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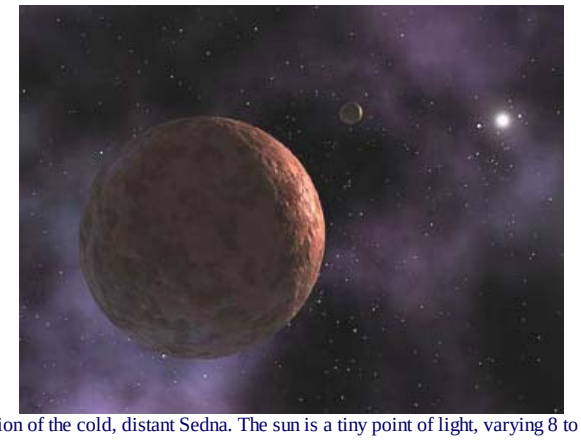
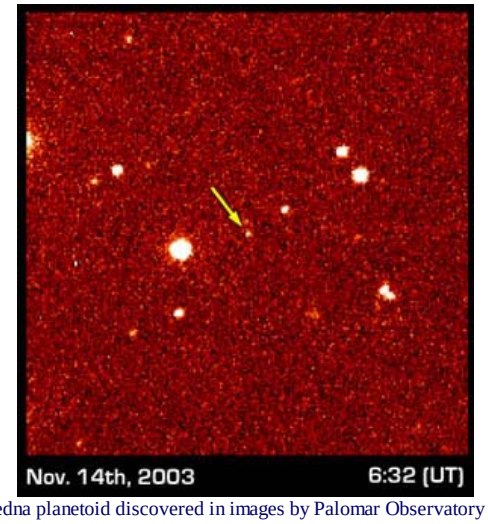
Is Our Solar System's Red, Mysterious Sedna An Alien Planetoid?



Artist's conception of the cold, distant Sedna. The sun is a tiny point of light, varying 8 to 84 billion miles away from the red planetoid in its bizarre orbit. A hypothesized tiny moon appears nearby. Graphic image courtesy Michael E. Brown, Cal Tech, Pasadena, California.

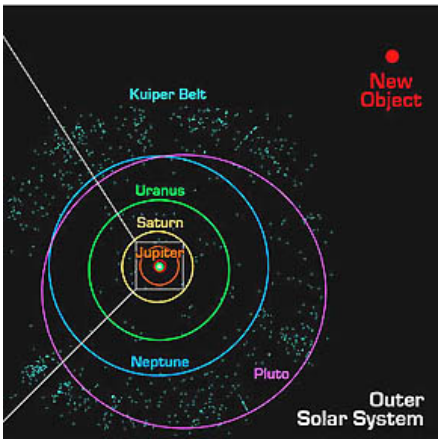
December 17, 2004 Salt Lake City, Utah - Some astrophysicists are trying to understand how our solar system formed, as baffling objects continue to be discovered. Only a year ago on November 14, 2003, a mysterious object was found at the far reaches of our solar system that has the strangest elliptical orbit of anything revolving around our sun.

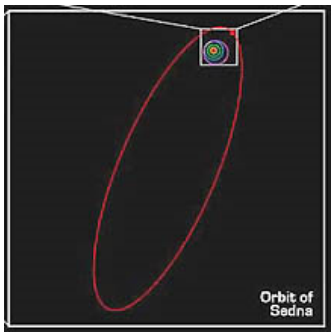


Sedna planetoid discovered in images by Palomar Observatory on November 14, 2003. Image credit: NASA/Caltech/Michael E. Brown.

Referred to as a planetoid, scientists named the object "Sedna," after the Inuit goddess who created Arctic sea creatures. The Arctic name is fitting for probably the *coldest* object in our solar system, with temperatures never rising above MINUS 400 degrees Fahrenheit. Ironically, as cold as it is, Sedna is red hot and shiny to look at through high-powered telescopes like the orbiting Spitzer Space Telescope. Astronomers says that the only other object so red in our solar system is Mars and to date, no one knows what makes Sedna so red.

Sedna is estimated to be three-quarters the size of Pluto. It travels in a very bizarre elliptical orbit that takes it in a range from about 8 billion to 84 billion miles from Earth beyond the Kuiper Belt of icy objects and near the edge of the Oort Cloud, the source of comets. At those distances, the planetoid takes at least 10,500 years to complete one revolution around the sun. Scientist have puzzled about what exactly Sedna is and how it got to be where it is in such a radically eccentric orbit?

