Data from the Fermi Large Area Telescope suggests there is a particle accelerator in the galactic center

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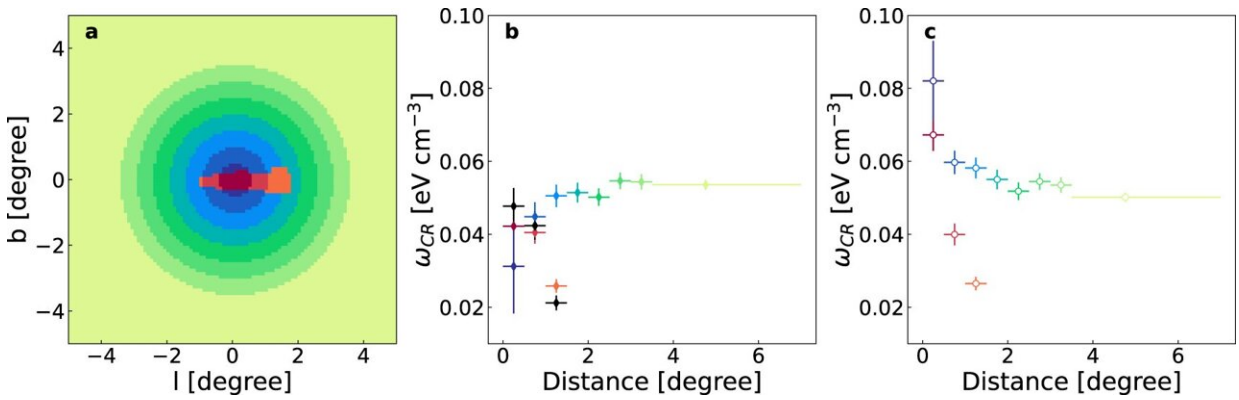

The segment division of the GC region and the inferred CR densities distribution. a The segments, annuli centered on the GC with a width of 0.5° except for the last one, where CR densities are derived, in the CMZ and off-CMZ are marked in red to orange and blue to green, respectively. The same color code is used to show data points of CR densities in corresponding segments in (b, c). b CR densities distribution from fittings with the GCE. For segments outside the CMZ, the CR density is almost a constant. In the CMZ, the CR density declines quickly as the distance increases from the GC. These facts strongly suggest different physical origins of CRs within and outside the CMZ. CR densities in the CMZ, inferred from analysis with the CS map29, are shown with black points, which agree well with those derived from the fitting with the Planck map. The error bars represent the 1σ statistical uncertainties. c CR densities distribution from fittings without the GCE, for which the inferred CR densities near the GC were boosted compared with those shown in (b). The error bars represent the 1σ statistical uncertainties. Credit: DOI:

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A team of researchers at the Chinese Academy of Sciences has found evidence of a powerful particle accelerator in the galactic center. In their paper published in the journal *Nature Communications*, the group describes their analysis of data obtained from the Fermi Large Area Telescope.

The galactic center is the rotational center of the Milky Way galaxy—prior research has shown that it contains a large black hole. There are also other entities in the galactic center, such as remnants from supernovae and the pulsar wind nebulae, but not much else is known about the interior of the galactic center due to its density. The cloud is so thick that it is nearly impossible to read many of the forms of radiation within it. Still, most in the field agree that the galactic center emits a lot of cosmic rays, many of which could be important because they make it to Earth.

In this new effort, the researchers sought to learn more about the cosmic rays emitted from the galactic center, particularly those that make their way to Earth. To that end, they obtained and analyzed data collected by various teams working at the Fermi Large Area Telescope. They focused most specifically on gamma rays emitted from the central molecular cloud—a type of cloud that forms from interstellar dust and hydrogen gas—situated between Earth and the galactic center. They found that the density of cosmic rays in the central molecular cloud was lower than that in the cosmic ray sea, which suggested that there is a barrier of some sort preventing cosmic rays from entering the central molecular cloud. But they also found evidence of the cosmic rays slowing as they passed through the cloud and then speeding up again after they emerged—evidence that something near the center of the galaxy serves

as a particle accelerator. They were not able to find evidence of what it might be, but suspect it could be the black hole, Sagittarius A*, wind nebulae or even leftover bits of a supernova.

More information: Xiaoyuan Huang et al, A GeV-TeV particle component and the barrier of cosmic-ray sea in the Central Molecular Zone, *Nature Communications* (2021). DOI: 10.1038/s41467-021-26436-z

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