First H.E.S.S. II data reveal promising pulsar signal

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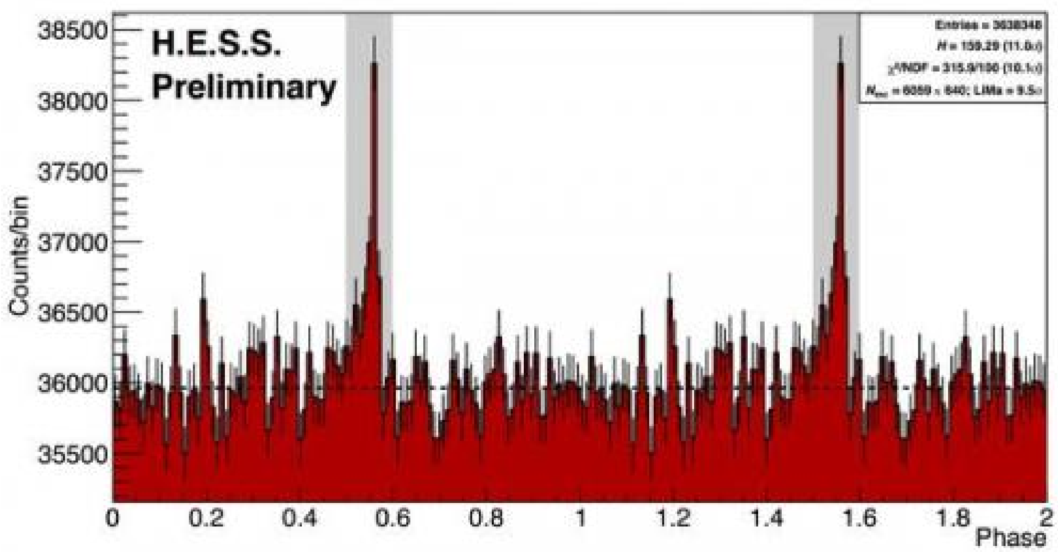
The H.E.S.S. telescope system with four 12-metre telescopes surrounding the new 28-metre CT5 telescope.

Following the intensive commissioning phase of the largest Cherenkov telescope worldwide (H.E.S.S. CT5), the H.E.S.S. collaboration has announced the detection of cosmic gamma rays of 30 gigaelectronvolts (GeV). The High Energy Stereoscopic System, which is located in Namibia, measured pulsed gamma-rays in the southern sky for the first time from ground level, thus demonstrating spectacularly its performance. The radiation originates from the Vela pulsar, the first pulsar detected by H.E.S.S. and – after the Crab pulsar – the second pulsar ever detected by ground-based gamma ray telescopes.

H.E.S.S. II is a system of reflecting telescopes of different sizes which detect cosmic gamma rays in sync. It is run by an international collaboration of 31 institutions in 10 countries, with major contributions by MPIK Heidelberg and CEA, CNRS, France. The 28-metre CT5 is placed in the centre of the four 12-metre telescopes that are operational since more than 10 years. It extends the energy range of the array to lower energies and allows for the detection of cosmic particle accelerators down to 30 GeV. The astroparticle physicists have now proven this, with significant analysis contributions of the H.E.S.S. group at DESY: In cooperation with scientists throughout Europe, a tailor-made reconstruction analysis was developed for these low-energy gamma rays. With this, the scientists were able to detect a pulsed, repeating gamma-ray signal in the energy range of 30 GeV and attribute it to the Vela pulsar. This opens the door to new observation possibilities of the inner Galaxy.

Besides intensive efforts in the construction and calibration of CT5, two years of intensive software development by DESY scientist Markus Holler determined this success. "For the reconstruction of the data from CT5, Markus Holler extended a highly sensitive analysis framework by our French colleagues, which is based on complex statistical algorithms. For the first time, this allows us to detect gamma radiation of only 30 GeV from ground level," beamed Stefan Klepser, speaker of the local H.E.S.S. experimental group at DESY. "Since we are able to survey a projected area of 10 hectares in the atmosphere, we have a considerably higher yield of gamma rays than for example satellite experiments like Fermi LAT." From some sources, it is possible to spot up to one gamma per second – a new record.



Plot for experts: Periodic gamma ray pulses of the Vela pulsar in the data of the H.E.S.S. experiment. One phase is equivalent to 89 milliseconds.

DESY's pulsar hunter Gianluca Giavitto, who applied the reconstruction analysis for the first time, in collaboration with H.E.S.S. colleagues from Humboldt-Universität zu Berlin and France, said: "The data reveal regular gamma ray pulses, repeating every 89 milliseconds, coming exactly from the direction of the Vela pulsar. The reconstructed energies of these gamma rays are in the range of 30 GeV." This shows that H.E.S.S. for the first time successfully measured pulsed radiation in the southern sky.

Cherenkov telescope systems consist of large segmented mirrors which focus optical Cherenkov light flashes. These flashes are generatedin the atmosphere, last only a few nanoseconds and are invisible for the human eye. They are generated by cascades of elementary particles triggered by cosmic radiation. With highly sensitive cameras, Cherenkov telescopes take pictures of these events which allow to identify gamma radiation. Collecting many such events, one can reconstruct sky images of cosmic particle accelerators which emit this radiation. The currently active telescope systems include VERITAS in Arizona (4 x 12m telescopes), MAGIC in La Palma (2 x 17m) and H.E.S.S. (4 x 12m + 1 x 28m). H.E.S.S. is the only system in the southern hemisphere and the only one with different reflector sizes. Therefore, H.E.S.S. ideally paves the way for the Cherenkov Telescope Array CTA, planned in international collaboration, which will be built from 2017 on with a total of about 100 Cherenkov telescopes of three sizes, distributed over two sites. DESY groups are participating in all three existing telescope systems and in CTA and they are engaged in an intensive technological exchange.

"The whole Milky Way is full of pulsars and from Namibia we can exactly observe its centre. The H.E.S.S. data show that with Cherenkov telescopes, we will still discover quite a number of mysteries in the universe," beams Christian Stegmann, head of the DESY institute in Zeuthen and spokesperson of the H.E.S.S. Collaboration. "With the participation in all active experiments, DESY is an ideal place to give an important impetus to this field of science."

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