Massive star reveals its unstable heart

Three-dimensional tour probes hidden secrets of $\boldsymbol{\eta}$ Carinae.

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With the help of powerful supercomputers, astronomers have plumbed the depths of one of the Galaxy's most puzzling stellar systems. A high-resolution simulation reveals what happens when the two bright stars that make up the η Carinae system swoop dramatically past each other every 5.5 years, as they did most recently last August.

 η Carinae lies 2,300 parsecs from Earth, in the southern constellation Carina. Astronomers have obsessed over it since the 1840s, when it brightened dramatically in the night sky because of some kind of internal instability that almost ripped it apart. Today the system exhibits smaller outbursts every 5.5 years, when its two stars pass at a distance roughly equal to that between the Sun and Mars.

Scientists unveiled a video showing the simulation of the August 2014 event on 7 January at a meeting of the American Astronomical Society, in Seattle, Washington.

The video depicts changes in η Carinae's primary star, which is at least 90 times more massive than the Sun and millions of times brighter, as its smaller partner approaches and swings around it. Gas blows off the main star in a dense, slow-moving stellar wind. The much smaller secondary star is just 30 times the mass of the Sun. It generates a lighter and faster-moving stellar wind, which bores through the gas coming off the giant like a ship plowing through a channel.

The video also shows a three-dimensional model of the turbulent boundary where the stellar winds collide. It reveals finger-like protrusions at the interface that scientists had not noticed until now.

"We didn't really know these existed," said Thomas Madura, an astrophysicist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, who led the simulation work. "We think these are real physical features that arise due to the physical instabilities of this really fast wind from the secondary [star] colliding with what's essentially a wall of gas" from the primary star.



NASA, ESA, and the Hubble SM4 ERO Team

The massive binary star system η Carinae has fascinated astronomers since an eruption in the 1840s.

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