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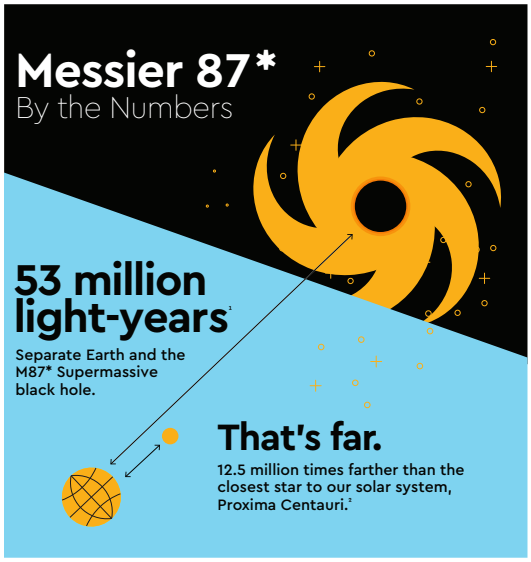
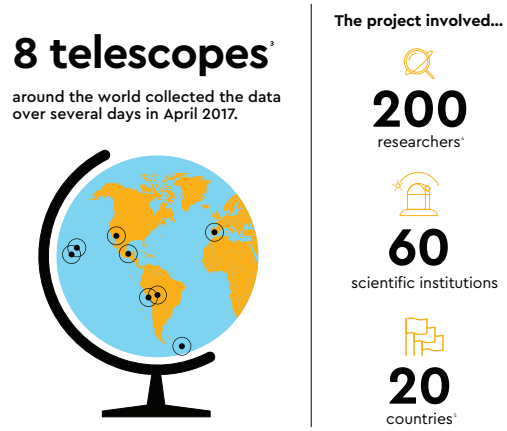
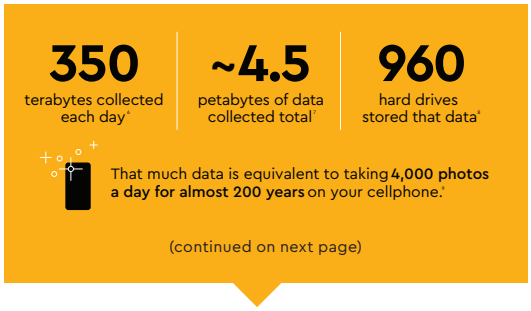
CASE STUDY

Western Digital Plays Pivotal Role in First-Ever Image of a Black Hole







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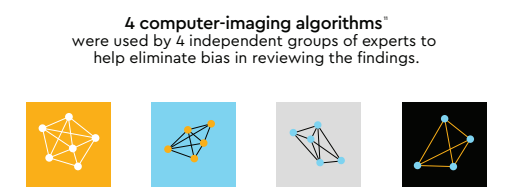
International black hole imaging team turns to Western Digital's Ultrastar® HDDs with HelioSeal® technology to capture massive amounts of data in extreme conditions

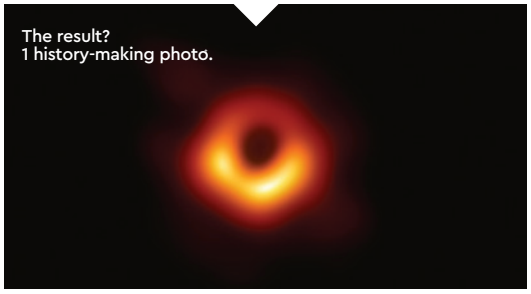
The galaxy known as M87 is 53 million light-years away.[1] With several trillion stars, a family of approximately 15,000 globular star clusters, and a supermassive black hole, it is one of the largest galaxies in our universe.[2]

Figure 1: Messier 87

When an international team of astronomers and computer scientists targeted the heart of M87 to capture the first-ever image of a black hole, it made headlines around the world. Less heralded was the astronomical amount of data needed to create that image—approximately 4.5 petabytes.[3] To put this in perspective, the size of a typical low-resolution smartphone photo is 3.5 megabytes. The data needed to create an image of the black hole was over 1,000,000,000X larger than a typical smartphone photo and is as much data as taking 4,000 typical smartphone photos per day for close to 900 years.[4] The Event Horizon Telescope project gathered that much data in the span of ten days in April 2017.[5]

Capturing M87's black hole was no small feat—one researcher compared it to taking a photo of an orange on the surface of the moon from Earth.[1] To create an instrument powerful enough to collect images even of an object of that size 53 million light-years away, researchers connected eight highly sophisticated telescopes around the world to create one virtual, Earth-sized telescope using a method called Very Long Baseline Interferometry (VLBI).





