You’ve probably heard about the inevitable death of our Sun in a few billion years. After using up all of its hydrogen fuel, our star will start to cool and expand its radius to engulf Mercury, Venus, Earth, and maybe even Jupiter. Once it completes its transformation into what is known as a red supergiant, our Sun will then continue to burn helium for up to a billion more years.

Red supergiants (RSGs) number around one billion out of the hundred billion stars in our Milky Way Galaxy. At a glance, they seem like they should be fairly easy to identify. But what if some of these stars are not all that they seem to be? What if they are hiding a secret under their outer layers? And if they are, how on Earth could we possibly detect it?

In 1977, astrophysicists Kip Thorne and Anna Żytkow came up with a theory for a rare, bizarre type of hybrid star – a Thorne- Żytkow (pronounced thorn-jit-kahv) object.¹ They proposed that in a binary star system, where two stars orbit each other, the stars could somehow spiral in and collide or merge to form a Frankenstein-esque new star. Specifically, this hybrid would be the union of a neutron star and a supergiant star. The neutron star, which is a super dense remnant of a massive star that is approximately the size of Earth, could spiral into the supergiant star, be pushed into it by the force of a nearby supernova, or just be engulfed when the star expanded in the process of becoming a supergiant. The resulting Thorne-Żytkow object would outwardly look just like any supergiant star, but would have a neutron star hiding at its core.

A basic diagram of the inner structure of a Thorne-Żytkow object.

So going back to our earlier question, how would we even know if an RSG is actually a Thorne-Żytkow object, if we can’t look inside of it? The answer is, we look extremely carefully for some very subtle clues. RSGs give off a specific spectrum, with certain elements being more abundant than others. A Thorne-Żytkow object, however, would show some larger amounts of other specific elements that we wouldn’t usually find in an RSG spectrum. This tells us that there is pollution from some unseen companion, beneath the outer layers of the giant star.

With only an estimated 20-200 Thorne-Żytkow objects in our galaxy, it seems like a pretty slim chance we’d find one. But recently, in 2014,
Emily Levesque (UW) and her team found a possible candidate. Located just outside our Milky Way in a neighboring dwarf galaxy called the Small Magellanic Cloud, star HV 2112 shows some weird abundances of elements like lithium, molybdenum, and rubidium – elements that we’d expect to see from an RSG with a neutron star at its core. This exciting discovery may only be the first of a few more new candidates, finally advancing Thorne-Żytkow objects from pure theory to a real, observable possibility.

Levesque and her team are excited to study HV 2112 further, and find more stars like it. The confirmation of a candidate Thorne-Żytkow object presents new possibilities into how stellar interiors work, and where some of the rarer elements in our universe like those found in HV 2112 are produced. Hopefully, future studies will be able to peel back the outer layers of these stars and judge their contents more thoroughly, rather than just their covers.

References
