A new 'guest star' will appear in the sky in 2024 – a space scientist explains how nova events work and where to look

August 1 2024, by Vahe Peroomian

Art depicts the Roman Emperor Henry III viewing the supernova explosion of 1054.

The stars aren't fixed and unchanging, unlike what many ancient people thought. Once in a while, a star appears where there wasn't one before, and then it fades away in a matter of days or weeks.

The earliest record of such a "guest star," named so by ancient Chinese astronomers, is a star that suddenly appeared in skies around the world on July 4, 1054. It quickly brightened, becoming visible even during the day for the next 23 days.

Astronomers in Japan, China and the Middle East observed this event, as did the Anasazi in what is now New Mexico.

In the second half of 2024, a nova explosion in the star system called T Coronae Borealis, or T CrB, will once again be visible to people on Earth. T CrB will appear 1,500 times brighter than usual, but it won't be as spectacular as the event in 1054.

I am a space scientist with a passion for teaching physics and astronomy. I love photographing the night sky and astronomical events, including eclipses, meteor showers and once-in-a-lifetime astronomical events such as the T CrB nova. T CrB will become, at best, the 50th brightest star in the night sky—brighter than only half the stars in the Big Dipper. It might take some effort to find, but if you have the time, you'll witness a rare event.

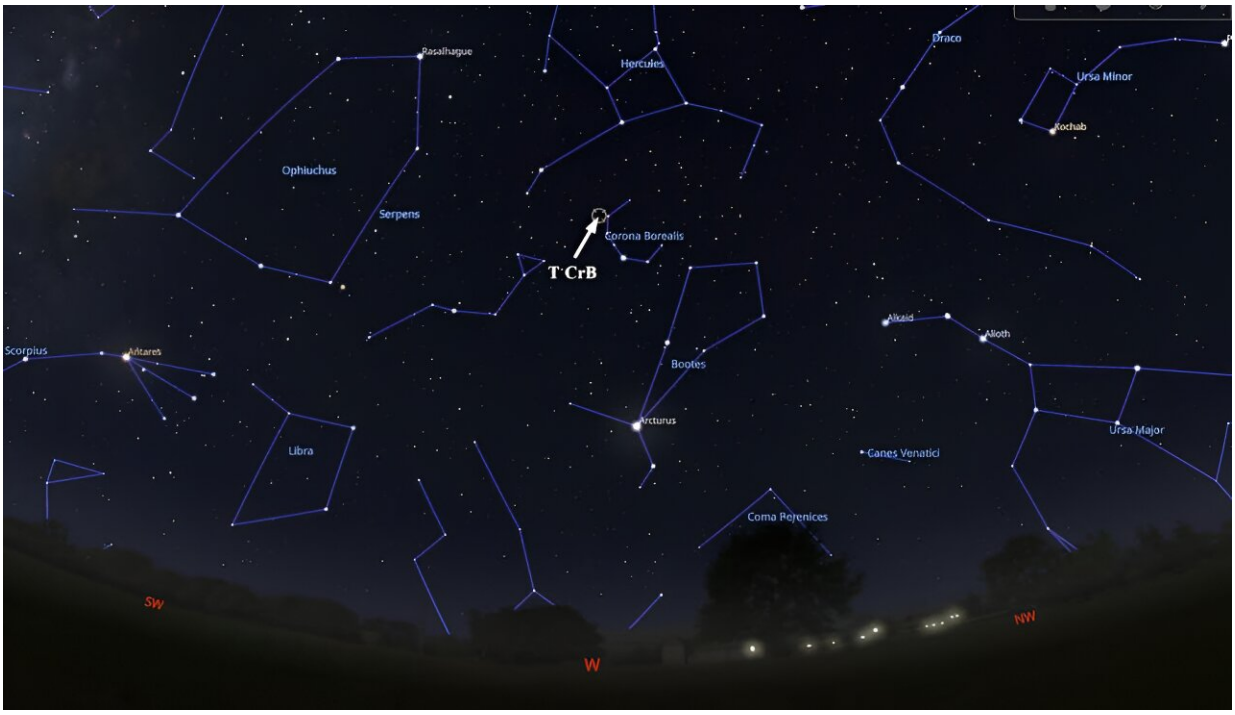
What is a nova?

In 1572, the famous Danish astronomer Tycho Brahe observed a new star in the constellation Cassiopeia. After reporting the event in his work "De Nova Stella," or "On the New Star," astronomers came to associate the word nova with stellar explosions.

Stars, regardless of size, spend 90% of their lives fusing hydrogen into helium in their cores. How a star's life ends, though, depends on the mass of the star. Very massive stars—those more than eight times the mass of our Sun—explode in dramatic supernova explosions, like the ones people observed in 1054 and 1572.

