FAO - Jorge Pullin

From - Andrew Wray 44 117 9301129



# Frontiers

The Milky Way is alive with the sound of space-time

> "If this turns out to be real, we'll be very proud and happy. Some people have been working on this for 30 years and it would be the realisation of our dreams"

Possible glimpses of gravitational ripples point to violent collisions in our Galaxy

## Gravity waves detected at last?

HAZEL MUIR

RIPPLES in the fabric of space-time caused by cataclysmic events deep within our Galaxy may have been picked up on Earth. If the results are confirmed, it will give astronomers an entirely new way to look at the Universe.

Einstein predicted the existence of ripples in space-time, or gravitational waves, in his general theory of relativity in 1915. The waves should pour out of hugely energetic events – such as exploding stars – at the speed of light and carry unique information on the events that produced them across vast stretches of space. Detecting them could help firm up our understanding of gravity and reveal astronomical oddities such as colliding black holes that might otherwise be completely undetectable. But so far the waves have eluded scientists.

Now, there are hints that a team of Italian researchers led by Eugenio Coccia of the INFN Frascati National Laboratories and Rome University has detected them. "This will be a really big deal if it's correct," says David Blair, an expert on gravitational waves at the University of Western Australia in Perth. "If we can detect gravitational waves, we'll be able to listen to the Universe as well as see it," he says. "These detectors will be like bionic ears for the human race."

The Italian team used two detectors. The first, known as EXPLORER, is a 2.3-tonne aluminium bar based at CERN, the European centre for particle physics near Geneva. The other is NAUTILUS, an identical bar at the Frascati lab.

To look for gravitational waves, the scientists constantly monitor vibrations in the bars. The waves should stretch and squeeze the bars a tiny amount, effectively making them "ring". To cut down vibrations from other sources, the bars are suspended on dampers and cooled to near absolute zero to quell thermal noise.

If identical bursts of vibrations are recorded at both Geneva and Frascati at the same time, it could be because a gravitational wave has just hit. And the signal from a gravitational wave should be strongest when the sides of the bars face the source of the wave.

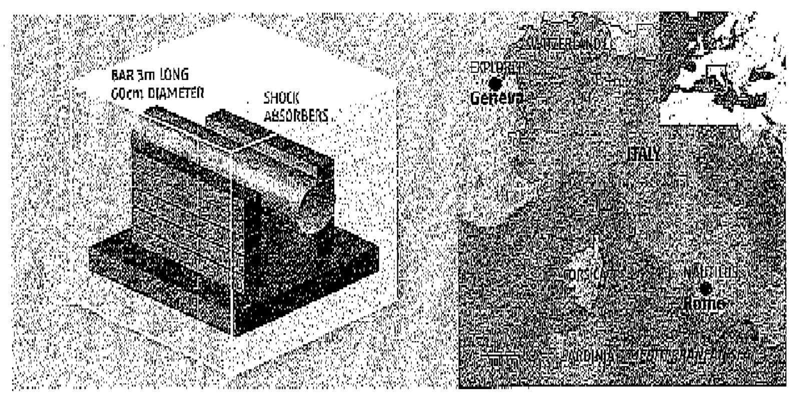
Coccia's group found that matching bursts of vibrations were most likely to be recorded when the sides of both of the bars faced into the Milky Way – which is exactly where most nearby sources of gravitational waves

### DETECTING GRAVITATIONAL WAVES

The gravitational wave detector is based on an aluminium bar, isolated from vibrations by shock absorbers and cooled to near absolute zero to reduce thermal vibration

Two detectors called EXPLORER and NAUTILUS, are placed around 700km apart, in Rome and Geneva

When a gravitational wave hits the bars, they contract and expand slightly. If both detectors record the same vibration at the same time, it could signal a gravitational wave



should be lurking. Coccia says the results hint that their detectors are hearing cataclysmic events in our own Galaxy.

