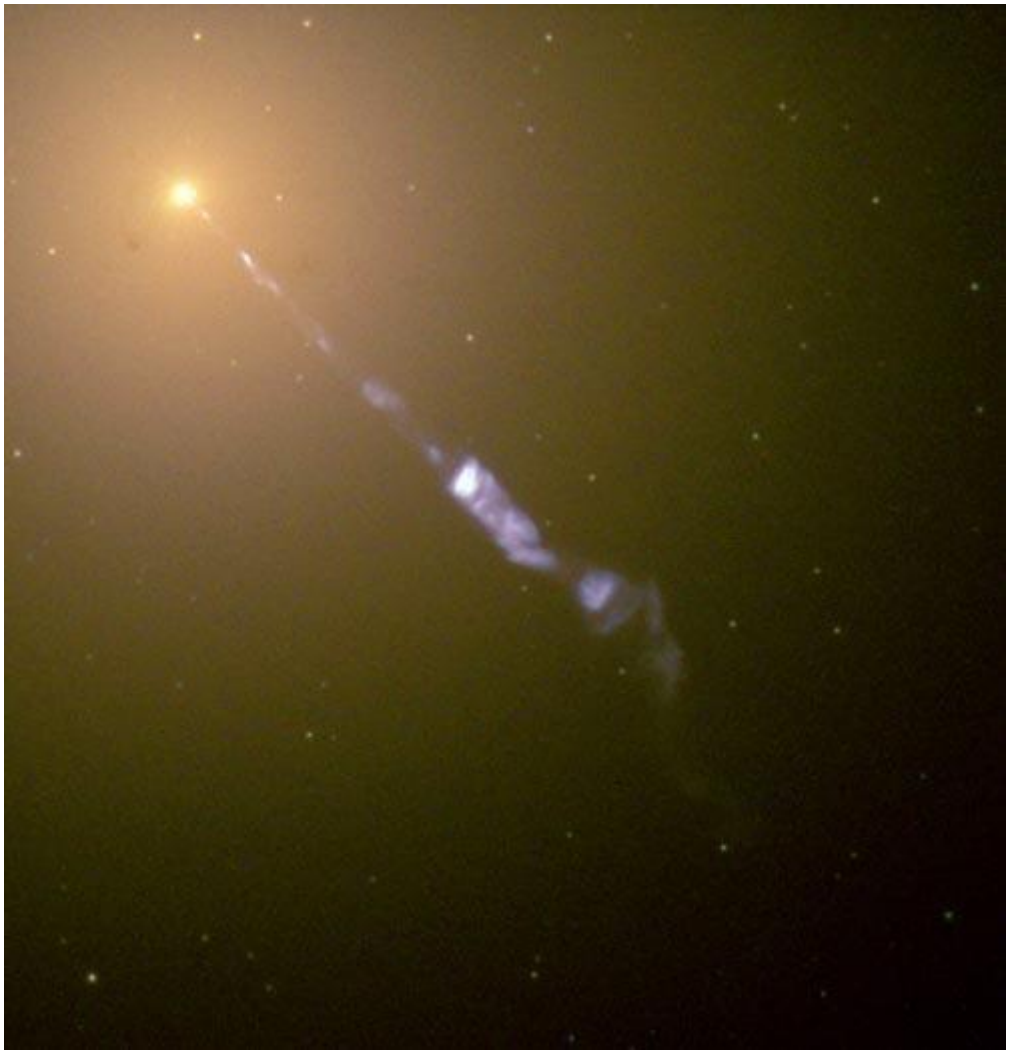
BLACK HOLE INVESTIGATION

BLACK HOLE AT CENTRE OF M87



A Hubble Space Telescope image showing a jet of superhot gas emitted from the core of M87 at 99 percent of the speed of light. The jet spans several thousand light-years. [NASA, Hubble Heritage Team (STScI/AURA)]

Discovery and observations

Identification

The black hole at the centre of the galaxy M87 is also known as NGC 4486, Virgo A, or M87 (Messier 87) and it is one of the closest active galactic nuclei to the Milky Way galaxy.[1] Due to the lack of a unified naming system for black holes, the supermassive black holes in the cores of galaxies are usually named after their host galaxy's names. In the same way, the name of the galaxy "M87" or "Messier 87" (which was catalogued by Charles Messier in the 1700s) can sometimes correspond to the black hole's name itself. The name NGC 4486, however, indicates that the name is listed in the New General Catalog because it begins with the designation "NGC".[2]

