Abstractions

LAST AUTHOR

Like many animals, humans rely primarily on eyesight to find their way around. But eyes aren't much use in the dark, so some creatures, including many bats, 'hear' their way instead. Using echolocation, a sophisticated system of orientation involving echoes, they can build up an acoustic picture of their surroundings, detect obstacles and find prey. Some echolocating bats use tongue clicks, but most use signals produced in the larynx. Until now, no morphological feature had been linked to the capacity for laryngeal echolocation. This meant that we did not know whether a crucial fossil species, *Onychonycteris finneyi*, which lived up to about 55 million years ago, could echolocate. Now, Brock Fenton at the University of Western Ontario in London, Canada, and his team have learned more (see page 939). Fenton tells *Nature* about the implications of their discovery.

How did the study come about?

Coauthor Nina Veselka chose bats for a scholar's electives programme that the University of Western Ontario offers to undergraduates. She began examining bat skulls to determine the arrangement and functional significance of little-studied bones. We borrowed 35 specimens from the Royal Ontario Museum in Toronto and performed micro-computed tomography on them. This imaging technique allowed us to see the fine details of the bats' ear and throat regions: the larynges, stylohyals and tympanic bones. Previous work had relied on dissecting these bones, a challenge in animals as small as bats.

What did you discover?

We found that the fusion or connection of two bone structures — the stylohyal bone in a bat's throat and the tympanic bone in the ear region of its skull — was a feature of all laryngeally echolocating bat species we studied. This distinguished these bats from all others in our sample, including one that echolocates with tongue clicks. We examined a skull from an *O. finneyi* specimen and found this same fusion feature, although it's possible the contact between the two bones is an artefact of preservation. So although we believe *O. finneyi* had the capacity for laryngeal echolocation, we aren't certain. We hope to obtain better-preserved fossils that will allow us to obtain a better picture of when laryngeal echolocation appeared.

How does the fusion point to laryngeal echolocation?

Echolocation works because bats can compare the calls they make with what they hear. The connection allows the bat to register in its brain the outgoing signal for comparison with returning echoes without the original signal's deafening the bat. ■

MAKING THE PAPER

Marat Gilfanov

X-rays yield clues to the evolution of a yardstick supernova.

Measuring distances is easy enough on Earth, but rather more tricky for astrophysicists and cosmologists attempting to map the Universe. For them, type Ia supernovae (SNIa) are akin to yardsticks. These supernovae burn with a known luminosity — not unlike the wattage of a light bulb — so as an observer on Earth looks at SNIa, their apparent brightness varies according to how far they are away. The locations of many far-flung SNIa can therefore be used to establish a cosmological distance scale with which to track the Universe's ever-expanding growth.

Although the usefulness of SNIa is undisputed, how they come about has been a subject of debate for more than two decades. These supernovae are known to result from a thermonuclear explosion that occurs when a white dwarf star somehow reaches a critical mass, roughly 1.4 times that of the Sun. Two ideas have so far been proposed for how dwarf stars might gain mass: first, that they do so by 'accretion', slowly draining material from a nearby companion star in a close binary system; second, that, in cases in which a binary star system is made up of two white dwarfs, the two could merge.

In 2008, Marat Gilfanov was scribbling down some numbers relating to an X-ray emission glow found in the Andromeda galaxy when he realized he might have the answer to how SNIa arise. It struck him that in the accretion model, a white dwarf would give off a distinctive X-ray emission signature for about 10 million years before the SNIa explosion. By contrast, the merger of two white dwarfs would be expected to give off an X-ray emission for just a short time before the explosion. "Since we were already studying the X-ray emission from the Andromeda galaxy, I did a simple back-of-the-envelope calculation," explains Gilfanov, an astrophysicist at the Max Planck Institute for Astrophysics in Garching, Germany. He calculated the predicted X-ray emissions if all SNIa in the galaxy came from white dwarfs accreting mass from another star. "My number was almost three orders of magnitude higher than what was actually observed from that galaxy," he says.

To be sure, Gilfanov and his graduate student Ákos Bogdán surveyed the X-ray emission data from six nearby galaxies, all of which are known as 'early-type' galaxies and contain very little neutral gas and dust, which can obscure X-ray emission from accreting white dwarfs. They found that, across the six, the measured X-ray flux was 30–50 times lower than would be predicted in the accretion scenario. Thus, they conclude that the vast majority — at least 95% — of supernovae in these early-type galaxies must result from the mergers of binary white dwarfs (see page 924).

Gilfanov and Bogdán spent almost a year combing through the theory and data to account for different modes of accretion and different types of galaxy. "Many times you go to bed thinking, 'I made a great discovery!' and then, in the morning, when you double-check, it disappears," says Gilfanov, adding that this one did hold up to scrutiny.

The story is not closed, however, because the scenario could be different for late-type galaxies and there might be other ways in which SNIa can be generated. "In computer models, scientists can make white dwarfs explode at below the critical mass," says Gilfanov. "But, so far, these supernovae look very different from the ones we actually see out there in the Universe." ■

FROM THE BLOGOSPHERE

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Nature Network bloggers can also be accessed through http://network.nature.com/blogs, which compiles the most recent posts, lists featured posts and includes links to the local hub blogs for London, New York and Boston. The page also lists the most active blogs: currently The Scientist by Richard Grant, iEditor by Henry Gee and Mind the Gap by Jennifer Rohn. ■

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