In lower mass stars, including our sun, once the hydrogen in the core is exhausted, the star expands into what astronomers call a red giant. The red giant is hundreds of times its original size and more unstable. Eventually, all that is left is a white dwarf—an Earth-sized remnant made up of carbon and oxygen. White dwarves are a hundred thousand times denser than diamond. Unless they're part of a binary star system, where two stars orbit each other, they slowly fade in brightness over billions of years and eventually disappear from sight.

T CrB is a binary star system—it's made up of a red giant and a white dwarf, which orbit each other every 228 days at about half the distance between Earth and the sun. The red giant is nearing the end of its life, so it has expanded dramatically, and it's feeding material into a rotating disk of matter called an accretion disk, which surrounds the white dwarf.



What the Los Angeles sky will look like on, as an example, Aug. 15, 2024, at 10 p.m. local time. The view will be very similar across the U.S., but T CrB will get closer and closer to the horizon and will be halfway between where it's shown here and the horizon by early September. By early October, it will be right on the horizon. Credit: Vahé Peroomian/Stellarium

Matter from the accretion disk, which is made mostly of hydrogen, spirals in and slowly accumulates on the surface of the white dwarf. Over time, this blanket of hydrogen becomes thicker and denser, until its temperature exceeds 18 million degrees Fahrenheit (10 million degrees Celsius).

A nova is a runaway thermonuclear reaction similar to the detonation of a hydrogen bomb. Once the accretion disk gets hot enough, a nova occurs where the hydrogen ignites, gets blown outward and emits bright light.

When will it occur?

Astronomers know of 10 recurrent novae—stars that have undergone nova explosions more than once. T CrB is the most famous of these. It erupts on average every 80 years.

Because T CrB is 2,630 light-years from Earth, it takes light 2,630 years to travel the distance from T CrB to Earth. The nova we will see later this year occurred over 2,000 years ago, but its light will be just reaching us later this year.

The accretion of hydrogen on the surface of the white dwarf is like sand in an 80-year hourglass. Each time a nova occurs and the hydrogen ignites, the white dwarf itself is unaffected, but the surface of the white dwarf is wiped clean of hydrogen. Soon after, hydrogen begins accreting on the surface of the white dwarf again: The hourglass flips, and the 80-year countdown to the next nova begins anew.

Careful observations during its past two novae in 1866 and 1946 showed that T CrB became slightly brighter about 10 years before the nova was visible from Earth. Then, it briefly dimmed. Although scientists aren't sure what causes these brightness changes, this pattern has repeated, with a brightening in 2015 and a dimming in March 2023.

Based on these observations, scientists predict the nova will be visible to us sometime in 2024.

How bright will it be?

Astronomers use a magnitude system first devised by Hipparchus of Nicaea more than 2,100 years ago to classify the brightness of stars. In this system, a difference of 5 in magnitude signifies a change by a factor

of 100 in brightness. The smaller the magnitude, the brighter the star.

In dark skies, the human eye can see stars as dim as magnitude 6. Ordinarily, the visible light we receive from T CrB comes entirely from its red giant, a magnitude 10 star barely visible with binoculars.

During the nova event, the white dwarf's exploding hydrogen envelope will brighten to a magnitude 2 or 3. It will briefly become the brightest star in its home constellation, Corona Borealis. This maximum brightness will last only several hours, and T CrB will fade from visibility with the naked eye in a matter of days.

Where to look

Corona Borealis is not a prominent constellation. It's nestled above Bootes and to the west of Ursa Major, home to the Big Dipper, in northern skies.

To locate the constellation, look due west and find Arcturus, the brightest star in that region of the sky. Then look about halfway between the horizon and zenith—the point directly above you—at 10 p.m. local time in North America.

Corona Borealis is approximately 20 degrees above Arcturus. That's about the span of one hand, from the tip of the thumb to the tip of the pinky, at arm's length. At its brightest, T CrB will be brighter than all the stars in Corona Borealis, but not as bright as Arcturus.

You can also use an interactive star chart such as Stellarium, or one of the many apps available for smartphones, to locate the constellation. Familiarizing yourself with the stars in this region of the sky before the nova occurs will help identify the new star once T CrB brightens.

Although T CrB is too far from Earth for this event to rival the supernova of 1054, it is nevertheless an opportunity to observe a rare astronomical event with your own eyes. For many of us, this will be a once-in-a-lifetime event.

For children, however, this event could ignite a passion in astronomy. Eighty years in the future, they may look forward to observing it once again.

Provided by The Conversation

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