The ability to photograph black holes has been a mystery to scientists and the general public for a decent amount of time. While it has been understood what a black hole could potentially look like and what they do, it has never been observed by the human eye. However, through recent discoveries, scientists have discovered ways to use telescopes around the world to work together and produce an image of a black hole. This ability has allowed scientists to understand if Albert Einstein's theory of relativity stands true at such a grand scale. This was made possible with a process called "very long baseline interferometry", and the use of the Event Horizon Telescope. The Event Horizon Telescope and the process of very long baseline interferometry allow scientists to view select properties of black holes. These properties further allow scientists to confirm their calculations with Einstein's theory of relativity and prove that it holds true.

The way VLBI works is by recording the data of each telescope to project an image. This at one point was done on magnetic tapes but is now done on computer hard drives. More recent experiments have been done where this data is stored via fibre optics instead for even higher processing speeds. This signal is then sampled with a standard time to get the image at the time they want. So once all the data is played back, the time is then adjusted to estimate the time of the radio signals arrival. Each antena is a different distance away from the source, just like in short based interferometry the delay between radio signals has to be added artificially to the other received signals. The image producing part of this telescope is called the phase of complex visibility. The complex visibility stage is all about symmetry of the source of the brightness. Any brightness distribution can be expressed as the sum of a symmetric component and an anti-symmetric component. The symmetric component only contributes to the real part of the complex visibility. Whereas anti-symmetric contributes the fake or invisible part. However, the visibility measurement can not be determined with VLBI so the source of brightness distributions is unknown.

The M87 black hole (the subject of this study) is 55 million light years away from the earth. NASA would need a telescope with an aperture the size of the earth in order to take a picture of an object that far away. This is impossible, so instead a technique known as Very Long Baseline Interferometry (or VLBI) is used. This means that instead of using one large telescope to take pictures, eight smaller telescopes are linked and used simultaneously, which produces the same effect. These eight telescopes are called the Event Horizon Telescope (or EHT), and six are located on earth, in Arizona, Northern Chile, Southern Spain, Hawai'i, Southern Mexico, and the South Pole. The other two telescopes are currently in orbit. The distance between the telescopes, 8985 miles at its furthest point, mimics the function of a much larger telescope, and allows for pictures to be taken of objects as far away as the M87 black hole. Once readings are taken by this massive array, an algorithm sorts the images and organizes them into an approximation of what the object in question might look like. With only eight telescopes, these "puzzle pieces" are only fragments of the true picture, but at least three more telescopes are being added to the current array as of 2020, and each new telescope will provide more information from which we can build our image of the universe.

The only properties of a black hole that can be observed are the light rings of stars that are being destroyed by it, the mass of the black hole, and the angular momentum of the black hole. Black holes are very hard to photograph, and technically should be impossible to photograph, because they are so dense that their gravitational waves suck up anything that comes near it--including light. To combat this, scientists from around the world have developed algorithms that piece together multiple images to construct an image of what a black hole could look like. Eventually, scientists of the Event Horizon Telescope have figured out a way to use the orbit of the earth combined with multiple high powered telescopes to take an image of a blackhole. As the Earth rotates, more coverage is allowed by the telescopes in different continents around the globe, therefore allowing the telescopes to have more power combined rather than one singular telescope. With these telescopes, scientists are able to take low resolution pictures of black holes. This is important because scientists have been using Albert Einstein’s theory of general relativity for over a hundred years, and finally with the ability to photograph a black hole, scientists can confirm if Einstein’s theory holds true in actuality.

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