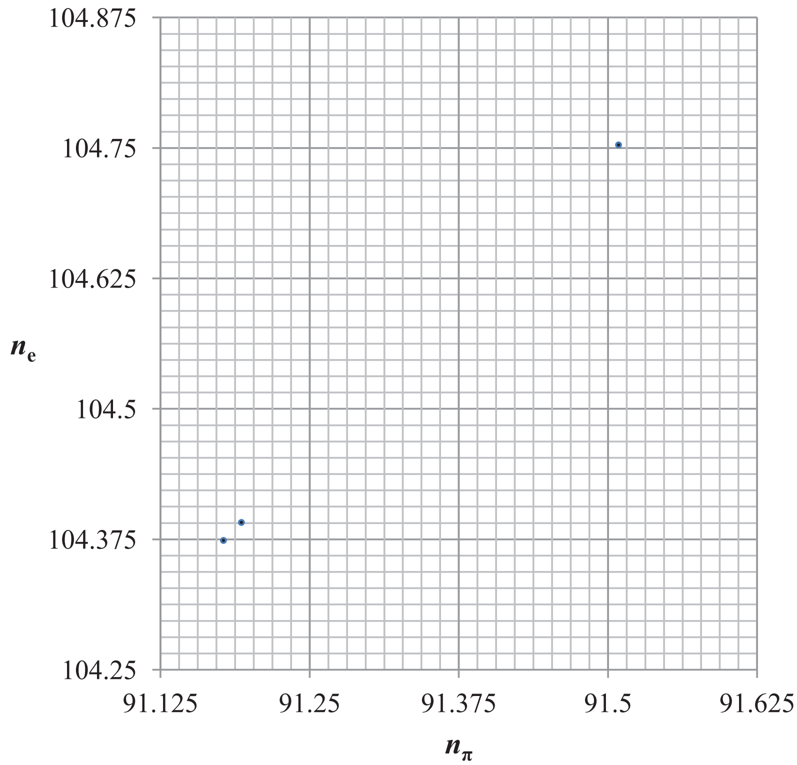

Figure 11: Numbers of Planck times elapsed after an arbitrary start, N_C, before the passing of each of the last three white cars in the random event experiment. Shown as powers n of π and e.

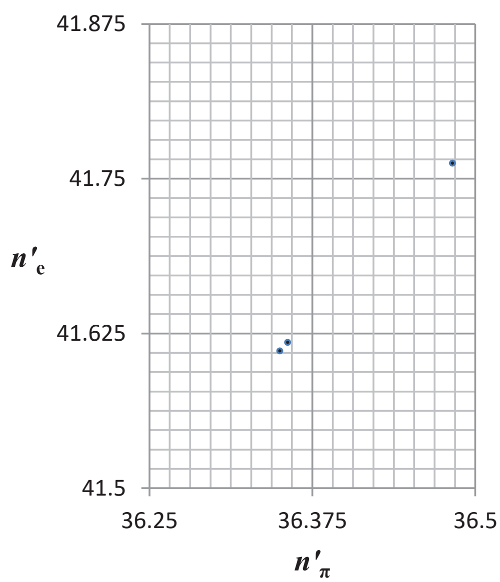

Figure 12: Reduced numbers, N_Q, corresponding to the values of N_C in Figure 11. Shown as powers n' of π and e.

6 Race Times

The times of the first three to finish in the two most recent Formula 1 Grand Prix – see Table 1 – have been converted into numbers, N_C, of Planck times and are plotted as powers of π and e in Figures 13 and 15. The corresponding numbers N_Q are plotted as powers of π and e in Figures 14 and 16.

Race	**Driver (Constructor)**	**Time**
	1. L. Hamilton (Mercedes)	1:31:45.279
Spanish GP	2. M. Verstappen (Red Bull)	+24.177s
(16 Aug 2020)	3. V. Bottas (Mercedes)	+44.752s
	1. M. Verstappen (Red Bull)	1:19:41.993
70th Anniversary GP	2. L. Hamilton (Mercedes)	+11.326s
(9 Aug 2020)	3. V. Bottas (Mercedes)	+19.231s

Table 1: Results of the two most recent Grand Prix

The values of N_C in Figure 13 (Spanish GP) and the corresponding values of N_Q in Figure 14 occupy sub-levels of various orders. For third place in the Spanish GP, the value of N_C occupies a sub-level of 2nd-order, probably at the expense of the order of sub-level occupation of the corresponding value of N_Q. The values of N_C in Figure 15 (70th Anniversary GP) and the corresponding values of N_Q in Figure 16 occupy high-order sub-levels. There are no clear differences in the order of sub-level occupation by N_C and N_Q.

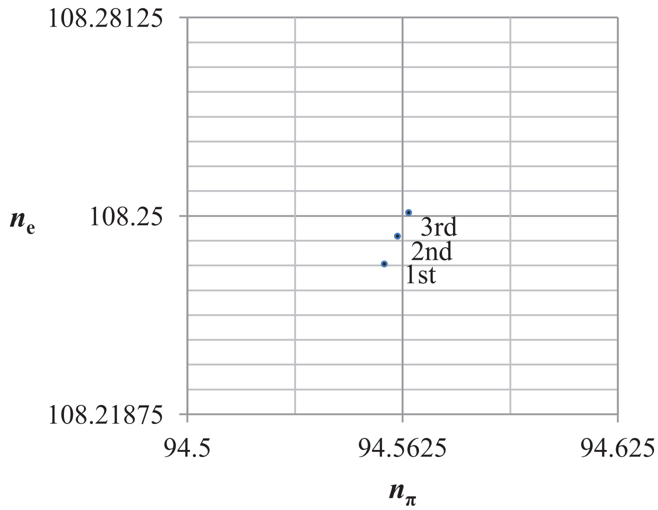

Figure 13: Numbers of Planck times elapsed during the 2020 Spanish Grand Prix, N_C. Shown as powers n of π and e.

