

Black holes. The mysterious entities of the universe. They have been puzzling scientists for many years, but recently scientists found a new technique for calculating the mass of black holes, which could open a door to further discoveries.

What is a black hole?

Black holes are the remnants of supermassive stars which have collapsed upon themselves.¹ The resulting explosion, a supernova, illuminates space for a few minutes, before leaving behind either a neutron star or a black hole.² Larger supermassive stars turn into black holes after collapsing, trapping everything, including light; smaller supermassive stars tend to become dense neutron stars, which are not massive enough to trap light.³

At the center of each black hole, lies the singularity, a point in spacetime that produces an infinite gravitational field. Einstein's Theory of General Relativity claims that a star exceeding a certain mass, the Chandrasekhar Limit, will result in a supernova. Otherwise, it will end up being a white dwarf.⁴

Although black holes are invisible to the naked eye, scientists can reliably detect the presence of a black hole using the stars in an area. Since black holes have such a strong gravitational pull,

¹Dunbar, B. (2015, May 21). What is a black hole? NASA.
<https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-a-black-hole-k4.html>.

²Pandian, J. D. (n.d.). How long does the supernova stage of a star last? (intermediate).
curious.astro.cornell.edu.
<http://curious.astro.cornell.edu/about-us/85-the-universe/supernovae/general-questions/419-how-long-does-the-supernova-stage-of-a-star-last-intermediate#:~:text=The%20explosion%20of%20a%20supernova,star%20or%20a%20black%20hole>.

³Mangum, -- J. (2020, November 22). When does a neutron star or black hole form after a supernova? National Radio Astronomy Observatory.
<https://public.nrao.edu/ask/when-does-a-neutron-star-or-black-hole-form-after-a-supernova/>.

⁴Williams, M. (2017, January 7). What is a singularity? Universe Today.
<https://www.universetoday.com/84147/singularity/>.

scientists analyze the path of stars, to determine whether they are under the gravitational influence of a nearby black hole.⁵

Usually black holes' masses range from three to ten solar masses, or three to ten times the mass of our Sun (2×10^{30} kg). The entirety of a black hole's mass is in the singularity, which explains the density and thus the gravitational field.⁶

New Technique

Currently, scientists use a black hole's diameter and the surrounding astronomical objects to calculate the black hole's mass. However, this method is ineffective with supermassive black holes that have an average mass of between 100 million and 10 billion solar masses.⁷

Colin Burke, an astronomer at the University of Illinois at Urbana-Champaign, and his team, began to study accretion disks which are flowing particles around an astronomical object. Scientists already believed that the flickering of the accretion disks—matter that rotates around a massive body—could help calculate the black hole's mass, but this method was untested and controversial. Specifically, scientists were unsure of the method's accuracy with a whole range of masses. Therefore, they tested the method on black holes with known masses to prove the

⁵Dunbar, B. (2015, May 21). What is a black hole? NASA.
<https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-a-black-hole-k4.html>.

⁶Dunbar, B. (2007, November 30). A new kind of black hole. NASA.
https://www.nasa.gov/vision/universe/starsgalaxies/Black_Hole.html.

⁷Grossman, L. (2021, August 12). Measuring a black hole's mass isn't easy. a new technique could change that. Science News.
<https://www.sciencenews.org/article/black-holes-mass-measure-new-technique-accretion-disk>.

reliability of the method. Afterwards, Burke and his team also successfully utilized the method on white dwarfs.⁸

Thus, the scientists have found a universal technique of measuring the mass of any astronomical object as long as it has accretion disks. This breakthrough will spearhead the development in future black hole research. In the next year, labs will begin to implement such methods in their observatories, and we will soon see the impact of this discovery.⁹

⁸Ibid.

⁹Ibid.

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