

Being a Promise and Being Arbitrary Are Not the Same Thing

— The Jump Between Planets and Dwarf Planets Is **320725**, the Largest Among Thirteen Bodies — It Is **2632** Times the Largest Jump Within Either Group, and **130** of **156** Exponent Pairs (**83.33** Per Cent) Sort Them the Same Way — [Paper 338]

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— *From thinking to syncing.* —

Abstract

Pluto ceased to be a planet because a definition changed. This paper asks whether that definition was arbitrary—the answer is that it is a promise, and it is not arbitrary. No new mathematical theorem and no new law is claimed. First, the smallest planet (Mars) and the largest dwarf planet (Pluto) are **320725** apart (Section 2). Second, this is the core of the paper. That jump is the largest of the twelve between thirteen bodies sorted in order (Section 3). Third, it is **2632.44** times the largest jump within either group (the **121.8354** between Saturn and Uranus) (Section 3). Fourth, the gap is not an artefact of the exponents. Of **156** pairs (p, q) in M^p/a^q , **130** (**83.33** per cent) sort them the same way (Section 4). Fifth, but drop the mass and the sorting fails. Mass alone already separates them by **20.4719**, and distance widens that by **15667** (Section 4). Sixth, the separator is whether the promise follows a gap in nature (Section 5).

Scope of this paper (scope note): No new mathematical theorem and no new law is claimed—the 2006 resolution of the International Astronomical Union, the Stern-Levison Λ , and the values of mass and semi-major axis are all standard. We do not build celestial mechanics—the derivation of Λ and the estimate of orbit-clearing time are not entered. The formula is used as given. We propose no classification—no new definition is offered. Only how an existing definition relates to the distribution in nature is looked at. We do not exhaust the catalogue—only thirteen bodies are treated; exoplanets and unclassified objects are left out. They are mentioned and no more. We do not adjudicate history—the politics of the 2006 resolution is not entered. We do not argue over the name—whether Pluto ought to be called a planet is not the question here. Relation to earlier papers: Paper 306 showed how many “base” units there are to be a promise—this paper descends from it and adds one step. Where 306 stopped at “it is a promise”, this goes on to “a promise, and there really is a gap where the line was drawn”. Paper 337 showed the edge of the solar system to be five edges—there five promises were each non-arbitrary; here one promise follows a gap in nature. Paper 95 separated convention from fact—the classification is convention and the gap is fact. This is a case where the two coincide. Paper 300 showed whether two things share a root is decidable—the test here is “is the gap the largest jump”, which means something only against the jumps within the groups. Paper 317 showed a significance level to be a promise per test—there the place of the promise was arbitrary; here it is not. There are two kinds of promise. What is added is sorting thirteen bodies and counting every jump between neighbours to show the boundary carries the largest, comparing it against the largest jump inside a group, moving the exponents over 156 pairs to measure how robust the sorting is, and putting the separator on whether the promise follows a gap in nature.

1. Notation and the Question

Setting: The 2006 resolution of the International Astronomical Union added to the conditions for a planet that it must have cleared the neighbourhood of its orbit. Pluto does not meet it and became a dwarf planet.

Observation 1.1

The Stern-Levison Λ turns “has cleared” into a number. With Earth set to 1,

$$\Lambda = \frac{M^2}{a^{3/2}},$$

where M is the mass and a the semi-major axis—a quantity proportional to the reciprocal of the time needed to clear the orbit.

Observation 1.2

Where to cut was decided by the resolution. Nature does not write “planets begin here”——so this is a promise, in the sense of Paper 306.

Observation 1.3

But being a promise does not mean being arbitrary. If there is a gap where the line falls, the line may be drawn anywhere and give the same classification——and whether there is a gap can be measured.

Question: Is there in fact a gap where the line was drawn?

2. The Λ of Thirteen Bodies

Calculation 2.1: Compute $\Lambda = M^2/a^{3/2}$ with Earth = 1 (computed in this paper).

Body	Class	M [Earth= 1]	a [AU]	Λ
Jupiter	planet	317.828	5.204	8.508342×10^3
Saturn	planet	95.159	9.582	3.052912×10^2
Uranus	planet	14.536	19.229	2.505768
Neptune	planet	17.147	30.103	1.780171
Venus	planet	0.815	0.723	1.079714
Earth	planet	1.000	1.000	1.000000
Mercury	planet	0.055274	0.387	1.268558×10^{-2}
Mars	planet	0.107447	1.524	6.138304×10^{-3}
Pluto	dwarf	0.002179	39.482	1.913885×10^{-8}
Eris	dwarf	0.002700	67.781	1.306368×10^{-8}
Ceres	dwarf	0.00015696	2.766	5.356077×10^{-9}
Haumea	dwarf	0.000670	43.130	1.584822×10^{-9}
Makemake	dwarf	0.000510	45.430	8.494274×10^{-10}

Observation 2.2

Checks——Earth's Λ comes out at exactly 1.0000000000, confirming the normalisation. And Jupiter's is 8.508342×10^3 , inside the expected 10^3 to 10^5 band——the formula is tried on two cases with known answers before the table is read.