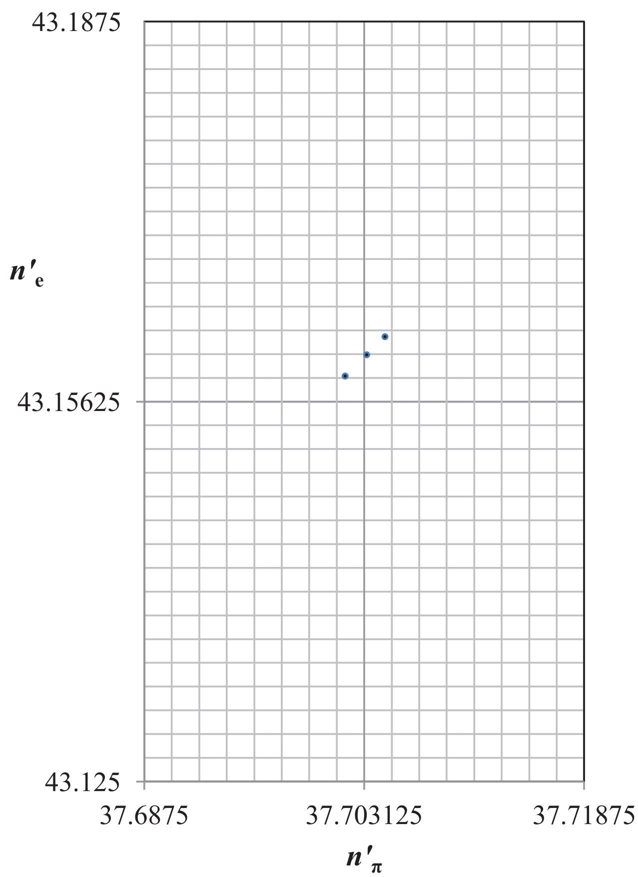

Figure 14: Reduced numbers, N_Q, corresponding to the values of N_C in Figure 13. Shown as powers n' of π and e.

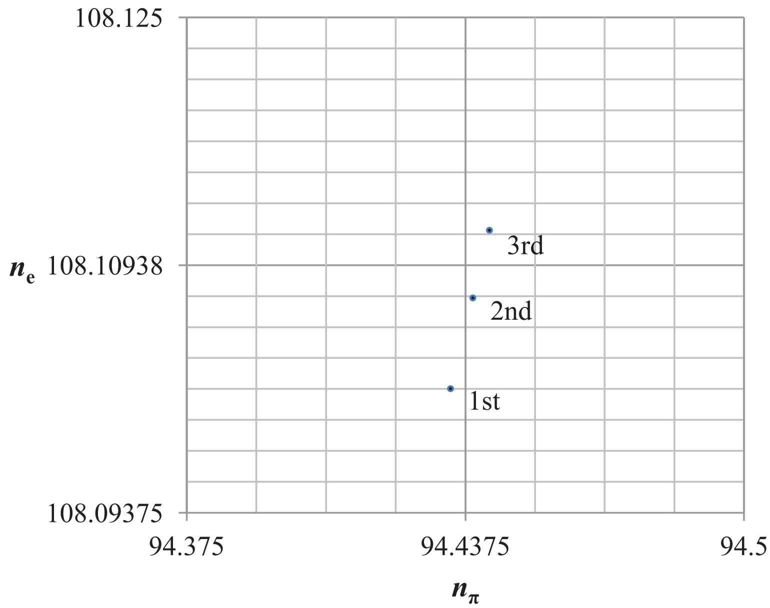

Figure 15: Numbers of Planck times elapsed during the 70th Anniversary Grand Prix, N_C. Shown as powers n of π and e.

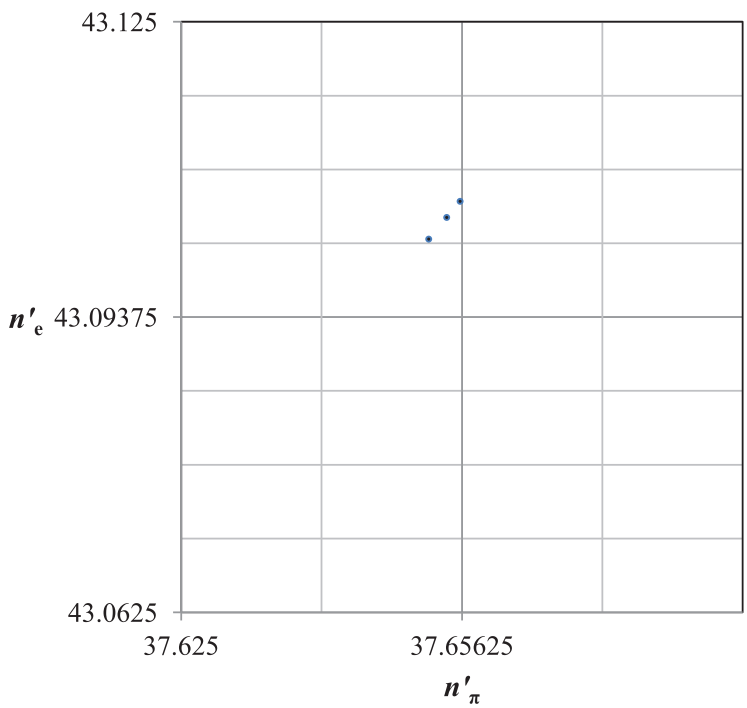

Figure 16: Reduced numbers, N_Q, corresponding to the values of N_C in Figure 15. Shown as powers n' of π and e.

7 Pseudo-Random Numbers

Pseudo-random numbers in the range 0-10000 have been produced using the RAND function of Excel and multiplying the resulting numbers (in the range 0-1) by 10000. The numbers produced were: 7657.81; 5415.08; 6898.42; 7899.84; 5373.20; 3703.22; 2909.93; 4283.28; 3737.41; 1809.93. The numbers, N_{C}, and the corresponding numbers, N_{Q}, occupy sub-levels in the number spaces n_{π}-n_{e}, and n'_{π}-n'_{e}, as shown in Figures 17-20.

