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Scientists' Good News: Earth May Survive Sun's Demise in 5 Billion Years

By [DENNIS OVERBYE](#)

There is new hope that [Earth](#), if not the life on it, might survive an apocalypse five billion years from now.

That is when, scientists say, the Sun will run out of hydrogen fuel and swell temporarily more than 100 times in diameter into a so-called red giant, swallowing Mercury and Venus.

Astronomers are announcing that they have discovered a planet that seems to have survived the puffing up of its home star, suggesting there is some hope that Earth could survive the aging and swelling of the Sun.

The planet is a gas giant at least three times as massive as Jupiter. It orbits about 150 million miles from a faint star in Pegasus known as V 391 Pegasi. But before that star blew up as a red giant and lost half its mass, the planet must have been about as far from its star as Earth is from the Sun — about 90 million miles — according to calculations by an international team of astronomers led by Roberto Silvotti of the Observatorio Astronomico di Capodimonte in Naples, Italy.

Dr. Silvotti said the results showed that a planet at Earth's distance "can survive" a red giant, and he said he hoped the discovery would prompt more searches.

"With some statistics and new detailed models, we will be able to say something more even to the destiny of our Earth (which, as we all know, has much more urgent problems by the way)," he said via e-mail.

Dr. Silvotti and his colleagues reported their results today in *Nature*.

In an accompanying commentary, Jonathan Fortney of [NASA](#)'s Ames Research Center in California wrote, "This system allows us to start examining what will happen to planets around stars such as our own Sun as they too evolve and grow old."

The star V 391 Pegasi is about 4,500 light years from Earth and is about half as massive as the Sun, burning helium into carbon. It will eventually sigh off another shell of gas and settle into eternal senescence as a white dwarf.

Meanwhile, the star's pulsations cause it to brighten and dim every six minutes. After studying the star for seven years, Dr. Silvotti and his colleagues were able to discern subtle modulations in the six-minute cycle, suggesting that the star was being tugged to and fro over a three-year period by a massive planet.

“Essentially, the observers are using the star as a clock, as if it were a G.P.S. satellite moving around the planet,” said Fred Rasio of [Northwestern University](#), who was not involved in the research.

This is not the first time that a pulsing star has been used as such a clock. In 1992, astronomers using the same technique detected a pair of planets (or their corpses) circling the pulsar PSR1257+12. And only yesterday, X-ray astronomers from the Goddard Space Flight Center in Greenbelt, Md., and the [Massachusetts Institute of Technology](#) announced that they had detected the remains of a star that radiation had whittled down to planetary mass circling a pulsar in the constellation Sagittarius. Those systems have probably endured supernova explosions.

The Pegasus planet has had to survive less lethal conditions, although it must have had a bumpy ride over its estimated 10 billion years of existence. Alan Boss of the Carnegie Institution of Washington said, “Stellar evolution can be a wild ride for a planet that is trying to survive, especially inner planets like Earth.”

When our own Sun begins to graduate from a hydrogen-burning main sequence star to a red giant, two effects will compete, the astronomers said. As the Sun blows off mass to conserve angular momentum, Earth will retreat to a more distant, safer orbit. At the same time, tidal forces between Earth and the expanding star will try to drag the planet inward, where it could be engulfed. The latter effect, in particular, is difficult to compute.

As a result, Mario Livio of the Space Telescope Science Institute said of the inner planets, “Earth's fate is actually the most uncertain because it is at the border line between being engulfed and surviving.”

A particularly dangerous time for Earth, Dr. Silvotti said, would be at the end of the red giant phase when the Sun's helium ignites in an explosive flash. In the case of V 391 Pegasi, that explosion sent a large fraction of the star's mass flying outward.

“This is another reason why the survival of a planet in a relatively close orbit is not trivial,” he said.

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