M87 Black Hole

Recently the results of the measures made in the galactic nucleus of the M87 galaxy have been published. In its interior an immense black hole resides that devours thousands of stars. In this process an enormous spurt of energy towards outside the galaxy is generated. These power spurts, denominated jets, can travel at speeds greater than the light. It is this possible?. Tags: M87, black hole, gamma rays, superluminical speed,

Image of the jet of the galactic nucleus of M87 caught by the telescope Hubble.

M87 is an Active Galactic Nuclei (AGN) located in the center of the Accumulation of Virgo, a grouping of thousands of galaxies that move meetings by the space, like an immense cosmic river, to a distance of 55 million light years. The diameter of M87 is a little greater than the one of our Galaxy but more thickness, by that contains many more stars.

M87 is one of the first galaxies that being observed the presence of an immense black hole in its nucleus, from the observations made in the decade of the 80. Although their peculiar observations begin in 1917, already then the astronomers suspected that something peculiar happened. Herbert Curtis in 1918 discovered a small finger of energy leaving the nucleus. Investigations with radio telescopes in the decade of the 50 detected great emissions of energy coming from the galaxy.

In the center of the M87 galaxy there is a black hole with a mass six trillion times greater than our Sun. When the protons and electrons coming from stars are accelerated by the immense black hole, this particle soup becomes a plasma and enter in spiral towards the black hole warming up itself until million degrees Celsius. The result is a great electromagnetic radiation in the zone of radio, x-rays and gamma rays. The part of the hot plasma that does not enter the black hole, manages to escape producing the one that denominates jets of thousands of light years of length.

The space telescope Hubble detects an amount of stars in the galactic nucleus, of thousand times greater of the awaited thing. Also detect gas clouds that turn in spiral form around the galaxy at great speeds. The optical instruments and radio telescopes detected jets that two great zones each one of about 200,000 years move almost at the speed of the light forming light.

The explanation to these observations agrees with the presence of a great black hole in the galactic center of M87, in principle thought that its mass was of about three trillion times that the one of the Sun, but recent studies have increased this mass six thousand billion.

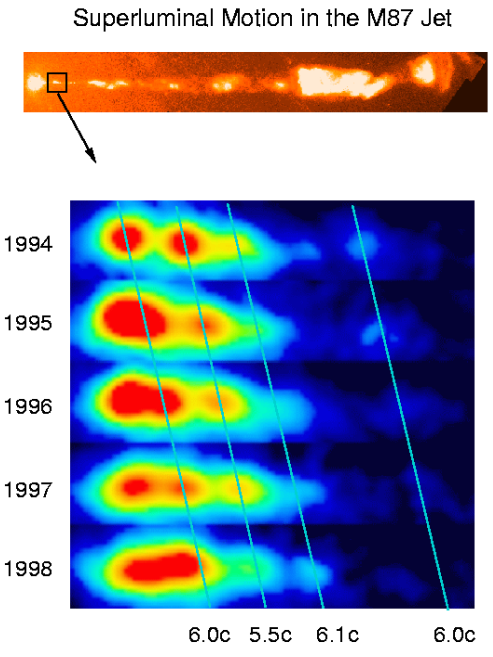
We see that the pattern of the observations agrees with the hypothetical explanation on black holes that did in post previous. To be a chance that now appears this study on the electromagnetic emissions of M87. They have been made using the telescopes MAGIC (Major Atmospheric Gamma-Ray Imaging Cherenkov) located in the canary island of the Palm, VERITAS (Very Energetic Radiation Imaging Telescope Array System) located in Arizona and H.E.S.S. (High-Energy Stereoscopic System) located in Namibia in a joint collaboration that has allowed to collect data during 120 hours of the jet of m87, which they are reduced to 90 after depurating these data.

The result is amazing, the gamma radiation is 10^{12} eV (electron volt), if we consider that the energy of the visible light is approximately 1 eV, this means that its energy is a trillion of times superior to the energy of the visible light. The gamma radiation is the greater radiation energy than it is known.