8 Random Integers

Random integers in the range 1-10000 have been supplied by Random.org. The numbers supplied were: 3747; 6518; 9652; 9124; 8719; 6582; 1932; 7783; 6840; 7049. Date stamp: 2020-08-17, 11:21:04 UTC. The numbers, N_{C}, and the corresponding numbers, N_{Q}, occupy sub-levels in the number spaces n_{π}-n_{e}, and n'_{π}-n'_{e}, as shown in Figures 21-24.

9 Capriciously-Chosen Integers

Ten integers were chosen capriciously, and written down swiftly. The numbers chosen were: 7648; 2112; 9876; 4422; 8096; 1825; 3011; 2884; 9208; 1189. Surprisingly, eight of the numbers, N_{C}, occupy sub-levels of 4th or lower order, as shown in Figure 25. Two of the numbers occupy 0th-order levels ($p = 0$); one of the two numbers lies at the intersection of two 0th-order levels. Not surprisingly, the two numbers, N_{C}, marked with an X, that do not occupy low-order sub-levels correspond to values of N_{Q} that occupy sub-levels (of 4th and 6th order), as shown in Figure 26.

Broadly similar but less striking results were found when ten integers were chosen capriciously by a second person, as shown in Figures 27 and 28. The numbers chosen were: 4365; 9120; 3472; 6658; 1493; 5743; 8627; 3354; 6891; 1754.

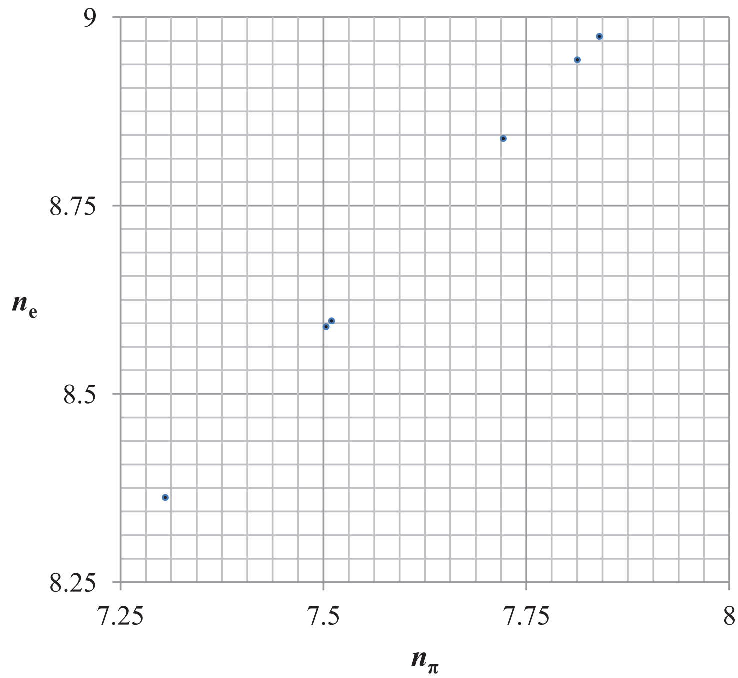

Figure 17: The six largest pseudo-random numbers, N_C, produced by the Excel RAND function. Shown as powers n of π and e.

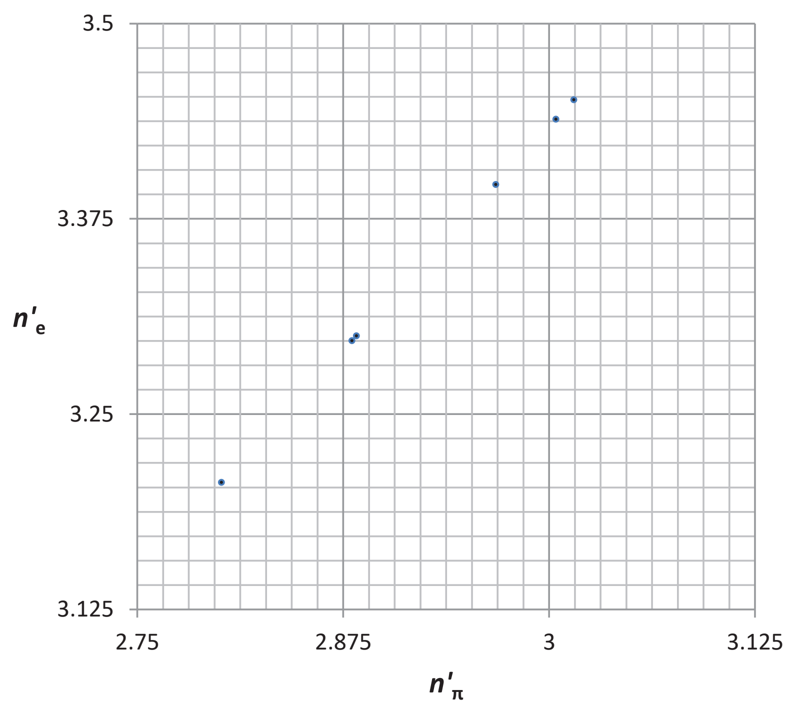

Figure 18: Reduced numbers, N_Q, corresponding to the values of N_C in Figure 17. Shown as powers n' of π and e.