Observation 2.3

The smallest planet is Mars at 6.138304×10^{-3} and the largest dwarf is Pluto at 1.913885×10^{-8} . The ratio is 3.207249×10^5 , a factor of **320725**——in decades, a gap of 5.5061.

Observation 2.4

Every one of the eight planets exceeds every dwarf planet. Not one exception——sorted by Λ , the classification falls into two clean blocks.

Observation 2.5

And this is not enough. “Falls into two blocks” can be said of any two groups——whether the gap is real cannot be told without comparing it to the jumps inside the groups.

3. The Core: The Boundary Jump Is the Largest of Twelve

Calculation 3.1: Sort the thirteen by Λ and take every ratio between neighbours (computed in this paper).

Rank	Body	Class	Ratio to the previous
1	Makemake	dwarf	—
2	Haumea	dwarf	1.8658
3	Ceres	dwarf	3.3796
4	Eris	dwarf	2.4390
5	Pluto	dwarf	1.4650
6	Mars	planet	320724.8577
7	Mercury	planet	2.0666
8	Earth	planet	78.8297
9	Venus	planet	1.0797
10	Neptune	planet	1.6487
11	Uranus	planet	1.4076
12	Saturn	planet	121.8354
13	Jupiter	planet	27.8696

Observation 3.2

This is the core of the paper. The largest of the twelve jumps falls exactly at the classification boundary——**320724.8577**, which is **2632.4440** times the second largest (the 121.8354 between Saturn and Uranus).

Observation 3.3

This is the right comparison for “is the gap real”. It must not be compared against the spread of the whole group——the planets themselves run over 1.386106×10^6 from Mars to Jupiter, which is larger than the boundary’s 3.207249×10^5 . Compare against the wrong thing and the gap disappears.

Observation 3.4

Compare spacings between neighbours, not spreads. The planets are spread widely in Λ , and a jump of 320725 never once occurs inside them——being widely spread and having a void in the middle are different things.

Observation 3.5

The dwarf planets are packed tighter still. Their internal jumps stay between 1.4650 and 3.3796——the boundary jump is five orders of magnitude above that.

Observation 3.6

So the line may be drawn anywhere and give the same classification. At $\Lambda = 10^{-3}$, at 10^{-5} , at 10^{-7} , the same 8 against 5——fixing the threshold and fixing the classification have come apart. This is what “a promise and yet not arbitrary” amounts to.

4. The Gap Is Not an Artefact of the Exponents

Setting: The exponents 2 and $3/2$ in $\Lambda = M^2/a^{3/2}$ come from an estimate of clearing time. If changing them broke the classification, the gap would be an artefact of the formula.

Calculation 4.1: Move (p, q) in M^p/a^q (computed in this paper).

p	q	Do the classes separate	Gap between the groups
2	3/2 (the original Λ)	yes	3.2072×10^5
2	0 (ignore distance)	yes	4.1910×10^2
1	0 (mass alone)	yes	2.0472×10^1
2	3	yes	2.8028×10^6
1	3/2	yes	1.6742×10^3
0	3/2 (ignore mass)	no	—
1	5	no	—

Observation 4.2

Over 156 pairs, p in steps of 0.25 and q in steps of 0.5, **130 (83.33 per cent)** sorted them the same way. The gap is not an artefact of the exponents in Λ —change the formula coarsely and the same 8 against 5 keeps coming out.

Observation 4.3

Fixing $p = 1$, separation holds for q from 0 to 4.75 and breaks at 5.00. So the tolerance is wide but not unlimited—weight distance too heavily and the far dwarf planets overtake the near planets.

Observation 4.4

Drop the mass, however ($p = 0$), and the classes do not separate. On distance alone, Mars and Pluto reverse—what carries the classification is mass; distance only reinforces it.

Calculation 4.5: What, then, is distance doing (computed in this paper)?

Criterion	Smallest planet / largest dwarf
Mass alone (M)	20.4719
$\Lambda = M^2/a^{3/2}$	320724.8577
Ratio	widened by 15667

Observation 4.6

Mass alone already separates them. Mars at 0.107447 and Eris at 0.002700, a factor of 20.4719—— Λ did not create the gap. It widened a gap already there by 15667.

Observation 4.7

This must be stated honestly. Part of Λ 's persuasiveness comes from showing 20.4719 as 320725——that the gap is real does not change, but the impression of five decades is made by the formula.

Observation 4.8

Moving the position does not restore the order. Put Pluto at the distance of Mars (1.524 AU) and $\Lambda = 2.5245 \times 10^{-6}$, still short of Mars's 6.138304×10^{-3} ——short by 2431.4992. At the same a , Λ goes as M^2 , so this ratio is the square of the mass ratio itself. Pluto is a dwarf planet not merely for being far.

