Turbulence May Promote the Birth of Massive Stars

February 23 2009

(PhysOrg.com) -- On long, dark winter nights, the constellation of Orion the Hunter dominates the sky. Within the Hunter's sword, the Orion Nebula swaddles a cluster of newborn stars called the Trapezium. These stars are young but powerful, each one shining with the brilliance of 100,000 Suns. They are also massive, containing 15 to 30 times as much material as the Sun.

Where did the Trapezium stars come from? The question is not as simple as it seems. When it comes to the theory of how massive stars form, the devil is in the details.

We know the basics: a cloud of cosmic gas draws itself together, growing denser and hotter until nuclear fusion ignites. But how does massive star formation begin? What determines how many stars form from a single cloud? New data from the Submillimeter Array (SMA), a joint project of the Smithsonian Astrophysical Observatory and the Academia Sinica Institute of Astronomy and Astrophysics, is helping to answer these questions.

The SMA allows astronomers to examine the earliest stages of star formation, which are hidden within cocoons of dust and gas that block visible light. In a study just accepted for publication in *The Astrophysical Journal*, a team of astronomers at the Harvard-Smithsonian Center for Astrophysics (CfA) studied two cosmic cocoons located 15,000 light-years away in the constellation Serpens Cauda.

One region shows significant heating, indicating that massive new stars must have already formed. The other region has ample material to form massive stars, but shows little signs of star formation. It is at one of the earliest stages yet identified in the birth of stars.

"The SMA enables us to see the dust and gas in the cocoon with amazing details, and to probe the initial stages of massive star formation," said Smithsonian astronomer Qizhou Zhang, who is lead author on the report.

By comparing the SMA data to theoretical predictions, astronomers can test their understanding of how stars more massive than the Sun form.

In star formation, gravity pulls material inward and condenses it. Gravity also tends to fragment the contracting cloud into smaller and smaller pieces, which leads to a star cluster. Such fragmentation may also inhibit the formation of massive stars. As a result, some theorists propose that massive stars must form from collisions of smaller protostars.

Two forces counteract gravity and suppress fragmentation of the cloud: thermal pressure from the heat of protostars, and turbulence. This may allow massive stars to form directly from accretion. Previous work suggested that thermal pressure was the stronger influence, but the new SMA study finds that turbulence is more important, at least at the spatial scales examined.

"What's unique about these SMA observations is that we can check some of the hypotheses for massive star formation against the observations for the first time," said Zhang. "Unlike what has been assumed in theoretical models, we found that fragmentation is suppressed in these clouds, not by stellar heating but rather by turbulence."

The team already has planned future studies. "We have just started to understand the initial conditions in distant, massive star-forming regions.

A large survey that we have launched with the SMA will, in the near future, reveal the nature of more of such objects," said Thushara Pillai of CfA, a co-author of the report.

More information: arxiv.org/abs/0902.0647

Provided by Harvard-Smithsonian Center for Astrophysics

Citation: Turbulence May Promote the Birth of Massive Stars (2009, February 23) retrieved 23 April 2024 from https://phys.org/news/2009-02-turbulence-birth-massive-stars.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.