The Name “Asteroid Belt” Overstates What Is There by Two Orders of Magnitude

— The four largest bodies (Ceres, Vesta, Pallas, Hygiea) sum to 1.485500×10^{21} kg, and the belt is estimated at twice that, 2.971000×10^{21} kg — the separator is whether one is looking at the trace of something that came together or of something that never could — [Paper 685]

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— From thinking to syncing. —

Abstract

The asteroid belt is sometimes described as the debris of a shattered planet. But everything in it together comes to four per cent of the Moon.The quantity a name suggests is set against the actual balance.No new theorem or law is claimed. First, and this is the core. The whole belt is four per cent of the Moon——the estimate of 2.971000×10^{21} kg is 0.040466 of the Moon and 4.974883×10^{-4} of the Earth (Section 2). **Second, wide as it is, what is in it sits in a few bodies——Ceres alone accounts for 0.316156 of the belt, and the four largest for about half** (Section 2). **Third, set beside the neighbouring planet, the orders do not match——Mars outweighs the belt by 215.9879, so the belt is not even the amount of a planet that failed to form** (Section 2). **Fourth, gathered together it is still small——a single sphere at 2700 kg/m³ would have a radius of 640.4473 km, which is 0.368709 of the Moon’s** (Section 3). **Fifth, so “a shattered planet” does not balance——had something shattered, the debris would sum to the original mass, and a body of 0.040466 of the Moon does not count as a planet** (Section 3). **Sixth, the separator is a trace of coming together against a trace of never doing so——the same scattered small bodies must be read in opposite directions according to which history produced them** (Section 4). **Keywords**: asteroid belt, mass balance, Ceres, prevented accretion, name and quantity, structure of the solar system.

Scope of this paper (scope note): **No new theorem or law is claimed——asteroid masses, estimates of the belt's total mass, and the account in which Jupiter's perturbations prevented accretion are all standard (Russell and Raymond 2011, de Pater and Lissauer 2010).Theories of origin are not entered——the dynamics of why nothing accreted is not treated; only the balance is stated.Individual bodies are not treated——identification, orbits, composition and families of asteroids are not the subject.The masses are not claimed——the values are representative, taking the belt at twice the four largest bodies is a customary rule of thumb, and the estimates carry a spread.No hazard is assessed——probabilities of impact on the Earth and their consequences are not treated.Relation to earlier papers**: **Paper 337 showed that the solar system has five edges and that the innermost and outermost differ by a factor of 5106——there one word named several distances; here one word suggests a quantity that is out by two orders. Both set a name against a number.**What is added is **setting the belt's mass against the Moon, the Earth and Mars**, **putting the share of Ceres at 0.316156**, **obtaining the radius 640.4473 km of the gathered sphere**, **showing that the shattered-planet account does not balance**, and **placing the separator on coming together against never doing so**.

1. Notation and the Question

Setting: **estimate the mass of the belt as twice the sum of its four largest bodies. The comparisons are the Moon, the Earth and Mars.**

$$M_{\text{belt}} \approx 2\sum_{i=1}^{4} m_i, \qquad \frac{M_{\text{belt}}}{M_{\text{Moon}}}, \qquad R = \left(\frac{3M_{\text{belt}}}{4\pi\rho}\right)^{1/3}$$

Take $\rho = 2700$ kg/m³. The Moon has mass 7.342×10^{22} kg and radius 1737 km.

Question: **how much does the name "asteroid belt" actually name?**

2. Four Per Cent of the Moon, All Told

Computation 2.1: **the four largest masses and their sum were taken.**

body	mass
Ceres	9.3930×10^{20} kg
Vesta	2.5890×10^{20} kg
Pallas	2.0410×10^{20} kg
Hygiea	8.3200×10^{19} kg
sum	1.485500×10^{21} kg

The belt is estimated at twice that, 2.971000×10^{21} kg.

Computation 2.2: the ratios are 0.040466 against the Moon, 4.974883×10^{-4} against the Earth and 0.004630 against Mars, so Mars outweighs the belt by 215.9879.

> **Observation 2.3**
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> **this is the core: “belt” is a word about extent, not about amount.The orbits span the whole region between Mars and Jupiter, and what fills them is 0.040466 of the Moon——taking extent and amount from the same word costs two orders of magnitude.**

Computation 2.4: Ceres alone accounts for 0.316156 of the belt.

> **Observation 2.5**
>
> **“countless small bodies” is also wrong as a statement about amount.They are numerous, but the mass sits in a few, the four largest holding about half——confusing the distribution of number with the distribution of mass costs another order.**

3. Gathered Together It Is Still Small

Computation 3.1: gathered into a sphere at 2700 kg/m³ the whole belt would have a radius of 640.4473 km, which is 0.368709 of the Moon’s 1737 km.

Observation 3.2

the shattered-planet account does not balance.Had a planet shattered, the debris would sum to its original mass, and that sum is 0.040466 of the Moon——to call such a body a planet, the word planet would have to be changed instead.

Observation 3.3

what is missing is the information.With Mars next door outweighing the belt by 215.9879, the absence of a planet here reads not as an accident but as a record that accretion was prevented——what is being counted is not what is there but what is not.

4. The Separator

Observation 4.1

the separator is a trace of coming together against a trace of never doing so.Scattered small bodies that were once one keep their total mass; bodies that never gathered keep a small one——one number, the total, separates the two histories.

Observation 4.2

beside Paper 337.Paper 337 showed the solar system to have five edges differing by a factor of 5106——there one word named several distances; here one word suggests a quantity out by two orders. The same gesture, setting a name against a number, applied to mass instead of distance.

Observation 4.3

what is not said.Neither the dynamics of origin nor any individual body is treated, and the masses are representative——what is shown is only the gap between what the name suggests and what the balance gives.

5. Roll Call and Closing

1. **four bodies sum to 1.485500×10^{21} kg** (Computation 2.1): **about half the belt.**
2. **belt at 2.971000×10^{21} kg** (Computation 2.1): **the estimate.**
3. **0.040466 of the Moon** (Computation 2.2): **the core.**
4. **4.974883×10^{-4} of the Earth** (Computation 2.2): **three orders further.**
5. **Mars outweighs it by 215.9879** (Computation 2.2): **the neighbour.**
6. **Ceres holds 0.316156** (Computation 2.4): **mass sits in a few.**
7. **gathered radius 640.4473 km** (Computation 3.1): **small.**
8. **0.368709 of the Moon's radius** (Computation 3.1): **not a planet.**
9. **shattered planet does not balance** (Observation 3.2): **the total is not kept.**
10. **came together or never did** (Observation 4.1): **the separator; Paper 337.**

Closing: **The name "asteroid belt" overstates what is there by two orders of magnitude.The four largest bodies sum to 1.485500×10^{21} kg and the belt is estimated at twice that, 2.971000×10^{21} kg, which is 0.040466 of the Moon and 4.974883×10^{-4} of the Earth.Ceres alone holds 0.316156 of it, and Mars next door outweighs the whole belt by 215.9879.Gathered into one sphere at 2700 kg/m³ it would have a radius of 640.4473 km, 0.368709 of the Moon's ——the shattered-planet account fails on the single point that debris must sum to the original mass.The separator is whether one is looking at the trace of something that came together or of something that never could.Placed among the earlier papers——Paper 337 showed one word naming five distances; here one word suggests a quantity out by two orders.To be honest——the dynamics of origin is not entered and every mass is representative.**

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