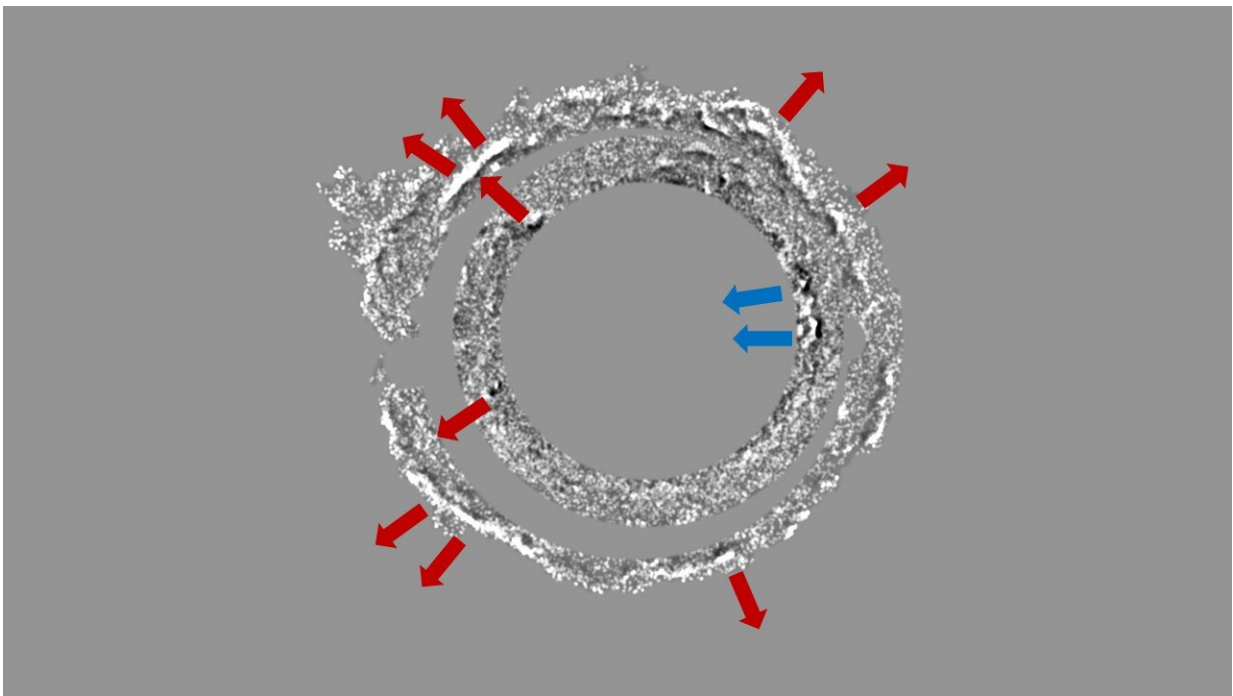


Ejection nebula of supernova Cassiopeia A does not expand evenly

March 28 2022



An image of Cassiopeia A showing only two shells of nebulae. The blue arrows on the right (astronomers call this the west side) show that the inner shell is not expanding outwards at this point, but inwards. The red arrows show that the other remnants do expand outwards. Credit: J.Vink/astronomie.nl

The inner nebula of the much-studied supernova Cassiopeia A is not moving smoothly outward. This has been discovered by astronomers from the University of Amsterdam and Harvard. The astronomers

suspect that the remains have collided with something. Their finding have been accepted for publication in *The Astrophysical Journal*.

Cassiopeia A is the remnant of an exploded star in the Cassiopeia constellation, about 11,000 light years away from us. Light from the [explosion](#) should have reached Earth for the first time around 1670. However, there was too much gas and dust around the star for the explosion to be seen with the [naked eye](#) or with the then very basic telescopes. The Cassiopeia A explosion nebula is expanding at an average rate of 4,000 to 6,000 kilometers per second and has a temperature of about 30 million degrees Celsius. The expansion is most likely occurring in gas that was blown out by the star long before the explosion. Cassiopeia A is now about 16 [light years](#) across.

19 years of data

The researchers, led by Jacco Vink (University of Amsterdam, the Netherlands) analyzed 19 years of data from the Chandra X-ray Observatory. This is an American X-ray satellite with Dutch spectrometers that orbits the Earth in a high elliptical orbit.

