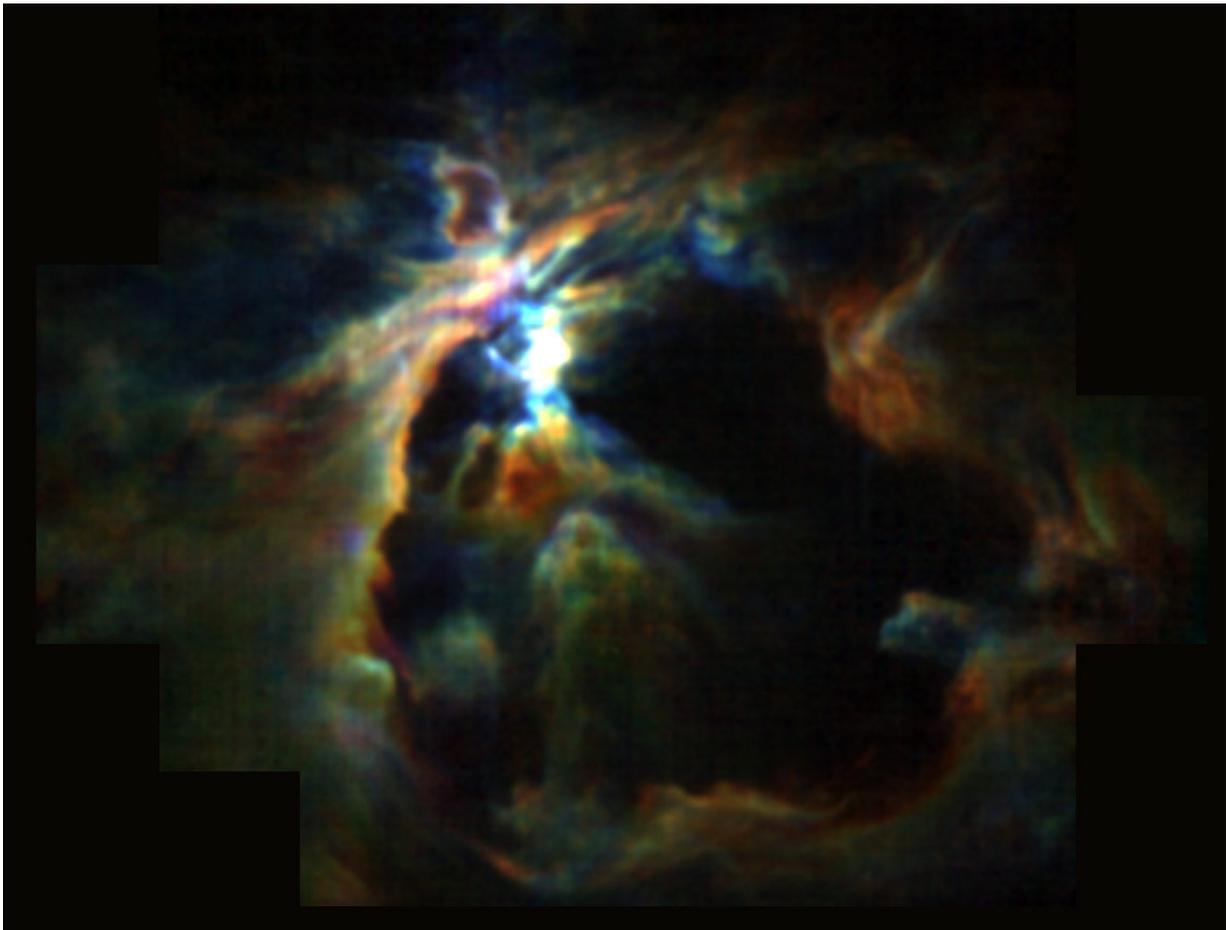


# Lifting the veil on star formation in the Orion Nebula

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The powerful wind from the newly formed star at the heart of the Orion Nebula is creating the bubble (black) and preventing new stars from forming in its neighbourhood. At the same time, the wind pushes molecular gas (colour) to the edges, creating a dense shell around the bubble where future generations of stars can form. Credit: NASA/SOFIA/Pabst *et al.*

The stellar wind from a newborn star in the Orion Nebula prevents more new stars from forming nearby. That is the result of new research conducted by an international research team led by the University of Cologne (Germany) and the University of Leiden (Netherlands) using NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA).

The result is surprising because until now, scientists thought that other processes, such as exploding stars (supernovae), were largely responsible for regulating the formation of stars. But SOFIA's observations suggest that infant stars generate stellar winds that can blow away the seed material required to form new stars, a process called feedback. The paper, "Disruption of the Orion Molecular Core 1 by the [stellar wind](#) of the massive star  $\theta 1$  Ori C," has now been published in *Nature*.

The Orion Nebula is among the best observed and most photographed objects in the night sky. It is the closest stellar nursery to Earth, and helps scientists explore how stars form. A veil of gas and dust makes this nebula extremely beautiful, but also shrouds the entire process of star birth from view. Fortunately, [infrared light](#) can pierce through this cloudy veil, allowing specialized observatories like SOFIA to reveal many of the star-formation secrets that would otherwise remain hidden.

At the heart of the nebula lies a small grouping of young, massive and luminous stars. Observations from SOFIA's instrument, the German Receiver for Astronomy at Terahertz Frequencies (GREAT), revealed for the first time that the strong stellar wind from the brightest of these baby stars, Theta1 Orionis C ( $\theta 1$  Ori C), has swept up a large shell of material from the cloud where this star formed, like a snow plow clearing a street by pushing snow to the road's edges.

"The wind is responsible for blowing an enormous bubble around the

central stars," explained Cornelia Pabst, a doctoral researcher at the University of Leiden and lead author of the paper. "It disrupts the natal cloud and prevents the birth of new stars."

Researchers used the GREAT instrument on SOFIA to measure the spectral line, which is like a chemical fingerprint, of ionized carbon. SOFIA's airborne location is above 99 percent of the water vapour in the Earth's atmosphere, which blocks infrared light, so the researchers were able to study the physical properties of the stellar wind.

"The large-scale Orion C+ observation demonstrates that such scale mapping is possible with SOFIA/upGREAT. The multi-pixel SOFIA/upGREAT receiver allows us to map larger regions in a shorter time compared to previous instruments. It is about 80 times faster than the single pixel HIFI receiver onboard the ESA cornerstone mission Herschel," says Ronan Higgins, who led the investigation from the University of Cologne's side.

Similarly, the astronomers use the ionized carbon's spectral signature to determine the speed of the gas at all positions across the nebula and study the interactions between massive stars and the clouds where they were born. The signal is so strong that it reveals critical details and nuances of the stellar nurseries that are otherwise hidden. But this signal can only be detected with specialized instruments—like GREAT—that can study far-infrared light.

At the center of the Orion Nebula, the stellar wind from  $\theta 1$  Ori C forms a bubble and disrupts star birth in its neighbourhood. At the same time, it pushes molecular gas to the edges of the bubble, creating new regions of dense material where future stars might form.

These feedback effects regulate the physical conditions of the [nebula](#), influence the star formation activity and ultimately drive the evolution of

the interstellar medium, the space between stars filled with gas and dust. Understanding how star formation interacts with the interstellar medium is key to understanding the origins of the [stars](#) we see today, and those that may form in the future.

**More information:** C. Pabst et al, Disruption of the Orion molecular core 1 by wind from the massive star  $\theta 1$  Orionis C, *Nature* (2019). [DOI: 10.1038/s41586-018-0844-1](https://doi.org/10.1038/s41586-018-0844-1)

Provided by University of Cologne

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