5. The Separator: Does the Promise Follow a Gap in Nature?

Observation 5.1

The separator——whether moving the threshold changes the classification or leaves it alone.

	Moving the threshold	Neighbouring jumps	Character of the promise
Following a gap	no change	boundary is largest	not arbitrary
Cutting a continuum	changes	boundary is ordinary	arbitrary

Observation 5.2

This is a measurable distinction. Count every jump between neighbours and see whether the boundary carries the largest—here it did, at 2632.4440 times the largest jump inside a group.

Observation 5.3

One step is added to Paper 306. Paper 306 wrote that the count of base units is a promise—this paper goes on to “a promise, and there really is a gap where the line was drawn”. “It is a promise” is not the end of a classification but the beginning of the next question.

Observation 5.4

It makes a pair with Paper 317. Paper 317 wrote that a significance level of 0.05 is a promise per test—there no gap in nature sits at 0.05, and 0.04 or 0.06 would have served. Here the threshold moves and the classification does not. Under one word “promise”, some follow gaps and some cut continua.

Observation 5.5

To be stated honestly—that there is a gap does not make the classification useful. What is shown is “there is a void where the line was drawn”, not “this classification is scientifically fruitful”—usefulness is another question, and this paper does not answer it.

Observation 5.6

One last thing—the gap may yet be filled by a body not yet found. One object with Λ near 10^{-4} would collapse the boundary jump at a stroke—this conclusion holds for the thirteen bodies now known, and it takes a falsifiable form. Which is precisely the evidence that the claim is not empty.

6. The Census and the Close

1. Mars 6.138304×10^{-3} , Pluto 1.913885×10^{-8} (Calculation 2.1): a factor of **320725**.
2. Earth's Λ is exactly 1.0000000000 (Observation 2.2): the normalisation checks.
3. Every planet exceeds every dwarf (Observation 2.4): no exception.
4. The boundary carries the largest of twelve jumps (Calculation 3.1): **320724.8577**.
5. **2632.4440** times the largest inside a group (Observation 3.2): Saturn to Uranus, **121.8354**.
6. Do not compare against the spread (Observation 3.3): the planets span 1.386106×10^6 .
7. **130** of **156** pairs sort the same (Observation 4.2): **83.33** per cent.
8. q holds to **4.75** and breaks at **5.00** (Observation 4.3): wide but not unlimited.
9. Mass alone separates by **20.4719** (Calculation 4.5): Λ widened it by **15667**.
10. Pluto at Mars's distance is short by **2431.4992** (Observation 4.8): not merely for being far.

Closing: Pluto ceased to be a planet because a definition changed, and that definition is indeed a promise—nature does not write “planets begin here”. But being a promise does not mean being arbitrary. There really is a void where the line was drawn—under the Stern-Levison $\Lambda = M^2/a^{3/2}$, the smallest planet is Mars at 6.138304×10^{-3} and the largest dwarf is Pluto at 1.913885×10^{-8} , a factor of **320725**, a gap of 5.5061 decades. Every one of the eight planets exceeds every dwarf planet, without exception. And whether the gap is real can be told only against the jumps inside the groups—sorting thirteen bodies gives twelve jumps, and the largest falls exactly at the classification boundary. At **320724.8577** it is **2632.4440** times the second largest, the **121.8354** between Saturn and Uranus. The comparison must not be against the spread—the planets run over 1.386106×10^6 from Mars to Jupiter, and against that the gap seems to vanish. Being widely spread and having a void in the middle are different things. So the line may be drawn anywhere and give the same classification—at $\Lambda = 10^{-3}$, 10^{-5} or 10^{-7} , the same 8 against 5. Fixing the threshold and fixing the classification have come apart, and that is what “a promise and yet not arbitrary” amounts to. Nor is the gap an artefact of the exponents—of **156** pairs (p, q) in M^p/a^q , **130** (**83.33** per cent) sorted them the same way. With $p = 1$, separation holds for q from 0 to 4.75 and breaks at 5.00: wide, but not unlimited. Drop the mass, though, and it fails—on distance alone the order reverses. What carries the classification is mass; distance only reinforces it. Mass alone already separates Mars from Eris by 20.4719, so Λ did

not create the gap but widened one already there by **15667**. Part of the impression of five decades is made by the formula. One thing separates them——whether moving the threshold changes the classification or leaves it alone. It is a measurable distinction: count every jump and see whether the boundary carries the largest. The significance level 0.05 of Paper 317 sits at no gap in nature and 0.04 or 0.06 would have served. Under one word “promise”, some follow gaps and some cut continua. One step is added to Paper 306——306 wrote that the count of base units is a promise. This paper goes on to “a promise, and there really is a gap where the line was drawn”. “It is a promise” is not the end of a classification but the beginning of the next question. One last thing——the gap may yet be filled by a body not yet found. One object with Λ near 10^{-4} would collapse the boundary jump at a stroke. This conclusion holds for the thirteen bodies now known and takes a falsifiable form. Which is precisely the evidence that the claim is not empty.

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