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Fermi Bubbles from the Galactic Bar and Spiral Arms

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A survey of the diffuse gamma-ray sky revealed 'bubbles' of emission above and below the Galactic disc symmetric around the centre of the Milky Way, so they are presumed to be from the centre with a height of 10 kpc. They have been proposed to be blown by cosmic rays originating from the star formation in the Galactic Centre, or jet activity from the supermassive black hole in the GC, or even more speculatively, explained as decay products from the expected annihilation of the elusive dark matter particles. At present there is no favoured explanation. Using a novel template fit, which allows to determine the background and Fermi bubble signal in every direction, we find that the bubbles originate from shock wave accelerated cosmic rays interacting with the gas in the Galactic bar and spiral arms. The observation of the bubbles from the tangent point of the Centaurus arm uniquely proves that the bubbles do not originate from the GC, but are connected to outflows from star-formation regions. Using the bubbles as tracers for star-formation regions we find for the bar an angle between the bar and the line connecting the Sun and the GC of $12.3 \pm 2.1^\circ$ and a half length of the bar of 5.9 ± 0.1 kpc. These unprecedented precision of the bar morphology is possible, because the gamma-rays are not affected by extinction from the dust.

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