BLACK HOLES

Encroaching shadow

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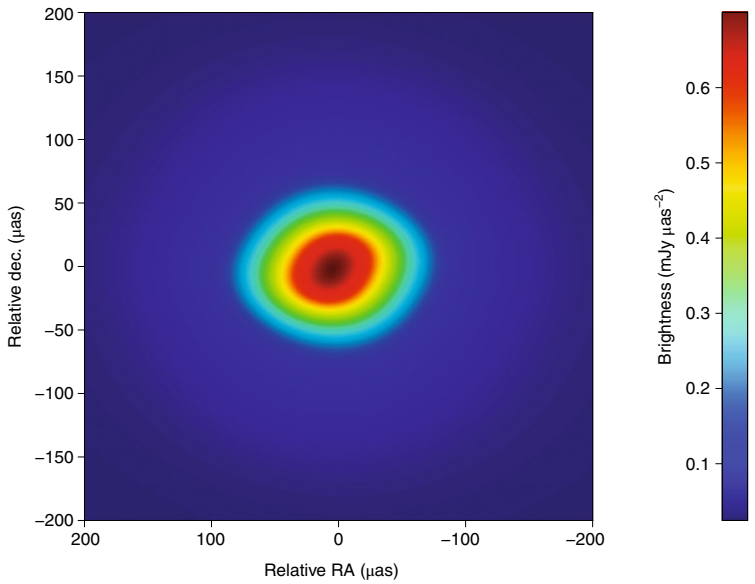

Credit: AAS/IOP

It is not every day that one takes a real close-up look at a black hole. Yet this is exactly what the Event Horizon Telescope (EHT), a constellation of sensitive radio telescopes spread across the globe, is meant to do, any day now. The road to this important upcoming milestone however is paved with many challenges. Sara Issaoun and collaborators published a radio image (pictured) of Sgr A*, the black hole at the centre of our Galaxy, at unprecedented resolution. This image will be key to understanding and interpreting future EHT data of the black hole shadow.

This feat was made possible by combining the sensitivity and resolving powers of the Global Millimetre Very Long Baseline Array (GMVA) and the phased Atacama Large Millimeter/submillimeter Array (ALMA). The observations boast an angular resolution of ~87 μas at 3.5 mm (86 GHz). The data reveal an elliptical radio source with a size of ~228 × 143 (±46 × 20) μas. The interpretation of the image is however non-trivial as the interstellar medium behind which Sgr A* lies scatters the radio waves received by our antennas. Different scattering models considered, Issaoun et al. conclude that the unscattered source is rather circular ($1 . 2^{+0.3}_{-0.2}$ axial ratio) with a size of ~120 ± 34 μas. This size corresponds to just 12 ± 3.4 Schwarzschild radii.

The authors then run detailed general-relativistic magnetohydrodynamic simulations with different black hole configurations — some are dominated by emission from an inefficient accretion disk, like the one we expect Sgr A* to have, while others are dominated by a radio jet — which they convolve with their observational setup and compare with their observations. This comparison reveals that if there is a dominant radio jet, then it should be closely aligned to our line of sight (hence the nearly circular shape of the radio source).

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