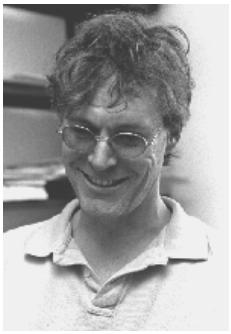




Sedna is estimated to be three-quarters the size of Pluto, about 1000 miles in diameter.
Its bizarre elliptical orbit takes it from 8 billion miles at its closest to 84 billion miles at its most distant from Earth beyond the Kuiper Belt of icy objects and near the edge of the Oort Cloud, the source of comets.
Our Earth takes 365 days to go around the sun. Sedna takes 10,500 years to complete one revolution around the sun.
Graphic images courtesy Mike Brown, Ph.D., Cal Tech, Pasadena, California.

Now, in the December 2 issue of *Nature*, physicist Ben Bromley, from the University of Utah, and astronomer Scott Kenyon, of the Smithsonian Astrophysical Observatory at Harvard in Cambridge, Massachusetts, have come up with a startling hypothesis, based on their work with computer simulations. The team thinks that Sedna is an *alien planetoid* from somewhere else in our galaxy that was pulled into our solar system when an *alien star* passed by about 4 billion years ago. Astronomers have been looking at distant stars the past few years to find planets and now have a long list of extrasolar planets. So, how ironic that we might have an extrasolar planetoid in our own solar system. I talked this week with Dr. Bromley about mysterious Sedna and his computer simulation studies of Sedna's bizarre orbit that suggest the red object was left behind by a star that passed by our solar system about four billion years ago.

Interview:



Benjamin Bromley, Ph.D., Physicist,
University of Utah, Salt Lake City, Utah.

Ben Bromley, Ph.D., Assoc. Prof. of Physics, University of Utah, Salt Lake City, Utah:
"Sedna is an object that was found in November of 2003. It's an object that orbits quite far away from the sun, compared to the 9 major planets we know of. Sedna gets no closer than about twice the distance between the sun and Neptune. It travels on a highly elliptical path, taking it to about 1,000 times the Earth's orbital distance from the sun. This is a very

unusual orbit and completely unexpected from the point of view of other bodies we've seen orbiting our solar system.

What could possibly put an object like Sedna out there on this peculiar orbit? Most bodies that have elliptical orbits were placed on these orbits by interaction with one of the major planets. For example, Neptune Neptune put Pluto on its eccentric orbit. It would be interesting if Sedna were put on its orbit by some Neptune-like planet way out in the remote boondocks of the solar system. But we don't know of any (out there).

So, our work was inspired by Sedna to attempt to explain it. One of the best and only explanation we could come up with was that Sedna was the result of an interaction with another passing star early in the history of the solar system.

HOW IN YOUR WORK DID YOU GET BACK SO FAR AS 4 BILLION YEARS?

That's a very good question. The requirement that we work with a very young solar system in the production of Sedna's orbit is that our sun must have had an encounter with another star. That could only have happened very early in the history of the solar system. The sun, we believe, like other stars was born in a cluster of stars. So, at early times, the cluster members could have passed by each other. In time, that cluster would sort of disintegrate, just sort of dissolve into the blur that is our Milky Way. So, we need for the star encounter to have happened early to make the chance of a stellar encounter, an interaction between our sun and a passing star, be plausible.

At this point in time, 4.5 billion years after the sun was formed, we expect there will be no such encounters. The chances are very small that we're going to run into another star in the Milky Way.

The Passing Alien Star Hypothesis

A passing star explains two things: first, it explains Sedna's peculiar orbit. Second, it also explains a structure of the solar system that has been somewhat mysterious. Outside of Neptune, there is a belt of objects a ring or disk of objects that are small about 1,000 miles in diameter and smaller. There are about 1,000 known of these objects and they are called Kuiper Belt objects. As we map the outer solar system at further distances from Neptune, we find that there is an edge to this Kuiper Belt. It sort of stops. There are no more objects outside about 50 times the Earth's orbital radius from the sun, compared with Neptune's 30 times that same distance.

So, the surprise is that this edge exists. When we look out at other stars where planet formation is occurring, we find evidence for planetary disks places where things like these Kuiper Belt objects form. There is no abrupt edge or signal that there is some mechanism that turns off the formation of these objects at some specific distance.

Kuiper Belt Is Sheared Off As If Something Cut Through One Side

So, the fact that our Kuiper Belt has a sharp edge is a real surprise. A passing star can actually sharpen the Kuiper Belt. It can disrupt orbits of objects that are formed outside the observed Kuiper Belt. So, (the passing star) explains two things an important fact.

