

The Care and Feeding of Black Holes

© Walter Driedger, P. Eng., 2000 May 20. [walter\(at\)driedger\(dot\)ca](mailto:walter(at)driedger(dot)ca)

First published in *Astronomy*, July 1995

This Adobe® file is available for download at <http://www.driedger.ca/>.

Gravitational attraction,
Always mutually shared,
Is the product of the masses
Over distance squared.

Congratulations! You just got a birthday card from your dear Aunt Sally in which she wishes you long life and prosperity and tells you that she is giving you something you have always wanted: A little black hole of your own! Her name is Blackie and she weighs only about nine hundred million tons. A quantum black hole, a mere pup who was left over from the Big Bang and has been starving ever since. That accounts for her puny, undernourished size. She is waiting in a high Earth orbit and is anxious for you to take delivery at your earliest convenience.

Understandably you are a little nervous. Black holes have acquired an undeserved reputation as dangerous and untrustworthy pets. Nothing could be further from the truth! A quantum black hole of reasonable mass, say a few billion tons, can be taught to follow you around like a puppy. The secret is in the feeding.

As with any large pet, a black hole involves some serious responsibilities. Before we get into the details, let's review a few of their important habits. It is well known that a black hole will swallow anything nearby without ever getting indigestion. The operative word here is "nearby". As long as you keep a reasonable distance, there is no danger. The actual size of Blackie is somewhat less than that of an atom. But that is a little misleading. Her gravitational field extends well beyond that. One advantage is that it drops off very rapidly. In fact at about eight feet out, her gravity is about equal to that of our Earth at the surface. Don't move any closer! At four feet, the gravity is four times Earth. Two feet closer and it rises to sixteen. One foot closer and you'll be two feet less. I mean that the gravity at your feet would be about **fifty** times the gravity your body was designed to handle. The rest of you would be further away and consequently the gravity would be a lot less. You are certain to suffer from a loss of structural integrity, you will disintegrate. In fact, you will come unglued. Your feet would be ripped off while your head would remain quite light at a gravity of one. Blackie can be very affectionate but you have to be careful.

As your feet proceed toward Blackie, the gravitational field they encounter becomes ever more intense. Your feet would get ripped into molecules, the molecules into atoms, and the atoms into sub-atomic particles. This would all happen in a flash -- a flash of light, radiation and atomic debris. But as long as you keep a friendly distance, at least eight feet, you will be quite safe.

Your first job will be to bring Blackie home. This requires a certain amount of thought. Trying to use her gravitational attraction to tow her might work, but I don't recommend it. A possible approach would be to tether a thousand ton weight at the end of a cable and dangle it near her, like bait. At the eight foot distance, the weight would attract Blackie with the force of one thousand tons. This doesn't really carry a lot of weight when opposed to Blackie's 900 million. There is also the likelihood that you might misjudge the distances and that Blackie would swallow up your bait in the aforementioned flash.

Another method is suggested in Larry Niven's story *The Borderland of Sol*. The villain of the piece, Dr. Julian Forward, manipulated his black hole by blasting it with ions so that it acquired a large electric charge. He then towed it about using an opposite charge. This has the same disadvantage as using gravity. The force drops off as the square as the distance. If you are too far the attraction is too small. If you get a little too close, Blackie would come after you, and you would get sucked into her, faster than you would like. There is another problem -- the charge wouldn't last. At the event horizon -- that's the very edge of Blackie herself -- the fabric of space is so badly warped that it keeps breaking up into electron and positron pairs. If Blackie had a negative charge, she would suck up all the positrons and her charge would soon be neutralized. The remaining electrons would be attracted to your ship and neutralize its charge. If the charges of Blackie and your ship were reversed, the positrons would be attracted to the ship. Since positrons are anti-matter, they would react with the electrons in your ship and each one would result in two 511 Kev X-rays. Not nice!

A slightly better method is to give Blackie and your ship the same electric charge, preferably positive. The positrons would be repelled by both and the nasty X-ray problem would be avoided. This has a further advantage of allowing you to push Blackie instead of towing her. When the two charges are the same, they repel. As you approach Blackie you will start to push her in the direction you want. The closer you approach her, the greater the force. This way it is not critical how close you come. An excellent safety feature. Nevertheless the problem of Blackie producing anti-matter pairs and neutralizing her own charge still remains.

Arthur Clarke, in *Imperial Earth* spends some time discussing the use of black holes as a means of actually driving a space ship. That would be ideal. We need to harness Blackie like a husky and have him pull our sleigh around. Clarke was very vague on the details, no doubt due to secretive ways of the Space Transportation Authority. They bamboozled him with some claptrap about powerful electric and magnetic fields. The fact is that it is quite simple to harness Blackie. It's all in the feeding.

As I had mentioned before, when Blackie swallows something, she emits a belch of radiation. As the radiation blasts away from the point of impact, a recoil force works against Blackie, pushing her in the opposite direction. Whenever you want her to go in a certain direction, just toss a few tons of bones at the opposite side of her. A few tons of anything will do, it doesn't have to be bones. And along we go prodding her in whatever direction we like.

Only one small addition is needed to our system -- a leash. That is not actually so difficult to contrive. You place yourself directly in front of her with your rear end protected by a large radiation shield. A long arm reaches out behind and around your pet. When you want to go forward just lob a few tons of "bones" at her using a sort of hook shot from the rear. Blackie lets out a belch and moves forward. Then you toss in a few pounds from the front. Blackie lets out a little belch and slows down a trifle. The radiation travelling forward strikes your radiation shield and pushes you forward. In this manner Blackie travels forward and as she goes she pushes you along. For steering, you aim your hook shots a little to one side or the other. For major changes in direction you will have you use your attitude thrusters to swing your ship, and the leash, around to the other side. That's all there is to it. It's all in the feeding.

A word of caution about bringing her home: Few municipalities allow large pets to be kept within city limits. Blackie can become very bad-tempered if she is not fed regularly. Of course you can support her on the surface of the earth but she requires an enormous amount of feed to keep her nicely balanced just at the surface. Even then she swallows a steady stream of atmosphere as a desert. If you neglect her feeding for even an instant she will start to settle down into the ground. As soon as she does this she will swallow some, belch, slow down, and gradually bore her way towards the center of the earth. The hole will be very straight because whenever she touches the side of her little tunnel she will belch and slowly bounce over to the other side. All of this makes a frightful racket that can be heard for thousands of miles and the neighbors are certain to complain. The radiation sickness also makes them irritable. So unless you live on a very large acreage you had better find a suitable boarding kennel for her up in orbit.

Orbital kennels are not at all expensive. In fact you will be paid to leave her there. She will be treated very well. You see, at the kennel she will be surrounded by a large spherical water tank. As Blackie is fed, her radiation belches will heat up the water to steam. The steam is used to produce electric power in the usual way. The power is sold to provide for her upkeep. Her keepers will use a computer to carefully calculate the proper location of feeding so that Blackie remains at the center of the water tank. The more they feed her, the more power they sell.

Black holes make excellent pets. They never suffer from illness and they can't possibly die. They just get bigger and bigger. I'm sure you will enjoy her very much. She can be very affectionate. Just don't get too close!

REFERENCES

1. What happens if you fall into a black hole?
(http://www.weburbia.demon.co.uk/physics/fall_in.html)