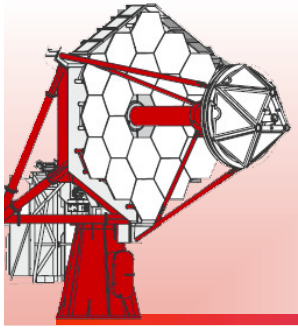

Tools and Procedures for the ASTRI Mini-Array Calibration

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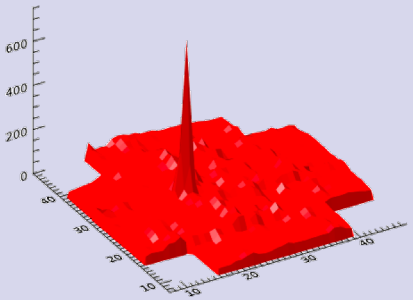
The **ASTRI Mini-Array** (ASTRI-MA) is an INAF project to construct and operate an array of nine innovative IACTs to study sources emitting emitting gamma-rays in the TeV spectral band [see Antonelli's talk n.832]. Each telescope is characterized by a dual-mirror optical system and a curved focal surface covered by a SiPM sensors camera managed by a fast front-end electronics. This array will be installed at the Teide Astronomical Observatory, operated by the Instituto de Astrofisica de Canarias, in Tenerife (Canary Islands, Spain).

The **ASTRI-MA telescopes require calibrations** both for each single telescope and its components and for the entire array. Purpose of the calibration is:

- to obtain all the necessary calibration coefficients to correctly reduce and analyse the ASTRI-MA scientific observational data [see Lombardi 's poster n.85] . These will be stored in the relative database.
- to monitor the health of the telescopes and possible degradation of their sub-systems.

The ASTRI-MA calibration plan

- Calibrate the single telescope**:** monitor the stability of the calibration coefficients and the optical throughput relative to the telescope components (optics, camera, pointing system), as obtained during the assembly and verification phases.
- Calibrate the array**:** intercalibrate the telescope response and time resolution using selected shower events and the trigger rate levels.
- Characterize the Atmosphere**:** evaluate the transmission of the atmosphere for different environmental conditions; measure the night sky background level.



Calibration with Scientific Data

The, so-called, Variance technique is based on the statistical analysis of the signal detected by the front-end electronics whose variance, due to the poissonian distribution of detected NSB photons, is proportional to the flux impinging on the camera pixel [see Iovenitti's poster n.826]. The analysis of these data will allow to monitor the telescope pointing and the point spread function (PSF) and to evaluate the level of night sky background.

Muon ring images: acquired by each single Cherenkov camera during normal data taking, allow us to evaluate the optical throughput and to monitor the PSF.

Calibration with Auxiliary tools

The ASTRI-MA will benefit of auxiliary instruments specifically devoted to calibration purpose:

Fiber Optic Calibrator: A 2-mm diameter optical fiber, illuminated alternately by blue, green, and red laser diodes, placed around the focal plane detector to calibrate the pixel gain, whenever necessary

Pointing Monitor Camera: hosted by each telescope to continuously obtain an astrometric calibrated field-of-view of the region pointed by the telescope.

UVSiPM: a small calibrated detector mainly devoted to measure the level of night sky background in the same spectral range of the ASTRI cameras. Mounted on the external structure of one of the ASTRI-MA telescopes, and aligned with the related ASTRI Cherenkov camera, UVSiPM will acquire data simultaneously to the array.

Illuminator: a portable ground-based device designed to uniformly illuminate the telescope's aperture with a pulsed or continuous reference photon flux. It will be used, whenever necessary, to perform the absolute end-to-end calibration of each ASTRI-MA telescope.