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DIGEST

The IceCube Lab, located near the South Pole, recently created a "photo" of our home galaxy – using not photons, but neutrinos.

MARTIN WOLF, ICECUBE/NSF

ASTRONOMY

IceCube scientists snap first neutrino "image" of the Milky Way

Machine learning produces the first particle portrait of our home galaxy.

DEEP UNDER the ice at the South Pole sits a telescope that captures ghost particles.

The telescope – called the IceCube Neutrino Observatory – has just analysed 10 years of data using new machine learning techniques and found evidence of neutrino emissions from the Milky Way.

They've even been able to create the first neutrino "image" of our Milky Way.

If this result pans out, it would provide scientists with a long-sought source of cosmic rays.

"As is so often the case, significant breakthroughs in science are enabled by advances in technology," says Denise Caldwell, from the US National Science Foundation.

"The capabilities provided by the highly sensitive IceCube detector, coupled with new data analysis tools, have given us an entirely new view of our galaxy – one that had only been hinted at before.

"As these capabilities continue to be refined, we can look forward to watching this picture emerge with ever-increasing resolution, potentially revealing hidden features of our galaxy."

Neutrinos are tricky particles to catch. They have high energy but no electrical charge and almost no mass. They travel at nearly the speed of light, and blip through whole planets without interacting with them.

But the saving grace is that there are a lot of them – trillions pass through our bodies every second.

One way to catch them is through large telescopes like the IceCube Neutrino Observatory – which is 2.5 km under the ice and can detect when neutrinos occasionally create charged particles.

But there's not just one type of neutrino either.

"Searches for astrophysical neutrino sources are affected by an overwhelming background of muons and neutrinos produced by cosmic ray interactions with Earth's atmosphere," the scientists write in their new paper.

"Atmospheric muons dominate this background; IceCube records about 100 million muons for every observed astrophysical neutrino."

Even worse, cosmic rays produced within the Milky Way arrive from random directions, meaning that it's incredibly difficult to confirm where exactly they are coming from.

However, after using IceCube's 10 years of data and a new machine learning model, the team found neutrino emissions from the Milky Way's galactic plane at a 4.5 sigma level of certainty.

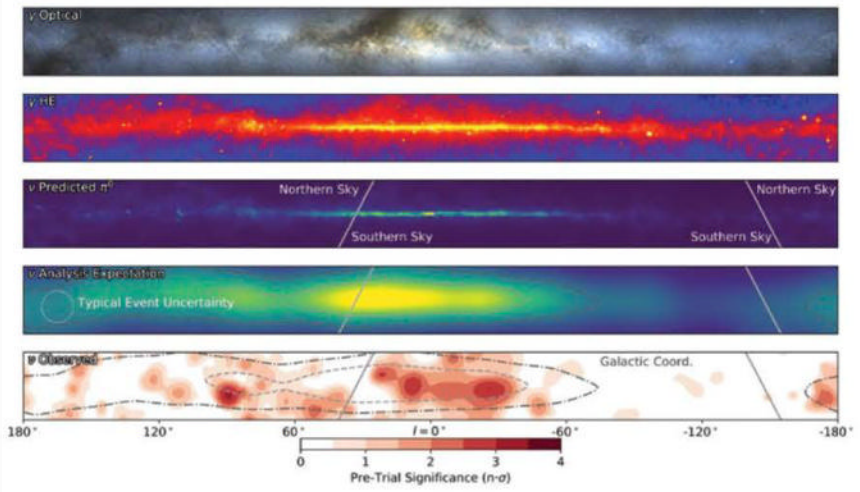
The scientists will need to get up to sigma 10 to confirm the findings. And although they know it's coming from the Milky Way, they also don't have exact positions of where in the galaxy it's coming from – that's the next step.

"Observing our own galaxy for the first time using particles instead of light is a huge step," says Naoko Kurahashi Neilson, professor of physics at Drexel University in Philadelphia, US, and a member of the IceCube team.

"As neutrino astronomy evolves, we will get a new lens with which to observe the universe."

The research is published in *Science*.

Multi-messenger portraits of home



These images, centred on the Milky Way's heart, show the entire galactic plane in light (optical, gamma rays) and in particles (neutrinos – both predictions and actual observations).

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