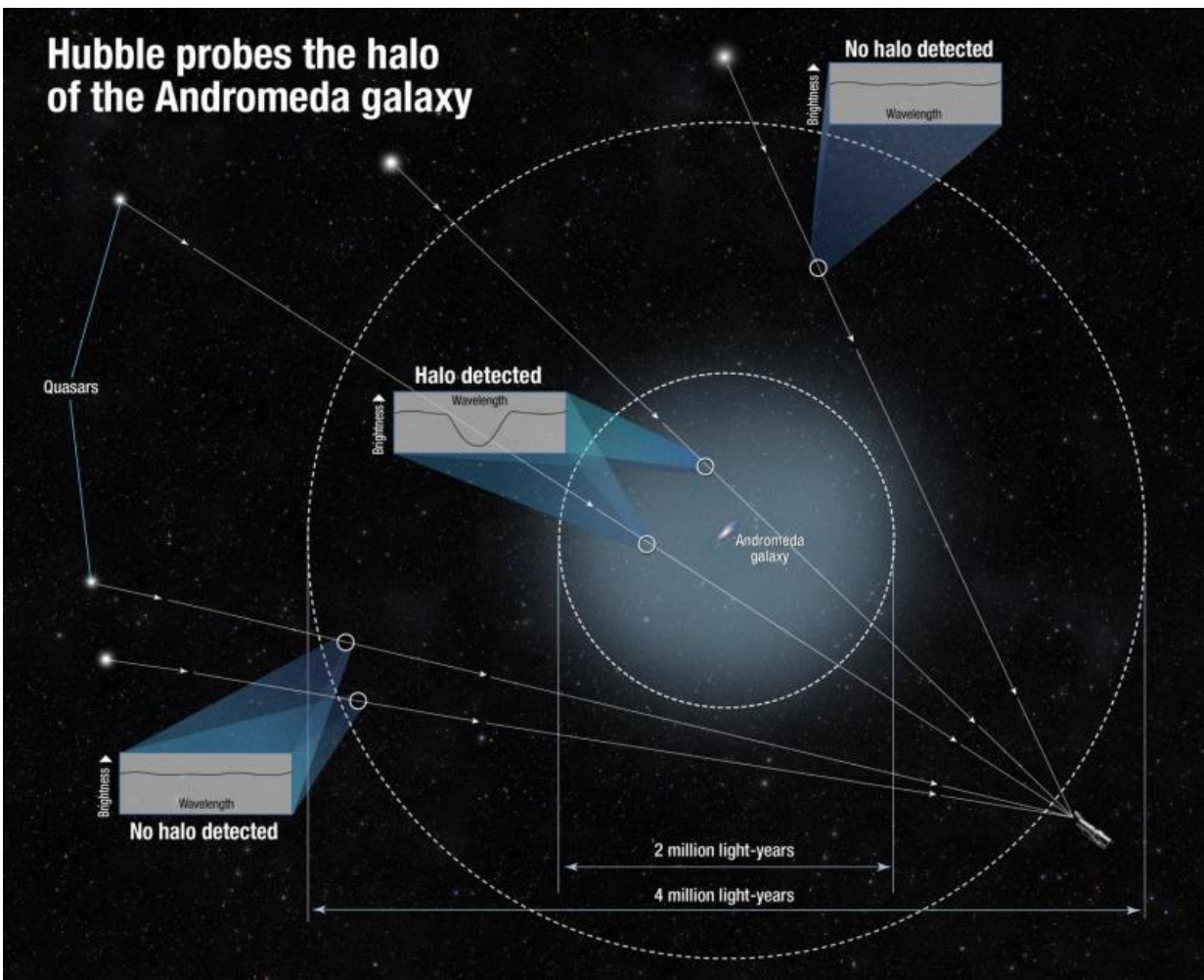


Hubble Finds Giant Halo Around the Andromeda Galaxy

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This diagram shows how scientists determined the size of the halo of the Andromeda galaxy. Because the gas in the halo is dark, the team measured it by using the light from quasars, the very distant bright cores of active galaxies powered by black holes. They observed the quasars' light as it traveled through

the intervening gas. The halo's gas absorbed some of that light and made the quasar appear darker in a very small wavelength range. By measuring the tiny dip in brightness at that specific range, scientists could tell how much gas is between us and each quasar. Some quasars showed no dip in brightness, and this helped define the size of the halo. Credit: NASA, ESA, and A. Feild (STScI)

Scientists using NASA's Hubble Space Telescope have discovered that the immense halo of gas enveloping the Andromeda galaxy, our nearest massive galactic neighbor, is about six times larger and 1,000 times more massive than previously measured. The dark, nearly invisible halo stretches about a million light-years from its host galaxy, halfway to our own Milky Way galaxy. This finding promises to tell astronomers more about the evolution and structure of majestic giant spirals, one of the most common types of galaxies in the universe.

