New evidence that some supernovae may be a “double detonation”

In other cases, another member of the system will go on to form a second white dwarf. If gravitational instabilities bring these two objects together, then their collision will create a single object with a much higher mass. This will also restart fusion, leading to an explosion.

We have found evidence for both of these events happening. However, there are some questions about whether they happen often enough to explain the frequency of type Ia supernovae that we see. Both mechanisms require stars of sufficient mass orbiting within a reasonably close distance for either mass transfer or a collision to occur. So, astronomers have been considering other ways of blowing up a white dwarf.

The most promising option appears to be a double detonation. This can also require the transfer of some helium-rich material from another companion, but it can also occur if the white dwarf ends up with some unfused helium left on its surface. Regardless of how it ends up there, the helium can start fusing if enough of it pools up, or simply if its movement causes a sufficiently high local density in one region. However it happens, once fusion starts, the entire surface of the white dwarf will quickly follow, creating detonation number one.

That in turn will create compression in the carbon-oxygen portion of the white dwarf, pushing it past the density needed for that to start fusing. Once again, the initiation of fusion heats and compresses nearby material, creating a chain

reaction that triggers widespread fusion in the white dwarf, blowing it to pieces as part of detonation two.

A shell game

The key thing about this is that it allows the explosion of white dwarfs before they reach a mass sufficient enough to trigger the fusion of their carbon and oxygen. Instead, it can potentially happen any time enough helium gathers on their surface. A double-detonation event would also be very difficult to detect, as the explosions would happen in rapid succession, and the environment in the immediate surroundings of a type Ia supernova is going to be complex and difficult to resolve.

https://arstechnica.com/science/2025/07/new-evidence-that-some-supernovae-may-be-a-double-detonation/