

Black hole vs. wormhole

The Urth list — 17 messages, 4 voices, 02 Jul 1998

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mary whalen — 02 Jul 1998, 19:52

This is Sean Whalen (prion).

In looking through the archives, I've seen much discussion about the black hole at the center of Urth's sun which is causing it to die prematurely.

However, if a black hole really was at the center of the sun, or even touched it, it would absorb all the material of the sun in seconds, growing a small bit (relatively) in the process. Urth would be circling a black hole, not a red dwarf.

I have always assumed that it is a wormhole at the center of the sun. It is at least twice referred to as "the worm at the heart of the sun."

I think this is partly a pun by Wolfe, as well as representing the dragon (called worm by the Norse) Nidhogg(r), who gnaws at the roots of Yggdrasil, the World Ash.

A wormhole is not a physical object, it is a four-dimensional structure of space-time that has the physical form of a spherical hole in the universe, leading to another place. The mass at the center of the sun would fall into the hole and lose mass, which is what the inhabitants of Urth see. The more mass that falls into the hole, the smaller the sun gets. With less mass it fuses less of its atoms and produces less energy, which is why it is red (red is the least energetic form of visible light). It would, however, take many millennia for the sun to become consumed entirely. That's much longer than the few seconds it would take for a black hole of any size to consume it, however, but VERY much shorter than the billions of years it would exist as a fusing star otherwise, and the trillions upon trillions of years it would have, after it stopped fusing, as a white dwarf.

This also relates to some comments I remember about the "black hole" possibly being the other side of the white fountain that Severian inserts into the old sun. It was theorized by someone that it's like a time loop, the hole exists because he will create the fountain and vice versa.

This theory cannot be so because if it were so, the fountain would just plug the hole and the sun would remain a small red star. The fountain has to give more than is taken for the old sun to grow larger and gain back the energy.

But, more than this, the white fountain would be unable to "plug" a black hole at all. A black hole is a physical object with mass and size. The fountain puts out energy and matter, and is physical as well. You can't plug an object with another object. The black hole would just be fed more by the matter coming from the fountain. And as I said earlier, the black hole would have consumed the sun seconds after they touched anyway!

A wormhole, however, could be "plugged." The white fountain would send all the matter the hole would be able to take into it, and leave enough left over to continually be replenishing the sun as well. It would not just stop dying, but begin growing.

I think I should also comment here about what Baldanders said about black hole, white fountains, and energy flow between dimensional levels.

Baldanders is the only character in the books who calls the thing at the sun's center a black hole. He also says it has taken him a (presumably long) lifetime of study to figure this out. However, he doesn't really have a very powerful technology for matters like this (he's mainly a biologist) and is wrong, I believe.

However, he's right about the flow of energy between universes (which he may have learned from the Hierodules, who are in a position to know about such things, if asked). Even though Il'I Tzadkiel tells Severian that the Brook Madregot flows from the higher state of Yesod to Briah, this is the natural outlet of energy, just like all matter. However, just as Baldanders says, when a black hole forms in a universe, it sends matter into a higher universe as a white fountain.

This is just like a chemical reaction. The normal state is for entropy to cause matter to go into a lower state (like the Brook does), but if there is enough matter concentrated into one place, a reaction occurs releasing more heat, increasing the energy level. Just as you must apply concentrated heat of a certain and specific amount to an object to cause it to burn, releasing energy as fire, you must concentrate a certain amount of matter into a space to cause this matter to gain a level.

prion

Jason Voegele — 02 Jul 1998, 23:04 · follows mary whalen

prion wrote:

However, if a black hole really was at the center of the sun, or even touched it, it would absorb all the material of the sun in seconds, growing a small bit (relatively) in the process. Urth would be circling a black hole, not a red dwarf.