Mass and classification

Messier 87 hosts one of the most massive supermassive black holes to date, which has an estimated mass of more than 3.2 billion solar masses, however, recent reports made using more accurate measurement and prediction methods suggest that the mass could be more than 6 billion solar masses.[3][4] The discovery and measurement of the mass are based on velocity measurements of a whirlpool of hot gas rotating around the black hole forming an accretion disk. The presence of the disk, as found in recent Hubble images, allows for very accurate measurement of the mass of the object at the center of the disk. Recent methods include the application of comprehensive gas-dynamical models that includes the generation of emission-line profiles collected from the telescope and spectrograph optics as well as from the new Space Telescope Imaging Spectrograph observations from the Hubble Space Telescope. This creates a complete kinematic structure of the emission-line disk within ~40 pc from the nucleus, and some amount of velocity dispersion is detected in the gas disk that is required to match the observed line widths. Then a model is studied where the velocity dispersion provides support to the disk size and determines the approximate mass of the black hole with taking into account the errors from measurements and predictions done earlier.[5]

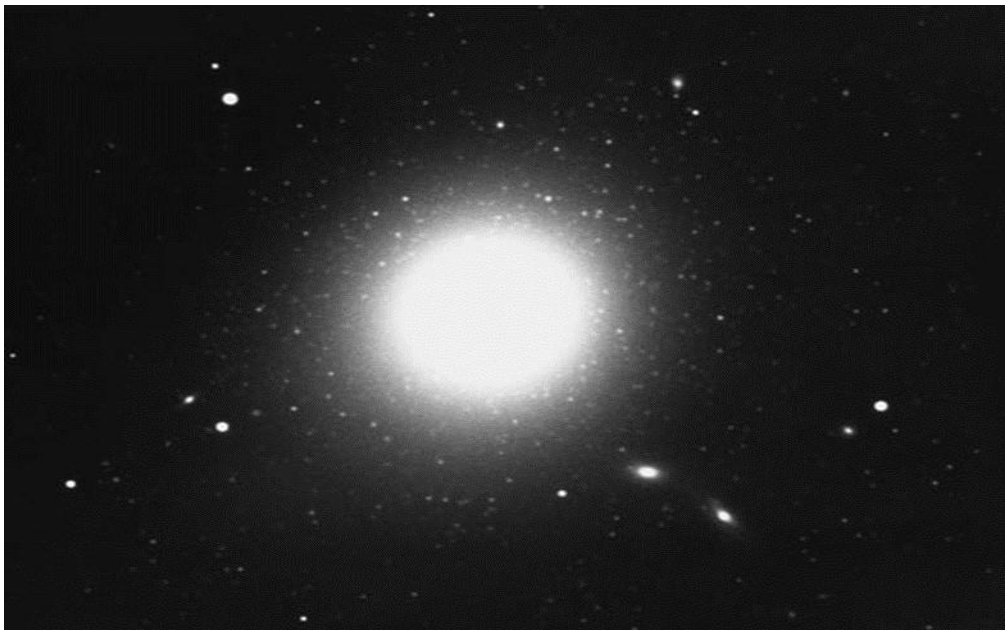
Evidence supporting the black hole's existence

A black hole is an object that is so massive yet compact nothing can escape its gravitational pull, not even light. The entity at the core of M87 fits this description perfectly. It weighed as much as 3 billion suns but had a size of about our solar system. Since the astronomers witnessed the tremendous gravitational field at the center of M87, it became

clear that the region contains only a fraction of the number of stars that would be necessary to create such a powerful attraction. It became evident that there must be something invisible. Astronomers used HST's Faint Object Spectrograph (detects light in near-ultraviolet to the near-infrared range) to measure the speeds of orbiting gas on either side of the disk from regions located about 60 light-years from the black hole at the center. The calculations showed that a disk of hot (about 10,000 Kelvin), ionized gas was orbiting at high speeds around an object that is extremely massive but extraordinarily compact, indicating a black hole. It is known to be located 50 million light-years away in the constellation Virgo. [6][12]

