Searching for very-high-energy electromagnetic counterparts to gravitational-wave events with the Cherenkov Telescope Array

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What is this contribution about?

In this contribution we investigate the capability of the Cherenkov Telescope Array (CTA) to detect very-high-energy (VHE, E > 100 GeV) counterparts to Gravitational Waves (GWs), with a focus on short Gamma-Ray Bursts (GRBs) possibly associated with binary neutron star (BNS) mergers.

Why is it relevant / interesting?

The recent joint observation of GW170817 and GRB 170817A represents the first direct proof that at least some BNS mergers are progenitors of short GRBs. GRBs are also known to emit VHE radiation, but no VHE counterpart to GWs has been observed so far.
Thanks to its unprecedented sensitivity, its rapid slewing capabilities and its large field-of-view (FOV), CTA will play a fundamental role in the follow-up of GWs at VHE. The detection of VHE gamma-rays in association with GWs will allow us to shed light on the dependence of the VHE emission from the progenitor system and from the environment of the source.

What have we done?

We have simulated a catalog of short GRBs associated with GW signals from BNS mergers; the sample of simulated BNS mergers and their GW detection has been produced in expectation of the fourth observing run of Advanced LIGO and Advanced Virgo (O4). We used this catalog to estimate the percentage of GRBs that could be detected by CTA for different exposure times, as a function of the delay time between the onset of the GRB emission and the starting of the observation of the sky region containing the source. To simulate realistic EM follow-up observations, we have also developed a scheduling algorithm, which has the goal of computing the most favorable sky coordinates for the observation; we have shown the application of this algorithm to a test case.

What is the result?

We have found that CTA is sensitive enough to detect both on-axis and off-axis GRBs with time delays up to 10 minutes. Further investigations are ongoing to estimate the expected joint GW and VHE EM detection rates.