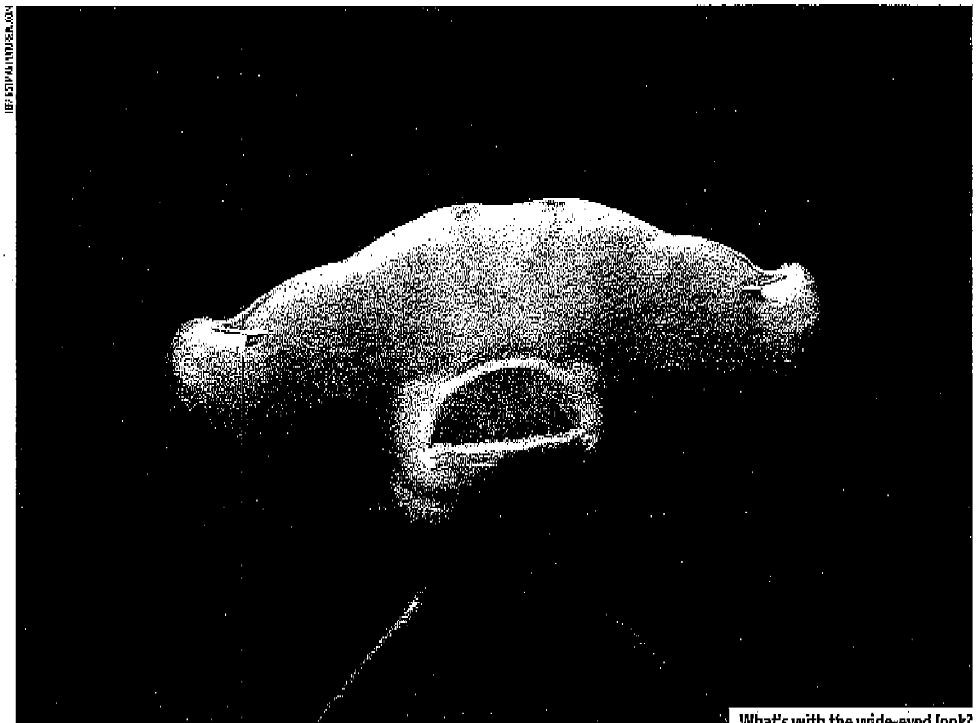
If the signals do prove to be gravitational waves, they are very common. There could be tens of invisible objects, such as black holes and neutron stars, slamming into each other in the galaxy every year, says Coccia. The team's report appears in the journal *Classical and Quantum Gravity* (vol 19, p 5449) and is posted at http://arxiv.org/abs/gr-qc/0210053.

Blair cautions that the result might be a mirage. Fluctuations in power across European electrical grids might trigger signals in both detectors simultaneously, for instance. Despite the team's efforts to cancel vibrations from other sources, the data will still be very noisy, Blair says, making it hard to judge the statistical significance of their results.

Similar findings have been reported before. For instance, the Italian team's founder, Guido Pizzella, reported possible gravitational waves from a supernova in a nearby galaxy in 1987. However, none of these claims was ever confirmed. "But this should definitely not be dismissed out of hand," Blair says. "Many people are quick to criticise others for digging deep into their data. The climate of opinion is such that you have to be rather brave to do it. I applaud the Italians for persisting in these attempts."

Coccia points out that the detectors are 10,000 times as sensitive as they were in 1987. However, he is first to admit that his team and other detectors need to gather more data before they can confirm the result. By the end of next year they hope to have collected enough data to remove any doubt.

"If this turns out to be real, we'll be very proud and happy," says Coccia. "Some people have been working on this for 30 years and it would be the realisation of our dreams." ●



What's with the wide-eyed look?

MORPHOLOGY

# How the shark won its hammerhead

IT'S a classic mystery of the deep. Why does the hammerhead shark have the bizarrely shaped head from which it gets its name?

There have been a variety of suggested explanations. Some simply say that the sharks use their heads to "hammer" and pin down their favourite food. More plausibly, others have speculated that the wide lobes of the hammerhead allow it to have longer electroreceptors, the organs that all sharks use to detect the electric fields produced by nearby prey. This might allow hammerheads to sense subtler electric fields from more distant prey than their narrow-headed cousins.

Now it turns out that the shark's head does indeed help it find and capture prey, but not in the way that zoologists expected. Stephen Kajiura and Kim Holland of the University of Hawaii at Manoa set out to test the conventional theory by tricking young sharks into chasing phantom prey. Using a system of wires on the bottom of a shallow pool, they set up electric fields that mimicked those created by the bottom-dwelling shrimp and fish that form the sharks' usual diet.

Sure enough, hungry sharks abruptly turned towards an electric field when they detected it. But when the researchers measured the distance at which this happened they found it was the same for 13 young hammerheads as it was for 12 young sandbar sharks, which have normal-shaped heads.

The two types of sharks proved equally adept at sensing the electric fields: each was able to detect the source from up to 30 centimetres away. That ruled out any improved sensitivity from the wider head. However, the hammerheads enjoy another, more prosaic, advantage: their wider heads let them sweep more than twice as wide a swathe of the seafloor as they swim, which must boost their chance of encountering food (*The Journal of Experimental Biology*, vol 205, p 3609).

The researchers also found that hammerheads could turn more sharply when they detected the phantom prey. "They're a much more bendy shark," says Kajiura, who is now at the University of California at Irvine. In part, that's because they have more slender bodies than the sandbar sharks. However, Kajiura has other, unpublished data that suggests that the hammerheads' broad heads can act as fins to improve manoeuvrability.

So far, the researchers have only experimented with young sharks, so adult hammerheads may gain some other advantage from their head shape. "I'd love to have adult sharks to play with," says Kajiura. For obvious logistical reasons, though, that has so far proved difficult. Bob Holmes ●