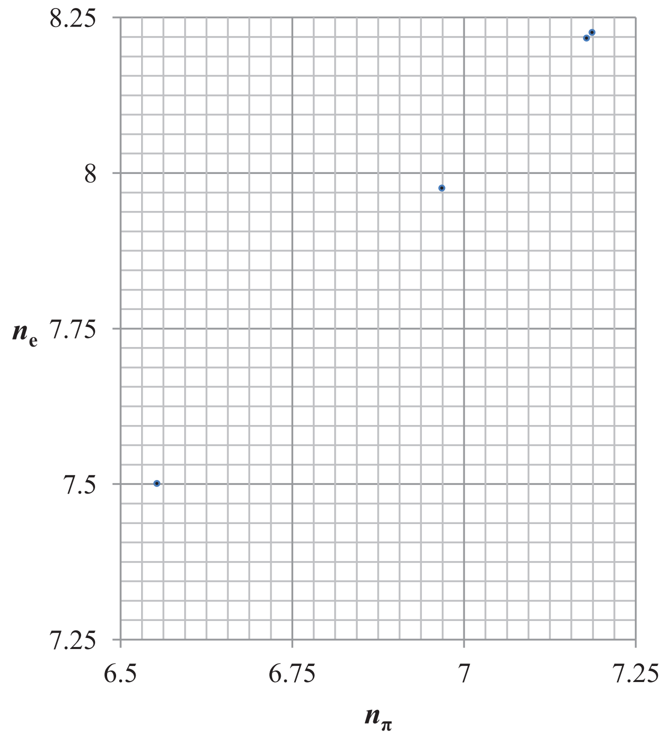

Figure 19: The four smallest pseudo-random numbers, N_C, produced by the Excel RAND function. Shown as powers n of π and e.

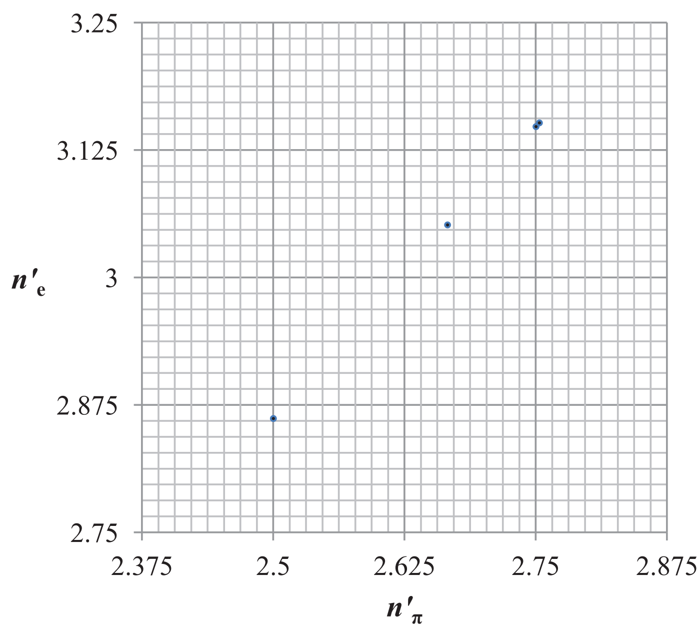

Figure 20: Reduced numbers, N_Q, corresponding to the values of N_C in Figure 19. Shown as powers n' of π and e.

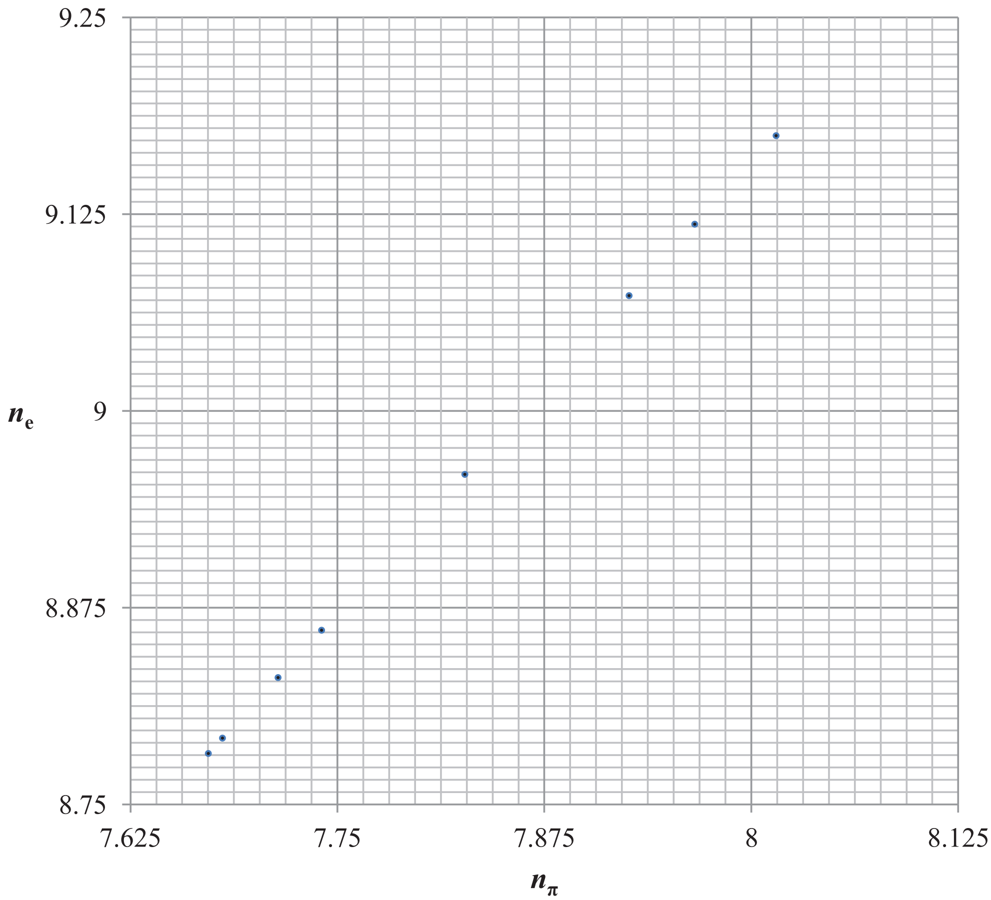

Figure 21: The eight largest random integers, N_C, supplied by Random.org. Shown as powers n of π and e.

