Close-up of a dying heavyweight

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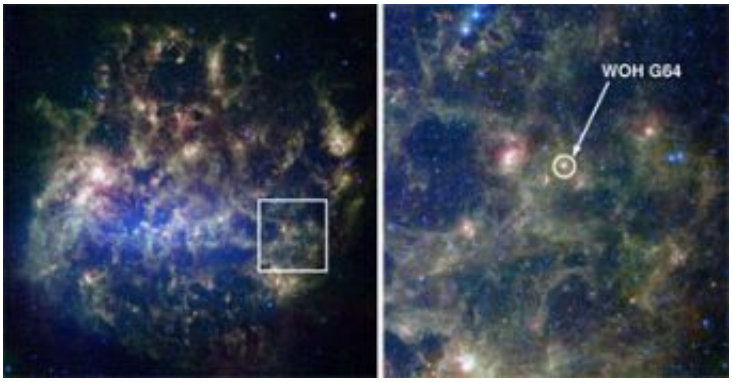

Infrared image of the Large Magellanic Cloud, our next neighbour galaxy at a distance of 160,000 light years, and the star WOH G64. Image: NASA, Spitzer Satellite, SAGE Team

A team of researchers at the Max Planck Institute for Radio Astronomy (MPIfR) in Bonn and European Southern Observatory (ESO) in Garching near Munich have for the first time taken a close-up of an individual dying supergiant star in our neighbouring galaxy, the Large Magellanic Cloud. By combining two 8.2-m telescopes in Chile as an interferometer, they achieved the resolving power of a 60-m telescope.

Geared with such a refined view, they discovered that the dying supergiant star is developing a thick dust torus around it. They estimated that the star had an initial mass of about 25 times the mass of our sun. But now, the star is shedding material so rapidly that it has already lost 10 - 40% of its initial mass and is speeding toward its final fate as a

supernova (*Astronomy & Astrophysics*, DOI 10.1051/000-6361:200809469).

When a star becomes older, it ejects a huge amount of material and gets embedded in a thick envelope, in which a variety of molecules and dust form. Researchers have been trying for decades to understand how such aging stars lose a considerable amount of their mass before their death.

A straightforward approach to tackle this issue is to take a very close look at the envelope surrounding the stars. However, this is easier said than done because of the great distances to these stars. Even with the world's largest optical telescopes with 8 - 10 m diameters, it is still difficult to take a close-up shot of the envelopes around the aging stars closest to Earth, let alone those outside our own galaxy, the Milky Way.

Using two or more telescopes combined as an "interferometer" provides a way to achieve much higher resolving power than with an individual telescope alone. The ESO's Very Large Telescope Interferometer (VLTI) in Chile is one of the largest interferometers, combining two or three 8.2-m telescopes. A team of researchers at MPIfR and ESO used the VLTI instrument MIDI, operating at mid-infrared wavelengths, which is ideal for observing the thermal radiation from the dust envelope heated by the star.

The resolving power they obtained is so high that it would recognize a tennis ball placed on top of the Brandenburg Gate in Berlin from Bonn. This was powerful enough for the team to zoom in on a dying supergiant star called WOH G64, which does not belong to our Galaxy but to our neighbouring galaxy, the Large Magellanic Cloud, lying some 160,000 light years away.

"For the first time we could take a close-up look at an individual star outside our Galaxy, and this is an important first step to understand how

dying stars in other galaxies differ from their counterparts in our Milky Way", says Keiichi Ohnaka at the MPIfR, first author of the publication presenting the result. "We discovered that the dying supergiant star WOH G64 is surrounded by a thick dust torus which sort of looks like a thick bagel by comparing it with detailed theoretical modelling."

The diameter of the supergiant star is as large as the orbit of Saturn in the solar system. The dimensions of the whole torus are considerably larger: the inner edge of the torus is at 120 AU ("Astronomical Units", corresponding to the distance of the Earth from the sun), the total size of the torus reaches almost one light year.

The astronomers could also estimate that when WOH G64 was born several million years ago, its mass was about 25 times larger than that of our Sun. They found out that it has already shed 10 - 40% of its initial mass into the dust torus by means of a violent stellar wind.

What will happen to WOH G64 in future? Some day, in the next few thousand or ten thousand years, it will explode as a supernova like the famous SN1987A, also in the Large Magellanic Cloud. Judging by the mass of WOH G64, it will be as bright as SN1987A and will become visible to the unaided eye in the southern hemisphere. The supernova explosion will blow away most of the mass of WOH G64, which will then be recycled as the building blocks for stars of the next generation.

Citatation: Keiichi Ohnaka, Thomas Driebe, Karl-Heinz Hofmann, Gerd Weigelt, Markus Wittkowski, Spatially resolved dusty torus toward the red supergiant WOH G64 in the Large Magellanic Cloud, *Astronomy & Astrophysics*, DOI 10.1051/0004-6361:200809469

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