Making Jupiters

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A three-color infrared image of the IC 348 Nebula. Some of the stars in this young cluster could have Jupiter-sized planets orbiting them. Credit: NASA/JPL-Caltech

IC348 is a glowing nebula of young stars, hot gas, and cold dust seen in the direction of the constellation of Perseus. It is the nearest rich cluster of young stars to earth, being only about one thousand light-years away. Its proximity has made it an important laboratory for astronomers probing the early stages of stellar evolution and star formation. At an estimated age of only two to three million years, it is also a somewhat young cluster; IC348 did not shine in the night sky of the first hominids. For comparison, our sun is about 4.5 billion years old.

Most stars less than about a million years old are still surrounded by the disks of material from which they formed. These primordial disks contain gas and dust that is also the raw material for planets. As the star ages, planets and smaller bodies form out of some of that material; the rest is soon expelled, or accreted onto the star. After about 3-7 million years, the initial disks are gone. But then a new kind of disk begins to develop as orbiting rocky bodies collide with each other to produce a dusty disk of debris that can be seen with infrared instruments.

This is the simple picture, anyway, that astronomers think is the most consistent with their observations to date. The problem is that sensitive new data from the Spitzer Space Telescope, and other telescopes, suggest that primordial disks disappear faster, and debris disks appear sooner, around mid- or high mass stars than they do around stars like the sun or smaller. How and why this could occur is an important part of the story of how planets form in stellar systems.

The stars in IC348 have a range of masses and a median age perfect for probing the timing of disk evolution. SAO astronomers Thayne Currie and Scott Kenyon combined new Spitzer observations of IC348 with spectra taken using the 1.5m Tillinghast telescope at the Fred L. Whipple Observatory, and other archival datasets. They find clear evidence that the primordial disks around high and intermediate mass stars do disappear relatively quickly.

Their results imply that such stars have much less time to form giant gas planets -- those like Jupiter and Saturn -- than do their solar-mass counterparts. Since there is some evidence that Jupiter-like planets commonly exist around larger stars, there must be some very rapid (a few million years) and efficient ways of making them.

Astronomers have only recently begun to propose some ways that might happen. The new observations help lend some credibility to the emerging picture of giant gas planets around massive stars.

Source: Smithsonian Astrophysical Observatory