In the heart of the Orion Nebula

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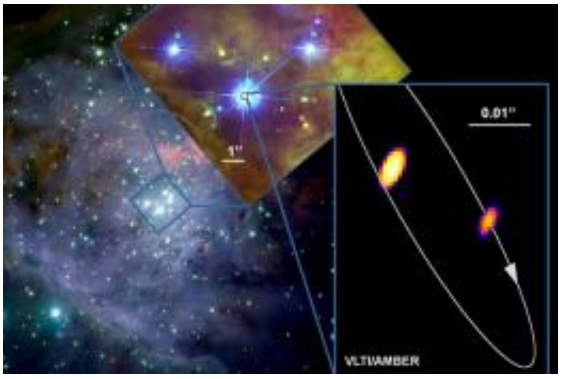

Zooming in the centre of the Orion star-forming region with the four bright Trapezium stars (Theta 1 Ori A-D). The dominant star is Theta 1 Ori C, which was imaged with unprecedented resolution with the VLT interferometer (lower right). Image: MPIfR/Stefan Kraus, ESO and NASA/Chris O'Dell

(PhysOrg.com) -- A team of astronomers, led by Stefan Kraus and Gerd Weigelt from the Max-Planck-Institute for Radio Astronomy (MPIfR) in Bonn, used ESO's Very Large telescope Interferometer (VLTI) to obtain the sharpest ever image of the young double star Theta 1 Ori C in the Orion Trapezium Cluster, the most massive star in the nearest high-mass star-forming region. The new image clearly separates the two young, massive stars of this system.

The observations have a spatial resolution of about 2 milli-arcseconds, corresponding to the apparent size of a car on the surface of the moon. The team was able to derive the properties of the orbit of this binary system, including the masses of the two stars (38 and 9 solar masses) and

their distance from us (1350 light-years). The results show the fascinating new possibilities of high-resolution stellar imaging achievable with infrared interferometry.

A particularly promising way to increase the angular resolution of conventional optical telescopes is the method of interferometry. This technique allows astronomers to combine the light from several telescopes, forming a huge virtual telescope with a resolving power corresponding to that of a single telescope with 200 m diameter. The Very Large Telescope Interferometer (VLTI) now offers this revolutionary technique to European astronomers and allows them to directly reconstruct images from the interferometric infrared data. A team of European astronomers utilized the VLTI and its near-infrared beam-combination instrument AMBER to demonstrate the imaging capabilities of this unique facility and to study the intriguing massive young star Theta1 Ori C in unprecedented detail.

Theta 1 Ori C is the dominant and most luminous star in the Orion star-forming region. Located at a distance of only about 1300 light years, it is the nearest region where massive stars are born and provides a unique laboratory to study the formation process of high-mass stars in detail. The intense radiation of Theta 1 Ori C is ionizing the whole Orion nebula. With its strong wind, the star also shapes the famous Orion proplyds, young stars still surrounded by their protoplanetary dust disks.

Although Theta 1 Ori C appeared to be a single star, both with conventional telescopes and the Hubble Space Telescope, the team discovered the existence of a close companion. "VLTI interferometry with the AMBER instrument allowed us, for the first time, to obtain an image of this system with the spectacular angular resolution of only 2 milli-arcseconds", says Stefan Kraus. "This corresponds to the resolving power of a space telescope with a mirror diameter of 130 meters." The VLTI image reveals that in March 2008 the angular distance between the

two stars was only about 20 milli-arcseconds. Fig. 1 shows the VLTI/AMBER image and, in addition, position measurements of the binary system obtained over the last 12 years. These additional observations were obtained using the technique of bispectrum speckle interferometry with 3.6 to 6m-class telescopes, allowing high-angular resolution observations even at visual wavelengths down to 440 nm.

The collection of measurements shows that the two massive stars are on a very eccentric orbit with a period of 11 years. Using Kepler's third law, the masses of the two stars were derived to be 38 and 9 solar masses. Furthermore, the measurements allow a trigonometric determination of the distance to Theta 1 Ori C and, thus, to the very centre of the Orion star-forming region. The resulting distance of 1350 light-years is in excellent agreement with the work of another research group led by Karl Menten, also from MPIfR, who measured trigonometric parallaxes of the nonthermal radio emission of Orion Nebula stars using the Very Long Baseline Array. These results are important for studies of the Orion region as well as the improvement of theoretical models of high-mass star formation.

Since 1609, when Galileo Galilei first pointed a telescope towards the sky, the field of observational astronomy has strongly evolved in both spectral coverage and angular resolution. "Our observations demonstrate the fascinating new imaging capabilities of the VLTI. This infrared interferometry technique will certainly lead to many fundamental new discoveries", says Gerd Weigelt.

More information: S. Kraus, G. Weigelt, Y.Y. Balega, J.A. Docobo, K.-H. Hofmann, T. Preibisch, D. Schertl, V.S. Tamazian, T. Driebe, K. Ohnaka, R. Petrov, M. Schoeller, M. Smith, Tracing the young massive high-eccentricity binary system Theta 1 Orionis C through periastron passage, *Astronomy & Astrophysics* (accepted)

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