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Each individual telescope was part of a virtual telescope called the Event Horizon Telescope. The individual telescopes were synchronized together with GPS and highly-accurate atomic clocks to ensure consistency in the images they captured. Each data point the telescopes captured was digitized, time-stamped and saved to hard disk drives (HDDs).[6]

The hard drives used for this astronomy data needed to be both powerful enough to collect megabytes of data per second flowing from telescopes around the world, and tough enough to withstand the punishing environments where many of these instruments are based.

Western Digital's Ultrastar HDDs with HelioSeal technology helped provide the solution for collecting massive amounts of data in extreme conditions. HelioSeal technology hermetically seals the hard drive and replaces air with helium, which is 1/7th the density of air. Western Digital was the first company to ship helium-filled HDDs, which enable higher densities, higher performance, less energy and greater reliability compared to air-filled drives.

Helium-filled HDDs enabled data capture and storage in the extreme climates of some of these telescopes, from freezing temperatures in Antarctica to high altitudes in Mexico, where air-filled drives would not function properly.

Once the drives collected the astronomy data, they were transported (not via the internet, but by plane and by car[6]) to research centers in the U.S. and Germany for processing—the end result of which, of course, is the iconic image that captivated the world in 2019.

The M87 black hole image is the perfect example of the power that data represents. With the ability to collect and analyze data at scale, we can see what was previously unseen and reveal insights that previously lay in shadow. In a very real way, data is opening up a whole universe of discovery.

This content is produced by WIRED Brand Lab in collaboration with Western Digital.

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[2] Messier 87 (https://www.nasa.gov/feature/goddard/2017/messier-87)

[3] AskScience AMA Series: We are scientists here to discuss our breakthrough results from the Event Horizon Telescope. AUA! (https://www.reddit.com/r/askscience/comments/bbknik/askscience_ama_series_we_are_scientists_here_to/ekk3cgp/)

[4] Average file sizes vary but cellphone photos are generally ~3–3.5 MB. Examples of the number of photos that can be stored are provided for illustrative purposes only. Results will vary based on resolution, content, file compression, file format, file size, host device, pre-loaded files, settings, software and other factors. (https://www.cnet.com/news/iphone-6s-camera-filesizes-4k-live-photos-hdr/)

[5] How They Took the First Picture of a Black Hole (https://www.nytimes.com/interactive/2019/04/10/science/event-horizon-black-hole-images.html)

[6] The Hidden Shipping and Handling Behind That Black-Hole Picture (https://www.theatlantic.com/science/archive/2019/04/black-hole-hard-disks-picture/587119/)

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[2] How Long Would It Take To Travel To The Nearest Star? (https://www.universetoday.com/15403/how-long-would-it-take-to-travel-to-the-nearest-star/)

[3] How They Took the First Picture of a Black Hole (https://www.nytimes.com/interactive/2019/04/10/science/event-horizon-black-hole-images.html)

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[5] Astronomers Capture First-Ever Image of a Supermassive Black Hole (https://www.smithsonianmag.com/science-nature/astronomers-capture-first-images-supermassive-black-hole-180971927/#vDRqXF0GA5hxH9wp.99)

[6] Black hole images captured in world first (https://www.ucl.ac.uk/news/2019/apr/black-hole-images-captured-world-first-0)

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[9] Average file sizes vary but typical low-resolution cellphone photos are generally ~3–3.5 MB. Examples of the number of photos that can be stored are provided for illustrative purposes only. Results will vary based on resolution, content, file compression, file format, file size, host device, pre-loaded files, settings, software and other factors. (https://www.cnet.com/news/iphone-6s-camera-filesizes-4k-live-photos-hdr/)

[10] Behind the Scenes of the First Black Hole Photo (https://www.popularmechanics.com/space/telescopes/a27131631/behind-the-scenes-of-the-first-black-hole-photo/)

[11] Algorithms gave us the black hole picture. She's the 29-year-old scientist who helped create them (https://www.washingtonpost.com/science/2019/04/10/algorithms-gave-us-black-hole-pic-this-scientist-helped-create-them/?utm_term=.ca75c249a84d)

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