HESS-II: a new camera for exploring the violent Universe

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Upper part of the camera: the granularity of its 2.15 m diameter photosensitive area is twice that of the cameras currently used in HESS. © Collection Ecole Polytechnique, Philippe Lavialle

HESS, one of the world's best-performing ground-based gamma ray detectors, will soon boast a fifth telescope that will double its potential for making new discoveries. The telescope will be equipped with a camera designed and built by French scientists as part of the HESS joint project, which involves several CNRS laboratories.

Enhanced sensitivity provides this new electronic eye with an image twice as sharp as that of the cameras already installed on HESS. It has just been completed and is currently on display at the Ecole Polytechnique. This new camera will considerably increase the overall performance of HESS, which will be renamed HESS-II and will push back the boundaries of the visible, lifting the veil on the mysteries of the most violent phenomena in the Universe.

Supernovas, black holes, active galactic nuclei, etc.: the existence of the most violent phenomena in the Universe is revealed by cosmic gamma rays, the sources of which are systematically tracked down. This is the objective of the HESS experiment. Composed of four telescopes of 12 meters in diameter, the HESS observatory is situated on a high plateau in Namibia, in South-West Africa.

Since it was commissioned in 2004, HESS has opened a new window on the Universe by unveiling a multitude of previously undetected gamma ray sources: of the 84 sources discovered to date, 53 have been detected by HESS. It is currently one of the best-performing ground-based gamma observatories in the world. Unlike conventional telescopes that observe the stars directly, the HESS telescopes lie in wait for the furtive light produced by the interaction in the atmosphere of high-energy gamma rays coming from the Universe.

In fact, such gamma rays generate veritable showers of particles similar to those produced in particle accelerators. To capture the signal from these interactions in the atmosphere, the four HESS telescopes are equipped with extremely sensitive and rapid electronic cameras, enabling HESS to map celestial objects emitting high-energy gamma radiation.

In order to increase the instrument's sensitivity and reveal some of the mysteries of our Universe, the researchers involved in HESS are developing an even more efficient device, known as HESS-II, which consists in adding a very large central telescope of 28 m in diameter to the existing system. The 596 m^2 of this telescope's mirror (compared to 107 m^2 for each of the 4 telescopes already in place) will concentrate the light on a camera that has just been built. With a sensitive surface area of 2.15 m in diameter and a granularity twice that of the cameras used at present, it will be able to detect gamma photons one by one with a response time on the nanosecond (10^{-9} s) scale. This camera is a real eagle's eye and the key component of the fifth telescope. It represents

France's main contribution, with IN2P3/CNRS as project manager.

The French laboratories, backed up by a network of industrial partners, built on the expertise acquired in developing cameras for the first four telescopes. The new camera still needs to undergo calibration tests before being shipped to Namibia and installed on the fifth telescope, which is expected to be fully operational by 2011.

HESS-II, which is more sensitive and covers a broader energy range, will pave the way for new discoveries and will make it possible to expand the catalogue of high-energy sources in the Universe. More specifically, this new network should help to increase the number of known sources emitting high-energy gamma rays and significantly improve images of celestial objects, such as the remains of supernovae.

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