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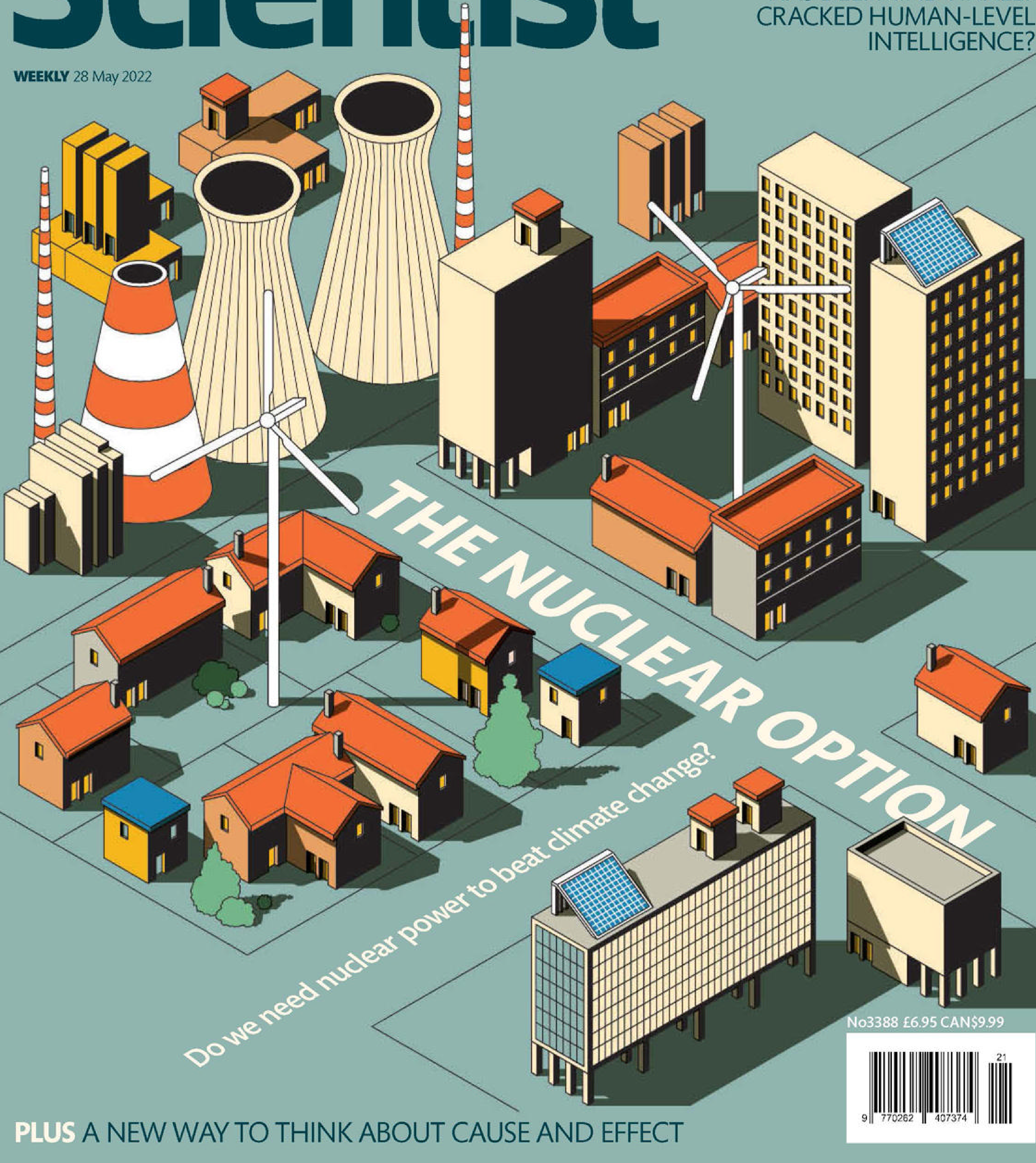