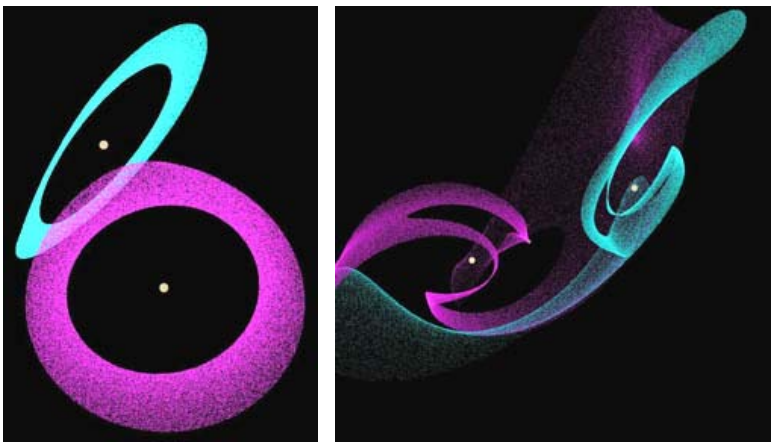
LET ME MAKE SURE THAT I FULLY UNDERSTAND WHAT YOU MEAN: IF THE HYPOTHESIZED ALIEN STAR HAD COME BY ABOUT 4 BILLION YEARS AGO AND WE ALREADY HAD THE KUIPER BELT RESIDUE OF ICY SNOWBALLS OUT THERE, THEN A PASSING SUN MIGHT HAVE SHEARED OFF COMING THROUGH THAT KUIPER BELT AREA?

That's perfect. I wish I had said it that way myself. So we ran simulations of this process of a passing star, trying to observe - using a computer - the formation of these objects and the shearing of the disk in which the Kuiper Belt objects lie by a passing star. And in addition, to the placement of one of these objects on a Sedna-like orbit.

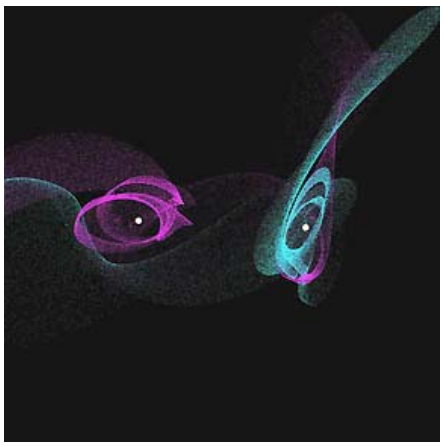
Computer Simulation of Planet(oid) Captures

The surprise was in our simulation some of the objects were disappearing. They were just not around the sun anymore. When we looked at the output of our simulations, we noticed

that some of the objects were actually traveling along with the passing star.



Capturing planets: A simulated stellar flyby. A passing star and the Sun may have exchanged small planets and dust as they
flew by each other. These images depict three stages of this process: Initially (top left image), the dust and planets orbit in circular
disks around their parent star. As the Sun and the passing star approach each other, the force of gravity can yank small bodies from one star
to the other (top right image). Once the stellar encounter is complete, the disks contain a mixture of captured and indigenous planet
(image below). Images courtesy Benjamin Bromley, Ph.D., Univ. of Utah, Salt Lake City.



So, we understand that planet formation is something that happens quite commonly around other stars. We see it in young stars today. So, why couldn't the sun have done the same thing that the passing star did to our own solar system? Why couldn't our sun have captured material from the passing star? That's what led to our prediction that this is a possibility that Sedna is a captured planet.

Could Our Moon Also Be Captured Alien Star Residue?

AND WHAT ABOUT OUR OWN MOON BEING CAPTURED?

It's more difficult to place material into the inner solar system from a passing star. A more probable scenario for the moon's formation is that in the process of building up the planet Earth a process of essentially coagulation of material sticking together and clumping up through gravitational attraction the process was rough, in some sense. It involved a major collision between two bodies and the moon was likely gouged out of the Earth by this process. To have it captured is a more difficult thing for the Earth to do.

I THINK SOME SCIENTISTS OVER THE YEARS HAVE SPECULATED THAT PERHAPS THE MOON WAS CAPTURED THAT'S WHY I WAS RAISING IT IN THE CONTEXT OF YOUR RESEARCH.

Yes. The next best idea is that the moon was floating around the inner solar system somewhere and in the process of forming the Earth the various forces that kick smaller bodies around perhaps the moon was stolen, if you will, by the Earth, trapped as it passed or grazed. There is work being done to simulate these various processes. We do some of this work when we are seeing how planets like the Earth form. We watch as simulated bodies travel around the Sun. They interact, sometimes collide, sometimes pair up for a time, and perhaps the moon was involved in that sort of dance.