Environment

The black hole forms a part of the active galactic nuclei of the galaxy M87.[1] Recent observations obtained by high-resolution interferometry on the origin of the jet show that it could be located inside the innermost stable circular orbit diameter. There is evidence of radio signatures from the jets directly indicating that the jets might be launched at tremendous speeds from the origin causing them to form relativistic jets.[7][8] As gas spirals into the black hole, it's heated to high temperatures producing X-rays, so signatures of X-ray emissions from the accreting disk are detected, showing evidence of the disk's presence.M87 is at the center of the Virgo Cluster, a collection of thousands of galaxies that drift in space together. It is a giant elliptical galaxy which perhaps is 10 times as massive as the Milky Way. In the center of the galaxy surrounding the region of the black hole, there is an immense number of stars present.[9]



A ground-based view of the elliptical galaxy M87. [NOAO/AURA/NSF]

Uniqueness

With an apparent brightness of 9.59, the galaxy and the black hole jets have been observed with the aid of larger amateur telescopes under excellent conditions recently, which is quite rare since no high-end telescopes were used.[10][11]

Author : Faiyaz Ahmed (faiyaz1)

References

1. Kobzar, O., Sushchov, O., Hnatyk, B. and Marchenko, V. (2016). *The Influence of Magnetic Fields on UHECR Propagation from Virgo A*. [online] Arxiv.org. Available at: **arXiv:1602.01683v1**

2. Blackholes.stardate.org. (2018). *How are black holes named? - Articles - StarDate's Black Hole Encyclopedia*. [online] Available at: http://blackholes.stardate.org/resources/faqs/black-hole-names.html

3. Jacewicz, P. and Krasiński, A. (2012). *Formation of Gyrs old black holes in the centers of galaxies within the Lemaître–Tolman model*. [online] Arxiv.org. Available at: **arXiv:1101.5307v2**

4. McConnell, N., Ma, C., Gebhardt, K., Wright, S., Murphy, J., Lauer, T., Graham, J. and Richstone, D. (2011). *Two ten-billion-solar-mass black holes at the centres of giant elliptical galaxies*. [online] Arxiv.org. Available at: **arXiv:1112.1078v1**

5. Walsh, J., Barth, A., Ho, L. and Sarzi, M. (2013). *THE M87 BLACK HOLE MASS FROM GAS-DYNAMICAL MODELS OF SPACE TELESCOPE IMAGING SPECTROGRAPH OBSERVATIONS*. The Astrophysical Journal, Volume 770, Number 2 ,[online] Available at: http://iopscience.iop.org/article/10.1088/0004-637X/770/2/86/meta

6. Holland Ford, Richard Harms, Zlatan Tsvetanov, Arthur Davidsen, Gerard Kriss, Ralph Bohlin, George Hartig , Linda Dressel, Ajay K. Kochhar and Bruce Margon , Hubblesite.org. (1994). *HubbleSite: News - Hubble Confirms Existence of Massive Black Hole at Heart of Active Galaxy*. [online] Available at: http://hubblesite.org/news_release/news/1994-23

7. Gariel, J., Marcilhacy, G. and Santos, N. (2013). *UNBOUND GEODESICS FROM THE ERGOSPHERE AND THE MESSIER 87 JET PROFILE*. [online] Arxiv.org. Available at: **arXiv:1303.6474v1**

8. Komberg, B. and Zhuravlev, V. (2016). *Reflections on works by I.S.Shklovsky regarding the nature of radio galaxies*. [online] Arxiv.org. Available at: **arXiv:1605.06994v1**

9. Blackholes.stardate.org. (2018). *M87 Fact Sheet - StarDate's Black Hole Encyclopedia*. [online] Available at: http://blackholes.stardate.org/objects/factsheet-M87.html

10. Sandrasavaglio.files.wordpress.com. (2017). [online] Available at: https://sandrasavaglio.files.wordpress.com/2017/12/9_2017_stars_gals.pdf

11. Astronomy-mall.com. (2018). *M87 Jet*. [online] Available at: https://astronomymall.com/Adventures.In.Deep.Space/m87jet.htm

12. Stsci.edu. (2018). *FOS Webpage*. [online] Available at: http://www.stsci.edu/hst/fos