Giant star expels multiple dust shells

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An international team led by Leen Decin, a K.U. Leuven (Belgium) astronomer, has discovered a series of dust shells in the vicinity of CW Leonis, a dying giant star. The star expelled the shells in the course of its long life: the most distant shell was expelled 16,000 years ago and, in that time, has drifted more than 7,000 billion kilometres from the star.

CW Leonis is an evolved star in the Leo constellation, 500 light-years from Earth. The dying star has become a carbon-rich red giant star: "Until recently, it was thought that giant star's surroundings were homogenous: evenly distributed matter without any exceptionally large clumps, but there are more and more indicators suggesting that this is not a reliable picture," says Leen Decin. "New images from the Herschel satellite confirm this in a spectacular way: We discovered more than a dozen shells expelled throughout the star's life as a giant. The weakest shell we found is 7,000 billion kilometres from the star."

The star ejected the various dust shells at intervals of 500 to 1,700 years. Because the dust shells have travelled so far from the star, they are also very cold, approximately -248°C. The astronomers believe that ever-fainter shells are also present even further in space—all the way to the violent edges where the material ejected from the star collides with the thin interstellar gas and dust that fills the void between the stars in our galaxy. The oldest shells have probably already disappeared there.

Infrared astronomy

CW Leonis is no longer visible to the naked eye: the light emitted from

the star is infrared. However, the Herschel space telescope is equipped with PACS, an instrument that captures infrared images. Specialists from K.U. Leuven and IMEC worked together to build the instrument, which guaranteed that the Institute for Astronomy had observation time with the satellite.

The images of the CW Leonis star and its surroundings show the infrared light emitted by the shell's dust particles themselves. From the images, researchers can determine the dust's temperature, and the quantity of dust in each shell. Relating each to the other, an idea of the various stages of the star's life emerges.

A year ago, CW Leonis provided astronomers with another surprise. Using infrared astronomy, Decin discovered warm water vapour in the envelope surrounding the star. This was an unexpected discovery, because, according to known chemical processes, one would not expect water vapour to form so close to a carbon-rich star.

In five billion years, our own sun will also swell into a red giant star. When it cools, it will produce large quantities of dust in the outermost layers of its atmosphere. Observing and understanding the episodes in the history of CW Leonis will help astronomers determine the fate of the sun.

Provided by Leuven University