"Halos are the gaseous atmospheres of galaxies. The properties of these gaseous halos control the rate at which stars form in galaxies according to models of galaxy formation," explained the lead investigator, Nicolas Lehner of the University of Notre Dame, Indiana. The gargantuan halo is estimated to contain half the mass of the stars in the Andromeda galaxy itself, in the form of a hot, diffuse gas. If it could be viewed with the naked eye, the halo would be 100 times the diameter of the full Moon in the sky. This is equivalent to the patch of sky covered by two basketballs held at arm's length.

The Andromeda galaxy, also known as M31, lies 2.5 million light-years away and looks like a faint spindle, about 6 times the diameter of the full Moon. It is considered a near-twin to the Milky Way galaxy.

Because the gas in Andromeda's halo is dark, the team looked at bright background objects through the gas and observed how the light changed.

This is a bit like looking at a glowing light at the bottom of a pool at night. The ideal background "lights" for such a study are quasars, which are very distant bright cores of active galaxies powered by black holes. The team used 18 quasars residing far behind Andromeda to probe how material is distributed well beyond the visible disk of the galaxy. Their findings were published in the May 10, 2015, edition of *The Astrophysical Journal*.

Earlier research from Hubble's Cosmic Origins Spectrograph (COS)-Halos program studied 44 distant galaxies and found halos like Andromeda's, but never before has such a massive halo been seen in a neighboring galaxy. Because the previously studied galaxies were much farther away, they appeared much smaller on the sky. Only one quasar could be detected behind each faraway galaxy, providing only one light anchor point to map their halo size and structure. With its close proximity to Earth and its correspondingly large footprint on the sky, Andromeda provides a far more extensive sampling of a lot of background quasars.

"As the light from the quasars travels toward Hubble, the halo's gas will absorb some of that light and make the quasar appear a little darker in just a very small wavelength range," explains co-investigator J. Christopher Howk, also of Notre Dame. "By measuring the dip in brightness in that range, we can tell how much halo gas from Andromeda there is between us and that quasar."

The scientists used Hubble's unique capability to study the ultraviolet light from the quasars. Ultraviolet light is absorbed by Earth's atmosphere, which makes it difficult to observe with a ground-based telescope. The team drew from about 5 years' worth of observations stored in the Hubble data archive to conduct this research. Many previous Hubble campaigns have used quasars to study gas much farther away than—but in the general direction of—Andromeda, so a treasure

trove of data already existed.

But where did the giant halo come from? Large-scale simulations of galaxies suggest that the halo formed at the same time as the rest of Andromeda. The team also determined that it is enriched in elements much heavier than hydrogen and helium, and the only way to get these heavy elements is from exploding stars called supernovae. The supernovae erupt in Andromeda's star-filled disk and violently blow these heavier elements far out into space. Over Andromeda's lifetime, nearly half of all the heavy elements made by its stars have been expelled far beyond the galaxy's 200,000-light-year-diameter stellar disk.

What does this mean for our own galaxy? Because we live inside the Milky Way, scientists cannot determine whether or not such an equally massive and extended halo exists around our galaxy. It's a case of not being able to see the forest for the trees. If the Milky Way does possess a similarly huge [halo](#), the two galaxies' halos may be nearly touching already and quiescently merging long before the two massive galaxies collide. Hubble observations indicate that the Andromeda and Milky Way [galaxies](#) will merge to form a [giant elliptical galaxy](#) beginning about 4 billion years from now.

More information: *Astrophysical Journal*,
[iopscience.iop.org/0004-637X/8 ... 04-637X_804_2_79.pdf](https://iopscience.iop.org/0004-637X/8...04-637X_804_2_79.pdf)

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