NASA/GODDARD (ADAPTED)

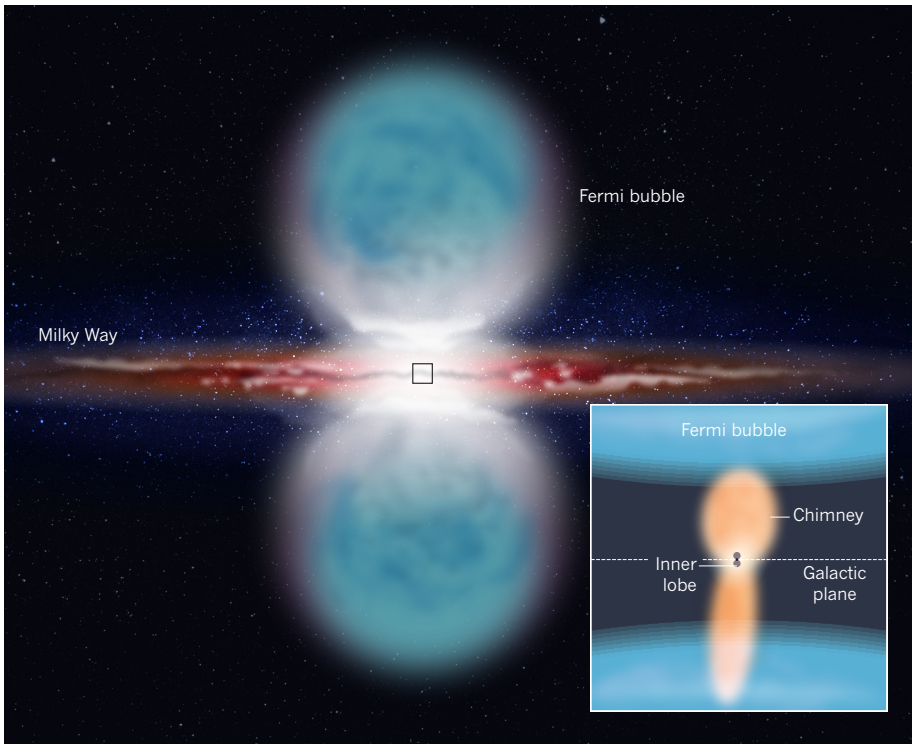

Figure 1 | Galactic chimneys and Fermi bubbles. Two huge structures, known as Fermi bubbles, are located above and below the plane of our Galaxy[1], and are centred on the supermassive black hole at the Galactic Centre. The bubbles are filled with highly energetic particles released from the Galactic Centre a few million years ago. X-ray and radio observations have also shown a much smaller pair of lobes of outflowing matter coming from the Galactic Centre. Ponti *et al.*[2] now report X-ray observations that reveal two 'chimney' structures that seem to connect the inner lobes to the Fermi bubbles.

near the chimney bases. However, although the plasma filling the smaller, inner lobes is also heated by supernovae, the new X-ray data do not support the idea that the chimneys are a direct continuation of the inner lobes. It is more likely that massive stars in the Galactic Centre are distributed non-uniformly, leading to the formation of separate outflows: a small one close to the supermassive black hole, and larger ones at the chimney bases.

The morphology of the chimneys suggests that they could be channels excavated by the powerful outflows from the supernovae at the chimney bases. Ponti and colleagues suggest that the chimneys might transport energy from the active region of the Galactic Centre to the Fermi bubbles. Various models have been used to estimate the power needed to create and sustain the Fermi bubbles, but the estimates differ by several orders of magnitude[1,5,6]. The lower end of these estimates comes from models in which the Fermi bubbles were created by a population of cosmic rays (consisting of protons and heavier ions) produced during supernova explosions in the Galactic Centre[5,7]. The energy involved in this scenario is in the same ballpark as the observed energetics of the chimneys. It should be noted that the observed energy values are at the lower limit of the total energy produced by the chimneys, because only a fraction of the total energy will be deposited as X-ray-emitting plasma.

In this supernova-powered scenario, the supermassive black hole has only a secondary role. However, the morphology of the central Galactic region could also be the result of extremely energetic outbursts produced after the accumulation of gravitationally disrupted stars close to the black hole[8]. In this case, the chimneys could facilitate the propagation of matter and energy from the black hole to rarefied, low-pressure regions above the Galactic disk[7]. The black hole might also generate outflows that are thousands of times more energetic than its observed radiation, as is the case for some other galaxies[9].

The discovery of the chimneys is another jigsaw piece in our picture of the complex processes that govern our Galaxy. But there are still many questions to be answered. At present, only part of the region at the base of the Fermi bubbles has been observed. Observations of the whole of this region will help to clarify whether the X-ray emissions from the chimneys are traces of outflows of gas passing through the inner lobes, or come from the heated gas surrounding the lobes. Detailed radio observations of the region occupied by the chimneys, and comparison of the features revealed by radio and X-ray observations, are also needed to help us better understand the energy transport from the Galactic Centre to Fermi bubbles. ■

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50 Years Ago

Conservationists, farmers and highway managers met in London on March 14 to discuss the function and management of road verges … all that is needed is cooperation for roadside verges to become a haven of rare and attractive plants while not interfering with the safety and amenity of what is described under Common Law as "a perpetual right of passage for the Queen and all her subjects" … [V]erges represent the last vestige of grasslands which existed before the modernization of agriculture. The rich pastures of the past often survive only on unploughed and unsprayed verges. Many roadside verges also provide a habitat for some of Britain's rare plants … at least twenty-seven of the three hundred rarest species grow on roadside verges; *Linum anglicum*, perennial flax, grows only in this habitat and the same goes for several other species. Clearly the loss of one roadside verge could mean the end of a species in Britain.
From *Nature* 22 March 1969

100 Years Ago

The Times of March 17 gives an account … of a remarkable Australian rainfall. It states that "the extraordinary rainfall at Melbourne threatens the greatest flood since 1891. The south-eastern corner of Victoria and New South Wales is almost engulfed … At Macedon 8 in. were registered in twenty-four hours, and other watersheds have been converted into lakes. Thousands of persons are homeless. Thirteen inches of rain in twenty-four hours has practically drowned the township of East Bellingen, in New South Wales. Although the damages are estimated to aggregate tens of thousands of pounds, the benefits from the breaking of the drought will be represented by hundreds of thousands."
From *Nature* 20 March 1919