These results are compatible with a black hole of mass 6.4 billion the sun and a radius of 20,000 million kilometers. This is known like the Schwarzschild radius that I will comment in the following post.

Another curiosity is that the jet moves faster than the light in the vacuum. The measures conducted in 2007 indicated that it moved to 2,3c but the present adjustments locate it to a speed of 1,1c. Surprising? Then no, I have done a little trap. It happens that sometimes one does not say, creating confusion as surely I have created to them. The solution is very simple and it is solved indicating that this measurement is the apparent speed of the jet from the Earth. I explain to them how it can be that we observe movements greater than the light, the truth is that they are not observed, are calculated.

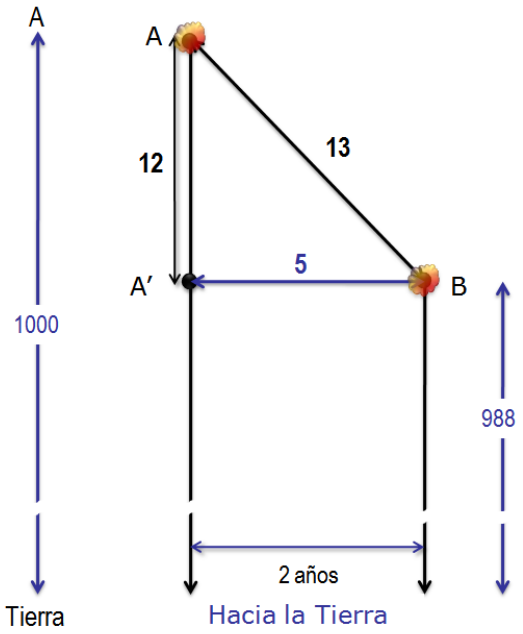
A distant object can seem that travels faster than the light from our point of view, and was indeed the observation of the jet of M87 by the Hubble the first time in detecting this apparent superluminical velocity in measures carried out between 1994 and 1998.



Let us see how it can happen from the following invented scheme, the selected values serve to illustrate the superluminical velocity. The triangle formed by AA' B is in AA' 12 light years and A'A 5 light years, this way its hypotenuse, or what it is the same, the AB distance calculates from the theorem of Pitagoras

$$\sqrt{12^2 + 5^2} = \sqrt{169} = 13$$

The situation happens when the jet in their movement approaches the Earth and it does at speeds near the light. It is as if the own jet persecuted to the light that it emits



Relativistic scheme of a jet

Let us suppose that in A, located to 1000 light years from Earth, the sparkle of a Jet takes place that moves at a speed of 13/14 c (0,93c) towards point B. Let us see as the movement is observed from the point of view of the Earth and from the Jet.

In the previous scheme we observed that in A the power emission of the jet takes place, from the Earth is continued observing during two years to position B. Since from the Earth perspective the jet seems to move of A' to B and the distance is 5 years light, it is easy to calculate the speed. It has taken 2 years in crossing 5 years light, therefore the apparent speed of the jet is

$$v_{jet\,apa} = \frac{5c}{2} = 2,5c$$

We see that according to the Earth the jet has moved to more of the double of the speed of the light. Now we know that only it is an illusion, because we have not considered the real triangulation of the movement.

Let us see that it happens from the point of view of the jet. The light of the sparkle of the jet in A arrives at the Earth after 1000 years to take place. The jet moves at the speed of 13/14 c towards the point B that is 13 light years from A . How long it takes in crossing this distance?

$$t_{AB} = \frac{13c}{\frac{13}{14}c} = 14 \ years$$

That is to say, the jet takes 14 years in crossing the distance of A to B. The light coming from B takes 988 years in arriving at the Earth, 14 + 988 = 1002 years after the sparkle in A. From the point of view of the Earth 2 years have only passed.

Even in these situations to the limit of the physics, the theory of relativity continues being fulfilled; nothing with mass can moves faster the speed of the light in the vacuum.