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As black hole swallows neutron star, UT scientists first to catch cosmic burp of gravity waves

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On Jan. 5, 2020, at 11:24 a.m., a 1-billion-year-old wave of energy crashed through the Earth, its oceans and every person on the planet. This wave was so intense that it stretched and distorted our bodies — and even time itself.

For an instant, each of us was a bit taller than usual, and then a bit shorter —and 11:24 a.m. went by just a bit slower for each of us and then sped up again as we became unwitting time travelers.

Don't recall this cosmic event? That's OK. No one else felt it either. In fact, the only reason we know this happened was that it was recorded by highly precise instruments in the United States and in Italy.

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A study published last week in The Astrophysical Journal Letters revealed the culprit behind this galactic blast: a black hole gulping down an entire star in one bite. It was the first time such an event has ever been recorded.

The study was written by a large, international team of scientists, including four physicists at the University of Texas.

"Somebody like me that is a little bit older and has been expecting this — I couldn't believe it when I saw it," said Pablo Laguna, chair of the UT physics department. "It was just amazing."

The black hole wasn't snacking on any old star — it gobbled a neutron star, which are as heavy as our own sun but are only about as big as the city of Austin — 20 miles wide or

so. Neutron stars are so dense, in fact, that making one would be like taking all of Manhattan and scrunching it up until it fit in your kitchen sink.

“Besides black holes, they are the most compact objects in the universe,” Laguna said.

From 2019: Science fact — Astronomers reveal first image of a black hole

While over the past few years scientists have recorded collisions between two black holes, or between two neutron stars, this was the first time they saw what’s known as a “mixed binary,” or the collision between a neutron star and a black hole.

Black holes and neutron stars are similarly dense because they are both born from the death of a star. When an old star dies, its afterlife can go one of three ways: it can obliterate itself so completely that there’s nothing left, it can collapse into itself to make a black hole, or it can be reborn as a neutron star.

Gravity from black holes and neutron stars tug on anything that gets near them — in the case of black holes, even light can't escape. If these dead stars get too close to each other, their massive gravity puts them on a collision course that can take millions of years. But when it finally happens, it's over in a millisecond.

This collision of the galactic heavyweights sends out a kind of shock wave that reverberates throughout the universe. The wave is so powerful that it disrupts both time and space. If it had happened inside the solar system, it would basically annihilate all life, Laguna said.

The actual collision that caused this gravitational wave happened so far away that we’re only now feeling the shock wave, almost a billion years later.

Unfortunately for the neutron star, the black hole always wins these encounters.

One of the smallest, closest black holes: Scientists call it 'the Unicorn.'

“There’s only one outcome when a black hole is involved. The black hole gets bigger,” said Deirdre Shoemaker, one of the UT physics professors who was part of the study.

Her team used UT’s Texas Advanced Computing Center — one of the largest supercomputer systems in the country — to solve Einstein’s complicated equations and model how the collision might have happened.

“You definitely cannot do it with a desktop computer,” said Laguna, who co-leads a research group focused on these models with Shoemaker. “We’re lucky that we have access to the one

in Texas."

Another photo of black hole released: This one sheds new light on its 'feeding habits.'

Special sensors in Italy and the states of Washington and Louisiana allowed the international team to record the gravitational wave last winter. These sensors work by bouncing a laser beam back and forth between mirrors spaced a few miles apart. Like a heartbeat, the laser usually bounces from one mirror to the next at a consistent pace. However, when a gravitational wave comes it distorts the length between the two mirrors and the laser takes a bit more or less time to bounce. This change in length is unbelievably tiny, but the instruments are sensitive enough to pick it up.

"They really are some of the most absolutely precise machines humankind has ever created," said Scott Ransom, an astronomer with the National Radio Astronomy Observatory in Virginia, who was not involved in the study. The instruments are so highly tuned, in fact, that even trucks driving on a road miles away can disrupt them.

Ransom said detecting this collision between the neutron star and the black hole has been the holy grail that astronomers have been seeking for decades. The discovery was so interesting in part because it was a final confirmation of the existence of a phenomenon that had been predicted decades ago.

RELATED: UT mathematician's work on black holes led to gravitational wave discovery

"I get shocked that… we have the capacity not only to imagine that it can happen but to predict it, and build something to measure it. That freaks me out about humans," Shoemaker said. "We get stuck on petty problems, but sometimes we have the capacity to solve something that seems like it should be beyond our capabilities."

While the discovery probably doesn't have a lot of practical or immediate implications for most people's day-to-day lives, Laguna said knowing what's out there in the universe can be interesting in its own right.

"Suppose you move to a different place … and suppose that you would have just spent the rest of your life without trying to find out what that neighborhood is — what it looks like," he said. "For me, it would just be sad to spend the entire history of humanity without trying to learn what this immense neighborhood is all about."