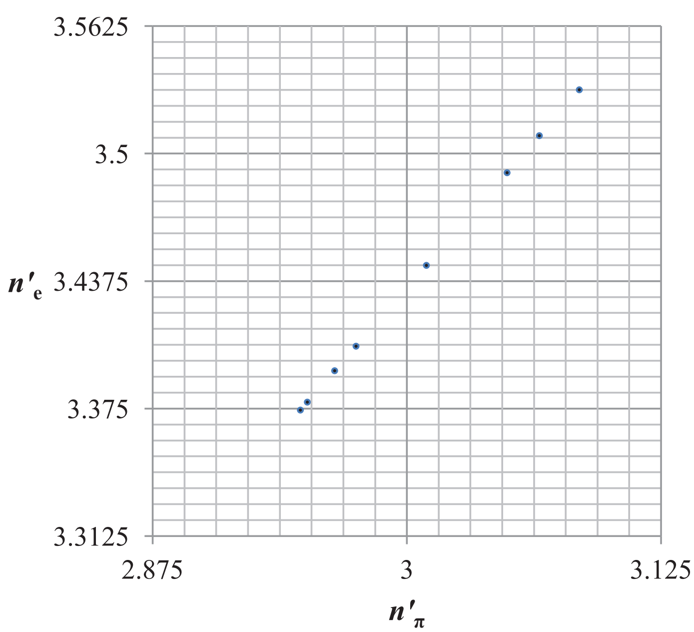

Figure 22: Reduced numbers, N_Q, corresponding to the values of N_C in Figure 21.
Shown as powers n' of π and e.

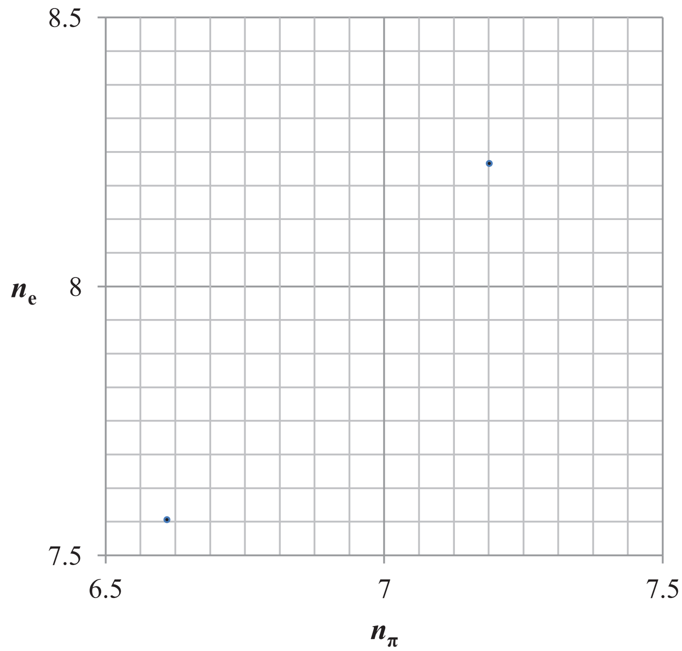

Figure 23: The two smallest random integers, N_C, supplied by Random.org. Shown as powers n of π and e.

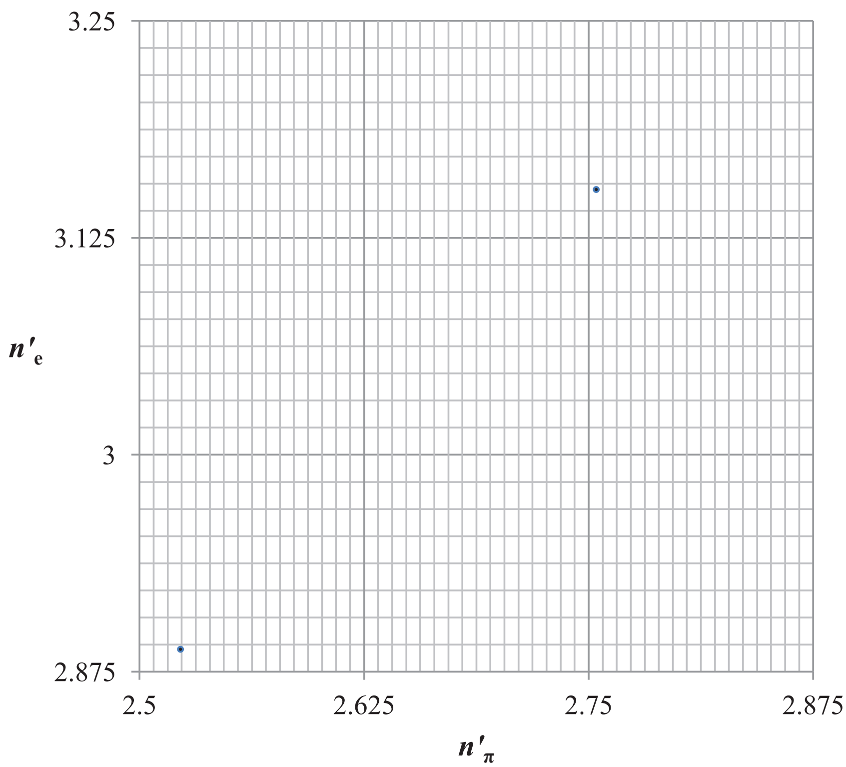

Figure 24: Reduced numbers, N_Q, corresponding to the values of N_C in Figure 23. Shown as powers n' of π and e.