While your theory that the cancer at the heart of the Sun is a wormhole (rather than a black hole) is interesting--and perhaps true--it is not necessarily true that a black hold would consume the Sun so quickly as you assert. Black holes have been given a reputation for being super powered vacuum cleaners in outer space. However, a black hole has NO effect (other than the normal gravitational attraction any other massive body would have) on objects that are not within the proper radius (Swarzchild radius, if I recall correctly). Thus, a small black hole could be moving around slowly within the heart of the Sun, sucking up little bits and pieces as it went, without an instantaneous mass-consumption of the Sun's energy. Witness David Brin's EARTH, or Dan Simmons' HYPERION for an example of a black hole slowly eating away at the Earth's core.

Jason Voegele

mary whalen — 02 Jul 1998, 20:36 · follows Jason Voegele

This is Sean Whalen (prion).

I'm afraid I must defend my remarks on the nature of black holes.

Jason Voegele asserts that a black hole is not a guzzler, but has only the gravitational effect of any other object of the same mass. This is absolutely true. However, if a massive object were to be near enough to touch the sun, let alone be within it, without revolving around it at nearly the

speed of light, the two would merge into a larger object consisting of both the components. If the massive object were a black hole, in the merging the end result would be a large black hole, as no black hole can be destroyed by the addition of new mass or transformed into any other class of object. The absorption effects are not limited to the Schwarzschild radius. This measure is the size of the radius of a black hole in comparison to its mass; a ratio relationship. The SR is thus the size of a black hole of a specific mass; that is, the mass can be exactly determined by the size of the black hole. The SR is merely, then, the size of the hole, the distance from the center at which matter can only escape by moving directly away from the hole at the speed of light. Anything closer, by definition, is inside of the hole. Its gravitational effects can be felt over an infinite distance, which increases in area at the speed of light, which is also the speed at which gravity propagates. The sun is slowly sucking everything in the universe into itself, as is everything, but most things are moving away from it much faster than its gravity absorbs matter inwards. In addition, Einsteinian mechanics and quantum mechanics are the sciences which describe some events of a black hole as opposed to Newtonian mechanics. If you are far away from the hole, it will be just like a massive object of the same mass would be, as I meant when in my post I described that the distant Urth would be circling the black hole, not falling into it. However, if an object is close to a black hole and not moving away very quickly (as it would certainly would not be doing if the black hole were inside of it) it will be sucked in because of gravity, just as a bird falls to the Earth if it stops flying.

prion

Jason Voegelé — 03 Jul 1998, 00:02 · follows mary whalen

prion,

You're certainly right about how such a black hole could "guzzle" the Sun if it were planted firmly inside of it. However, I just do not believe that it is necessarily such a fast process. A small black hole still has a small Schwarzschild radius and would thus be slurping some amount of energy from the Sun, but not necessarily guzzling the whole thing at once.

Jason Voegelé

(who is admittedly arguing from a fading memory of his Astronomy course several years ago)

-----Original Message-----

From: mary whalen <marewhalen at yahoo.com>
To: urth at lists.best.com <urth at lists.best.com>
Date: Thursday, July 02, 1998 11:39 PM
Subject: (urth) Black hole vs. wormhole
This is Sean Whalen (prion).

I'm afraid I must defend my remarks on the nature of black holes.

Jason Voegelé asserts that a black hole is not a guzzler, but has only the gravitational effect of any other object of the same mass. This is absolutely true. However, if a massive object were to be near enough to touch the sun, let alone be within it, without revolving around it at nearly the speed of light, the two would merge into a larger object consisting of both the components. If the massive object were a black hole, in the merging the end result would be a large black hole, as no black hole can be destroyed by the addition of new mass or transformed into any other class of object. The absorption effects are not limited to the Schwarzschild radius. This measure is the size of the radius of a black hole in comparison to its mass; a ratio relationship. The SR is thus the size of a black hole of

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prion

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mary whalen — 02 Jul 1998, 21:40 · follows Jason Voegele

This is Sean Whalen (prion).

Jason, thanks for addressing the issue of the object at the center of the sun in tBotNS, but I still know a black hole, of any size, would absorb the whole of the sun in a few seconds.

