

Astrowatch

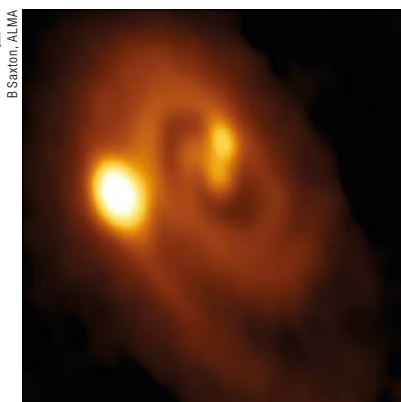
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Evidence suggests all stars born in pairs

The reason why some stars are born in pairs while others are born singly has long puzzled astronomers. But a new study suggests that no special conditions are required: all stars start their lives as part of a binary pair. The result has implications not only in the field of star evolution but also for studies of binary neutron-star and binary black-hole formation. It also suggests that our own Sun was born together with a companion that has since disappeared.

Stars are born in dense molecular clouds measuring light-years across, within which denser regions can collapse under their own gravity to form high-density cores opaque to optical radiation, which appear as dark patches. When the densities reach the level where hydrogen fusion begins, the cores can form stars. Although young stars already emit radiation before the onset of the hydrogen-burning phase, it is absorbed in the dense clouds that surround them, making star-forming regions difficult to study. Yet, since clouds that absorb optical and infrared radiation re-emit it at much longer wavelengths, it is possible to probe them using radio telescopes.

Sarah Sadavoy of the Max Planck Institute for Astronomy in Heidelberg and Steven Stahler of the University of California at Berkeley used data from the Very Large Array (VLA) radio telescopes in New Mexico, together with micrometre-wavelength data from the James Clerk Maxwell Telescope (JCMT) in Hawaii, to study the dense gas clumps and the young



Radio image of a triple-star system forming within a dusty disc in the Perseus molecular cloud, obtained by the Atacama Large Millimeter/submillimeter Array in Chile.

stars forming in them in the Perseus cluster – a star-forming region about 600 light-years away. Data from the JCMT show the location of dense cores in the gas, while the VLA provides the location of the young stars within them.

Studying the multiplicity as well as the location of the young stars inside the dense regions, the researchers found a total of 19 binary systems, 45 single-star systems and five systems with a higher multiplicity. Focusing on the binary pairs, they observed that the youngest binaries typically have a large separation of 500 astronomical

units (500 times the Sun–Earth distance). Furthermore, the young stars were aligned along the long axis of the elongated cloud. Older binary systems, with an age between 500,000 and one million years, were found typically to be closer together and separated around a random axis.

Subsequent to cataloguing all the young stars, the team compared the observed star multiplicity and the features seen in the binary pairs to simulations of stars being formed either as single or binary systems. The only way the model could reproduce the data was if its starting conditions contained no single stars but only stars that started out as part of wide binaries, implying that all stars are formed as part of a binary system. After formation, the stars either move closer to one another into a close binary system or move away from each other. The latter option is likely to be what happened in the case of the Sun, its companion having drifted away long ago.

If indeed all stars are formed in pairs, it would have big implications for models of stellar birth rates in molecular clouds as well as for the formation of binary systems of compact objects. The studied nearby Perseus cluster could, however, just be a special case, and further studies of other star-forming regions are therefore required to know if the same conditions exist elsewhere in the universe.

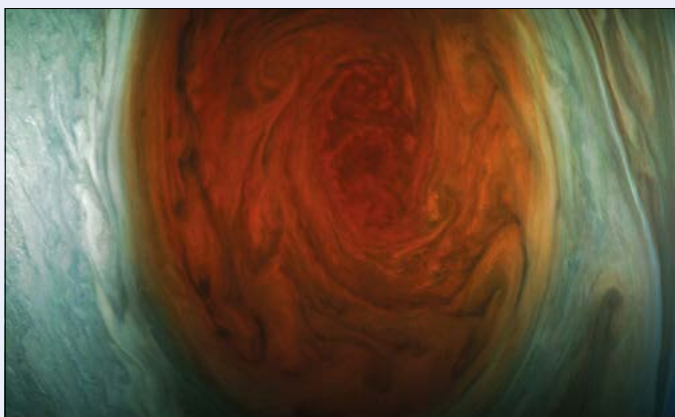
● Further reading

S Sadavoy and S Stahler 2017 *MNRAS* **469** 3881.

Picture of the month

This image from the Juno spacecraft shows the great red spot on Jupiter in beautiful detail. The Juno satellite was launched in 2011 and produced the image during a flyby on 11 July during which the satellite came as close as 3000 km to the cloud tops of Jupiter. The fast rotating storm on Jupiter is several times larger than the Earth and contains winds with speeds up to 600 km per hour. The feature is at least 150 years old, but observations of a large spot on Jupiter date back to the first astrophysical measurements from around 1600, although it is not clear if the storm observed at the time is the same that Juno captured now. The nature of the red colour is still not understood. One possibility is that it is due to chemicals that are formed as a result of cosmic-ray interactions with the ammonium hydrosulphide in Jupiter's atmosphere.

NASA/JPL-Caltech/SwRI/MSSS/Gerald Eichstädt



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