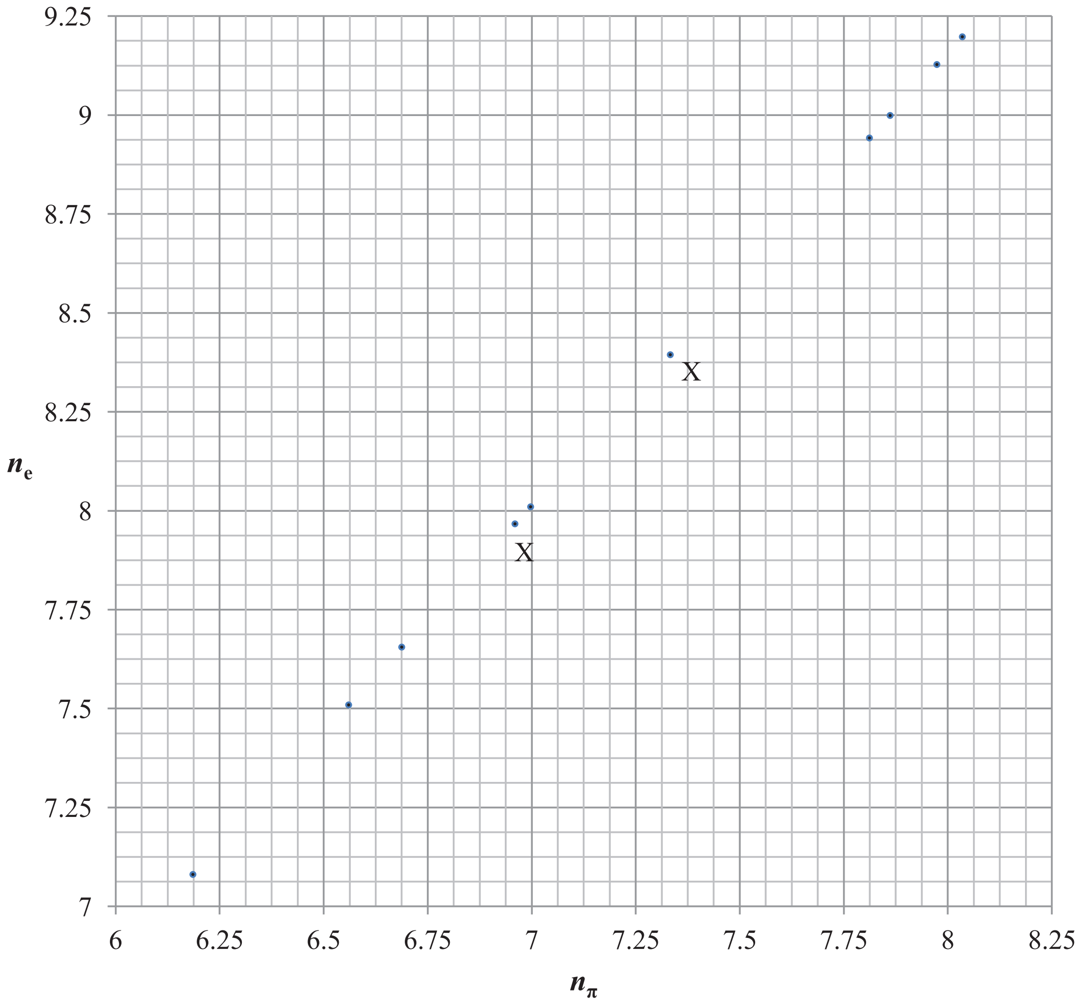

Figure 25: Ten integers, N_C, chosen capriciously.[3] Shown as powers n of π and e.

