Black Holes and Other Oddities

AiS Challenge

Final Report

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Team 017

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Executive Summary:

Black holes are mysterious things, they were thought of long before they were ever observed, and yet their inner workings are a complete mystery to all of us. The human mind can scarcely fathom something that consumes everything and yet produces nothing, but also cannot really accept something so fantastic as a parallel universe. One can only wonder, what is really out there, how big is it, and does it really make things disappear?

The goal of this project has been to explore the known facts and various theories pertaining to black holes. The end result of this study is to gain a working equation to calculate the mass of a black hole.

We utilized many forms of media. The most prominent of these would have to be the Internet due to the wide variety of sites and the ease of access. We used television documentaries and books to further our knowledge. We also gained assistance from a group of scientists called the Nuker Team who were quite helpful and even recommended several other sources, which also proved useful.

Our research did find the equations we had hoped for. We have learned more than we had initially expected. It is my belief that this project and the knowledge gained will stay with us forever.

Project Description:

Our first and most prominent goal was to find the mass of a black hole. The reason for undertaking such a task was that we foresaw a need for this knowledge sometime in the future. Should man ever actually take to the sky and find himself in an encounter with a black hole, several things should be known. The two most obvious questions are how close is too close, and once you do travel too close, what happens? We believe we may have found something of an answer to both of these questions. We have also found a rather simple way to calculate the mass of a black hole. Making it easier to study the object.

Methods Used:

We first began as any normal group would, with a great deal of research. We learned many fascinating things and soon began to dream up our own theory. We experimented with formulas that we found in various books and sites. After testing several formulas, we decided that the simplest formula was actually the best.

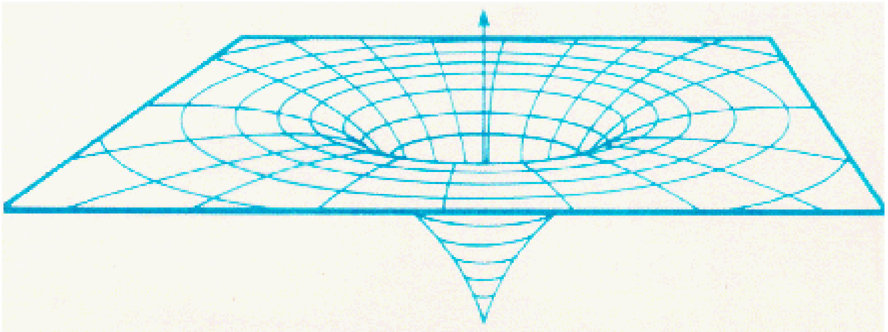
Findings:

We learned early on that the simplest way to calculate something's mass is to put your self in orbit around it or to observe something else in orbit. Once this is achieved you determine your objects orbital period (how long it takes something to encircle the black hole). The equation being $M_h = C_o^5/(2\pi G P_o^2)$. M_h being the mass of the hole, C_o and P_o being the circumference and period of any circular orbit around a hole, π being 3.14159, and G being Newton's gravitational constant, $1.327 * 10^{11}$ kilometers^3 per second^2 per solar mass. For example we could make the orbital period be P_o=5 minutes 46 seconds, its orbital circumference $C_o=10^6$ kilometers, one would obtain a mass M_h=10 solar masses (one solar mass is $1.989*10^{30}$ kilograms).

Conclusion:

One comes to the conclusion that a black hole is almost the same as any normal star. This is, in essence correct. It is the objects that a black hole consumes that give it its awesome mass, and yet somehow manages to not grow in any measurable way. It is our belief that this consumed mass does not actually go anywhere, but is compacted extremely tightly by the ever-growing gravity. The black hole is therefore something of a cycle. The more it absorbs, the more capable it is of making itself smaller. Which is the exact opposite of the theory of our own that we had formed earlier in the year, which made a reference to the possibility to white holes and pictured black holes as more of a tunnel to transport material. We believe that once an object does venture too close to a black hole, it is pulled in and smashed together with everything else. One could even go so far as to compare a black hole to a giant trash compactor. The reason that it curves space is because of its large mass, like a heavy rock on a sheet of rubber (see appendix A for a more visual explanation). We also discovered that black holes a far more common than many people believe. Many scientists think that black holes exist in that center of galaxies. This theory was formed due to the very short orbital period of objects close to the center of the galaxy (see appendix B for further explanation). Another way of finding black holes is to look for X-ray radiation, which black holes are believed to emit (an example of this can be seen in appendix C). In conclusion, black holes may not be as rare as many believe them to be. Perhaps further study of these mysterious objects may lead to a better understanding of them. But for now, man is left to speculate and observe from afar.