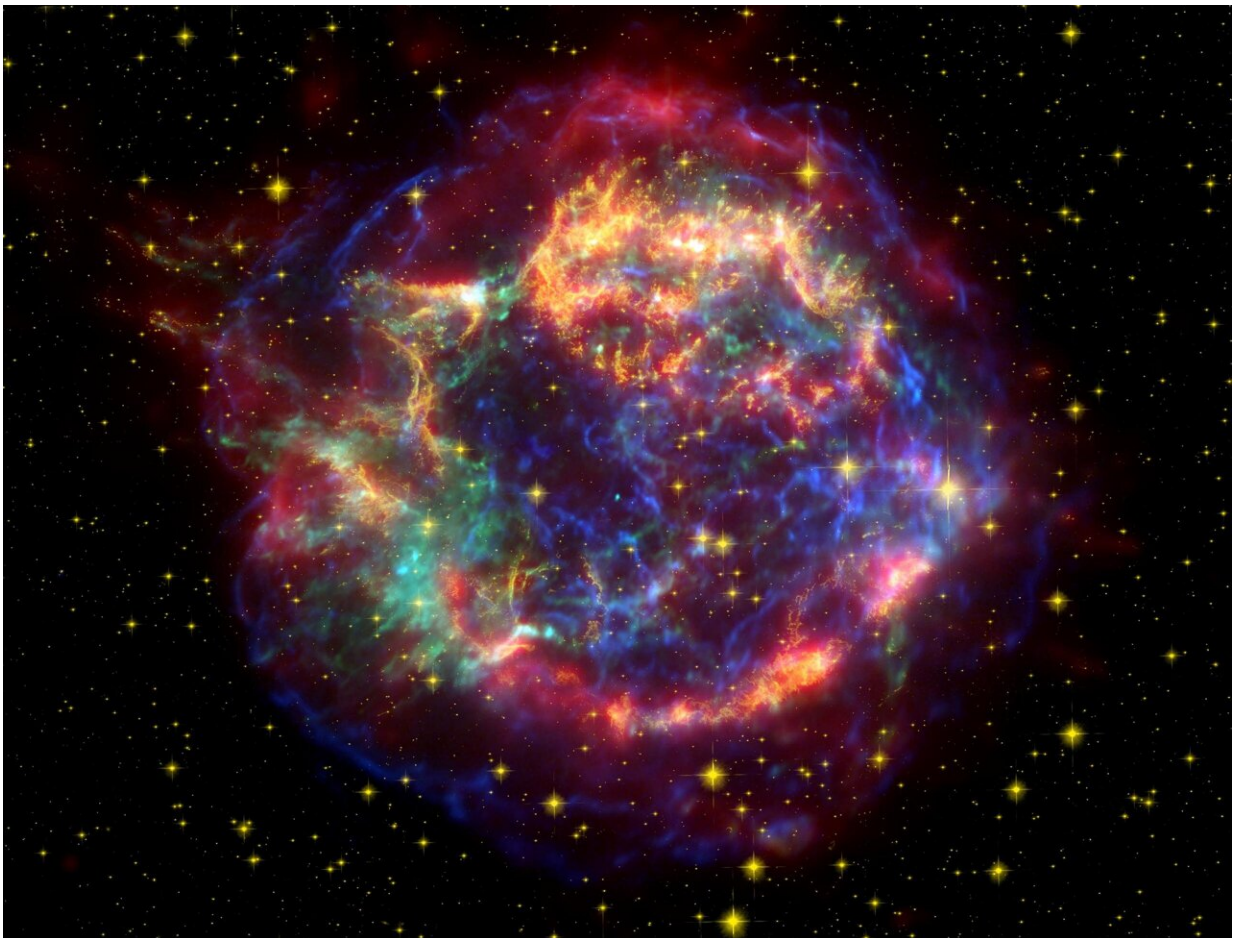
The scientists observed that on the western side of Cassiopeia A, the inner regions of the explosion nebula are not expanding, but moving inwards. The researchers also took measurements of the acceleration or deceleration of the outer shock wave. This outer shock wave turned out to accelerate in the west instead of decelerating as was expected.

"The backward movement in the west can mean two things," says Jacco Vink. "Either there is a hole somewhere, a kind of vacuum, in the supernova material, causing the hot shell to suddenly move inwards locally. Or the nebula has collided with something." From the models of Vink and his colleagues, a collision appears most likely. The computer models predict that after a collision, the shock first decreases in speed

but then accelerates. "Exactly as we have measured," says Vink.

Italian group

The collision scenario was also [investigated recently by an Italian group](#) with whom Vink collaborates. They suspect that the shock wave collided with a shell of gas particles. This shell would have been created when the unexploded star blew away an irregular wind of gas particles at the end of its life.



Coloured image of Cassiopeia A based on data from the space telescopes Hubble, Spitzer en Chandra. Credit: NASA/JPL-Caltech

The cooperation between Vink and the Italians did not happen out of the blue. The Italian group got to work on preliminary results that Vink showed at a conference in 2019. "When we recently found an acceleration and they predicted just that in their models, the puzzle pieces fell into place," says Vink.

Cassiopeia A has attracted a lot of attention lately. For example, NASA's new X-ray satellite IXPE published its [first image of the exploded star](#) on Valentine's Day. And the James Webb Space Telescope will turn its infrared gaze to the supernova remnants later this year.

More information: Jacco Vink, Daniel J. Patnaude & Daniel Castro, The forward and reverse shock dynamics of Cassiopeia A. arXiv:2201.08911v2 [astro-ph.HE], arxiv.org/abs/2201.08911. Accepted for publication in *The Astrophysical Journal*

Provided by Netherlands Research School for Astronomy

Citation: Ejection nebula of supernova Cassiopeia A does not expand evenly (2022, March 28) retrieved 19 June 2024 from <https://phys.org/news/2022-03-ejection-nebula-supernova-cassiopeia-evenly.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.