White dwarf with almost pure oxygen atmosphere discovered

April 1 2016, by Bob Yirka

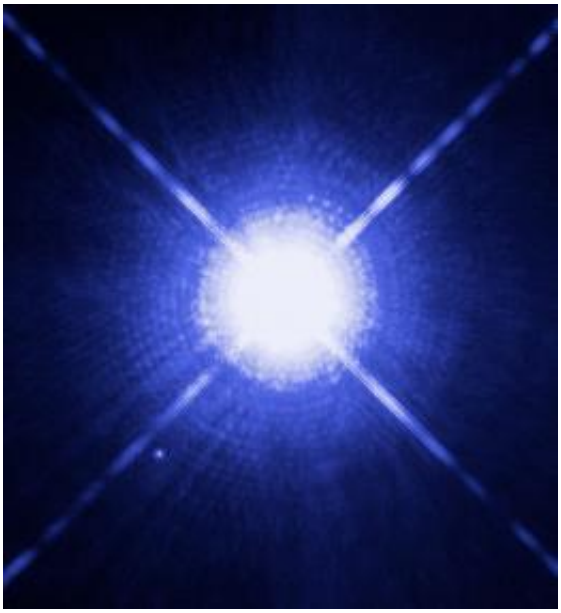

Image of Sirius A and Sirius B taken by the Hubble Space Telescope. Sirius B, which is a white dwarf, can be seen as a faint pinprick of light to the lower left of the much brighter Sirius A. Image: NASA, ESA

A trio of researchers, two with the Federal University of Rio Grande do Sul and the other with Universität Kiel has discovered something very unique—a white dwarf with an atmosphere that is made almost completely of oxygen. In their paper published in the journal *Science*, Kepler de Souza Oliveira, Detlev Koester and Gustavo Ourique describe how they came to discover the oddity and offer some ideas on how it might have come to exist. Boris Gänsicke with the University of

Warwick offers an essay on the work by the team in the same journal issue.

White dwarfs come about, scientists believe, when a relatively 'small' star runs out of fuel, losing its outer layer as the star shrinks down due to gravity—the stronger gravitational force then usually causes the heaviest elements to be drawn towards the core pushing the lighter ones, such as helium and hydrogen to the surface. But this new white dwarf is different, the researchers report, instead of the usual mix of light elements at the surface, there is almost nothing but pure oxygen. Nicknamed Dox, the star is the first ever of any kind to be observed to have a nearly pure oxygen outer layer.

Such a phenomenon has been predicted before, but most in the field never believed that such a star would ever be observed, thus it came as quite a surprise to team member Gustavo Ourique as he poured over thousands of simple graphs made from data generated by the New Mexico observatory. It was not until further tests were run that it was confirmed that the unique graph he had found turned out to represent data from the strange white dwarf.

Though it is impossible at this point to say with any certainty what caused the unique star formation, the researchers believe it is likely tied to an earlier event—they believe that Dox may once have been one of a pair of stars forming a binary system, and as the other star ran out of fuel it would have become a red giant, which would perhaps have been able to interact with its partner directly. The outcome, the researchers suggest could have laid the groundwork for a later explosion that caused Dox to lose its other lighter elements, leaving mostly pure oxygen in its outer layer.

More information: S. O. Kepler et al, A white dwarf with an oxygen atmosphere, *Science* (2016). DOI: 10.1126/science.aad6705

Abstract

Researchers have discovered a white dwarf star with an atmosphere dominated by oxygen, a type of white dwarf that has been theorized to exist but not identified to date. The finding could challenge the textbook wisdom of single stellar evolution, and provide a critical link to some types of supernovae discovered over the past decade. As relatively small stars (those less than ten times the mass of our sun) near the end of their lives, they throw off their outer layers and become white dwarf stars, which are very dense. The high gravity that occurs under such density causes the lighter elements, such as hydrogen or helium, to float to the surface of the star, masking the heavier elements below. While combing through data from the Sloan Digital Sky Survey (SDSS), Souza Oliveira Kepler et al. identified SDSS J124043.01+671034.68, a white dwarf with its outer layer of light elements stripped away, revealing a nearly pure layer of oxygen. Several different theories have predicted that the outer layer of a white dwarf can be stripped, but identification of SDSS J124043.01+671034.68 provides the first evidence of this phenomenon. One possibility is that interactions with a nearby companion in a binary star caused SDSS J124043.01+671034.68 to bare its oxygen envelope. Another possibility is that a massive pulse of burning carbon from the center of the star, emulating outwards, eliminated the lighter elements. A Perspective by Boris Gänsicke provides further context.

Citation: White dwarf with almost pure oxygen atmosphere discovered (2016, April 1) retrieved 5 May 2024 from https://phys.org/news/2016-04-white-dwarf-pure-oxygen-atmosphere.html