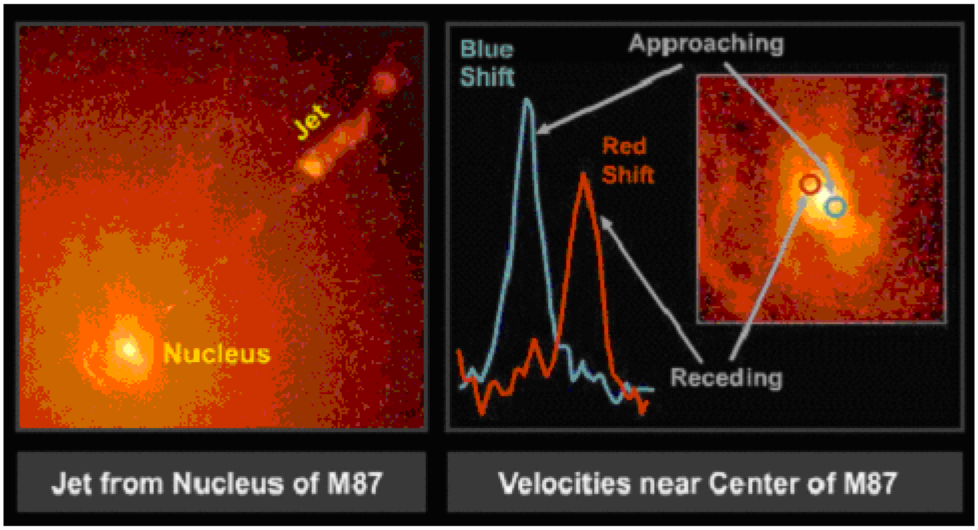
Appendix A



A black hole is comparable to a heavy rock placed on a rubber sheet. The sheet's distorted geometry is very similar to the distortions of the geometry of space around and inside a black hole.

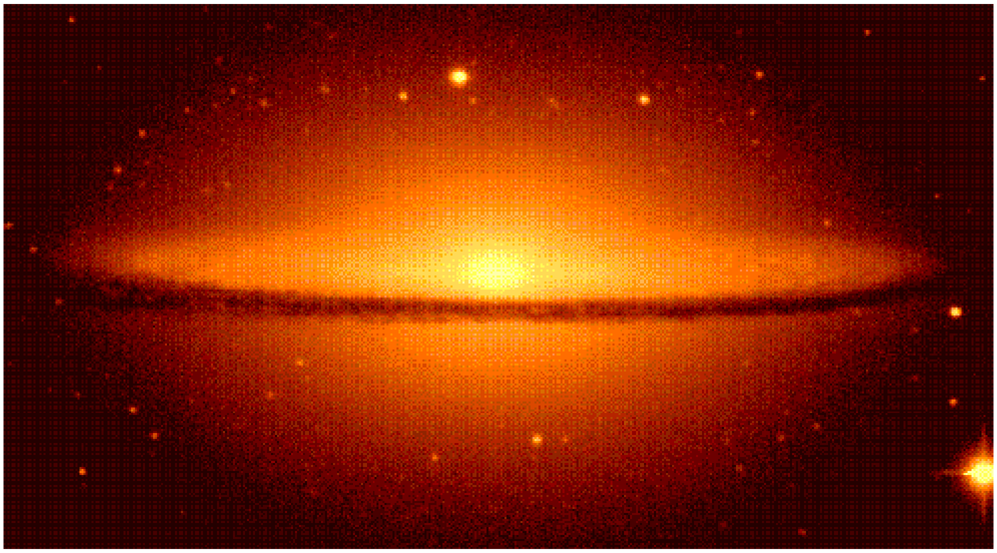
As a black hole feeds, its mass will increase as well as its gravitational pull, but its relative size will stay approximately the same because more pressure is exerted upon its mass.

Appendix B



Scientists have found two major pieces of evidence for black holes in the center of nearby galaxies. First they have noted that the center of all galaxies are rotating at high velocities. Observing the Doppler effect can prove this. As an object is tracked in its orbit it will swiftly shift from blue to red, showing its approach and recession. Another indication is that these centers are known to have long jet streams sometimes. Black holes also exhibit these jet streams when they are feeding.

Appendix C



This is the famous Sombrero galaxy (M104), a nearby spiral galaxy.

X-ray emission coupled with unusually high central stellar velocity cause many astronomers to speculate that a black hole lies at the Sombrero's center.

Resources

Equation and example taken from Black Holes &Time Warps

by Kip S. Thorne

Other Sources

- http://spaceflight.nasa.gov
- http://image.gsfc.nasa.gov
- http://scienceworld.wolfram.com
- http://www.astro.keele.ac.uk
- http://www.discovery.com