What is a Wolf-Rayet star?

6 February 2015, by Elizabeth Howell

M1-67 is the youngest wind-nebula around a Wolf-Rayet star, called WR124, in our Galaxy. Credit: ESO

Wolf-Rayet stars represent a final burst of activity before a huge star begins to die. These stars, which are at least 20 times more massive than the Sun, "live fast and die hard", according to NASA.

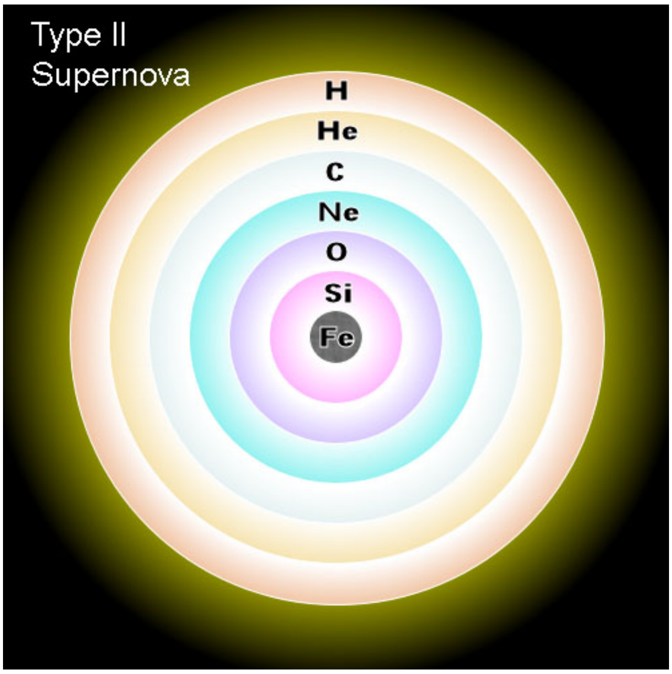
Their endstate is more famous; it's when they explode as supernova and seed the universe with cosmic elements that they get the most attention. But looking at how the star gets to that explosive stage is also important.

When you look at a star like the Sun, what you are seeing is a delicate equilibrium of the star's gravity pulling stuff in, and nuclear fusion inside pushing pressure out. When the forces are about equal, you get a stable mass of fusing elements. For planets like ours lucky enough to live near a stable star, this period can go on for billions upon billions of years.

Being near a massive star is like playing with fire, however. They grow up quickly and thus die earlier in their lives than the Sun. And in the case of a Wolf-Rayet star, it's run out of lighter elements to fuse inside its core. The Sun is happily churning hydrogen into helium, but Wolf-Rayets are ploughing through elements such as oxygen to try to keep equilibrium.

Because these elements have more atoms per unit, this creates more energy—specifically, heat and radiation, NASA says. The star begins to blow out winds reaching 2.2 million to 5.4 million miles per hour (3.6 million to 9 million kilometers per hour). Over time, the winds strip away the outer layers of the Wolf-Rayet. This eliminates much of its mass, while at the same time freeing its elements to be used elsewhere in the Universe.

Eventually, the star runs out of elements to fuse (the process can go no further than iron). When the fusion stops, the pressure inside the star ceases and there's nothing to stop gravity from pushing in. Big stars explode as supernova. Bigger ones see their gravity warped so much that not even light can escape, creating a black hole.



The core of a red or blue supergiant moments before exploding as a supernova looks like an onion with multiple elements "burning" through the fusion process to create the heat to stay the force of gravity. Fusion stops at iron. With no energy pouring from the central core to keep the other elements cooking, the star collapses and the rebounding shock wave tears it apart. Credit: Wikimedia

We still have a lot to learn about stellar evolution, but a few studies over the years have provided insights. In 2004, for example, NASA issued reassuring news saying these stars don't "die alone." Most of them have a stellar companion, according to Hubble Space Telescope observations.

While at first glance this appears as just a simple observation, cosmologists said that it could help us figure out how these stars get so big and bright. For example: Maybe the bigger star (the one that turns into a Wolf-Rayet) feeds off its companion over time, gathering mass until it becomes stupendously big. With more fuel, the big stars burn out faster. Other things the smaller star could influence could be the bigger star's rotation or orbit.

A composite image with Chandra data (purple) showing a "point-like source" beside the remains of a supernova, suggesting a companion star may have survived the explosion. Hydrogen is shown in optical light (yellow and cyan) from the Magellanic Cloud Emission Line Survey and there is also optical data available from the Digitized Sky Survey (white). Credit: X-ray: NASA/CXC/SAO/F.Seward et al; Optical: NOAO/CTIO/MCELS, DSS

Here's a few other facts about Wolf-Rayets, courtesy of astronomer David Darling:

- Their names come from two French astronomers, Charles Wolf and Georges Rayet, who discovered the first known star of this kind in 1867.
- Wolf-Rayets come in two flavours: WN (emission lines of helium and nitrogen) and WC (carbon, oxygen and hydrogen).
- Stars like our Sun evolve into more massive red giants as they run out of hydrogen to burn in the core. When these stars begin to shed their outer layers, they behave somewhat similarly to Wolf-Rayets. So they're called "Wolf-Rayet type stars", although they're not exactly the same thing.

Source: [Universe Today]

APA citation: What is a Wolf-Rayet star? (2015, February 6) retrieved 15 September 2019 from https://phys.org/news/2015-02-wolf-rayet-star.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.