

Results of the Parallel Operation of Large-size SiPM Detector Modules and PMTs in IACTs

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At the Max Planck Institute for Physics, we developed three prototype detector modules using silicon photomultipliers (SiPM) instead of PMTs for the imaging cameras of the Major Atmospheric Gamma Imaging Cherenkov (MAGIC) telescopes. The detector modules use Hamamatsu, SensL or Excelitas devices, respectively.

To achieve an active area comparable to a 1-inch PMT, we used a matrix of up to nine 6×6 mm² SiPMs, actively summing the individual signals while maintaining their fast signal response.

The installation of the three prototype modules was finished in 2017. Since then, they are operated alongside the PMT based camera on nightly basis. This data, comprised of Cherenkov light generated in extensive air showers and artificial light pulses, is collected during real telescope operation and used for performance comparisons.

The MAGIC camera structure allows for the installation of up to six prototype detector modules next to the PMTs and to operate them in parallel.

The outer camera rim, where we installed the SiPM based detector modules, is not included in the trigger. For an even better comparison, one prototype module was installed to the camera centre for a single night.

The two MAGIC telescopes, utilized in this study, are located on the Canary Island of La Palma. Each telescope consists of a 17 m diameter mirror dish, and a camera composed of a thousand photomultiplier tubes (PMTs).

We will present our findings on the SiPM performance using both collected data sets during telescope operations.

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