

Use of pixel time parameters in ASTRI Mini-Array event reconstruction: application in gamma/hadron separation.

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The ASTRI Mini-Array is an international project led by the Italian National Institute for Astrophysics (INAF) aimed at operating an array of nine small-sized (4-m diameter) Imaging Atmospheric Cherenkov Telescopes (IACTs). This array will conduct extensive galactic and extragalactic gamma-ray sky observations in the 1–200 TeV energy band, and it will be located at the Observatorio del Teide in Tenerife, Spain. The first three telescopes are expected to be operational within the next year.

In preparation for this deployment, the ASTRI team is developing a comprehensive Data Processing system that addresses all aspects of data management, reduction, and analysis. A key focus within this framework is enhancing the efficacy of the standard procedures employed by the Cherenkov data pipeline (A-SciSoft) for event reconstruction.

To improve the sensitivity of the array, particularly in discriminating between gamma-ray induced showers and hadron-induced showers, we are investigating the temporal evolution of the shower images. This temporal information can provide additional discriminatory power beyond the traditional morphological parameters. We have developed and tested a set of parameters derived from the pixel time tags, which record when the photoelectron content of each pixel exceeds the trigger threshold.

Through extensive testing, we have identified a subset of these time parameters that exhibit good discriminatory efficacy. Combining these time parameters with the standard morphological parameters has demonstrated a significant improvement in hadron rejection, especially at the lower end of the energy detection range. These preliminary results are encouraging, and we plan further tests and investigation to optimize their use.

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