[3] By HR

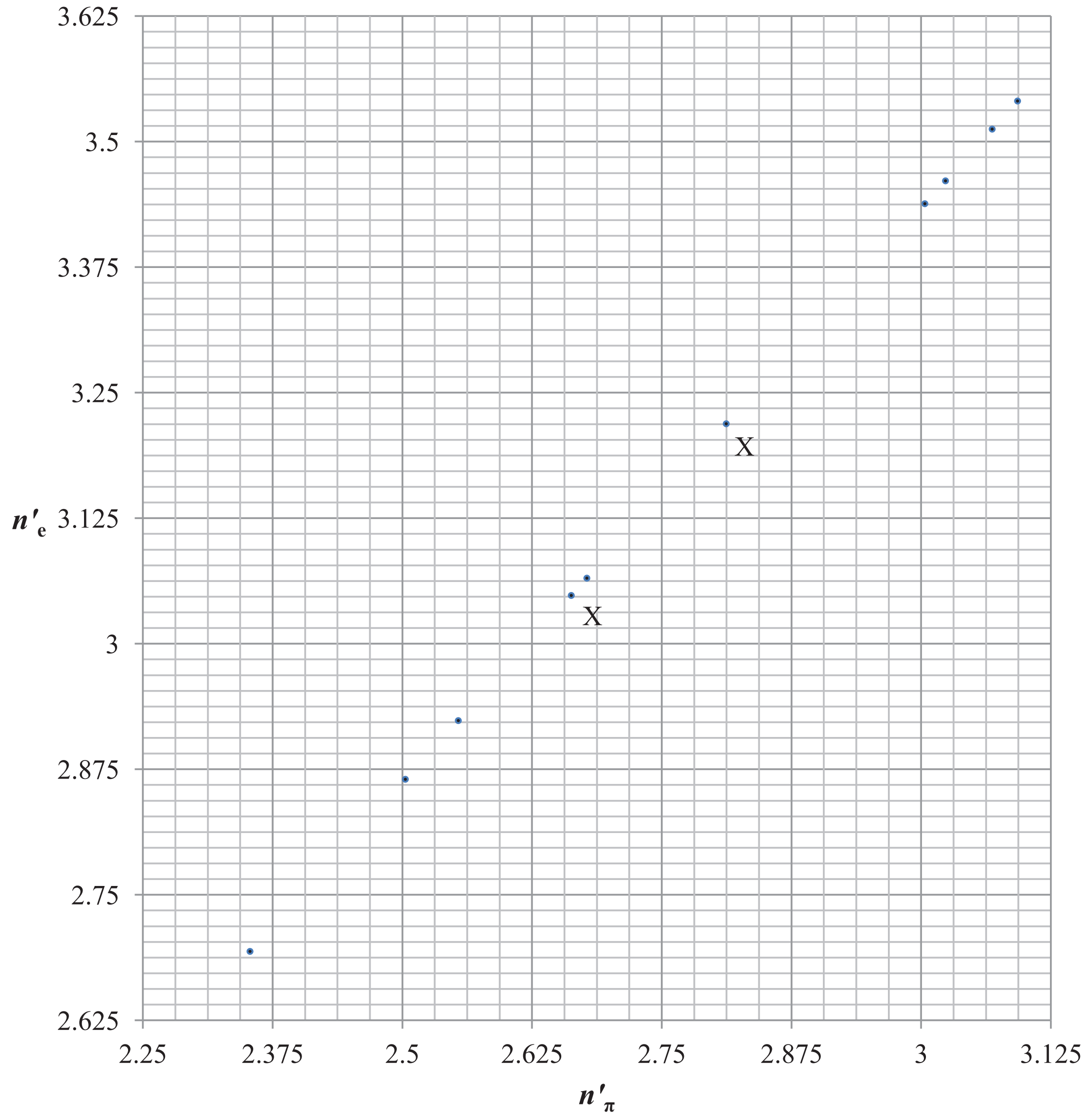

Figure 26: Reduced numbers, N_Q, corresponding to the values of N_C in Figure 25. Shown as powers n' of π and e.

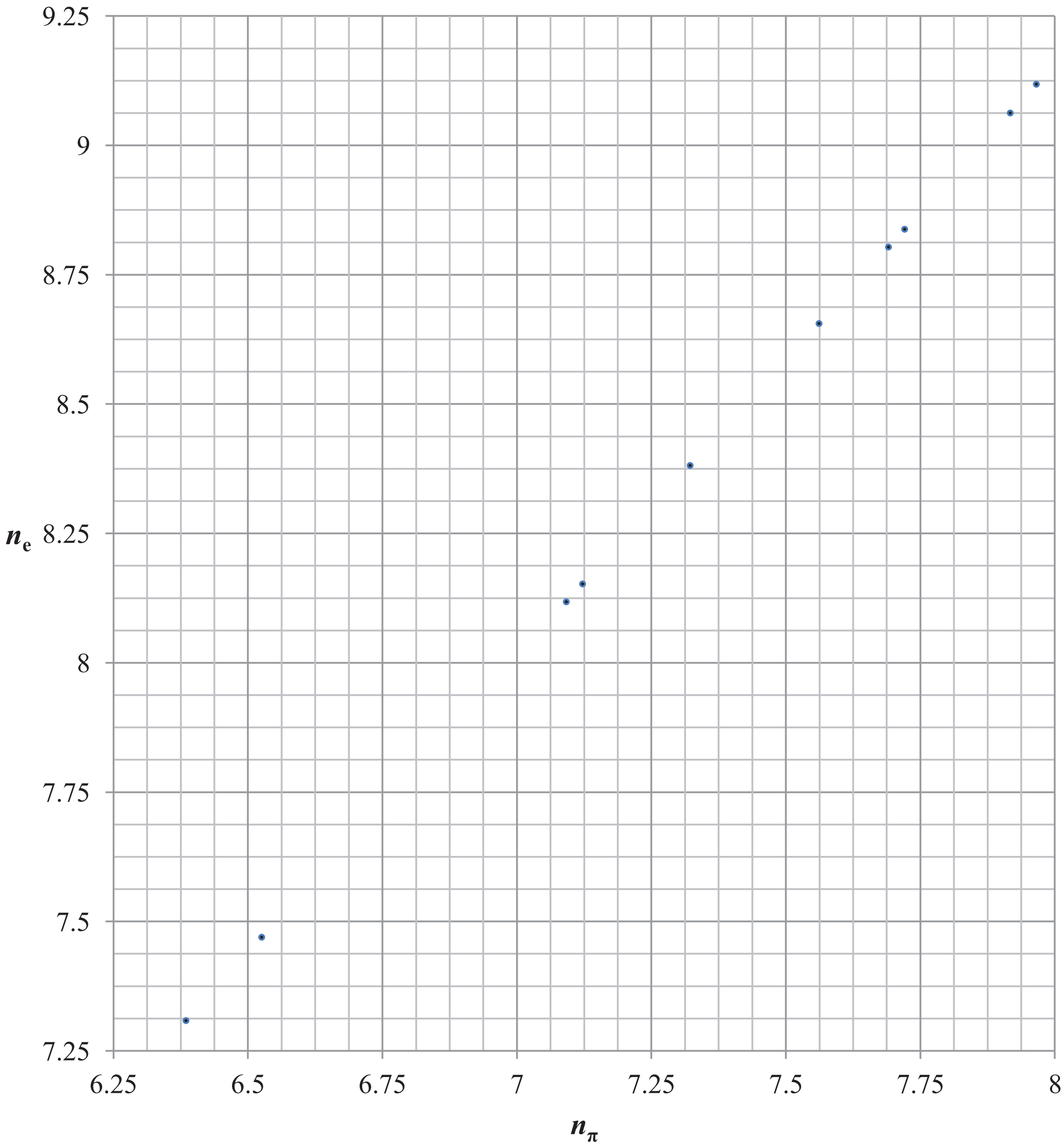

Figure 27: Ten integers, N_C, chosen capriciously.[4] Shown as powers n of π and e.

