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# A HERO'S BURIED TREASURE

JWST shows Herbig-Haro 797 to be twice the object astronomers expected. BY RICHARD TALCOTT

**WHEN THE JAMES WEBB SPACE TELESCOPE** (JWST) opened its eye to the universe in 2022, scientists anticipated getting a whole new view of star formation. The instrument's ability to see infrared light not only would help pierce the dusty veil that too often hides star birth from optical astronomers, but it also would reveal emission from many of the simple molecules that populate stellar nurseries.

Now researchers have harnessed both of these powers to reveal the inner workings of Herbig-Haro object 797 (HH 797), the outflow from a protostar still condensing from the interstellar medium. JWST's exquisite resolution shows that what astronomers previously thought was a single protostar with oppositely directed outflows is actually two protostars, each with its own pair of outflows.

## THE LOWDOWN ON HH 797

JWST's target lies in the southwestern corner of open star cluster IC 348. This stellar group, still immersed in its natal cocoon, started forming 2 million to 3 million years ago near the eastern edge of the Perseus molecular cloud complex. The region lies roughly 1,000 light-years from Earth, providing astronomers with a closer look than they can get at most other star-forming regions.

A protostar like the two at the heart of HH 797 has only just begun its journey to stardom. It continues to pull in nearby gas and dust, which forms an accretion disk that lies in the rotating object's equatorial plane. If it eats too much of this material too quickly, the developing star spews the excess out in two jets aligned with the protostar's rotational axis. These outflows carry away angular momentum, slowing the star's spin rate and helping to keep it from flying apart.

The jets themselves travel at hundreds of thousands of miles per hour. When they collide with their surroundings, they create shock waves that excite the interstellar molecules and cause them to emit infrared light. JWST is particularly attuned to picking up radiation from molecular hydrogen and carbon monoxide, creating the glorious details seen in the large image at right.

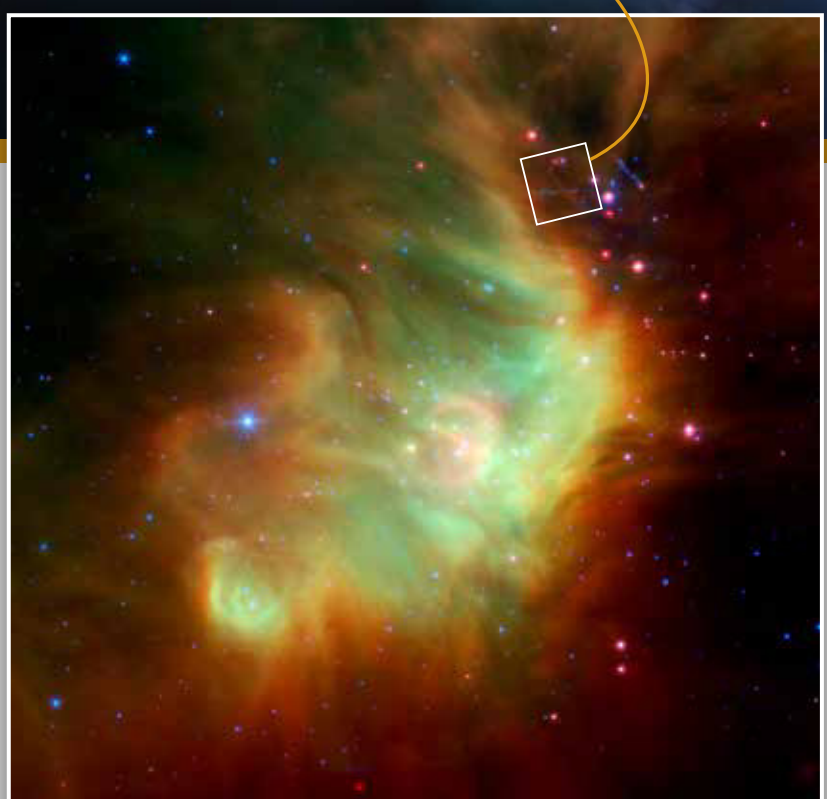
## A DEEP DIVE INTO HH 797

The luminous jets from HH 797 dominate the bottom half of the new JWST photograph. Although previous ground-based observations showed little of this detail, they were able to describe the velocities of the molecular gas. The material on the south (right) side moves away from us while that on the north (left) side approaches. Even more intriguing, earlier studies suggested that the jets were rotating, with the west (top) side spinning toward us and the east (bottom) side receding.

JWST revealed the truth: HH 797 comprises two sets of jets that run nearly parallel to one another. Each has its own set of shock waves moving at slightly different speeds, mimicking a single rotating outflow. The jets arise from a double star embedded in the dark gap located about one-third of the way from the right edge to the left edge of the jet. Astronomers estimate that each of these

The exquisite resolution of JWST shows the dual nature of the jets in Herbig-Haro 797 (bottom) along with the fan-shaped nebula LRLL 54361 (top). ESA/WEBB, NASA & CSA, T. RAY (DUBLIN INSTITUTE FOR ADVANCED STUDIES)

INSET: NASA's Spitzer Space Telescope captured this wide-field infrared image of open cluster IC 348 and its related nebulosity. HH 797 lies at the object's southwestern corner. NASA/ESA/J. MUZEROLLE (STSCI)/ E. FURLAN (NOAO AND CALTECH)/K. FLAHERTY (UNIVERSITY OF ARIZONA/STEWARD OBSERVATORY)/Z. BALOG (MAX PLANCK INSTITUTE FOR ASTRONOMY)/R. GUTERMUTH (UNIVERSITY OF MASSACHUSETTS, AMHERST)



protostars is only a few thousand years old and eventually will become stars similar to the Sun.

Adding to the JWST scene is the enigmatic object LRLL 54361 near the top of the image. Although this fan-shaped emission nebula also seems to be the creation of a protostar pair, this one releases a burst of light that propagates through the surrounding dust cloud approximately every 25 days.

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*Contributing Editor* **Richard Talcott** *described how to view the Great American Eclipse, part 2, in the April issue.*