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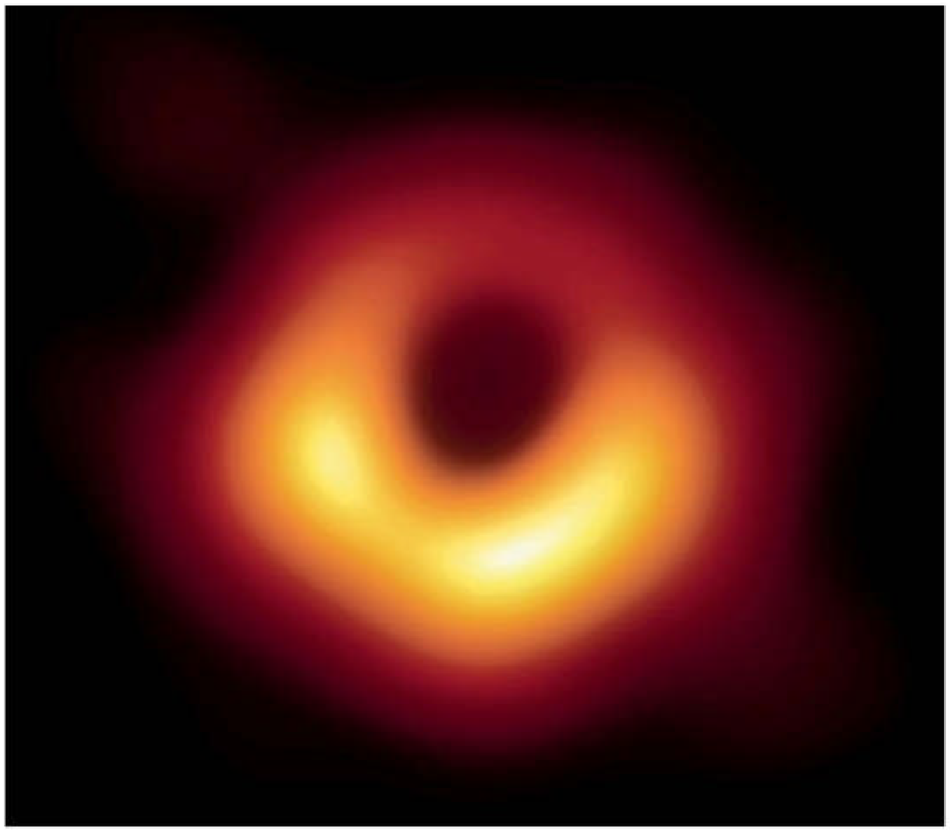
The first ever image of a black hole, at the centre of the galaxy M87, showed a bright outer ring of light in line with predictions, but a new analysis suggests that may not be accurate, reports **Leah Crane**



EHT COLLABORATION

The EHT image of the black hole at the centre of galaxy M87

THERE may be a problem with the first image of a black hole. After three years of analysis, a group of researchers in Japan has produced an image of M87* – the supermassive black hole at the centre of the M87 galaxy – that looks markedly different from the one released by the Event Horizon Telescope (EHT) collaboration in 2019. The researchers claim that the EHT group may have made a mistake.

To make the first black hole image (pictured), the EHT combined the power of eight radio telescopes around the world. The array essentially operates as one giant telescope, called an interferometer. Each pair of telescopes records a particular wavelength of light, and then all the information is combined to create the final image. "If the image on the sky were a musical song, you can think of the interferometer as measuring individual frequencies or notes in that song," says EHT project scientist Geoffrey Bower.

"These are the most thoroughly vetted interferometric images ever published"

These "notes" are combined using an algorithm that incorporates other information about the black hole and the telescope set-up to fill in the blanks and turn the interferometer's measurements into a picture. The most pronounced feature of the final image from the EHT is a bright ring – a result of the black hole's extreme gravity warping the light from the hot plasma swirling around it. But filling in the blanks to generate an image involves making some assumptions. If you start with a different set of assumptions, you will get a different picture.

That is what Makoto Miyoshi at the National Astronomical Observatory of Japan and his colleagues have done, and their results have them questioning whether this ring is really there. They reprocessed the data from the EHT with one significant difference: rather than restricting the light collected by the telescopes to a relatively small area as the EHT collaboration did, they assumed a much larger field of view.

With this change, no ring appeared in their final image. Instead, the image shows two distinct bright spots – one representing the area directly around the black hole, and another off to the side, possibly representing the base of a jet of matter that previous work has shown blasting out of M87* (arxiv.org/abs/2205.04623).

Miyoshi says the restricted field of view could have caused artefacts in the EHT's final image that are related to the arrangement of the telescope network, not real structures in space. "It may be that the same mistake formed the ring image in the case of [the recently released picture of] Sagittarius A*, too," says Miyoshi, referring to the black hole at the heart of the Milky Way. His work suggests that the EHT image of M87*, and perhaps that of Sagittarius A* as well, shouldn't appear to be doughnut-shaped.

Defending the ring

However, Bower says that Miyoshi's approach of relaxing the EHT's constraints on the field of view is incorrect and that the EHT group's original field of view reflects the area that the telescope actually observed, not an arbitrary choice. "[Miyoshi's team] used this extraordinarily large field of view, so they scatter the intensity of the light around this image," he says. "You can get almost anything you want if you give yourself that kind of freedom."

The EHT collaboration had four separate teams using different methods to turn the data into the final image, one of which was the same method that Miyoshi's team used, but with the field of view constrained. "These are the most thoroughly vetted interferometric images that have ever been published," says Bower.

They show no sign of the jet in M87*. This isn't unexpected, though, because the jet is expected to primarily emit light at lower frequencies than the ones that the EHT detects.

The ring structure seen in the final image is also not particularly unexpected, although the researchers hunted extensively for any way in which the picture might differ from theoretical predictions.

"We actually tried very hard not to find a ring," says EHT researcher Ziri Younsi at University College London. "We used traditional algorithms that have been used by the radio astronomy community for decades, and we used newer algorithms, and they all converged on the result we published."

The EHT collaboration put out a statement standing by its analysis, but Miyoshi and his colleagues are standing by their criticisms as well.

The EHT has taken new observations with additional telescopes added to the array, and researchers are now working on turning higher-resolution measurements taken in 2018 and early 2022 into images.

"A future image from those data sets will be a really important test of the overall method," says Bower. If other reanalyses of the original data don't settle this debate, the new data certainly will. ■