[4] By the author

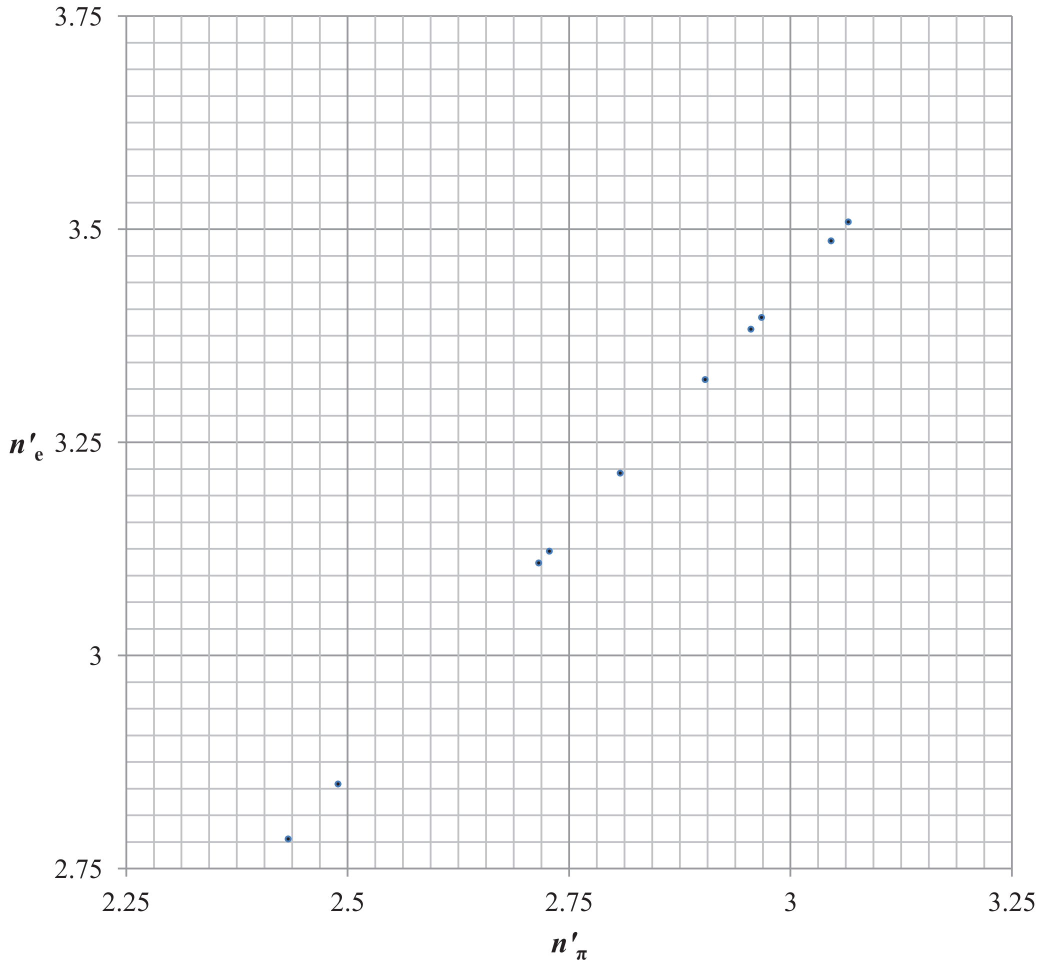

Figure 28: Reduced numbers, N_Q, corresponding to the values of N_C in Figure 25. Shown as powers n' of π and e.

10 Discussion

When we measure a classical parameter in natural (Planck) units or observe the value of a random pure number produced by some process, then the answer we find has a probabilistic basis. Expressing the measured number, N_{C}, as π raised to the power n_{π} and as e raised to the power n_{e}, the most probable values of n_{π} and n_{e} lie on the levels or low-order sublevels of the 'classical' n_{π}-n_{e} number space: the value of N_{C} is encoded on the n_{π}-n_{e} number space. By way of the Quantum/Classical connection, the value of N_{C} corresponds to a 'reduced number', N_{Q}. Expressing N_{Q} as π raised to the power n'_{π} and as e raised to the power n'_{e}, the most probable values of n'_{π} and n'_{e} lie on the levels or low-order sublevels of the 'quantum' n'_{π}-n'_{e} number space: the value of N_{Q} is encoded on the n'_{π}-n'_{e} number space. As a result of the Quantum/Classical connection, the number of steps counted for a walk, the duration of a walk in numbers of Planck units and random numbers are all encoded in compressed format on the n'_{π}-n'_{e} number space.

The larger the number N_{C} (the value in units of the measured 'classical' parameter or a pure number), the smaller the value of $N_{\mathrm{Q}}/N_{\mathrm{C}}$, and the greater the degree of data compression. For distance measurements on astronomical scales, $N_{\mathrm{Q}}/N_{\mathrm{C}}$ can be as small as $a_0/R_{\mathrm{OU}} \approx 1\text{x}10^{-37}$, where R_{OU} is the radius of the observable universe and a_0 is the Bohr radius. For a walk of 10000 steps, $N_{\mathrm{Q}}/N_{\mathrm{C}} \approx 3\text{x}10^{-3}$. Mapping N_{C} onto N_{Q} by way of the Quantum/Classical connection reduces the amount of data to be encoded without necessarily losing important information.

In [4] and [5], we calculated the dark energy density as the density of Planck-scale zero-point energy in a 5-sphere (the S^5 in $AdS_5 \times S^5$) of Bohr radius, and also as the density of the Planck energy on the boundary of the observable universe. The Quantum/Classical connection was found by equating the two expressions for the dark energy density. Assuming that all classical data (values of N_{C}) are encoded on the boundary of the observable universe, in line with the holographic principle, it seems that the compressed data are encoded in the $AdS_5 \times S^5$ bulk, the exponent n'_{π} originating in the length of the S^1/Z_2 orbifold and the exponent n'_{e} originating in the radius of the 5-sphere.

References

1. B. F. Riley, The Act of Measurement I: Astronomical Distances, viXra:2006.0247
2. B. F. Riley, The Act of Measurement II: Closer to Home, viXra:2006.0246
3. B. F. Riley, The Act of Measurement III: The Land Speed Record, viXra:2007.0045
4. B. F. Riley, The Cosmological Constant from $\mathrm{AdS}_5 \times \mathrm{S}^5$, viXra:1307.0107
5. B. F. Riley, The Cosmological Constant from a Distant Boundary, viXra:1502.0017
6. B. F. Riley, The Quantum/Classical Connection, viXra:1809.0329
7. 2018 CODATA recommended values