Re: Space Probe

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- *From*: "David Nakamoto" <res07oeg@xxxxxxxxxxx>

- *Date*: Fri, 31 Mar 2006 19:13:54 GMT

Hi Larry !

The analogy is based roughly on calculations I did concerning this subject, but it was done in my head, in response to practically the same question on asteroid distribution asked during a public star party. I believe the use of sand grains might be too large, if you can believe that, and that the particles might be even smaller, on the average (I was using the diameter of the largest asteroids to keep the calculations manageable in my head, but the volume was the real headache).

Just for fun. let's run through my reasoning now, using numbers pulled off the Internet. Of course, a lot is assumed here, but for this sort of fast calculation I consider the assumptions reasonable and will give a value in the ballpark.

I assume a sand grain is 1 mm large, or small if you prefer.

Since I'm relating the density of sand grains over California to the density of large bodies in the asteroid belt, let's work with areas rather than volumes. If we had worked with volumes for the Asteroid belt the figures for the distance between objects would be a lot larger, since adding a dimension provides more "breathing room." Or looking at it another way, we're in effect reducing the volume the asteroids would normally occupy. It's like squishing a loaf of raison bread flat; the distances between the raisons gets shorter.

Assume the Asteroid Belt exists between 2.3 and 3.3 AU away from the Sun. 1 AU = 150,000,000 km or 150e06 km, so the distances are 2.3 * 150e6 km = 345e6 km and 3.3 * 150e6 km = 495e6 km. Area is r^2 * pi, so the areas are 345e6 km * 345e6km * 3.14 = 374e15 sq. km and 495e6 km * 495e6 km * 3.14 = 770e15 sq. km. Subtracting one area from the other gives the area of the Asteriod belt if it were in two dimensions (remember, it is not). So the Asteroid Belt occupies 396e15 sq. km.

Let's assume we're dealing with objects 1 km across on the average and that there are 10 million of them. Then there is 396e15 sq. km / 10e6 = 39.6e9 sq. km / asteroid, or an average distance of almost 200,000 km from one asteroid to another. So we're dealing with a factor of (40 billion sq. km) / (1 sq. km per asteroid) = 40 billion.

So what happens if we use sand grains instead of asteroids? If the average palm can hold a volume of 76mm * 76mm * 25mm = 144,400 cu. mm, let's assume that's also the number of 1mm sand grains it can hold (it'll actually hold a lot less due to spaces between the sand grains, but let's go with this). Then it'll take an area of 144,400 sand grains * 40 billion sq mm /sand grain = 5.7e15 sq. mm. 5.7e15 sq mm * (1 sq. m / 1 million sq mm) = 5.7 trillion sq m. 5.7 trillion sq m * (1 sq km / 1 million sq m) = 5,700 sq km.

California occupies 163,707 sq miles, or 424,000 sq km. or 73 times the area needed for the density of the asteroids in the main belt, by these rough calculations. Los Angeles occupies 4000 sq. miles or 10,400 sq km. So if I had said scatter those sand grains over Los Angeles county I would have been more correct . . . but how many people even in Los Angeles has a good handle on how large LA County is? (^_^)

I don't claim this is accurate, but it gives a rough feeling for how empty the Asteroid Belt really is.

Sincerely,
−−− Dave Nakamoto
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−−
Pinprick holes in a colorless sky
Let inspired figures of light pass by
The Mighty Light of ten thousand suns
Challenges infinity, and is soon gone

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"Larry Stedman" <stedman@xxxxxxxxxxxxxx> wrote in message
news:stedman−4A1D1E.09462629032006@xxxxxxxxxxxxxxxxxxxxxxxxxx

> Dave, a great analogy! I assumed that there wouldn't be a problem with micro particles and your analogy and the lack of any meteorite or dust detection by the space craft going through certainly confirms that.
>
> Is the analogy something you picked for dramatic effect or does it mirror reality? Is the relative volume of space between Mars and Jupiter vs. all the asteroid matter actually in the same ratio as California's surface area vs. a handful of sand?
>
> It would be interesting to do the actual calc. We'd have to remove several clumps of sand from the initial mass to represent the main asteroids and then see what was left over. One crucial factor would be to use the estimates of how many pieces (and their size), the left over asteroid "dust" is supposed to be. Maybe the parallel is even less than a handful of sand!
>
> As to the textbook drawings... I'd rather have them put nothing between Mars and Jupiter than continue to mis−represent the space as filled with

thousands of particles and little free space. Maybe the textbooks should represent the asteroid belt by only putting in several of the major asteroids and then adding a thin arrow pointing to the space between Mars and Jupiter labeling it "asteroid belt" and explaining in a short caption that there are many small objects and particles, but that the space there is still virtually empty.

(1) Take a sheet of paper as large as California.
(2) Have someone take a handful of sand and scatter it evenly across that sheet.
(3) Now, go out there and look for those individual sandgrains.

Larry Stedman
Suburban Milky Way

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