At the Schwartzchild radius, the outer edge of the black hole, matter is drawn by gravity toward the center at the speed of light, and thus nothing can escape from this distance. At greater and greater distances from the center, matter is drawn toward the center at slower and slower speeds, but as the hole absorbs the matter right next to it while in the sun, it grows larger and its gravitational force grows as well, in a self-feeding cycle that only ends after all of the sun's matter has been drawn into it, which occurs more and more quickly as it absorbs the matter right next to it at almost the speed of light all the time, and it's surface area increases the more it absorbs. Don't forget that the sun's own gravity is drawing all it's material inward towards the center without any help from the black hole. That's why the sun experiences fusion: the matter of the sun is pulled toward the center by the sun's gravity with such force that the atoms fuse together and produce energy. With a black hole at the center, all of the mass that would be fusing would be drawn into the hole almost immediately and would continue to be drawn into it at an increasing rate as the hole's size and gravity increased. This (w)hole process would take only a few second to occur.

prion

mary whalen — 02 Jul 1998, 23:08 · follows mary whalen

This is Sean Whalen (prion).

I've just thought of some new evidence for the thing at the center of Urth's sun not to be a black hole.

Do you know what a quasar or active galactic nucleus is? It's a black hole that is absorbing a large amount of mass by sucking in neighboring stars. As the gravity draws the matter toward it at an increasing speed, the matter bunches up together at high (near light) speed. As it presses together, it is eventually so pressurized that the atoms fuse in huge numbers and release energy. The energy released in this way that is not pointing toward the black hole escapes, and we see the light (and other radiation) given off with telescopes.

This same process occurs with a black hole of any size that is absorbing mass. When there's much more mass than there is hole, a lot of mass is involved in the process. The fusion caused by this would cause an explosion, assuming the hole didn't grow big enough for it to absorb all the rest of the mass before the energy can make it through the mass (which I think it would probably be able to do).

This same process happens in large suns that die. When a large star is "alive," it is undergoing fusion in its core. When the core has been fused into iron, no more energy is gained by fusing the iron into large molecules, energy is absorbed instead. When this happens, the star's gravity is still pulling the star toward the center, but the core is releasing no energy that's pushing out. The core fuses more, absorbing gravitational energy. It becomes so massive, it pulls the core together until the protons and electrons in its atoms actually are fused together themselves into neutrons. THIS fusion releases a lot of energy. It causes a supernova. The outer part of the star is blown away by the energy, along with much of the fused and unfused matter near the core. What remains of the core is a neutron star.

If an even more massive star has fused its core into iron, the gravity pulling in is so powerful it immediately forms a black hole at the center. The outer layers rush toward this gravity center so quickly that much of it fuses and releases a lot of energy. This is a more powerful supernova (I believe it's called a hypernova, but I don't remember for sure).

If the star is even more massive, the black hole that forms from the core is so massive it sucks all the rest of the star into it so quickly that almost no energy escapes. In this case, no supernova occurs.

prion

William H. Ansley — 03 Jul 1998, 02:22 · follows mary whalen

I still know a black hole, of any size, would
absorb the whole of the sun in a few seconds

prion,

I don't know if you're right about this but it seems to my tired and befuddled brain (after reading over 20 of your messages more or less in a row) that you've absorbed the entire Urth list in nearly as short a time. 8->

William Ansley

mary whalen — 03 Jul 1998, 08:38 · follows William H. Ansley

This is Sean Whalen (prion).

Peter Stephenson wrote:

I suspect prion's right about what a real black hole >would do to the sun. I don't necessarily think that >matters to Wolfe.

