Webb snaps highly detailed infrared image of actively forming stars

July 26 2023

NASA's James Webb Space Telescope has captured a tightly bound pair of actively forming stars, known as Herbig-Haro 46/47, in high-resolution near-infrared light. Look for them at the center of the red diffraction spikes, appearing as an orange-white splotch. Herbig-Haro 46/47 is an important object to study because it is relatively young—only a few thousand years old. Star systems take millions of years to fully form. Targets like this give researchers insight into how much mass stars gather over time, potentially allowing them to model how our own sun, which is a low-mass star, formed—along with its planetary system. Credit: Image: NASA, ESA, CSA. Image Processing: Joseph DePasquale (STScI)

Young stars are rambunctious. NASA's James Webb Space Telescope has captured the "antics" of a pair of actively forming young stars, known as Herbig-Haro 46/47, in high-resolution near-infrared light.

To find them, trace the bright pink and red diffraction spikes until you hit the center: The stars are within the orange-white splotch. They are buried deeply in a disk of gas and dust that feeds their growth as they continue to gain mass. The disk is not visible, but its shadow can be seen in the two dark, conical regions surrounding the central stars.

The most striking details are the two-sided lobes that fan out from the actively forming central stars, represented in fiery orange. Much of this material was shot out from those stars as they repeatedly ingest and eject the gas and dust that immediately surround them over thousands of years.

When material from more recent ejections runs into older material, it changes the shape of these lobes. This activity is like a large fountain being turned on and off in rapid, but random succession, leading to billowing patterns in the pool below it. Some jets send out more material and others launch at faster speeds. Why? It's likely related to how much material fell onto the stars at a particular point in time.

The stars' more recent ejections appear in a thread-like blue. They run just below the red horizontal diffraction spike at 2 o'clock. Along the right side, these ejections make clearer wavy patterns. They are disconnected at points, and end in a remarkable uneven light purple circle in the thickest orange area. Lighter blue, curly lines also emerge on the left, near the central stars, but are sometimes overshadowed by the bright red diffraction spike.

All of these jets are crucial to star formation itself. Ejections regulate how much mass the stars ultimately gather. (The disk of gas and dust feeding the stars is small. Imagine a band tightly tied around the stars.)

Now, turn your eye to the second most prominent feature: the effervescent blue cloud. This is a region of dense dust and gas, known both as a nebula and more formally as a Bok globule. When viewed mainly in visible light, it appears almost completely black—only a few background stars peek through.

In Webb's crisp near-infrared image, we can see into and through the gauzy layers of this cloud, bringing a lot more of Herbig-Haro 46/47 into focus, while also revealing a deep range of stars and galaxies that lie well beyond it. The nebula's edges appear in a soft orange outline, like a backward L along the right and bottom.

This nebula is significant—its presence influences the shapes of the jets shot out by the central stars. As ejected material rams into the nebula on the lower left, there is more opportunity for the jets to interact with molecules within the nebula, causing them both to light up.

There are two other areas to look at to compare the asymmetry of the two lobes. Glance toward the upper right to pick out a blobby, almost sponge-shaped ejecta that appears separate from the larger lobe. Only a few threads of semi-transparent wisps of material point toward the larger lobe. Almost transparent, tentacle-like shapes also appear to be drifting behind it, like streamers in a cosmic wind.

In contrast, at lower left, look beyond the hefty lobe to find an arc. Both are made up of material that was pushed the farthest and possibly by earlier ejections. The arcs appear to be pointed in different directions, and may have originated from different outflows.

Take another long look at this image. Although it appears Webb has snapped Herbig-Haro 46/47 edge-on, one side is angled slightly closer to Earth. Counterintuitively, it's the smaller right half. Though the left side is larger and brighter, it is pointing away from us.

Over millions of years, the stars in Herbig-Haro 46/47 will fully form—clearing the scene of these fantastic, multihued ejections, allowing the binary stars to take center stage against a galaxy-filled background.

Webb can reveal so much detail in Herbig-Haro 46/47 for two reasons. The object is relatively close to Earth, and Webb's image is made up of several exposures, which adds to its depth.

Herbig-Haro 46/47 lies only 1,470 light-years away in the Vela Constellation.

Provided by NASA's Goddard Space Flight Center

Citation: Webb snaps highly detailed infrared image of actively forming stars (2023, July 26) retrieved 29 April 2024 from
https://phys.org/news/2023-07-webb-snaps-highly-infrared-image.html