How we found the source of the mystery signals at the Dish

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Scientists knew the mystery signals were close by the Parkes radio telescope: but what was the source? Credit: Flickr/Amanda Slater, CC BY-SA

Everyone likes solving a mystery, and the hunt for the source of strange signals detected by Australia's Parkes radio telescope is a classic. Although how "aliens" became involved in the story is more of a media mystery.

But first to those strange signals. A few months ago I wrote about searching for fast radio bursts (FRBs). The source of these powerful, millisecond bursts is unknown but we're getting closer to understanding them.

The first FRB was found in 2007. It actually occurred in 2001, but was discovered six years later during a more close and careful inspection of archival data from the Parkes radio telescope. That same care was applied to other old data sets in the hope that more FRBs waited to be discovered.

As part of her PhD at Swinburne University, Sarah Burke Spolaor looked through other old data sets using similar techniques. Instead of finding undiscovered FRBs, she found these strange new signals that she called perytons. They were like FRBs, but different.

When astronomers look for pulses from astrophysical sources (like pulsars or FRBs) we use a few key features to tell the real signals apart from the noise of radio devices on Earth.

First, a pulse that has travelled through space experiences dispersion, meaning that the signal arrives at different times at different wavelengths because of how it travels through interstellar electrons. Since signals from Earth don't travel through all those electrons, they don't follow the same wavelength-time relation.

Secondly, we use a receiver on the Parkes telescope that has 13 pixels that each look at a different place on the sky. A pulse coming from a fixed point in the sky will appear in only one pixel (or a few neighbouring pixels if it is very bright) but signals from Earth will usually appear in all 13 at the same time.

The perytons first reported by Burke Spolaor and colleagues in 2011 passed the first test, they had a similar wavelength-time relation as the pulses of interest, but they didn't pass the second; they were in all 13 beams at once. So the signals had to be coming from Earth, that much was clear. But what could be causing them? (The paper also notes that the name peryton was chosen from mythology to be unassociated with an exactphysical phenomenon, due to the ambiguous origin of the detections. Perytonsare winged elk that cast the shadow of a man.)

Hunting the local source

The answer wasn't immediately obvious, as only about 11 perytons were found, all in old data from 1998 to 2002, making it difficult to trace back the source of the odd pulses.

In their 2011 paper, Burke Spolaor and colleagues suggested possible origins such as lightning, solar bursts or transient events within Earth's atmosphere, but no conclusive link could be made. Further investigation showed the perytons were more likely of human-generated origin.

And so perytons became a sort of troubling mystery. Even with the discovery of more FRBs in the past three years, perytons still lurked in the shadows. Since it has been known from the start that perytons come from a source nearby nearby, they haven't been an active field of study for radio astronomers, and no new leads had come up to hint at where they might be coming from.

Until recently. Earlier this year, we got the breakthrough we needed to solve the peryton mystery once and for all.

Three new perytons were spotted in our data at Parkes during the week of January 19. Each one was discovered within a day of when it happened thanks to advances in data processing used at Parkes.

Speedy software to search for bursts developed by former Swinburne PhD student Ben Barsdell and incorporated into our newest project the SUrvey for Pulsars and Extragalactic Radio Bursts (SUPERB) led to quicker detection. Since we found them in relatively short order, we were able to go back and look at whether anything special was happening on site during that particular week. Astronomers from SUPERB began working with the staff at Parkes to try to hunt down the source of the perytons.

An important clue

According to the on-site staff, nothing out of the ordinary was happening that week that might be responsible, but they did provide one more important clue.

In December 2014 CSIRO installed a radio frequency interference (RFI) monitor at the Parkes site to monitor the RFI environment around the telescope. This type of monitoring becomes increasingly important as radio-emitting technologies such as mobile phones, Wi-Fi and digital television encroach on radio telescope sites.

The RFI monitor data, which hadn't been available for previous peryton discoveries, revealed something important: at the time of each peryton event, there was also a period of radio emission at the frequency 2.5 GHz, out of the range we were observing with the telescope. Whatever was causing the perytons had to be responsible for these spikes, too.

Many consumer electronics emit at 2.5 GHz and the most notorious of these is the microwave oven. So we began to test the microwave ovens on site (one in the staff kitchen and one in the visitors' centre) to see if we could make the perytons happen on purpose. Our initial tests of running the microwave oven in a normal mode were unsuccessful and we didn't see any perytons from either of the microwave ovens.

Finally, on March 17, almost two months after our initial find, we tested the microwave ovens in a slightly unusual way. We tried stopping the microwave oven by opening the door and boom! We saw perytons just like the ones we'd seen before!

We found that we could generate perytons in our data by simply having a direct line of sight between the microwave oven and the telescope receiver (without the telescope surface itself in the way) and stopping the microwave oven by opening the door. Perytons come from microwave ovens! Solved!

From a scientific perspective this work was a satisfying conclusion to months of hard work by a large group of people. But from the media's perspective this story was apparently too tempting not to spin.

Who mentioned the aliens?

Most of the media coverage about this work has centred around "baffled scientists" and "alien signals from space" in a way that makes astronomers sound like puzzled boffins who thought they'd found something Nobel prize-worthy that ended up coming from next door.

Indeed in some cases it was sufficient to copy and paste a previous headline and article but add the word "aliens" a few more times for good measure. It became clear that the majority of writers had never read our paper or taken time to properly represent our science, an unfortunate and frustrating outcome.

Alas we were never looking for extra-terrestrial life, studying alien signals or confusing astronomy with gastronomy. We always knew perytons were coming from nearby and the real fun lay in putting all the pieces together to solve the puzzle.

Even though one radio mystery has been solved another still remains – the source of the fast radio bursts.

We still don't know exactly what is causing the FRBs that started this whole peryton investigation, although we find that they cannot be explained by the same microwave ovens and many properties of FRBs point towards a genuine astrophysical origin. So the hunt continues.

Source: The Conversation

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