It is possible Wolfe wouldn't have known or cared about the real effects of a black hole in the sun. However, since the story would be entirely scientifically plausible (in general) if it were a wormhole instead, which is what I have been arguing. It also is referred to as a "worm" in several parts of The Book of the New Sun. I think this is meant to be a pun on wormhole. The reason he would want to make this pun, is that in Norse mythology the decay of the universe is caused by a worm (what we call a dragon) who is gnawing at the roots of the World Ash (a giant tree that leads from Heaven to Hell).

prion

mary whalen — 04 Jul 1998, 09:47 · follows mary whalen

This is Sean Whalen (prion).

Matt Freestone wrote:

This sounds right- it's a positive feedback cycle, but >it doesn't prove your claim that the process only >takes a few seconds: it depends how big the black >hole was to start with, and on the rate of growth.

The initial size of the black hole doesn't have much to do with the time for the cycle to complete. Any size of a hole would complete the process in under a minute (probably under thirty seconds, but I'm not sure). Even a microscopic black hole would absorb enough mass in under a second to be much more massive than a human.

The calculations that an astrophysicist would have to perform would be how small the initial black hole would be before the outer part of the star exploded before the black hole finished (as it would if the hole was microscopic). I explained that stars which naturally create black holes at their cores (which our sun will never be able to do) either are going to fall entirely into the black hole (if it's big enough to absorb it in some number of seconds) or partially explode (if it's smaller and takes a few extra seconds).

Scientists still don't know the exact size a black hole must be in relation to the star it's absorbing to completely absorb it (and it's more complex than just a ratio on these two things). Nevertheless, in either case, the process is very quick.

prion

Jason Voegelé — 04 Jul 1998, 14:39 · follows mary whalen

Well, I've pretty much given up on the debate about a black hole absorbing a star in a matter of seconds since I don't have the facts to back up my side, and prion seems to know quite a bit more about the process anyway. But this statement has me a little confused:

prion wrote:

Scientists still don't know the exact size a black hole must be in relation to the star it's absorbing to completely absorb it (and it's more complex than just a ratio on these two things).

Are you suggesting that there is some critical size for which a black hole is able to completely absorb a MUCH larger star? If so, what about a black hole that is VERY small, on the order of a

few nanometers in diameter? Of course, I doubt such a thing could occur naturally, but the text suggests that it's an artificial creation anyway (at least in the sense that it didn't occur without some bit of tinkering by someone out there). Would such a small black hole still be capable of absorbing a star so quickly?

Anyone on a close personal relationship with Stephen Hawking? 8^)

Jason Voegele

mary whalen — 04 Jul 1998, 12:51 · follows Jason Voegele

This is Sean Whalen (prion).

Jason, I've pretty much exhausted my knowledge about black holes, too, so don't worry.

To explain that (admittedly complex) sentence, what I meant was that if a small black hole has to absorb a significantly larger amount of mass all at once, the mass far away from the black hole will be accelerated so much that it squashes against the mass closer to the black hole, and some of this mass will fuse, releasing energy and causing an explosion which lets some of the outer mass accelerate in the opposite direction enough to escape the black hole's gravity. A black hole can absorb an infinite amount of mass, but difficulties like this can arise if it tries to absorb all of it at once.

Atomic-size (and much smaller) black holes can exist naturally. In fact, there is a theory that they form all the time all throughout space. They would quickly absorb into themselves all matter if it weren't for the fact that there is a quantum mechanical process called Hawking Radiation (named after Stephen Hawking) that takes advantage of the fact that quantum uncertainty dictates that the mass of the black hole is not 100% certain to be in the black hole. This slight chance causes some particles and antiparticles to form outside of the black hole that are made up of the material of the black hole itself. These are usually drawn back into the black hole and cause no change. However, these naturally forming sub-atomic black holes only need to have this chance of losing matter happen once, because the loss takes all the mass of the hole quickly so that the particles that would be reabsorbed have nowhere to be drawn back to. There is a lot more about this phenomenon, but it really doesn't matter here.

prion

mary whalen — 05 Jul 1998, 11:20 · follows mary whalen

This is Sean Whalen (prion).