I've seen some beautiful simulations, however, of actual collisions between the Earth and another object that produced a large amount of debris, including what eventually became the moon.

WHAT IS OUR BEST CHANCE OF TRYING TO GET SOME KIND OF COMPOSITION SPECTROSCOPY ON SEDNA?

That's a really good question. We will learn a lot more about objects like Sedna. Presumably there are others. As our technology gets better, as we put higher powered instrumentation on Sedna, perhaps we will be able to determine its composition. My dream scenario is that we would actually be able to send something out to the outer solar system and directly probe objects like Sedna.

Searching for Other Alien Planetoids In Our Solar System

I just want to emphasize that the important next step for us in our understanding of the outer solar system is the detection of more objects. One we have a better map of the outer solar system, we'll really be able to understand what went on 4 billion years ago. We'll be able to tell if a passing star really did lose some material to the sun and we will be able to provide the details of how the star passed by.

IT'S INCREDIBLE AND IT ALSO MAKES ME WONDER ABOUT THE HYPOTHESIS OF A PROFESSOR IN A SOUTHEAST UNIVERSITY THAT THIS MIGHT HAVE BEEN A BINARY STAR SYSTEM IN THE BEGINNING AND SOMEWHERE OUT THERE BETWEEN THE KUIPER BELT AND THE OORT CLOUD AT LEAST 1/4 OF A LIGHT YEAR AWAY THAT THERE MIGHT BE A BROWN DWARF ORBITING.

Yes, that is an exciting possibility.

COULD THE DEMISE OF THAT BINARY STAR IN SOME WAY HAVE BEEN IMPACTED BY THIS PASSING ALIEN STAR THAT LEFT SEDNA HERE?

That would be one possible next step for our simulations. we would love to put in more detail and realism, considering the fact that our star was partner with some other large object.

THAT GOT AFFECTED BY A PASSING ALIEN STAR.

Yes! Yes, it would be very interesting to simulate the evolution of a cluster of stars and see what those various possibilities are and how in detail the cluster evaporates.

WHAT IS SEDNA MADE OUT OF THAT IS DIFFERENT FROM THE EARTH AND THE REST OF THE SOLAR SYSTEM?

That's a great question. On one hand, I really hope is like the other objects we see in the outer solar system because what that means is that planet formation as we observed it to happen around our own sun is the same for other stars. That would increase the likelihood that other stars are capable of producing life-bearing planets like the Earth.

On the other hand, it would be really exciting if Sedna were very different because we will learn something from that piece, too.

The Search for Other Life On Extrasolar Planets

- Current number of extrasolar planets discovered around main sequence stars:
  118 planetary systems
  134 planets
  14 multiple planet systems

This work in researching planet formation is extremely exciting. We're going to be having just a wonderful as our theories grow and understanding strengthens, we'll be able to compare these ideas with what we are actually seeing in the universe. The technology for detecting planets is growing in great leaps and bounds and we hope within a decade or so, we'll be able to image planets like the Earth. This is a really good time to be working in this field.

AND IF YOU CAN IMAGE PLANETS LIKE THE EARTH, YOU ARE RIGHT NEXT DOOR TO THE QUESTION: IS THERE OTHER LIFE IN THE UNIVERSE?

That's it. That for me is the biggest question of all and the ultimate driver in this type of work. If we can answer that that's it: Are we alone?"

More Information:

If it happened once, could our solar system have another destructive encounter with a passing alien star? Dr. Bromley thinks not. He says the chance is "effectively nil" because the sun no longer is close to other stars in a cluster as it once was four billion years ago.

Editor's Note: The closest stars to our Sun are the trio, Alpha Centauri A, Alpha Centauri B and Proxima at 4.35 light-years distance. Alpha Centauri A is a yellow star with a spectral type of G2, exactly the same as the Sun's. Therefore its temperature and color also match those of the Sun. Alpha Centauri B is an orange star with a spectral type of K1. Whereas Alpha Centauri A and B are stars like the Sun, Proxima is a dim red dwarf with a spectral type of M5 - much fainter, cooler, and smaller than the Sun. Proxima is so faint that astronomers did not discover it until 1915.

For more information, see **03/15/04 Earthfiles** report about Sedna's discovery.

Websites:

About Sedna: **http://www.gps.caltech.edu/~mbrown/sedna/**

About Planet Formation:

http://cfa-www.harvard.edu/~kenyon/pf/index.html

http://www.obspm.fr/encycl/cat1.html

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