

Special Reports

HESS Detects Mysterious High-Energy Sources in the Milky Way¹

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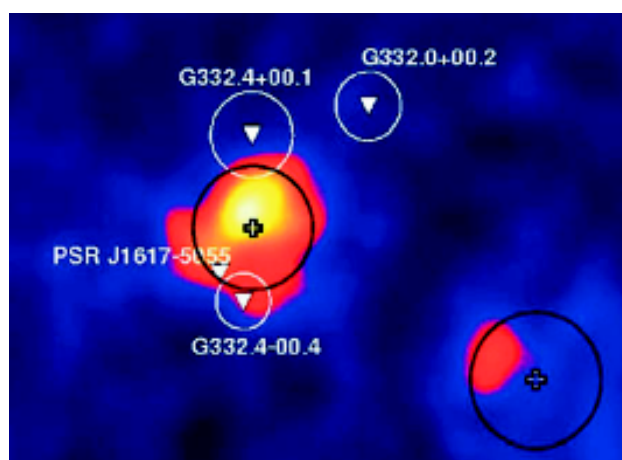
The first detailed image of the central part of our galaxy at very-high-energy gamma rays shows several sources. Surprisingly, some of them do not have a known counterpart at radio, optical or X-ray wavelengths, so their nature is a complete mystery.

Gamma rays at tera-electron-volt energies are detected using the Earth's atmosphere as a detector. The passage of such a photon through the upper atmosphere triggers a shower of relativistic electrons and positrons moving faster than the speed of light in the air, thus emitting Cherenkov radiation. This faint bluish light-flash can be detected at night by dedicated ground-based telescopes.

Currently, the most sensitive Cherenkov telescope array is the European-African High Energy Stereoscopic System (HESS) located in the Namibian desert (CERN Courier, January/February 2005, p. 30). It consists of four mirror telescopes 13 m in diameter placed at the corners of a square of side 120 m. Its image resolution of a few arc-minutes has enabled for the first time a map to be made at tera-electron-volt energies of the central part of our galaxy, the Milky Way.

The image published in the journal *Science* by Felix Aharonian and an international team of scientists reveals eight new sources of very-high-energy gamma rays in the central 60° of the disc of our galaxy. This essentially doubles the number of sources known at these energies. Three of the newly discovered sources could be associated with supernova remnants, two with giga-electron-volt gamma-ray sources discovered by the Energetic Gamma-Ray Experiment Telescope (EGRET) aboard the Compton Gamma-Ray Observatory, and in three cases an association with pulsar-powered nebulae such as the Crab Nebula is not excluded.

¹ The permission for reprinting the present report, as published previously in *CERN Courier*, Vol. 45, No. 4, May 2005, was granted through the author, Dr. Marc Türler, and *CERN Courier*.



Detail of the map of the galaxy at very-high-energy gamma rays obtained by the HESS telescope array. Black crosses and circles show the position of the best fit and the extent of two newly discovered sources. Possible known counterparts are shown by white triangles and are labelled. The lower-right source cannot be associated with a known source at other wavelengths. Image: Courtesy the HESS collaboration.

However, at least two of the sources discovered by HESS are not at a position where there is a possible counterpart. These could be members of a new class of “dark” particle accelerators.

Cosmic particle accelerators are believed to accelerate charged particles in strong shockwaves such as those produced when the gas expelled from a supernova hits the ambient interstellar medium. High-energy gamma rays are secondary products, which have probably been boosted to tera-electron-volt energies by ultra-relativistic electrons through the inverse Compton process. Gamma rays are easier to detect because they travel in straight lines from their source—unlike charged particles, which are deflected by magnetic fields in the galaxy. The discovery of new sources in the HESS survey of the galaxy therefore helps to solve the long-standing question of the origin of cosmic rays.

Further reading

F. Aharonian *et al.*, *Science* **307**, 1938 (2005).