I don't think I know any sources that say what would happen if a black hole spontaneously appeared in the center of a normal star. I'm basing my arguments on the properties of black holes and applying them to an abnormal situation.

I'm also not using any new information to back up my theory. Everything I've said that applies to a black hole being able to absorb a sun in which it appears is based on properties that were worked out well before any of the New Sun books were written.

It's true that no one can create wormholes today, but no one can make black holes either. The properties and physical description of wormholes are scientifically described today, they're just four-dimensional holes; nothing complex.

It's possible that the black hole could be regulated, but why? If someone put it there, why would

they want it to be so slow? And they could just make a wormhole instead, and not have to monitor or control it at all.

prion

mary whalen — 05 Jul 1998, 21:05 · follows mary whalen

This is Sean Whalen (prion).

Mantis, I don't doubt that if the sun became an accretion disk around a black hole it would last longer than if a black hole simple appeared at the center of the sun, or was simply inserted with no effort to form an accretion disk. However, Urth's sun is definitely not a disk circling a black hole, it's still a sphere.

prion

mary whalen — 06 Jul 1998, 09:41 · follows mary whalen

This is Sean Whalen (prion).

All right, I think Damien Broderick's evidence shows conclusively that a black hole could exist inside the sun. However, I still don't think that this is what happened to Urth's sun.

First of all, liberation of energy from matter by gravitation is much more efficient than doing so by fusion. It seems that using a black hole would actually cause the lifetime of the sun to dramatically increase as a main sequence star. Why would Urth's sun become to weak so quickly if this were true?

Finally, how do you plug up a black hole? A black hole takes in matter, a white hole puts out matter. As the black hole takes matter in, it grows. Putting a white hole by a black hole would cause the black hole to enlarge, not plug it. Since the two objects can't occupy the same space, it also seems that there would be an unbalancing effect caused by the unequal push of the energy of the white hole in one direction and the suction of the black hole in the other. This would probably make the sun be turbulent, rather than stable.

prion

Peter Westlake — 06 Jul 1998, 16:54 · follows mary whalen

At 09:41 1998-07-06 -0700, prion wrote:

This is Sean Whalen (prion).

...

Finally, how do you plug up a black hole?

Suppose the white hole was the other end of the black hole, so that they were two ends of a wormhole (which prion is keen on). Mightn't they just cancel out?

Of course, that makes the creation of the White Fountain in _Urth_ a bit hard to explain, unaccompanied as it is by a black hole. Hmmm... maybe a black hole meeting a white hole is like two bits of pipe between universes meeting and joining into a longer bit of pipe, which passes by our universe altogether. A very Spectacled-Bear-like notion.

SBear.

mary whalen — 06 Jul 1998, 17:11 · follows Peter Westlake

This is Sean Whalen (prion).

SBear, I don't think that the black hole and white fountain are the same hole. If that were so, when they canceled each other out, which I'm not sure that they would do anyway, the sun would remain small and red. The white fountain is continuing to send forth matter and energy from itself, with is replenishing the sun back to it's old characteristics. I think I may have discussed this in my original post on black holes.

prion

mary whalen — 02 Aug 1998, 17:45 · follows mary whalen

This is Sean Whalen (prion).

This is the latest thing I can think of that I think is evidence that the object in Urth's sun is a wormhole rather than a black hole.

If the sun became cool enough to be red, the Urth would be much colder than it is in the books. However, if the Urth were closer to the sun, it could continue to exist in a fairly reasonable, though uncomfortable, state.

The mass of the sun would fall through the wormhole and no longer be in the sun. This process would cause the sun to gradually become less massive. The Urth would have less of a gravitational pull toward the sun, but still be moving at the same speed. It could only stay in orbit by moving closer to the sun. I don't know enough about physics to determine if this also could cause the moon to come closer to the Urth as a result of complex interactions.

A blackhole would absorb mass from the sun, but it would still be there in the black hole. The mass of the system would not change and the Urth would continue in its current orbit. It would be much colder than it is in the books if this happened.

prion