

# Become a Muon hunter

**Help astronomers find elusive muons disguised as gamma rays with ASTERICS citizen science experiment!**

*Giuseppe Cimò, cimo@jive.eu*

The Dissemination, Engagement and Citizen Science (DECS) team of the ASTERICS collaboration have worked closely with Lucy Fortson from the VERITAS group to develop a new citizen science experiment: Muon Hunter.

VERITAS is an array of telescopes designed to detect very high energy gamma-rays ( $>10^{11}$  eV). Through their interaction with the Earth's atmosphere, the gamma-rays produce a shower of particles that travel through the atmosphere, emitting Cherenkov light which is then detected by four 12-m telescopes of VERITAS. These gamma-rays originate in astrophysical environments like the expanding blast waves thrown out by supernova explosions, or from powerful streams of material that flow from the cores of active galaxies at speeds close to that of light.

Muons are a prominent background contaminant when observing very-high-energy gamma rays on Earth. They produce a distinctive ring-like shaped image in the VERITAS camera. If only the edge of a ring is detected, it looks like an ellipse, which is exactly the shape of a

gamma-ray showers. These similar shapes can be obvious for the human eye, but computers find it very difficult to tell the difference between an incomplete ring and a complete ellipse. The citizen science volunteers of the Muon Hunter project identify these partial rings to help reduce the camera background. In the future, the VERITAS team can use these images to better train algorithms to disentangle between these events.

The aim of the project is to classify muons for VERITAS, which is not a major facility in ASTERICS but a precursor to the Cherenkov Telescope Array (CTA). The final goal is to build on the success of Muon Hunter and create tools to study data handling in the preparation for the CTA.

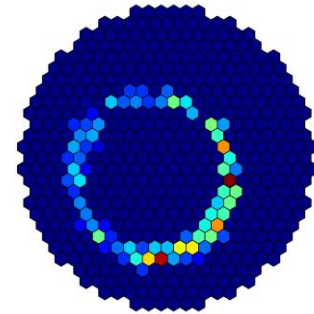
The Muon Hunter was released on February 28th 2017 and it was immediately very popular in the citizen science community. It became one of the most engaged experiments on the Zooniverse platform with more than 1.5 million classifications after only one week. In May 2017, three months after the experiment was released, the project is 98% complete.

If you want to become a Muon Hunter, hurry up! Find the experiment on the Zooniverse website:

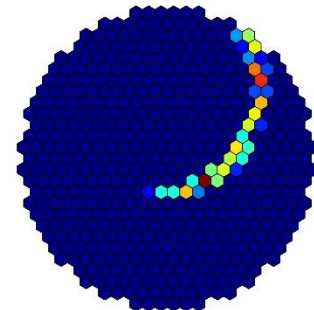
<https://www.zooniverse.org/project/s/zooniverse/muon-hunter>

The Muon Hunter project was developed using the Zooniverse tools following the first citizen science workshop organised by the ASTERICS-DECS team in the summer of 2016. A second citizen science workshop is now being

prepared for the fall of 2017. We welcome new ideas to be introduced and initiated during the workshop.



**This is an example of a complete muon ring that is fully contained in the camera. These identifications are used to calibrate VERITAS.**



**This is an example of an incomplete muon ring. The image is a partial ring. One end of the arc stops before hitting the edge of the camera.**

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