

Aging star's weight loss secret revealed

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The star VY Canis Majoris is a red hypergiant, one of the largest known stars in the Milky Way. It is 30-40 times the mass of the Sun and 300 000 times more luminous. In its current state, the star would encompass the orbit of Jupiter,

having expanded tremendously as it enters the final stages of its life. New observations of the star using the SPHERE instrument on the VLT have clearly revealed how the brilliant light of VY Canis Majoris lights up the clouds of material surrounding it and have allowed the properties of the component dust grains to be determined better than ever before. In this very close-up view from SPHERE the star itself is hidden behind an obscuring disc. The crosses are artefacts due to features in the instrument. Credit: ESO

A team of astronomers using ESO's Very Large Telescope has captured the most detailed images ever of the hypergiant star VY Canis Majoris. These observations show how the unexpectedly large size of the particles of dust surrounding the star enable it to lose an enormous amount of mass as it begins to die. This process, understood now for the first time, is necessary to prepare such gigantic stars to meet explosive demises as supernovae.

VY Canis Majoris is a stellar goliath, a red hypergiant, one of the largest known stars in the Milky Way. It is 30-40 times the mass of the Sun and 300 000 times more luminous. In its current state, the star would encompass the orbit of Jupiter, having expanded tremendously as it enters the final stages of its life.

The new observations of the star used the SPHERE instrument on the VLT. The adaptive optics system of this instrument corrects images to a higher degree than earlier adaptive optics systems. This allows features very close to bright sources of light to be seen in great detail. SPHERE clearly revealed how the brilliant light of VY Canis Majoris was lighting up clouds of material surrounding it.

And by using the ZIMPOL mode of SPHERE, the team could not only peer deeper into the heart of this cloud of gas and [dust](#) around the star, but they could also see how the starlight was scattered and polarised by

the surrounding material. These measurements were key to discovering the elusive properties of the dust.

Careful analysis of the polarisation results revealed these grains of dust to be comparatively large particles, 0.5 micrometres across, which may seem small, but grains of this size are about 50 times larger than the dust normally found in interstellar space.

Throughout their expansion, massive stars shed large amounts of material—every year, VY Canis Majoris sees 30 times the mass of the Earth expelled from its surface in the form of dust and gas. This cloud of material is pushed outwards before the star explodes, at which point some of the dust is destroyed, and the rest cast out into interstellar space. This material is then used, along with the heavier elements created during the supernova explosion, by the next generation of stars, which may make use of the material for planets.

Until now, it had remained mysterious how the material in these giant stars' upper atmospheres is pushed away into space before the host explodes. The most likely driver has always seemed to be [radiation pressure](#), the force that starlight exerts. As this pressure is very weak, the process relies on large grains of dust, to ensure a broad enough surface area to have an appreciable effect.

"Massive stars live short lives," says lead author of the paper, Peter Scicluna, of the Academia Sinica Institute for Astronomy and Astrophysics, Taiwan. "When they near their final days, they lose a lot of mass. In the past, we could only theorise about how this happened. But now, with the new SPHERE data, we have found large grains of dust around this hypergiant. These are big enough to be pushed away by the star's intense radiation pressure, which explains the star's rapid mass loss."

The large grains of dust observed so close to the star mean that the cloud can effectively scatter the star's visible light and be pushed by the radiation pressure from the star. The size of the dust grains also means much of it is likely to survive the radiation produced by VY Canis Majoris' inevitable dramatic demise as a supernova. This dust then contributes to the surrounding interstellar medium, feeding future generations of [stars](#) and encouraging them to form planets.

This research was presented in a paper entitled "Large dust grains in the wind of VY Canis Majoris", by P. Scicluna et al., to appear in the journal *Astronomy & Astrophysics*.

More information: Research paper (PDF):

[www.eso.org/public/archives/re ... eso1546/eso1546a.pdf](http://www.eso.org/public/archives/re...eso1546/eso1546a.pdf)

Provided by ESO

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