

TeV Transients with the ASTRI Mini-Array: a case study with GRB 190114C

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What is this contribution about?

In this contribution we present the capabilities of the ASTRI Mini-Array to detect TeV transients like gamma-ray bursts (GRBs) and TeV counterparts from gravitational waves (GW) and astrophysical neutrinos.

Why is it relevant / interesting?

The ASTRI Mini-Array will be composed of nine dual-mirror Cherenkov telescopes operating in the energy range between 1 TeV and 200 TeV. Thanks to its sensitivity at several TeV, it will investigate the TeV emission by transient phenomena. GRBs have been proved to be TeV emitters and the newly-discovered energetic component in a few GRBs needs further investigation to understand its nature and emission processes. TeV emission from neutrino and GW counterparts can similarly shed light on their sources and their environment where the gamma-ray emission is produced.

What have we done?

We adopted the temporal and spectral properties of the VHE component recently discovered by MAGIC in GRB 190114C as a template to study the detection prospects with the ASTRI Mini-Array. Starting from the theoretical model (and model parameters) used to describe GRB 190114C VHE emission (SSC radiation from electrons accelerated in the interaction between the jet and the external medium), theoretical spectra at energies higher than 1 TeV and its time evolution was derived. These spectra were used as a template to simulate the emission from GRBs at shorter distances: $z=0.078$ (corresponding to the redshift of GRB 190829A, detected by H.E.S.S.), and the intermediate redshift $z=0.25$. The luminosity in their rest frame has been assumed to be the same of GRB 190114C, but their emission has been rescaled for the different cosmological distances. The proper amount of EBL has been included, to compute the observed emission at those redshifts. The resulting theoretical lightcurves and spectra have been used as input to perform simulations of detectability with the ASTRI Mini-Array.

What is the result?

The preliminary study presented here, shows the feasibility of the ASTRI Mini-Array to detect bright and nearby GRBs. However, the number of GRB candidates for being observed by ASTRI is limited to a few per year, mainly by the limited volume of Universe that can be probed by TeV gamma rays, due to the EBL absorption. Simulations are ongoing to optimize the observation strategies and the selection of candidates to be observed from GW and neutrino alerts.